PROJECT MANUAL

CONTRACT REQUIREMENTS
DIVISION 21 – DIVISION 33 SPECIFICATIONS

GMP CONSTRUCTION DOCUMENTS
FEBRUARY 2022

OWNER:
SAVANNAH – CHATHAM COUNTY PUBLIC SCHOOL SYSTEM

FOR:
C22-01 SAVANNAH ARTS ACADEMY ADDITION & RENOVATION

PROJECT NO. CMA-1916

CIVIL	LANDSCAPE ARCHITECT	STRUCTURAL
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ARCHITECTURAL	**MECHANICAL**	**ELECTRICAL**
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VOLUME II

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SECTION 21 01 10 – FIRE PROTECTION GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

B. It is recognized that separate sub-contracts may be instituted by THIS CONTRACT'S GENERAL CONTRACTOR with others. It is the responsibility of THIS CONTRACT'S GENERAL CONTRACTOR to completely inform, coordinate and advise those sub-contractors as to all of the requirements, conditions and information associated with providing and installing their portion of the total job.

1.2 IMPOSED REGULATIONS:

A. Applicable provisions of the State and Local Codes and of the following codes and standards in addition to those listed elsewhere in the specifications are hereby imposed on a general basis for plumbing work. In each case, the prevailing edition shall be the current adopted edition of the state where the project is located.

1. *International Fire Code*.
2. *NFPA Documents*.

1.3 SCOPE OF WORK:

A. Provide all labor, materials, equipment and supervision to construct complete and operable fire protection systems as indicated on the drawings and specified herein. All materials and equipment used shall be new, undamaged and free from any defects.

1.4 EXISTING SERVICES AND FACILITIES:

A. Damage to Existing Services: Existing services and facilities damaged by the Contractor through negligence or through use of faulty materials or workmanship shall be promptly repaired, replaced, or otherwise restored to previous conditions by the Contractor without additional cost to the Owner.

B. Interruption of Services: Interruptions of services necessary for connection to or modification of existing systems or facilities shall occur only at prearranged times approved by the Owner. Interruptions shall only occur after the provision of all temporary work and the availability of adequate labor and materials will assure that the duration of the interruption will not exceed the time agreed upon.

C. Removed Materials: Existing materials made unnecessary by the new installation shall be removed, shall remain the property of the Owner and shall be stored at a location and in a manner as directed, or, if classified by the Owner's authorized representative as unsuitable for further use, shall become the property of the Contractor and shall be removed from the site.

1.5 PRODUCT WARRANTIES:

A. Provide manufacturer's standard printed commitment in reference to a specific product and normal application, stating that certain acts of restitution will be performed for the Purchaser or Owner by the manufacturer, when and if the product fails within certain operational conditions and time limits. Where the warranty requirements of a specific specification section exceed the manufacturer's standard warranty, the more stringent requirements will apply and modified manufacturer's warranty shall be provided. In no case shall the manufacturer's

warranty be less than one (1) year.

1.6 PRODUCT SUBSTITUTIONS:

A. General: Materials specified by manufacturer's name shall be used unless prior approval of an alternate is given by addenda. Requests for substitutions must be received in the office of the Architect at least 10 days prior to opening of bids.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS:

A. Standard Products: Provide not less (quality) than manufacturer's standard products, as specified by their published product data. In addition to the indication that a particular product/model number is acceptable, comply with the specified requirements. Do not assume that the available off-the-shelf condition of a product complies with the requirements; as an example, a specific finish or color may be required.

B. Uniformity: Where multiple units of a general product are required for the work, provide identical products by the same manufacturer, without variations except for sizes and similar variations as indicated.

C. Product Compatibility, Options: Where more than one product selection is specified, either generically or proprietarily, selection is Purchaser's or Installer's option. Provide adaptations as needed for interfacing of selected products in the work.

D. Equipment Nameplates: Provide a permanent operational data nameplate on each item of power operated equipment, indicating the manufacturer, product name, model number, serial number, speed, capacity, power characteristics, labels of tested compliance, and similar essential operating data.

E. Locate nameplates in easy-to-read locations. When product is visually exposed in an occupied area of the building, locate nameplate in a concealed position (where possible) which is accessible for reading by service personnel.

PART 3 - EXECUTION

3.1 PRODUCT INSTALLATION, GENERAL:

A. Except where more stringent requirements are indicated, comply with the product manufacturer's installation instructions and recommendations, including handling, anchorage, assembly, connections, cleaning and testing, charging, lubrication, startup, test operation and shut-down of operating equipment. Consult with manufacturer's technical experts, for specific instructions on unique product conditions and unforeseen problems.

B. Protection and Identification: Deliver products to project properly identified with names, models numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged or protected to prevent deterioration during shipment, storage and handling. Store in a dry, well ventilated, indoor space, except where prepared and protected by the manufacturer specifically for exterior storage.

C. Permits and Tests: Provide labor, material and equipment to perform all tests required by the governing agencies and submit a record of all tests to the Owner or his representative. Notify the Architect five days in advance of any testing.

END OF SECTION 21 01 10

SECTION 21 01 20 – FIRE PROTECTION STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. Industry Standards: It is a general requirement that fire protection work comply with applicable requirements and recommendations of standards published by listed agencies and trade associations, except to the extent more detailed and stringent requirements are indicated or required by governing regulations. Listing of Associations, Standards, and Abbreviations:

1. AWS American Welding Society, Inc.
   2501 NW 7th St., Miami, FL 33125
   305/642-7090
2. CISPI Cast Iron Soil Pipe Institute
   2020 K. St., NW, Washington, DC
   202/233-4536
3. NEC National Electrical Code by NFPA
4. NEMA National Electrical Manufacturers Association
   1300 N 17th Street, Suite 1847
   Rosslyn, VA 22209
   703/841-3200
5. NFPA National Fire Protection Association
   407 Atlantic Ave.,
   Boston, MA 02210
   617/482-8755
6. UL Underwriters' Laboratories, Inc.
   207 East Ohio St.,
   Chicago, IL 60611
   312/642-6969

PARTS 2 AND 3 - PRODUCTS AND EXECUTION (Not applicable)

END OF SECTION 21 01 20

SECTION 21 02 10 – FIRE PROTECTION COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. Coordinate the actual location of all fire protection work visible in finished spaces with the Architect/Engineer.

PART 2 - PRODUCTS

2.1 PRODUCT COORDINATION:

A. Power Characteristics: Refer to the electrical sections of the specifications and the electrical drawings for the power characteristics available for the operation of each power driven item of equipment. The electrical design was based on the typical power requirements of the equipment manufacturers scheduled or specified. Any modifications to the electrical system which are required due to the use of an approved equivalent manufacturer shall be made at no additional cost to the owner. All changes must be clearly documented and submitted for review by the Architect/Engineer prior to purchasing equipment. Coordinate purchases to ensure uniform interface with electrical work. The fire protection contractor shall furnish a detailed list of equipment electrical characteristics to the electrical contractor for the purpose of preparing the coordination affidavit required by Division 26.

B. Coordination of Options and Substitutions: Where the contract documents permit the selection from several product options, and where it becomes necessary to authorize a substitution, do not proceed with purchasing until coordination of interface of equipment has been checked and satisfactorily established.

C. Firestopping: Refer to architectural drawings for the locations of all fire rated ceilings, floors and walls. The contractor shall furnish detailed shop drawings of all firestopping details to be used for both piping and ductwork. All firestopping details shall be U.L. listed and subject to approval by the State Fire Marshal.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION:

A. Substrate Examination: The Installer of each element of the work must examine the condition of the substrate to receive the work, and the conditions under which the work will be performed, and must notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

B. Do not proceed with the installation of sleeves, anchors, hangers, roof penetrations and similar work until coordination drawings have been processed and released for construction. Where work must be installed prior to that time in order to avoid a project delay, review proposed installation in a project coordination meeting including all parties involved with the interfacing of the work.

3.2 CUTTING AND PATCHING:

A. Structural Limitations: Do not cut structural framing, walls, floors, decks and other members

intended to withstand stress, except with the Architect's or Engineer's written authorization. Authorization will be granted only where there is not other reasonable method for completing the work, and where the proposed cutting clearly does not materially weaken the structure.

B. Where authorized, cut opening through concrete (for pipe penetrations and similar services) by core drilling or sawing. Do not cut by hammer-driven chisel or drill.

C. Other work: Do not endanger or damage other work through the procedures and processes of cutting to accommodate mechanical work. Review the proposed cutting with the Installer of the work to be cut, and comply with his recommendations to minimize damage. Where necessary, engage the original Installer or other specialists to execute the cutting in the recommended manner.

D. Where patching is required to restore other work, because of either cutting or other damage inflicted during the installation of fire protection work, execute the patching in the manner recommended by the original Installer. Restore the other work in every respect, including the elimination of visual defects in exposed finishes, as judged by the Architect. Engage the original Installer to complete patching of the following categories of work:
   1. Exposed concrete finishes.
   2. Exposed masonry.
   3. Waterproofing and vapor barriers.
   4. Roofing, flashing and accessories.
   5. Interior exposed finishes and casework, where judged by the Architect to be difficult to achieve an acceptable match by other means.

3.3 COORDINATION OF FIRE PROTECTION INSTALLATION:

A. General: Sequence, coordinate and integrate the various elements of fire protection work so that building systems will perform as indicated and be in harmony with other work of the building. The Architect/Engineer will not supervise the coordination, which is the exclusive responsibility of the Contractor. Comply with the following requirements:
   1. Install piping and similar services straight and true, aligned with other work and with overhead structures and allowing for insulation where applicable. Conceal where possible.
   2. Arrange work to facilitate maintenance and repair or replacement of equipment. Locate services requiring maintenance on valves and similar units in front of services requiring less maintenance. Connect equipment for ease of disconnecting, with minimum of interference with other work.
   3. Give the right-of way to piping systems required to slope for drainage (over other service lines). Piping shall be located to avoid interference with ductwork and light fixtures.
   4. Store materials off the ground and protected from standing water and weather.

B. Drawings: Conform with the arrangement indicated by the contract documents to the greatest extent possible, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, comply with the Architect's decision on resolution of the conflict.

C. Electrical Work: Coordinate the fire protection work with electrical work, and properly interface with the electrical service. In general, and except as otherwise indicated, install fire protection equipment ready for electrical connection. Refer to electrical sections of the specifications for electrical connection of fire protection equipment.

D. Utility Connections: Coordinate the connection of fire protection systems with exterior underground utilities and services. Comply with the requirements of governing regulations, franchised service companies and controlling agencies. Provide a single connection for each service except where multiple connections are indicated.

END OF SECTION 21 02 10

SECTION 21 02 20 – FIRE PROTECTION SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUBMITTAL FORMS AND PROCEDURES:

A. The purpose of submittals is to demonstrate to the Architect/Engineer that the Contractor understands the design concept. The Architect/Engineer's review of such drawings, schedules, or cuts shall not relieve the Contractor from responsibility for deviation from drawings or specifications unless he has, in writing, called the Architect/Engineer's attention to such deviations at the time of submission, and has received from the Architect/Engineer, in writing, permission for such deviations. All submittals must be completely checked by the Contractor prior to submission for review.

B. Hard Copy Submittals: Submittal data shall be placed in one or more hard-back 3-ring binders, arranged and labeled according to specification section. Each binder shall contain a title page and table of contents. Provide separator tabs, and label by specification section. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor’s Name, Division 21 Superintendent’s name, Suppliers and point of contact for each, and date. Except as otherwise indicated in other sections, submit 5 complete copies. Quantity indicated does not include copies required for regulatory agencies.

C. Electronic Submittals: If the Architect agrees to allow electronic submittals via an on-line information management product such as “Submittal Exchange, etc., all electronic submittal files shall be organized to match the bid documents for specification section and name. Each submittal file shall be complete for each specification section. Multiple partial submittals per specification section will be rejected. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor’s Name, Division 21 Superintendent’s name, Suppliers and point of contact for each, and date.

D. Submittals shall be made for all items contained in the following specification sections:

1. Fire Protection Coordination
2. Fire Protection Identification
3. Fire Protection Pipe, Tube, and Fittings
4. Fire Protection Hangers and Supports
5. Fire Protection Seismic Control
6. Fire Protection Sprinkler System
7. Clean-Agent Fire Suppression System
8. Fire Pump
9. Fire Pump Controller
10. Jockey Pump
11. Jockey Pump Controller
12. Hydraulic Calculations

E. Response to Submittals: A Submittal Review Report shall be issued by the Architect/Engineer with the following classifications for each item:

1. "No Exceptions Taken": No corrections, no marks. Contractor shall submit copies for distribution.
2. "Make Corrections Noted": A few minor corrections. Items may be ordered as marked up without further resubmission. Submit copies for distribution.
3. "Revise and Resubmit": Minor corrections. Item may be ordered at the Contractor's

option. Contractor shall resubmit drawings with corrections noted.

4. "Rejected": Major corrections or not in accordance with the contract documents. No items shall be ordered. Contractor shall correct and resubmit drawings.

PART 2 - PRODUCTS

2.1 SUBMITTAL REQUIREMENTS:

A. General: Each specification section shall list the required submittal items. All submittal items shall conform to the requirements listed below. For each major section of submittal data, include a summary page which lists items and model numbers for each piece of equipment.

B. Shop Drawings: Prepare shop drawings to accurate scale except where diagrammatic representations are specifically indicated. Show clearance dimensions of critical locations, and show dimensions of spaces required for operation and maintenance of equipment. Show piping connections and other service connections, and show interface with other work including structural support. Indicate by note, the portions of fire protection work shown on the shop drawings which deviated from the indication of work in the contract documents, and explain the reasons for the deviations. Show how such deviations coordinate with interfacing deviations on shop drawings for other portions of the work, currently or previously submitted.

C. Manufacturer's Data: Where pre-printed data is submitted for more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided. Delete or mark-out significant portions of preprinted data which are not applicable. Where operating ranges are shown, mark data to show portion of range required for project application. Expansion or elaboration of standard data to describe a non-standard product must be processed as a shop drawing submittal. For each product include the manufacturer's production specifications, installation or fabrication instructions, nearest source of supply (including telephone number), sizes, weights, speeds, operating capacities, piping and service line connection sizes and locations, statements of compliance with required standards and governing regulation (include manufacturer's signed statements if not covered in printed data), performance data (where applicable) and similar information needed to confirm compliance with the requirements.

D. Certifications: Where specifically indicated, submit with notarized execution.

E. Test Reports: Submit test reports which have been signed and dated by the firm performing the test and prepared in the manner specified in the standard or regulation governing the test procedures as indicated.

F. Manufacturer's Product Warranties: Where pre-printed and published warranty includes substantial deviation from required warranty (as judged by the Architect or Engineer), product is automatically disqualified from use on the project, except where manufacturer prepares and issues a specific product warranty on the product, stating that it is in lieu of the published warranty, and is executed by an authorized officer, and complies with the requirements. Warranties shall comply with the requirements of individual specification section where those requirements exceed the manufacturer's standard warranty.

PART 3 - EXECUTION

3.1 CLOSEOUT REQUIREMENTS:

A. Operating Instructions: Submit manufacturer's operating instructions for each item of fire protection equipment and supplement with additional project application instructions where necessary. Prepare and submit specific operating instructions for charging, start-up, control or sequencing of operation, phase or seasonal variations, shut-down, safety and similar

operational instructions. Prepare in typewritten form in completely explained and easily understood English language.

B. Maintenance Manuals: Organize each copy of the required system maintenance manuals to include an index followed by thumb-tab marked sections for each of the following:
   1. System operating instructions.
   2. Emergency instructions including addresses and telephone numbers of service sources.
   3. Regular system maintenance procedures including lubrication.
   4. Spare parts listing and stocking recommendations.
   5. Inspection, adjusting, rebalancing, cleaning, parts replacement, and similar maintenance instructions and recommendations, including the proper use of tools and accessories.
   6. Valve schedule and control diagram for each system.
   7. Manufacturer's data for each operating item in each system.
   8. Manufacturer's product warranties and guarantees relating to the system and equipment items in the system.
   9. Corrected or approved issues of submittal items relating to the system.
   10. Bind each maintenance manual in one or more vinyl-covered, 2", 3-ring binder, plus pocket-folder type binders for folded drawings, and mark the back spine of each binder with system identification and volume number.

C. Maintenance Materials: Deliver to Owner’s representative at the location as directed, in containers or packages suitable for storage and fully identified.

D. Guarantees: Where indicated as "Certified", provide guarantee which, in addition to execution by an authorized officer of each guarantor, is attested to by the Secretary of each guarantor and bears the corporate seal.

END OF SECTION 21 02 20

SECTION 21 02 30– FIRE PROTECTION IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in the manufacture of identification systems required for this product.

B. Submittals: Submit manufacturer's data on materials and submit a sample of each type required.

PART 2 - PRODUCTS

2.1 FIRE PROTECTION IDENTIFICATION MATERIALS:

A. Plastic Pipe Markers:

1. General: Product manufacturer's standard pre-printed, flexible or semi-rigid, permanent, color-coded, plastic-sheet pipe markers, complying with ANSI A13.1.

2. Small Pipe: For external diameters less than 6 inches, provide full band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
   a. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
   b. Adhesive lap joint in pipe marker overlap.
   c. Laminated or bonded application of pipe marker to pipe.
   d. Taped to pipe with color-coded plastic adhesive tape, not less than 3/4 inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inch.

3. Large Pipes: For external diameters of 6 inches and larger, provide either full-band or strip-type pipe markers, but not narrower than 3 x letter height (and of required length), fastened by one of the following methods:

   a. Laminated or bonded application of pipe marker to pipe.
   b. Taped to pipe with color-coded plastic adhesive tape, not less than 1-1/2 inches wide: full circle at both ends of pipe marker, tape lapped 3 inches.

4. Lettering: Comply with piping system names as specified, scheduled or shown, and abbreviate only as necessary for each application length.

5. Arrows: Print each pipe marker with arrow indicating direction of flow, either integrally with piping system service lettering or as separate unit of plastic (to accommodate both directions).

6. Install pipe markers on piping of the following piping systems:
   Automatic Wet Pipe Sprinkler System Water
   Automatic Dry Pipe Sprinkler System Water
   Fire Standpipe System Water
   Clean-Agent Fire Suppression System Piping

B. Plastic Tape: Manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

1. Width: Provide 1-1/2 inches wide tape markers on pipes with outside diameters of less than 6 inches, 2-1/2 inches wide tape on larger pipes.
2. Color: Comply with ANSI A13.1.

C. Engraved Plastic-Laminate Signs:

1. General: Provide engraving stock melamine plastic laminated, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core, letter color, except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
2. Thickness: 1/16 inch, except as otherwise indicated.
3. Fasteners: Self-tapping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate the substrate.

D. Valve Tags:
1. Valve signs shall be in accordance with NFPA 13.
2. The identification sign shall be secured with corrosion-resistant wire, chain, or other approved means.
3. Valve tags shall be installed at all shut-off, balancing, metering, and drain valves. Valve tag shape and designations shall with NFPA and UL.

E. Valve Charts:
1. Valve charts shall be provided for fire protection systems. Charts shall be located at the riser.
2. Valve charts shall be typed listing all valve tags. List shall include identification number, valve location in system (e.g., Corridor 123, etc.) and its function (e.g., shut-off, balancing, drain, etc.). Charts shall be mounted in a wooden frame with glass cover.

2.2 LETTERING AND GRAPHICS:

A. General: Coordinate names, abbreviations and other designations used in the identification work, with the corresponding designations shown, specified or scheduled. Provide numbers, lettering recommended by manufacturers or as required for proper identifications and operation/maintenance of the systems and equipment.

B. Multiple Systems: Where multiple systems of the same generic name are shown and specified, provide identification which indicates the individual system number as well as the service.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION:

A. Coordination: Where identification is to be applied to surfaces which require painting and other covering or finish, including valve tags in finished spaces, install identification after completion of covering or painting.

B. Piping System Identification:
   1. General: Install pipe markers on each system indicated to receive identification, and include arrows to show normal direction of flow.

C. Locate pipe markers as follows wherever piping is exposed to view in mechanical rooms, accessible maintenance spaces (including accessible areas above ceilings) and exterior non-concealed locations:
   1. Near each valve and control device.
   2. Near each branch, excluding short take-offs for fixtures. Mark each pipe at branch, where there could be a question of flow pattern.
   3. Near locations where pipes pass through walls or ceilings, or enter non-accessible enclosures.
   4. Near major equipment items and other points of origination and termination.
   5. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment.

D. Do not mark piping exposed in finished occupied spaces.

E. Fire protection Equipment Identification: Install an engraved plastic laminate sign on or near each major item of fire protection equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for all major items of fire protection equipment.

F. Valve tags shall be attached to the valve handwheel with cable ties.

END OF SECTION 21 02 30

SECTION 21 02 40 – FIRE PROTECTION WORK CLOSEOUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DOCUMENTATION PROCEDURES:

A. Signed Commitments: Do not proceed with transfer of fire protection systems to the Owner for operation until warranties, performance certifications and similar commitments to be signed by Contractor and other entities have been executed and transmitted to Architect (for Owner's records).

1.3 RECORD DRAWINGS:

A. Explanation: Except where otherwise indicated, fire protection drawings (contract drawings) prepared by Architect/Engineer, contract/drawings, are diagrammatic in nature and may not show locations accurately for various components of fire protection systems. Shop drawings, including coordination drawings, prepared by Contractor shall show certain portions of work more accurately to scale and location, and in greater detail.

B. General Recording Procedure: Maintain a white-print set, blue-line or black-line, of fire protection contract drawings and shop drawings in clean, undamaged condition, for mark-up of actual installations which vary substantially from the work as shown. Mark-up whatever drawings are most capable of showing the installed conditions accurately; however, where shop drawings are marked, record a reference note on appropriate contract drawing. Mark with erasable pencil and use multiple colors to aid in the distinction between work of separate systems. In general, record every substantive installation of fire protection work which previously is either not shown or shown inaccurately, but in any case record the following:

1. Underground and aboveground piping, both exterior and interior, drawn to scale and fully dimensioned.
2. Fire Protection "Project Record" shall be maintained as part of the "Project Record" specified in Division 1.

PART 2 - PRODUCTS

2.1 NOT APPLICABLE:

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES:

A. General Coordination: Sequence closeout procedures properly, so that work will not be endangered or damaged, and so that every required performance will be fully tested and demonstrated.

B. System Performance Test Run: At the time of fire protection work closeout, check each item in each system to determine that it is set for proper operation. With Owner's representative and Architect/Engineer present, operate each system in a test run of appropriate duration to demonstrate compliance with performance requirements. During or following test runs, make final corrections or adjustments of system to refine and improve performances wherever possible, including noise and vibration reductions, elimination of hazards, better response of controls, signals

and alarms, and similar system performance improvements. Provide testing or inspection devices as may be requested for Architect's/Engineer's observation of actual system performances. Demonstrate that controls and items requiring service or maintenance are accessible. Test run shall be scheduled to coincide with Engineer's final inspection of the fire protection work.

C. Cleaning and Lubrication: After final performance test run of each fire protection system, clean system. Lubricate both power and hand operated equipment and remove excess lubrication. Touch-up minor damage to factory painted finishes and other painting specified as fire protection work; refinish work where damage is extensive.

D. General Operating Instructions: In addition to specified training of Owner's operating personnel specified in individual fire protection sections, and in addition to preparation of written operating instructions and compiled maintenance manuals specified, provide general operating instructions for the fire protection systems. Conduct a walk-through explanation and demonstration for orientation and education of Owner's personnel to be involved in continued operation of building.
   1. Describe each basic system and how its control system functions.
   2. Explain and point out identification system, displayed diagrams, signals, alarms and similar provisions of the work.
   3. Describe basic sequencing requirements and interlock provisions for system start-up, phasing and shut-down.
   4. Emphasize emergency procedures and safety provisions for protection of equipment and safety of occupants during equipment malfunction, disasters, power failures and similar unusual circumstances.
   5. Outline basic maintenance procedures.

E. Demonstrate what adjustments have been made and can continue to be made to reduce noise and vibration, improve system output, decrease energy consumption and similar performance improvements.

F. Point out operational security provisions, safety, unavoidable hazards and similar operator limitations. Display and conduct a "thumb-through" explanation of maintenance manuals, record drawings, meter readings and similar service items.

G. Construction Equipment: After completion of performance testing and Owner's operating instructions and demonstrations, remove installers tools, test facilities, construction equipment and similar devices and materials used in execution of the work but not incorporated in the work.

3.2 CONTINUED SYSTEM OPERATIONS:

A. Final Acceptance: At time of substantial completion of fire protection work, Owner's operating personnel will take over operation of fire protection systems. However, until time of final acceptance, respond promptly with consultation and services on whatever operation or maintenance problems may remain or arise.

END OF SECTION 21 02 40

SECTION 21 03 10 – FIRE PROTECTION EXCAVATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. Coordination: Where excavation and backfill for fire protection work passes through or occurs in the same areas as work specified in the Division 2 sections, comply with both the requirements of the Division 2 sections and the requirements of this section, whichever is the more stringent (as determined by the Architect/Engineer in cases of conflicting requirements).

1.3 JOB CONDITIONS:

A. Existing Utilities: Locate and protect existing utilities and other underground work in a manner which will ensure that no damage or service interruption will result from excavating and backfilling.

PART 2 - PRODUCTS

2.1 BACKFILL MATERIALS:

A. Subbase Material: A graded mixture of gravel, sand, crushed stone or crushed slag.

PART 3 - EXECUTION

3.1 EXCAVATING:

A. Inspection: The excavator must examine the areas to be excavated, and the conditions under which the work is to be performed, and notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with excavating until unsatisfactory conditions have been corrected in a manner acceptable to the excavator.

B. General:

1. Do not excavate until the work is ready to proceed without delay, so that the total time lapse from excavation to completion of backfilling will be minimum.
2. Provide signs, illuminations and barricades as necessary to prevent accidents at excavations.
3. Excavate with vertical sided excavations to the greatest extent possible, except where otherwise indicated. Where necessary, provide sheeting and cross-bracing to sustain sides of excavations. Remove sheeting and cross-bracing during backfilling wherever such removal would not endanger the work or other property. Where not removed, cut sheeting off at a sufficient distance below finished grade to not interfere with other work.
4. Excavate for piping with 6" to 9" clearance both sides of pipe, except where otherwise shown or required for proper installation of pipe joints, fittings, valves and other work. Provide a minimum of 12" clearance around underground tanks.
5. For work to be supported directly on undisturbed soil, do not excavate beyond required depths, and hand excavate the bottom cut to accurate elevations. Except as otherwise indicated, support the following work on undisturbed soil at the bottom of the excavations:

a. Piping of 5" and less pipe/tube size.
b. Cast-in-place concrete.

6. Where directed, excavate additional depth to reach satisfactory soil-bearing conditions. Backfill with subbase material, compacted as directed, to indicated excavation depth.
7. Except as otherwise indicated, excavate for exterior water-bearing piping so that the top of piping will not be less than 2'- 0" vertical distance below finished grade.
8. Store excavated material (temporarily) near the excavation, in a manner which will not interfere with or damage the excavation or other work.
   a. Retain excavated material which complies with the requirements for backfill material.
   b. Dispose of excavated material which is either in excess of quantity needed for backfilling or does not comply with requirement for backfill material.

3.2 DEWATERING:

A. Maintain dry excavations by removing water. Pump minor inflow of ground water from excavations; protect excavations from major inflow of ground water by installing temporary sheeting and waterproofing. Provide adequate barriers which will protect other excavations from being damaged by water, sediment or erosion from or through excavations.

3.3 BASE PREPARATION:

A. Install subbase material to receive fire protection work, and compact by tamping to form a firm base for the work. For piping, shape the subbase to fit the shape of the bottom 90 degrees of the cylinder, for uniform continuous support.
B. Shape subbases and bottoms of excavations with recesses to receive pipe bells, flanges connections, valves and similar enlargements in the piping systems.

3.4 BACKFILLING:

A. Do not backfill until installed work has been tested and accepted, wherever testing is indicated.
B. Condition backfill material by either drying or adding water uniformly, to whatever extent may be necessary to facilitate compaction to the required densities. Do not backfill with frozen soil materials.
C. Backfill simultaneously on opposite sides of work, and compact simultaneously; do not dislocate the work from installed positions.
D. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (percent of maximum density, ASTM Standard Proctor), using power-driven hand-operated compaction equipment.
   1. Lawn/Landscaped Areas: 90%
   2. Roadways: 95%
   3. Paved Area, Other than Roadways: 95%
E. Backfill to elevations matching adjacent grades, at the time of backfilling excavations for mechanical work.
F. Where compaction tests indicate lower densities of backfill than specified, continue compaction (and re-excavation and backfilling where necessary) and provide additional testing as directed by the Architect/Engineer.

3.5 PERFORMANCE AND MAINTENANCE:

A. Where subsidence is measurable or observable at fire protection work excavations during the guarantee period, remove the surface (pavement, lawn or other finish), add backfill material, compact and replace the surface treatment. Restore the appearance, quality and condition

of the surface or finish to match adjacent work, and eliminate evidence of the restoration to the greatest extent possible.

END OF SECTION 21 03 10

SECTION 21 20 10 - FIRE PROTECTION SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE:

A. Fire Protection Supply Pipe: Route the building fire main to the municipal water main and connect to the supply line at the appropriate time and location. Contractor shall field verify exact location of water main prior to start of construction.

B. Work Includes but is not limited to:
   1. Installing a complete "Wet Pipe" Automatic Sprinkler system throughout the building.
   2. Install a complete fire pump system.

C. Related Work Specified Elsewhere:
   1. Wiring of flow alarm switches and tamper switches and connection of switches to building alarm system are specified in Section 271010.

D. Sprinkler Design Requirements: (for ordinary group 2 hazard)
   1. The sprinkler system shall be a wet pipe type. The design area shall be the most remote 1500 square feet. The design density shall be 0.20 gpm/ft^2. Hose requirement shall be 250 gpm.
   2. The contractor shall submit 4 complete sets of sprinkler shop drawings and hydraulic calculations to the architect for review, prior to ordering material and/or cutting pipe. Contractor shall not cut any piping until shop drawings have been reviewed and accepted. The contractor shall show in dashed lines the location of all ductwork, lights and diffusers.
   3. The contractor shall be responsible for coordinating sprinkler piping and heads locations with other trades. Contractor shall relocate sprinkler piping and heads as necessary in order to avoid conflict with ductwork, lights and structure.
   4. Provide auxiliary drains at low points in system and for trapped sections as required by NFPA-13. Locate auxiliary drains in mechanical closets or other locations out of sight.
   5. The contractor shall include a ten pound (10 psi) buffer in the hydraulic calculations, i.e. the pressure required for the sprinkler system (including hose stream) shall be a minimum of 10 psi less than the available pressure at the required flow.
   6. The contractor shall perform a flow test prior to commencing design and shall provide test information to the Architect for approval. Sprinkler system design shall be based upon the contractor’s flow test.

1.3 QUALITY CRITERIA:

A. Permits, Licenses, Inspection Fees:
   1. Obtain and pay for permits, licenses and inspection fees as may be required for performance and approval of the work performed under this section of the specifications.
   2. Comply with all requirements of NFPA 13, NFPA-20, NFPA-24 and the State Fire Marshall and local codes.

B. Materials: Materials specified by manufacturer's name shall be used unless prior approval of a substitute is given by addenda.

1.4 SUBMITTALS:

A. Before materials and equipment are purchased, submit for Architect's approval, a complete schedule of materials and equipment to be incorporated in the work. Submittals shall include the following:
   1. Complete Shop Drawings with hydraulic calculations
   2. Fire Pump and Accessories
   3. Jockey Pump and Accessories
   4. All Valves
   5. Fire Department Connections
   6. Sprinkler Heads
   7. Tamper Switches
   8. Pipe Hangers and Supports
   9. Pipe and Fittings
   10. Cabinets
   11. Access Panels
   12. Alarm Valve

B. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and be specifically identified with the applicable style number.

C. Sprinkler heads shall be referred to on drawings, submittals and other documentation, by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

1.5 TESTING PIPE SYSTEMS:

A. Tests shall be conducted in the presence of the Architect or his designated representative. Equipment, materials, and instruments for testing shall be furnished by the Contractor without additional cost to the Owner.

B. Automatic Sprinkler Piping: The automatic sprinkler systems shall be hydrostatically tested in their entirety or in zones defined by shut-off valves. The piping shall be tested at a pressure of 200 psig , measured at the low point in the system or zone, and shall be proved tight at this pressure for a period of not less than two hours. Leaks detected shall be repaired by tightening, rewelding joints, or replacing damaged pipe or fittings. Caulking of joints will not be permitted.

1.6 OPERATION AND MAINTENANCE INSTRUCTIONS:

A. Operating and Maintenance Instructions, printed and bound in hard cover three ring loose leaf notebooks, shall be provided for each item of equipment listed below; 5 separate copies shall be provided. Each notebook shall be provided within an identifying label under a clear plastic cover shield on the front cover which shall identify the Project, Engineer, Contractor and Date.
   1. National Fire Protection Association Pamphlet No. 25.
   2. Copies of All Approved Submittal Data (listed above under submittals).
   3. As-Built copies of Design Drawings and Hydraulic Calculations.

1.7 SEISMIC REQUIREMENTS:

A. Provide seismic protection for the sprinkler system. Design and install seismic protection in accordance with the requirements of NFPA 13 section titled "Protection of Piping Against Damage Where Subject to Earthquakes." Seismic requirements may be waived by the Authority Having Jurisdiction. Provide written documentation of waiver.

1.8 GUARANTEE:

A. All equipment shall be guaranteed as specified under the General and Special Conditions. Guarantee on all equipment shall start and coincide with the Contractor's guarantee obligations.

PART 2 - PRODUCTS AND INSTALLATION

2.1 PIPE AND FITTINGS:

A. Pipe and fittings listed herein shall be for the services indicated.

2.2 SPRINKLER:

A. Piping Options:
   1. Schedule 40 black steel pipe: ASTM A-795, A-53, or A-135 with class 150 or 300 pound malleable iron threaded fittings, welded steel fittings, or with mechanical grooved joint couplings. Mechanical couplings for main sprinkler and standpipe risers shall be rigid type coupling.
   2. Schedule 10 black steel pipe: ASTM A-135 pipe, UL listed for sprinkler systems. Fittings for thin wall pipe shall be same type specified for Schedule 40 pipe.

2.3 JOINTS:

A. Mechanical grooved joint couplings shall be listed for use in fire protection systems.
   1. Grooved End Fittings: Fittings shall be ductile iron (ASTM A536); forged steel (ASTM A234); or fabricated from carbon steel pipe (ASTM A53); with pre-grooved ends for use with mechanical couplings of the same manufacturer.
   2. Mechanical Couplings: Coupling housings shall be ductile iron (ASTM A536). Bolts and nuts shall be carbon steel track-type (ASTM A183), minimum tensile 110,000 psi. Gaskets shall be Grade "E" EPDM, for water services from -30 to +230□F. At joints allowing controlled movement, expansion, contraction of deflection, flexible couplings with shall be used. At all joints not requiring flexibility, a rigid coupling shall be used.
      a. Rigid Type: Coupling housings cast with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with NFPA 13.
      b. Flexible Type: Use in locations where vibration attenuation and stress relief are required.
   3. Flange Adapter: Flat face, for direct connection to ANSI Class 125 or 150 flanged components.

B. Welded flanged joints shall be faced true, provided with 1/16 inch ring type gasket, and made square and tight. Flanges shall have raised or flat faces to mate with adjacent flanges or valves. Welding shall comply with ANSI B31.1.

C. Welded joints shall be butt welded in accordance with ANSI B31.1.

D. Qualification of Welders:
   1. All welders employed for the work shall be qualified under the requirements of ANSI B31.1.0, Section 127.5.
   2. Evidence of the welder's qualifications shall be submitted to the Architect before any welds are made.
   3. Coupling for sprinkler piping shall be Victaulic Model 75.

E. Underground Pipe:

1. Standard weight ductile iron pipe with mechanical "bolted type" joints.
2. Provide tie rods and thrust blocks at each change of direction of the underground fire service piping. Install tie rods and thrust blocks in accordance with NFPA-24 requirements.

2.4 FIRE DEPARTMENT VALVES:

A. Valves:
1. Valves of the same type shall have the name or trademark of the manufacturers and the working pressure stamped or cast on the valve body.
2. All valves installed in horizontal lines shall be installed with the stems horizontal or above. Valve handwheels shall be oriented, when installed, to provide maximum accessibility for operation.
3. All valves requiring packing shall be designed and constructed such that they can be repacked under pressure.
4. Valve handwheels shall be malleable iron.
5. Fire Department Valves: Fire department angle valves shall be 2½" size pressure reducing type complete with cap and chain. Valves shall have polished brass finish and shall be Elkhart UP-25, Potter-Roemer 4085 or equivalent by Nibco or Sierra.

2.5 VALVES, EQUIPMENT AND ACCESSORIES FOR FIRE PROTECTION SYSTEM:

A. Gate Valves 2½ Inch and Larger: Valves shall be O.S. and Y type with iron body, bronze trim, solid wedge, and flanged ends for 175 pound W.W.P. Valves shall be U.L. listed with identification mark for such stamped or cast on valve body. Valve shall be Crane; Stockham, Nibco/Scott, or Kennedy.

B. Gate Valves 2 Inches and Smaller: Valves shall be O.S. and Y type with bronze body, solid wedge, and threaded ends for 175 pound W.W.P. Valves shall be U.L. listed with identification mark for such stamped or cast on valve body. Valves shall be Crane, Stockham, Nibco/Scott, or Kennedy.

C. Check Valves 2 Inches in Size and Smaller: Check valves shall be horizontal swing type with bronze body, composition disc, threaded ends for 200 pound W.O.G. and shall be Crane, Stockham, Nibco/Scott, or Kennedy.

D. Swing Check Valves 2½ Inch and Larger: Check valves shall be horizontal swing type with iron body, bronze trim, and flanged ends for 175 pound W.W.P. Valves shall be UL listed with identification mark for such stamped or cast on the valve body. Valves shall be Crane, Stockham, Nibco/Scott, or Kennedy.

E. Wafer Check Valves 4 inch and Larger: Valves shall be iron body with bronze trim, EPDM O-ring seals and stainless steel Hinge pins. Valve shall be UL listed and FM approved. Wafer check valves shall be Grinnell, or equivalent by Victaulic or Gruvlock.

F. Spring-Assisted Check Valves 2½ inch and Larger: Valve shall be UL listed and FM approved. Valves shall have a ductile iron body with aluminum bronze or elastomer encapsulated ductile iron disc, stainless steel spring and shaft and grooved ends. Spring-assisted check valves shall be Victaulic or Gruvlock.

G. Butterfly Valves 2½ inch and Larger: Valve shall be UL listed and FM approved. Valves shall have a ductile iron body, elastomer encapsulated ductile iron disc with integrally cast stem and grooved ends. Butterfly valves shall be Victaulic, Gruvlock, or Kennedy.

H. Globe Valves: Valves shall have bronze body, rising stem, composition disc, threaded ends for 200 pound W.O.G. and shall be Crane, Stockham, Nibco/Scott, or Kennedy.

I. Angle Valves: Valves shall have bronze body, rising stem, composition disc, threaded ends for 200 pound W.O.G. and shall be Crane, Stockham, Nibco/Scott, or Kennedy.

J. Sprinkler Wet Pipe Alarm Valves: Valves shall be U.L. listed and shall be furnished with all standard trim including pressure gauges, by-pass, test valves, electric alarm pressure switch and main drain. Valve shall be cast iron or ductile iron, and all parts in contact with water shall be non-ferrous. Internal parts shall be replaceable without removal of valve from installed position. Valve shall be Victaulic, Central Sprinkler, Viking, Grinnell, Automatic Sprinkler, or Reliant.

K. Electric alarm pressure switches shall be dual switch closer or opener type, and shall be System Sensor, United Electrics, Potter or Viking.

L. Supervisory Switches: The valve for each sprinkler system shall be provided with a valve mounted switch capable of detecting motion of the valve from a full open position. Switches shall be Underwriters Laboratories listed and Factory Mutual approved. Switch shall be System Sensor, United Electrics, Potter or Viking.

M. Water Flow Switches: water flow switches shall be line mounted vane type with retard. Switch shall consist of two single pole, double throw, snap action switches and an adjustable, recycling pneumatic retard, contained inside a general purpose die-cast housing. Switches shall be capable of either horizontal or vertical mounting, and shall be Underwriters Laboratories listed and Factory Mutual approved. Switch shall be System Sensor, United Electrics, Potter or Viking.

N. Electric Bell: Bell shall be 10" round red enameled steel bell 120 Volt A.C. electric motor. Bell shall be Potter-Roemer, Viking, System Sensor or United Electrics.

O. In-Building Riser: In-Building Riser shall be installed as indicated on the plans. Riser shall be composed of a single extended 90 degree fitting of fabricated 304 stainless steel tubing, maximum working pressure 200 psi. The fitting shall have a flanged-end connection on the outlet (building) side and a CIPS coupler on the inlet (underground) side. In-Building Riser shall be Ames Fire & Waterworks, Zurn, or Viking.

P. Riser Manifold Assembly: shall be UL Listed for horizontal or vertical installation as a one-piece, fabricated assembled unit. The riser manifold assembly shall consist of a cast, non-welded, ductile iron body with grooved end connections having all brass and galvanized trim. The manifold piping shall clearly identify manifold pipe size, flow direction, test, drain, and gauge outlets. A built-in drain port shall be available to permit hydrostatic testing without draining the system. Assembly shall have a working pressure rating of 300 psi.

2.6 SPRINKLER HEADS:

A. Sprinkler heads shall be glass-bulb type. Body shall be die cast brass, with hex-shaped wrench boss cast into the body to facilitate installation and reduce the risk of damage during installation.

B. Sprinkler head types shall be coordinated with the Architect.

C. Upright sprinkler heads shall be ½ inch spray type with bronze finish. Sprinklers shall be Viking, Central Sprinkler, Reliable, Grinnell or Automatic Sprinkler.

D. Pendent sprinkler heads unless otherwise indicated pendent sprinkler heads shall be quick response ½ inch spray type with chrome plated finish and white escutcheon plate. Sprinklers shall be Viking, Central Sprinkler, Reliable, Grinnell or Automatic Sprinkler.

E. Sidewall sprinkler heads shall be quick response ½ spray type with chrome plated finish and white escutcheon. Provide dry type sprinkler heads where indicated. Sprinklers shall be Viking, Central Sprinkler, Reliable, Grinnell or Automatic Sprinkler.

F. Concealed pendent sprinkler heads shall be ½ inch spray type with chrome plated finish and white escutcheon and ceiling plat. Sprinklers shall be Viking, Central Sprinkler, Reliable, Grinnell or Automatic Sprinkler.

2.7 HANGERS FOR FIRE PROTECTION PIPING:

A. Hanger for 4" and larger horizontal lines shall be Clevis type hangers, B-Line, Anvil, or Erico.
B. Hanger for horizontal lines up to 3½" shall be band type hangers, B-Line, Anvil, or Erico.
C. Supports for vertical lines passing through floor shall be riser clamp type, Fee & Mason, Carpenter and Patterson, B-Line, Anvil, or Erico.

2.8 FIRE DEPARTMENT CONNECTION:

A. The fire department connection shall be a Two way wall mounted type with clappers, caps and chains, and identification base plate. Finish shall be polished brass. Fire department connections shall be Potter Roemer, Elkhart or Sierra. Fire department connections shall be 5” locking Storz type.

2.9 FIRE PUMP AND ACCESSORIES:

A. The pump shall be an diesel driven type. The pump shall be selected by the fire sprinkler contractor and based on providing flow to meet the automatic sprinkler demand and pressure requirements. The pump shall meet the requirements of Underwriters' Laboratories, Factory Mutual and NFPA 20. The pump shall be furnished complete with all necessary accessories including but not limited to a controller, jockey pump, jockey pump controller, 2½" test hose valves with caps and chains, hose valve header, suction and discharge gauges, casing relief valve, main relief valve, automatic air release valve, ball drip valve, batteries, complete fuel system and gate valves and check valves.
B. Fire pump frame shall be provided with vibration isolation.
C. The pump manufacturer shall provide the services of a factory trained technician for check-out and start-up of the fire pump systems.

2.10 FREEZE PROTECTION:

A. Aboveground wet pipes in unheated areas such as the fire service line serving the dry pipe valve shall be protected from freezing by tracing with self-regulating, heat trace tape. Heat trace tape shall be spiral wrapped as indicated on the drawings. Pipes shall then be insulated with 1" thick fiberglass insulation with all season jacket. Insulation exposed to weather shall be protected with an aluminum jacket weather sealed.

2.11 FIRE DEPARTMENT VALVE CABINETS:

A. Valve cabinets shall be a fire rated recessed 20 gauge box and 18 gauge frame steel cabinet, 2-1/2” brass hose valve and DUO-panel w/ tempered safety glass door. Cabinet finish color shall be white powder coat unless directed otherwise by Design Professional. Valve cabinet shall be Potter-Roemer FRC1810 series.

PART 3 - EXECUTION

3.1 GENERAL:

A. Unless specifically stated otherwise, the fire protection system shall conform to all other sections of this specification which apply to pipe installation, accessories and controls.
B. All threaded hose outlets shall comply with the local fire department requirements.
C. All shop drawings submitted on items requiring Underwriters' Listing shall bear evidence of Underwriters' approval.
D. All exposed fire system piping including valve room piping shall be cleaned of rust, grease

and scaled and shall be provided with a field applied prime coat and two coats of an oil based enamel paint. Color shall be red or as directed by architect.

E. The contractor shall perform all tests of Fire Protection Systems as required by governing codes and local authorities at no additional cost to the Owner. Tests shall be performed in the presence of the Owners representative.

3.2 INSTALLATION:

A. Install sprinkler piping with a slope to valve room and to auxiliary low point drains as required by NFPA 13.
B. Coordinate sprinkler installation with building structure and other trades.
C. Route drains to outside building and terminate 9" AFG.
D. Verify locations of lights and diffusers prior to installing sprinkler heads and piping.
E. Sprinkler heads shall be installed on centerline with lights, diffusers and doors, in living units. In layin tile ceiling the sprinkler heads shall be installed in the center of 2' x 2' tiles and in the center of the ½ tile in 2' x 4' tiles.
F. Contractor shall purge air from all wet pipe sprinkler system piping prior to final system completion.
G. [Provide return bends in heated areas in order to allow for adjusting heads to centerline.]
H. Install a spare sprinkler cabinet near the sprinkler riser. Provide number of spare sprinklers as required by NFPA-13, with at least one spare for each type of head installed.

END OF SECTION 21 20 10

SECTION 22 01 10 – PLUMBING GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

B. It is recognized that separate sub-contracts may be instituted by THIS CONTRACT'S GENERAL CONTRACTOR with others. It is the responsibility of THIS CONTRACT'S GENERAL CONTRACTOR to completely inform, coordinate and advise those sub-contractors as to all of the requirements, conditions and information associated with providing and installing their portion of the total job.

1.2 IMPOSED REGULATIONS:

A. Applicable provisions of the State and Local Codes and of the following codes and standards in addition to those listed elsewhere in the specifications are hereby imposed on a general basis for plumbing work. In each case, the prevailing edition shall be the current adopted edition of the state where the project is located.

1. International Plumbing Code.
2. International Gas Code.
3. International Energy Conservation Code.
4. International Fire Code.
5. NFPA 54

1.3 SCOPE OF WORK:

A. Provide all labor, materials, equipment and supervision to construct complete and operable plumbing systems as indicated on the drawings and specified herein. All materials and equipment used shall be new, undamaged and free from any defects.

1.4 EXISTING SERVICES AND FACILITIES:

A. Damage to Existing Services: Existing services and facilities damaged by the Contractor through negligence or through use of faulty materials or workmanship shall be promptly repaired, replaced, or otherwise restored to previous conditions by the Contractor without additional cost to the Owner.

B. Interruption of Services: Interruptions of services necessary for connection to or modification of existing systems or facilities shall occur only at prearranged times approved by the Owner. Interruptions shall only occur after the provision of all temporary work and the availability of adequate labor and materials will assure that the duration of the interruption will not exceed the time agreed upon.

C. Removed Materials: Existing materials made unnecessary by the new installation shall be removed, shall remain the property of the Owner and shall be stored at a location and in a manner as directed, or, if classified by the Owner's authorized representative as unsuitable for further use, shall become the property of the Contractor and shall be removed from the site.

1.5 PRODUCT WARRANTIES:

A. Provide manufacturer's standard printed commitment in reference to a specific product and normal application, stating that certain acts of restitution will be performed for the Purchaser or Owner by the manufacturer, when and if the product fails within certain operational conditions and time limits. Where the warranty requirements of a specific specification section exceed the manufacturer's standard warranty, the more stringent requirements will apply and modified manufacturer's warranty shall be provided. In no case shall the manufacturer's

warranty be less than one (1) year.

1.6 PRODUCT SUBSTITUTIONS:

A. General: Materials specified by manufacturer's name shall be used unless prior approval of an alternate is given by addenda. Requests for substitutions must be received in the office of the Architect at least 10 days prior to opening of bids.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS:

A. Standard Products: Provide not less (quality) than manufacturer's standard products, as specified by their published product data. In addition to the indication that a particular product/model number is acceptable, comply with the specified requirements. Do not assume that the available off-the-shelf condition of a product complies with the requirements; as an example, a specific finish or color may be required.

B. Uniformity: Where multiple units of a general product are required for the work, provide identical products by the same manufacturer, without variations except for sizes and similar variations as indicated.

C. Product Compatibility, Options: Where more than one product selection is specified, either generically or proprietarily, selection is Purchaser's or Installer's option. Provide adaptations as needed for interfacing of selected products in the work.

D. Equipment Nameplates: Provide a permanent operational data nameplate on each item of power operated equipment, indicating the manufacturer, product name, model number, serial number, speed, capacity, power characteristics, labels of tested compliance, and similar essential operating data.

E. Locate nameplates in easy-to-read locations. When product is visually exposed in an occupied area of the building, locate nameplate in a concealed position (where possible) which is accessible for reading by service personnel.

PART 3 - EXECUTION

3.1 PRODUCT INSTALLATION, GENERAL:

A. Except where more stringent requirements are indicated, comply with the product manufacturer's installation instructions and recommendations, including handling, anchorage, assembly, connections, cleaning and testing, charging, lubrication, startup, test operation and shut-down of operating equipment. Consult with manufacturer's technical experts, for specific instructions on unique product conditions and unforeseen problems.

B. Protection and Identification: Deliver products to project properly identified with names, models numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged or protected to prevent deterioration during shipment, storage and handling. Store in a dry, well ventilated, indoor space, except where prepared and protected by the manufacturer specifically for exterior storage.

C. Permits and Tests: Provide labor, material and equipment to perform all tests required by the governing agencies and submit a record of all tests to the Owner or his representative. Notify the Architect five days in advance of any testing.

END OF SECTION 22 01 10

SECTION 22 01 20 - PLUMBING STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. Industry Standards: It is a general requirement that plumbing work comply with applicable requirements and recommendations of standards published by listed agencies and trade associations, except to the extent more detailed and stringent requirements are indicated or required by governing regulations. Listing of Associations, Standards, and Abbreviations:

1. AGA American Gas Association
   1515 Wilson Blvd.
   Arlington, VA 22209
2. ASHRAE American Society of Heating, Refrigerating &
   Air Conditioning Engineers, Inc.
   1791 Tullie Circle, NE, Atlanta, GA. 30329
   404/636-8400
3. AWS American Welding Society, Inc.
   2501 NW 7th St., Miami, FL 33125
   305/642-7090
4. CISPI Cast Iron Soil Pipe Institute
   2020 K. St., NW, Washington, DC
   202/233-4536
5. NEC National Electrical Code by NFPA
6. NEMA National Electrical Manufacturers Association
   1300 N 17th Street, Suite 1847
   Rosslyn, VA 22209
   703/841-3200
7. NFPA National Fire Protection Association
   407 Atlantic Ave.,
   Boston, MA 02210
   617/482-8755
8. UL Underwriters' Laboratories, Inc.
   207 East Ohio St.,
   Chicago, IL 60611
   312/642-6969

PARTS 2 AND 3 - PRODUCTS AND EXECUTION (Not applicable)

END OF SECTION 22 01 20

SECTION 22 02 10 - PLUMBING COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. Coordinate the actual location of all plumbing work visible in finished spaces with the Architect/Engineer.

B. Plumbing Coordination Affidavit: Prior to ordering materials, provide the Coordination Affidavit required by Section 22 0220.

PART 2 - PRODUCTS

2.1 PRODUCT COORDINATION:

A. Power Characteristics: Refer to the electrical sections of the specifications and the electrical drawings for the power characteristics available for the operation of each power driven item of equipment. The electrical design was based on the typical power requirements of the equipment manufacturers scheduled or specified. Any modifications to the electrical system which are required due to the use of an approved equivalent manufacturer shall be made at no additional cost to the owner. All changes must be clearly documented and submitted for review by the Architect/Engineer prior to purchasing equipment. Coordinate purchases to ensure uniform interface with electrical work. The plumbing contractor shall furnish a detailed list of equipment electrical characteristics to the electrical contractor for the purpose of preparing the coordination affidavit required by Division 26.

B. Coordination of Options and Substitutions: Where the contract documents permit the selection from several product options, and where it becomes necessary to authorize a substitution, do not proceed with purchasing until coordination of interface of equipment has been checked and satisfactorily established.

C. Firestopping: Refer to architectural drawings for the locations of all fire rated ceilings, floors and walls. The contractor shall furnish detailed shop drawings of all firestopping details to be used for both piping and ductwork. All firestopping details shall be U.L. listed and subject to approval by the Authority having jurisdiction.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION:

A. Substrate Examination: The Installer of each element of the work must examine the condition of the substrate to receive the work, and the conditions under which the work will be performed, and must notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

B. Do not proceed with the installation of sleeves, anchors, hangers, roof penetrations and similar work until coordination drawings have been processed and released for construction. Where work must be installed prior to that time in order to avoid a project delay, review proposed installation in a project coordination meeting including all parties involved with the interfacing of the work.

3.2 CUTTING AND PATCHING:

A. Structural Limitations: Do not cut structural framing, walls, floors, decks and other members intended to withstand stress, except with the Architect's or Engineer's written authorization. Authorization will be granted only where there is not other reasonable method for completing the work, and where the proposed cutting clearly does not materially weaken the structure.

B. Where authorized, cut opening through concrete (for pipe penetrations and similar services) by core drilling or sawing. Do not cut by hammer-driven chisel or drill.

C. Other work: Do not endanger or damage other work through the procedures and processes of cutting to accommodate mechanical work. Review the proposed cutting with the Installer of the work to be cut, and comply with his recommendations to minimize damage. Where necessary, engage the original Installer or other specialists to execute the cutting in the recommended manner.

D. Where patching is required to restore other work, because of either cutting or other damage inflicted during the installation of plumbing work, execute the patching in the manner recommended by the original Installer. Restore the other work in every respect, including the elimination of visual defects in exposed finishes, as judged by the Architect. Engage the original Installer to complete patching of the following categories of work:

1. Exposed concrete finishes.
2. Exposed masonry.
3. Waterproofing and vapor barriers.
4. Roofing, flashing and accessories.
5. Interior exposed finishes and casework, where judged by the Architect to be difficult to achieve an acceptable match by other means.

3.3 COORDINATION OF PLUMBING INSTALLATION:

A. General: Sequence, coordinate and integrate the various elements of plumbing work so that building systems will perform as indicated and be in harmony with other work of the building. The Architect/Engineer will not supervise the coordination, which is the exclusive responsibility of the Contractor. Comply with the following requirements:

1. Install piping and similar services straight and true, aligned with other work and with overhead structures and allowing for insulation where applicable. Conceal where possible.
2. Arrange work to facilitate maintenance and repair or replacement of equipment. Locate services requiring maintenance on valves and similar units in front of services requiring less maintenance. Connect equipment for ease of disconnecting, with minimum of interference with other work.
3. Give the right-of way to piping systems required to slope for drainage (over other service lines). Piping shall be located to avoid interference with ductwork and light fixtures.
4. Store materials off the ground and protected from standing water and weather.

B. Drawings: Conform with the arrangement indicated by the contract documents to the greatest extent possible, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, comply with the Architect's decision on resolution of the conflict.

C. Electrical Work: Coordinate the plumbing work with electrical work, and properly interface with the electrical service. In general, and except as otherwise indicated, install plumbing equipment ready for electrical connection. Refer to electrical sections of the specifications for electrical connection of plumbing equipment.

D. Utility Connections: Coordinate the connection of plumbing systems with exterior underground utilities and services. Comply with the requirements of governing regulations, franchised service companies and controlling agencies. Provide a single connection for each service except where multiple connections are indicated.

END OF SECTION 22 02 10

SECTION 22 02 20 - PLUMBING SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUBMITTAL FORMS AND PROCEDURES:

A. The purpose of submittals is to demonstrate to the Architect/Engineer that the Contractor understands the design concept. The Architect/Engineer's review of such drawings, schedules, or cuts shall not relieve the Contractor from responsibility for deviation from drawings or specifications unless he has, in writing, called the Architect/Engineer's attention to such deviations at the time of submission, and has received from the Architect/Engineer, in writing, permission for such deviations. All submittals must be completely checked by the Contractor prior to submission for review.

B. Hard Copy Submittals: Submittal data shall be placed in one or more hard-back 3-ring binders, arranged and labeled according to specification section. Each binder shall contain a title page and table of contents. Provide separator tabs, and label by specification section. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor’s Name, Division 22 Superintendent’s name, Suppliers and point of contact for each, and date. Except as otherwise indicated in other sections, submit 5 complete copies. Quantity indicated does not include copies required for regulatory agencies.

C. Electronic Submittals: If the Architect agrees to allow electronic submittals via an on-line information management product such as “Submittal Exchange, etc., all electronic submittal files shall be organized to match the bid documents for specification section and name. Each submittal file shall be complete for each specification section. Multiple partial submittals per specification section will be rejected. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor’s Name, Division 22 Superintendent’s name, Suppliers and point of contact for each, and date.

D. Submittals shall be made for all items contained in the following specification sections:

1. Plumbing Coordination
2. Plumbing Identification
3. Plumbing Pipe, Tube, and Fittings
4. Plumbing Hangers and Supports
5. Pump and Day Tank System
6. Plumbing Vibration and Seismic Control
7. Plumbing Piping Systems Insulation
8. Gas Piping System
9. Domestic Water Piping System
10. Soil, Waste and Vent Piping System
11. Water Heaters
12. Plumbing Fixtures
13. Electric Water Coolers
14. Plumbing Coordination Affidavit (see Attachment No. 1 below)

E. Response to Submittals: A Submittal Review Report shall be issued by the Architect/Engineer with the following classifications for each item:

1. "No Exceptions Taken": No corrections, no marks. Contractor shall submit copies for distribution.
2. "Make Corrections Noted": A few minor corrections. Items may be ordered as marked up without further resubmission. Submit copies for distribution.

3. "Revise and Resubmit": Minor corrections. Item may be ordered at the Contractor's option. Contractor shall resubmit drawings with corrections noted.
4. "Rejected": Major corrections or not in accordance with the contract documents. No items shall be ordered. Contractor shall correct and resubmit drawings.

PART 2 - PRODUCTS

2.1 SUBMITTAL REQUIREMENTS:

A. General: Each specification section shall list the required submittal items. All submittal items shall conform to the requirements listed below. For each major section of submittal data, include a summary page which lists items and model numbers for each piece of equipment.

B. Shop Drawings: Prepare shop drawings to accurate scale except where diagrammatic representations are specifically indicated. Show clearance dimensions of critical locations, and show dimensions of spaces required for operation and maintenance of equipment. Show piping connections and other service connections, and show interface with other work including structural support. Indicate by note, the portions of plumbing work shown on the shop drawings which deviated from the indication of work in the contract documents, and explain the reasons for the deviations. Show how such deviations coordinate with interfacing deviations on shop drawings for other portions of the work, currently or previously submitted.

C. Manufacturer's Data: Where pre-printed data is submitted for more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided. Delete or mark-out significant portions of preprinted data which are not applicable. Where operating ranges are shown, mark data to show portion of range required for project application. Expansion or elaboration of standard data to describe a non-standard product must be processed as a shop drawing submittal. For each product include the manufacturer's production specifications, installation or fabrication instructions, nearest source of supply (including telephone number), sizes, weights, speeds, operating capacities, piping and service line connection sizes and locations, statements of compliance with required standards and governing regulation (include manufacturer's signed statements if not covered in printed data), performance data (where applicable) and similar information needed to confirm compliance with the requirements.

D. Certifications: Where specifically indicated, submit with notarized execution.

E. Test Reports: Submit test reports which have been signed and dated by the firm performing the test and prepared in the manner specified in the standard or regulation governing the test procedures as indicated.

F. Manufacturer's Product Warranties: Where pre-printed and published warranty includes substantial deviation from required warranty (as judged by the Architect or Engineer), product is automatically disqualified from use on the project, except where manufacturer prepares and issues a specific product warranty on the product, stating that it is in lieu of the published warranty, and is executed by an authorized officer, and complies with the requirements. Warranties shall comply with the requirements of individual specification section where those requirements exceed the manufacturer's standard warranty.

PART 3 - EXECUTION

3.1 CLOSEOUT REQUIREMENTS:

A. Operating Instructions: Submit manufacturer's operating instructions for each item of plumbing equipment and supplement with additional project application instructions where necessary. Prepare and submit specific operating instructions for charging, start-up, control or sequencing of operation, phase or seasonal variations, shut-down, safety and similar operational instructions. Prepare in typewritten form in completely explained and easily understood English language.

B. Maintenance Manuals: Organize each copy of the required system maintenance manuals to include an index followed by thumb-tab marked sections for each of the following:
   1. System operating instructions.
   2. Emergency instructions including addresses and telephone numbers of service sources.
   3. Regular system maintenance procedures including lubrication.
   4. Spare parts listing and stocking recommendations.
   5. Inspection, adjusting, rebalancing, cleaning, parts replacement, and similar maintenance instructions and recommendations, including the proper use of tools and accessories.
   6. Valve schedule and control diagram for each system.
   7. Manufacturer's data for each operating item in each system.
   8. Manufacturer's product warranties and guarantees relating to the system and equipment items in the system.
   9. Corrected or approved issues of submittal items relating to the system.
   10. Bind each maintenance manual in one or more vinyl-covered, 2", 3-ring binder, plus pocket-folder type binders for folded drawings, and mark the back spine of each binder with system identification and volume number.

C. Maintenance Materials: Deliver to Owner’s representative at the location as directed, in containers or packages suitable for storage and fully identified.

D. Guarantees: Where indicated as "Certified", provide guarantee which, in addition to execution by an authorized officer of each guarantor, is attested to by the Secretary of each guarantor and bears the corporate seal.

3.2 ATTACHMENT NO. 1 (Plumbing Coordination Affidavit):

A. The intent of Attachment Number 1 is to ensure that the electrical requirements for plumbing equipment have been reviewed and coordinated by the Contractor. No plumbing equipment shall be ordered, nor shall rough-in begin, before this coordination has taken place. This document shall be returned appropriately marked whether or not any changes are deemed to be necessary by the contractor.

END OF SECTION 22 02 20

ATTACHMENT NO. 1

SHOP DRAWING COORDINATION AFFIDAVIT

I, the Division 22 Superintendent, certify that I have reviewed the plumbing shop drawings for electrically driven equipment and that the accompanying plumbing shop drawings reflect the requirements of the actual equipment to be furnished for use on this project. In addition, the electrical requirements of said equipment have been coordinated with the Division 26 contractor.

NOTE: If no deviations are required please indicate by circling the appropriate answer above your signature.

PROJECT: _____ DEVIATIONS: Yes / No

COMPANY:_____

TITLE: _____ SIGNATURE: _____

TELEPHONE: _____DATE:_____

FAILURE TO PERFORM THE WORK REQUIRED BY THIS AFFIDAVIT, PRIOR TO ORDERING MATERIALS OR ROUGHING-IN, MAY RESULT IN IMPROPER CONNECTIONS BEING PROVIDED. THE EXPENSE OF CORRECTIVE MEASURES, IF REQUIRED, SHALL BE BORNE BY THE CONTRACTOR.

SECTION 22 02 30 - PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in the manufacture of identification systems required for this product.

B. Submittals: Submit manufacturer's data on materials and submit a sample of each type required.

PART 2 - PRODUCTS

2.1 PLUMBING IDENTIFICATION MATERIALS:

A. Plastic Pipe Markers:

1. General: Product manufacturer's standard pre-printed, flexible or semi-rigid, permanent, color-coded, plastic-sheet pipe markers, complying with ANSI A13.1.
2. Small Pipe: For external diameters less than 6 inches (including insulation, if any), provide full band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
   a. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
   b. Adhesive lap joint in pipe marker overlap.
   c. Laminated or bonded application of pipe marker to pipe (or insulation).
   d. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4 inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inch.
3. Large Pipes: For external diameters of 6 inches and larger (including insulation, if any), provide either full-band or strip-type pipe markers, but not narrower than 3 x letter height (and of required length), fastened by one of the following methods:
   a. Laminated or bonded application of pipe marker to pipe (insulation).
   b. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2 inches wide: full circle at both ends of pipe marker, tape lapped 3 inches.
4. Lettering: Comply with piping system names as specified, scheduled or shown, and abbreviate only as necessary for each application length.
5. Arrows: Print each pipe marker with arrow indicating direction of flow, either integrally with piping system service lettering or as separate unit of plastic (to accommodate both directions).
6. Install pipe markers on piping of the following piping systems:
   Domestic Cold Water
   Domestic Hot Water
   Dom. Hot Water Return
   Natural Gas

B. Plastic Tape: Manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick:

1. Width: Provide 1-1/2 inches wide tape markers on pipes with outside diameters including insulation of less than 6 inches, 2-1/2 inches wide tape on larger pipes.
2. Color: Comply with ANSI A13.1.

C. Engraved Plastic-Laminate Signs:

1. General: Provide engraving stock melamine plastic laminated, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core, letter color, except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
2. Thickness: 1/16 inch, except as otherwise indicated.
3. Fasteners: Self-tapping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate the substrate.

D. Valve Tags:
1. Valve tags shall be 18 gauge (minimum) brass with 1-1/4" (minimum) height and width. Identification letters and numbers shall be stamped in tag and shall be filled with black paint
2. Valve tags shall be attached to valve using cable ties. Cable ties shall be self-locking nylon ties.
3. Valve tags shall be installed at all shut-off, balancing, metering, and drain valves. Valve tag shape and designations shall be as follows:

Identification System	Shape	Numbers
Domestic Cold Water	Hexagonal	CW-1, 2, 3, ...
Domestic Hot Water	Hexagonal	HW-1, 2, 3, ...
Dom. Hot Water Return	Hexagonal	HWR-1, 2, 3, ...
Natural Gas	Octagonal	NG-1, 2, 3, ...

E. Valve Charts:
1. Valve charts shall be provided for plumbing systems. Charts shall be located [in the main mechanical room] [where shown on the drawings] [in each mechanical room].
2. Valve charts shall be typed listing all valve tags. List shall include identification number, valve location in system (e.g., Corridor 123, Water Heater WH-1, etc.) and its function (e.g., shut-off, balancing, drain, etc.). Charts shall be mounted in a wooden frame with glass cover.

2.2 LETTERING AND GRAPHICS:
A. General: Coordinate names, abbreviations and other designations used in the identification work, with the corresponding designations shown, specified or scheduled. Provide numbers, lettering recommended by manufacturers or as required for proper identifications and operation/maintenance of the systems and equipment.
B. Multiple Systems: Where multiple systems of the same generic name are shown and specified, provide identification which indicates the individual system number as well as the service.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION:
A. Coordination: Where identification is to be applied to surfaces which require insulation, painting and other covering or finish, including valve tags in finished spaces, install identification after completion of covering or painting.
B. All equipment, valves, etc. located above ceiling grids shall be located with an engraved marker permanently attached to the ceiling grid. The marker shall describe the item located above the ceiling.
C. Piping System Identification:
1. General: Install pipe markers on each system indicated to receive identification, and include arrows to show normal direction of flow.
D. Locate pipe markers as follows wherever piping is exposed to view in mechanical rooms, accessible maintenance spaces (including accessible areas above ceilings) and exterior non-

concealed locations:

1. Near each valve and control device.
2. Near each branch, excluding short take-offs for fixtures. Mark each pipe at branch, where there could be a question of flow pattern.
3. Near locations where pipes pass through walls or ceilings, or enter non-accessible enclosures.
4. Near major equipment items and other points of origination and termination.
5. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment.

E. Do not mark piping exposed in finished occupied spaces.

F. Plumbing Equipment Identification: Install an engraved plastic laminate sign on or near each major item of plumbing equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for all major items of plumbing equipment.

G. Valve tags shall be attached to the valve handwheel with cable ties.

END OF SECTION 22 02 30

SECTION 22 02 40 - PLUMBING WORK CLOSEOUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DOCUMENTATION PROCEDURES:

A. Signed Commitments: Do not proceed with transfer of plumbing systems to the Owner for operation until warranties, performance certifications and similar commitments to be signed by Contractor and other entities have been executed and transmitted to Architect (for Owner's records).

1.3 RECORD DRAWINGS:

A. Explanation: Except where otherwise indicated, plumbing drawings (contract drawings) prepared by Architect/Engineer, contract/drawings, are diagrammatic in nature and may not show locations accurately for various components of plumbing systems. Shop drawings, including coordination drawings, prepared by Contractor shall show certain portions of work more accurately to scale and location, and in greater detail.

B. General Recording Procedure: Maintain a white-print set, blue-line or black-line, of plumbing contract drawings and shop drawings in clean, undamaged condition, for mark-up of actual installations which vary substantially from the work as shown. Mark-up whatever drawings are most capable of showing the installed conditions accurately; however, where shop drawings are marked, record a reference note on appropriate contract drawing. Mark with erasable pencil and use multiple colors to aid in the distinction between work of separate systems. In general, record every substantive installation of plumbing work which previously is either not shown or shown inaccurately, but in any case record the following:

1. Underground and aboveground piping, both exterior and interior, drawn to scale and fully dimensioned.
2. Plumbing "Project Record" shall be maintained as part of the "Project Record" specified in Division 1.

PART 2 - PRODUCTS

2.1 NOT APPLICABLE:

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES:

A. General Coordination: Sequence closeout procedures properly, so that work will not be endangered or damaged, and so that every required performance will be fully tested and demonstrated.

B. System Performance Test Run: At the time of plumbing work closeout, check each item in each system to determine that it is set for proper operation. With Owner's representative and Architect/Engineer present, operate each system in a test run of appropriate duration to demonstrate compliance with performance requirements. During or following test runs, make final corrections or adjustments of system to refine and improve performances wherever possible, including noise and vibration reductions, elimination of hazards, better response of controls, signals and alarms, and similar system performance improvements. Provide testing or inspection devices as may be requested for Architect's/Engineer's observation of actual system performances. Demonstrate that controls and items requiring service or maintenance

are accessible. Test run shall be scheduled to coincide with Engineer's final inspection of the plumbing work.

C. Cleaning and Lubrication: After final performance test run of each plumbing system, clean system both externally and internally. Flush piping system by operating drains and similar means, and clean strainers and traps. Lubricate both power and hand operated equipment and remove excess lubrication. Touch-up minor damage to factory painted finishes and other painting specified as plumbing work; refinish work where damage is extensive.

D. General Operating Instructions: In addition to specified training of Owner's operating personnel specified in individual plumbing sections, and in addition to preparation of written operating instructions and compiled maintenance manuals specified, provide general operating instructions for the plumbing systems. Conduct a walk-through explanation and demonstration for orientation and education of Owner's personnel to be involved in continued operation of building.
   1. Describe each basic system and how its control system functions, including flow adjustments, temperature control and similar operations.
   2. Explain and point out identification system, displayed diagrams, signals, alarms and similar provisions of the work.
   3. Describe basic sequencing requirements and interlock provisions for system start-up, phasing and shut-down.
   4. Emphasize emergency procedures and safety provisions for protection of equipment and safety of occupants during equipment malfunction, disasters, power failures and similar unusual circumstances.
   5. Outline basic maintenance procedures.

E. Demonstrate what adjustments have been made and can continue to be made to reduce noise and vibration, improve system output, decrease energy consumption and similar performance improvements.

F. Point out operational security provisions, safety, unavoidable hazards and similar operator limitations. Display and conduct a "thumb-through" explanation of maintenance manuals, record drawings, meter readings and similar service items.

G. Construction Equipment: After completion of performance testing and Owner's operating instructions and demonstrations, remove installers tools, test facilities, construction equipment and similar devices and materials used in execution of the work but not incorporated in the work.

3.2 CONTINUED SYSTEM OPERATIONS:

A. Final Acceptance: At time of substantial completion of plumbing work, Owner's operating personnel will take over operation of plumbing systems. However, until time of final acceptance, respond promptly with consultation and services on whatever operation or maintenance problems may remain or arise.

END OF SECTION 22 02 40

SECTION 22 03 10 – PLUMBING PIPE, TUBE AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:2

A. Industry Standards:
   1. Qualify welding procedures, welders and operators in accordance with ASME B31.1 for shop and project site welding of piping work.
   2. Certify welding of piping work using the Standard Procedure Specifications by, and welders tested under supervision of, the National Certified Pipe Welding Bureau.
   3. Where plastic piping is indicated to transport potable water, provide pipe and fittings bearing approval label by the National Sanitation Foundation (NSF).

B. SUBMITTALS:
   1. Submit manufacturer's data, welding certifications, test reports, and product warranties as applicable for all piping materials.
   2. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and be specifically identified with the applicable style number.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:

A. General: Provide pipe and tube of the type, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements and comply with governing regulations and industry standards.

B. Black Steel Pipe: ASTM A 53, Schedule 40, [Schedule 10], [Schedule 5].

C. Galvanized Steel Pipe: ASTM A 53, Schedule 40, [Schedule 10], [Schedule 5].

D. Stainless Steel Pipe: ASTM A 312, Schedule 5S, full finish annealed pipe, certified for use with mechanical fittings.

E. Copper Tube: ASTM B88-89 Type (wall thickness) as indicated for each service; hard-drawn temper, except as otherwise indicated. Solder for use on domestic water piping shall be lead free type.

F. Copper Tube DWV: ASTM B 306-88 type.

G. Hubless Cast-Iron Soil Pipe: CISPI 301 or ASTM A 888 including standards for heavy duty coupling assembly ASTM C 564 and ASTM C 1540. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be listed by NSF.

H. Cast-Iron Hub-and-Spigot Soil Pipe: ASTM A 74 including ASTM C 564 and ASTM C1563 for compression gaskets. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be listed by NSF International.

I. Plastic Pipe:
   1. PVC-WATER: ASTM D2466-88
   2. PVC-DWV: ASTM D2665-88
   3. ABS-DWV: ASTM D2661-87
   4. CPVC-WATER: ASTM D2846, ASTM F441 and ASTM F442 with socket type solvent cement or threaded fittings and joints complying with ASTM F 437, ASTM F438 and ASTM F439.
   5. Polypropylene: ASTM F 2389-06 (PP) Piping Systems, CSA B137.11 (PP-R) Pipe and

Fittings for pressure applications, NSF/ANSI 14 and 61. Pipe and fittings shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. Pipe and fittings shall be provided with a factory applied, UV-resistant coating.

J. Plastic Pipe - Natural Gas Service:
   1. Polyethylene: ASTM D2513
K. Fiberglass Reinforced Pipe:
   1. ASTM D2996 with threaded and bonded joints.

2.2 PIPE/TUBE FITTINGS:

A. General: Provide factory-fabricated fittings of the type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube valve or equipment connections in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.
B. Cast-Iron Threaded Fittings for Steel Pipe: ASTM A 126-84 Class 125, plain or galvanized to match pipe.
C. Welded Fittings for Steel Pipe: ASTM A234.
D. Cast-Iron Flanged Fittings for Steel Pipe: ASME B16.1, including bolting. Class 125, plain or galvanized to match pipe.
E. Gaskets for Flanged Joints: ASME B16.21; full-faced for cast-iron flanges.
F. Gaskets for Hub and Spigot Pipe and Hubless Couplings: ASTM C 564, and ASTM C 1540 for heavy duty couplings, ASTM C 1563 for compression gaskets, and CISPI 310 or ASTM C 1277 for standard duty couplings.
G. Soldering Materials: Except as otherwise indicated, provide soldering materials as determined by the Installer to comply with installation requirements.
   1. Tin-Antimony Solder: ASTM B 32, Grade 95TA.
H. Mechanical Couplings for IPS Pipe: Coupling housings shall be ductile iron (ASTM A536). Bolts and nuts shall be carbon steel track-type (ASTM A183), minimum tensile 110,000 psi. Gaskets shall be Grade "E" EPDM, for water services from -30 to +230□F. At joints allowing controlled movement, expansion, contraction of deflection, flexible couplings with shall be used. At all joints not requiring flexibility, a rigid coupling shall be used. Fittings for pipe 2 inches and smaller shall be the mechanical compression type. Mechanical couplings shall be by Victaulic, Anvil or Grinnell.
   1. Rigid Type: Coupling housings cast with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with ANSI B31.1 and B31.9.
   2. Flexible Type: Use in locations where vibration attenuation and stress relief are required.
   3. Flange Adapter: Flat face, for direct connection to ANSI Class 125 or 150 flanged components.
I. Grooved End Fittings for Steel Pipe: Fittings shall be ductile iron (ASTM A536) forged steel (ASTM A234); or fabricated from carbon steel pipe (ASTM A53); with pre-grooved ends for use with mechanical couplings of the same manufacturer.
J. Mechanical Couplings for Hard Copper Tube: Coupling housings shall be ductile iron (ASTM A536), coated with copper colored alkyd enamel and cast with angle-pattern bolt pads for system rigidity. Bolts and nuts shall be carbon steel track-type (ASTM A183), minimum tensile 110,000 psi. Gaskets shall be Grade "E" EPDM FlushSeal® type, for water services from -30 to +230□F. Mechanical couplings shall be by Victaulic, Anvil or Grinnell.
K. Mechanical Couplings for Copper Pipe: Fittings 2"-4" size shall be wrought copper (ASTM B75 C12200 or ASTM B152 C11000 and ANSI B 16.22). Fittings 5" - 8" size shall be bronze sand

casting (ASTM B584-87) or copper alloy CDA844 (81-3-7-9) (ANSI B 16.18). Fittings shall have pre-grooved ends for use with mechanical couplings of the same manufacturer. Fittings shall be manufactured to copper tubing sizes. (Flaring of tube and fitting ends to IPS dimensions is not allowed.)

L. Copper Press-Connect Fittings: Fittings 2" and smaller size shall be cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end. Fittings 2½"-4" size shall be wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

M. Solvent Cement for PVC Joints: D2564-88.

N. Solvent Cement for ABS Joints: D2235-88.

O. Fusion Welding for Polypropylene Joints: Socket-fusion, elecrofushion, or butt-fusion, as applicable, in accordance with ASTM F 2389 and the manufacturer's specifications.

P. Pipe Sleeves:
   1. Iron Pipe Sleeves: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
   2. Sheet Metal Pipe Sleeves: Fabricate from galvanized sheet metal closed with lock-seam joints. For following pipe sizes provide gauge indicated: 3 inch pipe and smaller, 20 gauge; 4 to 6 inch pipe, 16 gauge; over 6 inch pipe, 14 gauge.
   3. Pipe Sleeve Caulking: 3M, except where another caulking system or material is specified or approved by Jaco or Flamestopper.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: Install pipe, tube and fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with a minimum of joints and couplings, but with adequate and accessible unions for disassembly and maintenance/ replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16" misalignment tolerance.
   1. Comply with ASME B31.1 Code for Pressure Piping.
   2. Comply with ASME B31.9 Code for Building Services Piping.

B. Locate piping runs as indicated on the drawings. Route vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown, or described by diagrams, details and notations or, if not otherwise indicated, run piping in the shortest route which does not obstruct usable space or block access for servicing the building and its equipment. Where possible, locate insulated piping for 1.0" clearance outside insulation. Changes in direction shall be made with fittings.

C. Piping System Joints: Provide joints of the type indicated in each piping system.

D. Threaded Joints: Thread pipe in accordance with ANSI B2.12; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

E. Welded Joints: Weld pipe joints in accordance with recognized industry practice and as follows: Weld pipe joints only when ambient temperature is above 0 degrees F. where possible. Bevel pipe ends at a 37.5 degree angle where possible, smooth rough cuts and clean to remove slag, metal particles and dirt. Install welding rings for butt welded joints. Use pipe clamps or tack-weld joints with 1.0" long welds; 4 welds for pipe sizes to 10". Build up welds with a stringer-bead pass, followed by a hot pass, followed by a cover or filler pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow holes and non-metallic inclusions. Do not weld-out piping system imperfections by tack-welding procedures; refabricate to comply

with requirements. Install forged branch-connection fittings wherever branch pipe is indicated, or install regular "T" fitting (at Contractor's option).

F. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

G. Mechanical Coupling Joints: Square cut pipe ends and deburr. Roll-groove pipe ends to manufacturer's specifications. Lubricate gaskets completely on interior and exterior using a non-petroleum based lubricant. Slide gasket over pipe ends between grooves. Engage coupling housing into grooves and tighten until housing bolt pads are in full contact on each side of joint. For pipes 2 inches and smaller, no groove is required. Mark pipe ends for proper insertion into couplings and fittings. Engage piping into fitting to full depth, indicated by marked pipe ends. Align pipe ends, position compression tool and press trigger until assembly cycle is complete. All grooved couplings, fittings, valves and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Grooved coupling manufacturer's factory trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove and installation of grooved piping products. Factory trained representative shall periodically inspect the product installation. Contractor shall remove and replace any improperly installed products.

H. Soldered Joints: Solder copper tube and fitting joints where required, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings with steel wool. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens. Use a non-corrosive paste flux and wire solder composed of 95 percent tin and 5 percent antimony.

I. Fusion Welding for Polypropylene Joints: Joint preparation, setting and alignment, fusion process, cooling times and working pressure shall be in accordance with the pipe and fitting manufacturer's specifications.

J. Hubless Cast-Iron Joints: Comply with the manufacturer's installation instructions, CISPI 310 and local code requirements.

K. Plastic Pipe/Tube Joints: Comply with manufacturer's instructions and recommendations and with applicable industry standards. Install all storm, soil, waste and vent plastic pipe underground in compliance with ASTM D 2321.

L. Insulating (Dielectric) Nipples: Comply with manufacturer's instructions for installing nipples in a manner which will prevent galvanic action and stop corrosion where the joining of ferrous and non-ferrous piping occurs.

M. Pipe Sleeves: Install pipe sleeves of the types specified wherever piping passes through the walls, floors or structural members of the work. Provide sleeves of adequate size, accurately centered in pipe runs. Size sleeves so that piping and insulation will have free movement in the sleeve, including allowance for thermal expansion. Where insulation includes a vapor barrier covering provide sleeve with sufficient clearance for installation of vapor barrier. Install length of sleeve equal to thickness of construction penetrated, except extend floor sleeves 0.25 inches above floor finish. Provide temporary support of sleeves during placement of concrete and other work around sleeves and provide temporary closure to prevent concrete and other materials from entering pipe sleeves.

1. Sleeve Type: At interior partitions and ceilings, install sheet metal sleeves.
2. Sleeve Type: At exterior penetrations both above and below grade, install iron pipe

sleeves.

3. Sleeve Type: Except as otherwise specified, install steel pipe sleeves.
4. Caulk pipe sleeves at exterior penetrations and at other locations where indicated. Provide sufficient quantities of oakum and lead to make permanent weather-tight closure between sleeve and piping, slightly recessed at exposed surface.

N. PVC piping exposed to sunlight shall be coated with water-based latex white paint to prevent UV light degradation.

3.2 CLEANING, FLUSHING AND INSPECTING:

A. General: Clean exterior surfaces of installed piping systems of superfluous materials and prepare for application of specified coatings.

B. Flush out piping system with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

3.3 PIPING TESTS:

A. General: Provide temporary equipment for testing, including pump and gages. Test piping systems before insulation is installed wherever feasible, and remove control devices before testing. Test each natural section of each piping system independently, but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating.

1. Required test period is 2 hours.

B. Unless otherwise specified for specific systems, hydraulically test each pressurized piping system at 150% of operating pressure indicated, but not less than 100 psig test pressure.

C. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.

D. Repair piping systems sections which fail the required piping test, by disassembly and re-installation, using new materials to the extent required to overcome leakage. Do not use chemicals, stop-leak compound, mastics, or other temporary repair methods. Drain test water from piping systems after repair work and retesting has been completed.

END OF SECTION 22 03 10

SECTION 22 03 20 – PLUMBING HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties on all items.

PART 2 - PRODUCTS

2.1 HANGERS AND SUPPORTS:

A. General: Except as otherwise indicated, provide factory-fabricated piping hangers and supports of the type specified complete with bolts and washers. Comply with the manufacturer's published product information. Size hangers and supports properly for piping and weight of the medium being transported. Provide insulation shields for all insulated piping.

B. Hangers for domestic hot and cold water piping [medical gas lines] shall be copper plated band type with adjusting nut; Anvil, B-Line, Erico Caddy, PHD Manufacturing or Hubbard Enterprises/Holdrite.

C. Hangers for cast iron or plastic drain and vent piping, [compressed air piping,] [and natural gas piping] shall be Clevis type, B-Line, Anvil, Erico Caddy, PHD Manufacturing or Hubbard Enterprises/Holdrite.

D. Special Hangers: Special hangers and attachments shall be as detailed or indicated on the drawings.

PART 3 - EXECUTION

3.1 HORIZONTAL PIPING SUPPORT:

A. Maximum spacing of hangers and supports for above-ground horizontal pipe and tubing shall be as follows:

1. Cast-iron pipe (all sizes) shall be supported at not more than five foot intervals and near each hub or hubless pipe joint and at multiple fittings as required.

B. Steel Pipe:

Nominal Pipe Size (inches)	Support Spacing (feet)
1-1/4 & smaller	7
1-1/2	9
2	10
2-1/2	11
3 & larger	12

C. Copper Tubing:

Tubing Size (inches)	Support Spacing (feet)
3/4 & smaller	5
1 to 2-1/2	6

3	10
4 and larger	12

D. Plastic Pipe:

Nominal Pipe Size (inches)	Support Spacing (feet)
3/4	3.0
3/4 to 1	3.5
1-1/4 to 1-1/2	4.0
2 to 2-1/2	4.5
3 and larger	5.5

E. Prevent electrolysis in the support of copper tubing by the use of hangers and supports which are copper plated, or by other recognized industry methods.

F. Branch piping located in walls, partitions or pipe chases shall be rigidly supported inside the wall or chase.

G. Piping installed above a roof shall be supported on pre-fabricated, non-penetrating supports by Pipe Pier or approved equal. Provide matching adjustable elevation kits.

3.2 VERTICAL PIPING SUPPORT:

A. Cast Iron Pipe: Support at each floor and support at each base and roof level with pipe clamps.

B. Plastic Piping: Support at 8 feet maximum intervals and near each joint.

C. Copper Tubing: Support at riser tops and 5 feet maximum on center for pipe 1-1/2" and larger and 4 feet on center for pipe 1-1/4" and smaller. Use copper plated pipe clamps.

D. Steel Pipe: Supports at top and bottom of riser and on 10 feet maximum centers.

E. Fixture Supports: See Fixture Schedule. Provide concealed supports and carriers recommended by the manufacturer of the fixtures and equipment to suit the structural and finish conditions.

3.3 ADJUSTMENT OF HANGERS AND SUPPORTS:

A. Adjust hangers and supports to bring piping to proper level, elevations and slopes.

END OF SECTION 22 03 20

SECTION 22 03 30 – PLUMBING EXCAVATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. Coordination: Where excavation and backfill for plumbing work passes through or occurs in the same areas as work specified in the Division 2 sections, comply with both the requirements of the Division 2 sections and the requirements of this section, whichever is the more stringent (as determined by the Architect/Engineer in cases of conflicting requirements).

1.3 JOB CONDITIONS:

A. Existing Utilities: Locate and protect existing utilities and other underground work in a manner which will ensure that no damage or service interruption will result from excavating and backfilling.

PART 2 - PRODUCTS

2.1 BACKFILL MATERIALS:

A. Subbase Material: A graded mixture of gravel, sand, crushed stone or crushed slag.

PART 3 - EXECUTION

3.1 EXCAVATING:

A. Inspection: The excavator must examine the areas to be excavated, and the conditions under which the work is to be performed, and notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with excavating until unsatisfactory conditions have been corrected in a manner acceptable to the excavator.

B. General:

1. Do not excavate until the work is ready to proceed without delay, so that the total time lapse from excavation to completion of backfilling will be minimum.
2. Provide signs, illuminations and barricades as necessary to prevent accidents at excavations.
3. Excavate with vertical sided excavations to the greatest extent possible, except where otherwise indicated. Where necessary, provide sheeting and cross-bracing to sustain sides of excavations. Remove sheeting and cross-bracing during backfilling wherever such removal would not endanger the work or other property. Where not removed, cut sheeting off at a sufficient distance below finished grade to not interfere with other work.
4. Excavate for piping with 6" to 9" clearance both sides of pipe, except where otherwise shown or required for proper installation of pipe joints, fittings, valves and other work. Provide a minimum of 12" clearance around underground tanks.
5. For work to be supported directly on undisturbed soil, do not excavate beyond required depths, and hand excavate the bottom cut to accurate elevations. Except as otherwise indicated, support the following work on undisturbed soil at the bottom of the excavations:
   a. Piping of 5" and less pipe/tube size.
   b. Cast-in-place concrete.
6. Where directed, excavate additional depth to reach satisfactory soil-bearing conditions.

Backfill with subbase material, compacted as directed, to indicated excavation depth.

7. Except as otherwise indicated, excavate for exterior water-bearing piping so that the top of piping will not be less than 2'- 0" vertical distance below finished grade.
8. Store excavated material (temporarily) near the excavation, in a manner which will not interfere with or damage the excavation or other work.
   a. Retain excavated material which complies with the requirements for backfill material.
   b. Dispose of excavated material which is either in excess of quantity needed for backfilling or does not comply with requirement for backfill material.

3.2 DEWATERING:

A. Maintain dry excavations by removing water. Pump minor inflow of ground water from excavations; protect excavations from major inflow of ground water by installing temporary sheeting and waterproofing. Provide adequate barriers which will protect other excavations from being damaged by water, sediment or erosion from or through excavations.

3.3 BASE PREPARATION:

A. Install subbase material to receive plumbing work, and compact by tamping to form a firm base for the work. For piping, shape the subbase to fit the shape of the bottom 90 degrees of the cylinder, for uniform continuous support.

B. Shape subbases and bottoms of excavations with recesses to receive pipe bells, flanges connections, valves and similar enlargements in the piping systems.

3.4 BACKFILLING:

A. Do not backfill until installed work has been tested and accepted, wherever testing is indicated.

B. Condition backfill material by either drying or adding water uniformly, to whatever extent may be necessary to facilitate compaction to the required densities. Do not backfill with frozen soil materials.

C. Backfill simultaneously on opposite sides of work, and compact simultaneously; do not dislocate the work from installed positions.

D. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (percent of maximum density, ASTM Standard Proctor), using power-driven hand-operated compaction equipment.

   1. Lawn/Landscaped Areas: 90%
   2. Roadways: 95%
   3. Paved Area, Other than Roadways: 95%

E. Backfill to elevations matching adjacent grades, at the time of backfilling excavations for mechanical work.

F. Where compaction tests indicate lower densities of backfill than specified, continue compaction (and re-excavation and backfilling where necessary) and provide additional testing as directed by the Architect/Engineer.

3.5 PERFORMANCE AND MAINTENANCE:

A. Where subsidence is measurable or observable at plumbing work excavations during the guarantee period, remove the surface (pavement, lawn or other finish), add backfill material, compact and replace the surface treatment. Restore the appearance, quality and condition of the surface or finish to match adjacent work, and eliminate evidence of the restoration to the greatest extent possible.

END OF SECTION 22 03 30

SECTION 22 11 10 - DOMESTIC WATER PIPING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. Code Compliance: Comply with governing regulations which require the products used for domestic water piping work to be selected from lists in certain published standards or codes as indicated therein.

1.3 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties as applicable for all items.

B. Provide certified copy of contractor’s sterilization test.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:

A. General: Comply with section 22 0310 for product requirements of piping materials. For each service, provide the piping materials indicated including, pipe, fitting, hangers supports, anchors, valves and accessories. Where more than one type is indicated, selection is Installer's option. Where type is not otherwise indicated, provide materials complying with governing regulations.

B. Service Water Piping:

1. Pipe Sizes 4" and Smaller: Copper tube of the size indicated.
2. Wall Thickness: Type K
3. Fittings: Wrought copper-solder joint (with lead free solder).

C. Water Distribution Piping:

1. Pipe Sizes 4" and Smaller: Copper tube of the size indicated
2. Wall Thickness: Type K (belowground)
   Type L (above ground)
3. Fittings: Wrought copper-solder joint (with lead free solder).

2.2 ACCESSORIES:

A. General: Provide factory-fabricated piping products of the size, type, rating and capacity indicated. Where not indicated, provide proper selection as determined by the Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections.

B. Watts is an approved manufacturer for water supply products.

C. Water Hammer Arrestors: Bellows type; precharged compressor chamber; stainless steel casing and bellows. Provide sizes complying with PDI Standard WH-201. Josam, Jay R. Smith, Watts, or Zurn.

D. Exterior Wall Hydrant HB/E: All brass freezeproof automatic draining type with round satin nickel flush mounting wall box, adjustable packing nut, teflon impregnated packing, vacuum breaker with hose thread and loose key operated. Woodford Manufacturing Co., Josam, Watts, Prier, or Zurn.

E. Interior Wall Hydrant HB/B: All brass with polished brass finish, flush mounting wall box, adjustable packing nut, teflon impregnated packing, vacuum breaker with hose thread and loose key operated. Woodford Manufacturing Co. Model, Josam, Watts, Prier, or Zurn.

F. Roof Hydrant HB/R: Exposed, non-freeze roof hydrant, with coated cast iron head and lift handle with lock option, bronze interior parts, galvanized steel casing, and bronze valve housing with drain port in housing. Complete with coated cast iron roof support sleeve with wide anchoring flange and clamp collar. Zurn, Watts, Woodford Manufacturing Co., Prier, or Josam.

G. Domestic Water Piping Strainers: Strainers shall be a "Y" bronze body type with 20 mesh stainless steel screen, and threaded ends, rated for 250 psig wwp at 210 degrees F. Strainers for domestic water shall be Watts, Wilkins, Keckley or Mueller.

H. Flow Control Valves: Valves for domestic hot water return shall have brass and stainless steel bodies, with integral ball valve, ground joint union, and solder ends. Valve shall be rated for 600 psig and flow rate, as shown on drawings. Flow control valves shall be Autoflow, Hays, or Griswold.

I. Pressure Reducing Valves: Valves shall be bronze body construction with renewable seats and integral check valve and strainer. Pressure reducing valves shall be by Watts, Bell & Gossett, Taco, Amtrol, or Armstrong.

J. Pressure Relief Valves: Valves shall be bronze construction engineered in accordance with the requirements of Section IV of the ASME Boiler and Pressure Vessel Code for Heating Boilers. Capacities shall be certified by the National Board of Boiler and Pressure Vessel Inspectors. Valves shall be by Bell & Gossett, Taco, Watts, or Armstrong.

K. Gate Valves: Valves 3 inches and smaller shall be all bronze, meeting MSS-SP80, inserted bonnet, solid wedge, non-rising stem type and rated at 125 SWP, 200 WOG. Handles shall be malleable iron with bronze stem. Valves shall be by Milwaukee, Nibco, Watts, Jomar, or Red-White.

L. Globe Valves: Valves 3 inches and smaller shall be all bronze, meeting MSS-SP80, inserted bonnet with integral seat and renewable disc. Valves shall be rated at 125 SWP, 200 WOG. Handles shall be malleable iron with bronze stem. Valves shall be by Watts, Milwaukee, Nibco, Watts, Jomar, or Red-White.

M. Check Valves: Valves 2 inches and smaller shall be bronze body with bronze seat and disc and shall be rated at 125 SWP, 200 W0G. Valves shall be by Milwaukee, Nibco, Watts, Jomar, or Red-White.

N. Ball Valves: Ball valves may be substituted for gate valves at the contractor's option. Ball valves shall have two-piece bronze or brass body, meeting MSS-SP110, full or standard port, blowout-proof stem and adjustable packing nut independent of handle. Valves shall be rated for 150 SWP, 600 WOG or 300 CWP. Valves shall be by Apollo, Milwaukee, Nibco, Victaulic, Watts Smith-Cooper, Jomar, or Red-White.

O. Thermometers: Piping systems thermometers shall be the red-reading mercury filled adjustable angle type. Thermometers shall be adjustable to any angle through a 180 degree arc and shall be provided with a locking device. Where possible, thermometers shall be installed not higher than 8 feet above finished floor. Final positioning of each thermometer shall be such that it is readable from the floor and it shall be locked in that position. Thermometers shall have V-cast aluminum case with baked enamel finish and 9 inch scale. Thermometers shall be provided with separable sockets, and where installed on insulated pipes, sockets shall be extension neck type. Thermometer scale range shall be 30 to 300 degrees F for hot water systems. Thermometers shall be by Wika, Trerice, Winters or Weiss.

P. Pressure Gauges: Gauges shall be connected to the piping system with threaded chrome-plated brass pipe and fittings. Gauges shall be the flangeless type and shall have 4-1/2 inch dials, cast aluminum cases, stainless steel heavy duty rotary gear movements, phosphor bronze bourdon tubes, forged brass rod sockets and tips, 1/2 % accuracy of scale range,

plexiglass dial covers, and 1/4 inch lower connections. Each gauge shall be provided with chrome plated brass lever handle cock and a stainless steel pulsation dampener. Provide compound gauges for locations which under negative pressure. Range for pressure gauges shall be selected so that the normal operating point for each application falls in the approximate midpoint of the gauge range. Gauges shall be by Wika, Trerice, Winters or Weiss.

Q. Access Panel: Access panels shall be 16 gauge steel door and frame with concealed hinge and vandal resistant latch. Panels shall be flush type. Access panel shall be by J. R. Smith, Watts, Zurn, Josam or Mifab.

R. Escutcheon Plates: Metal split-ring type units, with nickel or chrome plated finish. Provide units sized to fit closely outside of pipe insulation or bare pipe where no covering is required.

S. Automatic Air Vents: Provide automatic float type air vents in locations indicated on the drawings. Units shall be suitable for a maximum working pressure of 75 psig and a maximum operating temperature of 240 degrees F. Automatic air vents shall be as manufactured by Taco, Bell & Gossett, Amtrol, Wheatley or Armstrong.

T. Manual Air Vents: Vents shall consist of a 1/4 inch gauge cock with softdrawn copper discharge tube.

U. Sheet-Metal Pipe Sleeves: Fabricate from galvanized sheet metal closed with lock-seam joints. For following pipe sizes provide gauge indicated: 3 inch pipe and smaller, 20 gauge; 4 inch to 6 inch pipe, 16 gauge; over 6 inch pipe, 14 gauge.

V. Pipe Sleeve Caulking: 3M Fire Barrier Caulk, CP25N/S, except where another caulking system or material is specified, or equivalent by Hilti or Tremco.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING:

A. General: Comply with the requirements of section 22 0310 for installation of basic piping materials.

B. Expansion Compensation: Except as otherwise indicated, install piping, including mains, branches and runouts with offsets to allow for free expansion and contraction sufficient to prevent leaks and over-stressing of the piping system.

C. Sterilization: The entire water distribution system shall be thoroughly sterilized with a solution containing not less than 50 parts per million of available chlorine. The chlorinating material shall be liquid chlorine conforming to Federal Specification BB-C-120. The sterilization solution shall be allowed to remain in the system for a period of 24 hours, during which time all valves and faucets shall be opened and closed several times. After sterilization, the solution shall be flushed from the system with clean water until the residual chlorine content is not greater than 0.2 parts per million. After completion of sterilization water samples shall be sent to the Local Health Department (LDH) for testing. Approval must be received from LDH before the system is put into service.

3.2 INSTALLATION OF ACCESSORIES:

A. Install premanufactured accessories in accordance with the manufacturer's instructions and recommendations.

B. Access Panel: Install access panels as shown on drawings. Paint access panels to match walls or ceilings.

C. Escutcheon Plates: Install escutcheon plates at pipe sleeves where piping is exposed to view in occupied spaces of the building, on the exterior and elsewhere as indicated.

D. Water Hammer Arrestors: Install units at the top of each riser or as otherwise indicated to comply with PDI Standard WH-201.

E. Air Vents: Install manual air vents at high points in the system and as shown on the drawings.

END OF SECTION 22 11 10

SECTION 22 12 10 - SOIL, WASTE, VENT AND STORM PIPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties as applicable for all items.

1.3 QUALITY ASSURANCE:

A. Industry Standards: Comply with local regulations, the International Plumbing Code and standards established by the Plumbing and Drainage Institute (PDI) pertaining to floor drains.

B. General: Provide factory-fabricated drainage piping products of the size and type indicated. Where not indicated, provide proper selection as determined by the Installer to comply with the installation requirements and governing regulations. Contractor shall coordinate drainage products selected with finish conditions encountered.

C. Cast Iron Pipe: All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:

A. General: Comply with section 22 0310 for product requirements of piping materials. For each service, provide the piping materials indicated, including pipe, fittings, joints, hangers, supports, anchors and accessories. Where type is not otherwise indicated, provide materials complying with governing regulations.

B. Watts, Mifab and Wade are approved manufacturers for drainage products.

C. Soil, Waste and Vent Piping (Belowground):

1. Schedule 40 ABS-DWV or PVC-DWV pipe and fittings. Joints shall be solvent cement socket type.
2. Service weight cast iron hub and spigot pipe and fittings, ASTM A74. Joints in underground cast iron piping shall be made using an ASTM-C564 neoprene elastomeric compression gasket conforming to the requirements of ASTM C 1563.

D. Soil, Waste Drain and Vent Piping (Above Ground):

1. Schedule 40 plastic ABS-DWV or PVC-DWV pipe and fittings. Joints shall be solvent cement socket type above ground. If ABS or DWV pipe and fittings are used aboveground all penetrations of rated walls, floors, and assemblies shall be protected in an approved manner, including penetrations of one side of an assembly.
2. Hub less cast iron pipe and fittings conforming to CISPI 301 or ASTM A888. Joints in above ground cast iron shall be made using standard CISPI 310, ASTM C 1277, and ASTM C 564 stainless steel no-hub couplings or cast iron no-hub couplings.
3. Galvanized steel pipe with threaded cast iron fittings or DWV Type copper pipe with solder joint fittings may be used for waste and vent piping 1-1/2 inch and 1-1/4 inch in size.

E. Storm Drain Piping (Below Ground):

1. Schedule 40 ABS-DWV or PVC-DWV pipe and fittings. Joints shall be solvent cement socket type.
2. Service weight cast iron hub and spigot pipe and fittings, ASTM A74. Joints in

underground cast iron piping shall be made using an ASTM-C564 neoprene elastomeric compression gasket conforming to the requirements of ASTM C 1563.

F. Storm Drain Piping (Above Ground):
   1. Schedule 40 plastic ABS-DWV or PVC-DWV pipe and fittings. Joints shall be solvent cement socket type above ground. If ABS or DWV pipe and fittings are used aboveground all penetrations of rated walls, floors, and assemblies shall be protected in an approved manner, including penetrations of one side of an assembly.
   2. Hub less cast iron pipe and fittings, CISPI 301 or ASTM A888. Joints in above ground cast iron shall be made using stainless steel no-hub standard couplings, CISPI 310, ASTM C 1277 and ASTM C564 or stainless steel no-hub heavy duty couplings, ASTM C 1540 and ASTM C 564.

G. Food Service Waste & Vent Piping (Below Ground):
   1. Type 316L stainless steel hub and spigot pipe and fittings. Pipe wall thickness shall be minimum 0.039" for 1-1/2" and 2" nominal pipe diameters, 0.049" for 3" and 4" nominal pipe size, 0.059" for 6" nominal pipe size, and 0.079" for 8" nominal pipe size. Joints shall be made using an EPDM compression gasket. Products meet or exceed the performance requirements of ASME A112.3.1-2007 and IGC 275-10.
   2. Service weight cast iron hub and spigot pipe and fittings, ASTM A74. Joints in underground cast iron piping shall be made using an ASTM-C564 neoprene elastomeric compression gasket conforming to the requirements of ASTM C 1563.

2.2 FLOOR DRAINS , FLOOR SINKS AND ROOF DRAINS:

A. Drains installed in waterproofed floors and roofs shall be provided with flashing clamps.

B. Floor Drain FD-A: shall have a coated cast iron body with integral pipe stops, flashing collar, seepage flange, vandal-proof screws and 6" diameter round Nikaloy strainer. Drains shall be:
   1. J.R. Smith
   2. Josam
   3. Watts
   4. Zurn

C. Floor Drain FD-B: shall have a coated cast iron body with integral pipe stops, flashing collar, seepage flange, sediment bucket, vandal-proof screws and 9" diameter round Nikaloy strainer with raised flange. Drains shall be:
   1. J.R. Smith
   2. Josam
   3. Watts
   4. Zurn

D. Floor Drain FD-C: shall have a coated cast iron body with integral pipe stops, flashing collar, seepage flange, sediment bucket, vandal-proof screws and 8" diameter polished nickel bronze strainer and oval funnel. Drains shall be:
   1. J.R. Smith
   2. Josam
   3. Watts
   4. Zurn

E. Floor Sink FS-A: shall have a cast iron body with 8" deep porcelain enameled acid resisting interior, flashing collar, drainage flange, aluminum dome strainer and polished nickel bronze anti-tilting strainer. Drains shall be:
   1. J.R. Smith
   2. Josam
   3. Watts
   4. Zurn

F. Roof Drains RD-A: shall have a coated cast iron body with adjustable top, clamp ring/gravel stop, large sump, deck clamp, drain receiver, aluminum mushroom dome, and no-hub connection. Drains shall be:
   1. J.R. Smith
   2. Josam
   3. Watts
   4. Zurn

G. Roof Drains RD-B: shall have a coated cast iron body with adjustable top, clamp ring/gravel stop, large sump, deck clamp, drain receiver, 3" cast iron standpipe, aluminum mushroom dome, and no-hub connection. Drains shall be:
   1. J.R. Smith
   2. Josam
   3. Watts
   4. Zurn

H. Hub drains shall have a pipe hub (or one pipe size increaser if plastic pipe is used) set in the floor with the top 1" above the finished floor. Waste piping from fixtures and equipment shall be connected solid into the hub [unless noted otherwise on the drawings].

I. Open hub drains shall have a pipe hub (or one pipe size increaser if plastic pipe is used) set in the floor with the top 1" above the finished floor. Indirect waste piping shall terminate 2" above the top of the hub.

2.3 CLEANOUTS:

A. Cleanout plugs shall be cast bronze or brass countersunk type with taper threads complying with ANSI B2.

B. Cleanouts on underground drainage shall have piping extended to the floor and finished with cleanout plug and removable floor plate.

C. Cleanouts shall be the same size as the pipe on which installed, except cleanouts on underground piping shall be a maximum of 4".

D. Cleanouts in waterproofed floors shall have flashing clamp.

E. Cleanouts in carpeted floors shall be provided with a carpet marker.

F. Concrete Floors: Cleanouts shall have cast iron body with integral pipe stop, adjustable round scoriated nickel bronze cover and rim, vandalproof securing screw, and countersunk bronze plug. Cleanouts shall be:
   1. J.R. Smith
   2. Josam
   3. Zurn
   4. Watts

G. Quarry Tile or Ceramic Tile Floors: Cleanouts shall have cast iron body with integral pipe stop, adjustable square scoriated nickel bronze cover and rim, vandalproof securing screw, and countersunk bronze plug. Cleanouts shall be:
   1. J.R. Smith
   2. Josam
   3. Zurn
   4. Watts

H. Resilient Tile Floors: Cleanouts shall have cast iron body with integral pipe stop, adjustable square nickel bronze cover recessed for tile, vandalproof securing screw, and countersunk bronze plug. Cleanouts shall be:
   1. J.R. Smith
   2. Josam

3. Zurn
4. Watts

I. Terrazzo Floors: Cleanouts shall have cast iron body with integral pipe stop, adjustable round nickel bronze cover recessed for terrazzo, vandalproof securing screw, and countersunk bronze plug. Cleanouts shall be:
   1. J.R. Smith
   2. Josam
   3. Zurn
   4. Watts

J. Carpeted Floors: Cleanouts shall have cast iron body with integral pipe stop, adjustable round scoriated nickel bronze cover and rim, bronze carpet marker, and countersunk bronze plug. Cleanouts shall be:
   1. J.R. Smith
   2. Josam
   3. Zurn
   4. Watts

K. Exterior Areas: Cleanouts to grade shall have cast iron body with integral pipe stop, heavy duty round cast iron tractor cover with vandalproof screw, and countersunk bronze plug. Cleanouts shall be:
   1. J.R. Smith
   2. Josam
   3. Zurn
   4. Watts

L. Wall Cleanouts: shall consist of a threaded recessed tapped cleanout tee with tapered thread bronze plug, vandalproof securing screw, and round stainless steel wall plate. Cleanout shall be:
   1. J.R. Smith
   2. Josam
   3. Zurn
   4. Watts

2.4 INTERCEPTORS:

A. Grease interceptors shall be field fabricated or pre-fabricated type, as shown on the drawings.

2.5 DRAINAGE ACCESSORIES:

A. Flashing for Plumbing Vent Piping Passing Through Roofs: Unless otherwise indicated, flashing for plumbing VTR's shall be Stoneman "Stormtite" Model S1000-4, open top, 4 pound seamless lead flashing assembly or equivalent. Install flashing in accordance with manufacturer's instructions

B. Escutcheon Plates: Metal split-ring type units, with nickel or chrome plated finish. Provide units sized to fit closely outside of pipe insulation or bare pipe where no covering is required.

C. Downspout Nozzle: Cast Nikaloy downspout nozzle with loose wall flange, insect screen and threaded inlet connection. Nozzle size shall match size of connecting storm drain pipe shown on drawings. Downspout nozzle shall be Josam, J.R. Smith, Watts or Zurn.

D. Inline Floor Drain Trap Sealer: Provide trap sealer with ASB plastic body, keeper pin neoprene rubber diaphragm and sealing gasket. Trap sealer unit shall comply with the requirements of ASSE 1072. Basis of design is Sure Seal.

E. Sidewall Vent Air Inlets: Provide polished bronze body with securing mechanism and vandalproof screws. Air inlets shall be J. R. Smith, Watts or Zurn.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING:

A. General: Comply with the requirements of section 22 0310 for installation of basic materials.

B. Testing: The piping of the soil, waste and vent system shall be tested with water before installing fixtures. Water test shall be applied to the soil, waste and venting system either in its entirety or in sections. If the test is applied to the entire system, all openings in the piping shall be closed except the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening of the section under test shall be plugged and each section shall be filled with water and tested with at least a 10 foot head of water. In testing successive sections, at least the upper 10 feet of the next preceding section shall be tested so that each joint or pipe in the building except the upper most 10 feet of the system has been submitted to a test of at least 10 foot head of water. The water shall be kept in the system, or in the portion under test, for at least 30 minutes before the inspection starts; the system shall be tight at all joints. Joints that fail the test shall be remade and retested.

C. Protection: The installer of drains shall advise the Contractor of required protection for the drains during the remainder of the construction periods, to avoid clogging with construction materials and debris to prevent damage from traffic and construction work.

D. During construction all pipe openings shall be capped or plugged, when not being worked on, to prevent foreign objects and construction debris from entering system.

E. Horizontal drainage piping 2-1/2" and smaller shall be graded at a minimum of 1/4 inch per foot, unless noted otherwise. Horizontal drainage piping 3" and larger shall be graded at a minimum of 1/8 inch per foot, unless noted otherwise.

F. All underground plastic soil, waste and vent and storm drainage piping shall be installed in compliance with ASTM D2321.

G. Food Service Waste & Vent Piping: Piping shall be installed per the manufacturer's instructions. Piping shall be routed from food service area to the inlet of the grease interceptor.

3.2 INSTALLATION OF ACCESSORIES:

A. Install escutcheon plates at pipe sleeves where piping is exposed to view in occupied spaces of the building, on the exterior and elsewhere as indicated.

B. Cleanouts in vertical piping shall be roughed-in with the centerline 18" above the finished floor.

C. Install drains in accordance with manufacturer's written instructions and in locations indicated.

D. Coordinate with soil and waste piping as necessary to interface drains with drainage piping system.

E. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

F. Install drains at low points of the surface areas to be drained. Set tops of drains flush with finished floor or deck.

G. The installer shall advise the General Contractor of required protection for drains and cleanouts during the remainder of the construction period, to prevent damage from traffic and construction work.

H. After installation, cover the tops of drains with duct tape or some other strong material during the remainder of the construction process, to avoid clogging with construction materials and debris.

END OF SECTION 22 12 10

SECTION 22 14 10 - GAS PIPING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties as applicable for all items.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:

A. General: Comply with the Section 22 0310 for product requirements of piping materials. For each service, provide the piping materials indicated including pipe, tube, fittings, hangers, supports, anchors, valves, and accessories. Where more than one type is indicated, selection is Installer's option.

B. Above Ground: Schedule 40 black steel pipe of the size indicated with Class 150 malleable iron threaded fittings.

C. Below Ground: Plastic pipe and fittings conforming to ASTM D2513, Grade 2406.

2.2 ACCESSORIES:

A. Gas Pressure Regulators: shall be diaphragm actuated with cast iron body, aluminum diaphragm chamber, and all internal parts designed for use with [natural] [LP] gas. Regulators shall be adjustable, with automatic loading, automatic low pressure cut-off, and full internal relief. The regulator shall be adjusted for outlet pressure indicated on the drawings. The outlet pressure shall not vary more than 1 inch w.c. from the set point at specified capacity. The regulator shall be capable of complete shut-off in the event the supply pressure is interrupted or the gas demand exceeds the regulator capacity and shall remain off until the regulator is manually reset. The regulator shall have a weatherproof, bug proof, screened vent cap installed in the vent tapping. Regulators shall be:

Regular

1. Sensus (Rockwell)
2. Fisher
3. Singer

With Full Relief

4. Sensus (Rockwell)
5. Fisher
6. Singer

B. Gas Solenoid Valves: Valves 3 inch in size and smaller, shall be 2-way, normally closed type with manual reset for low pressure service. The valve shall have an aluminum body, Buna N seat, and Buna N disc. Maximum pressure drop shall not exceed 1" w.c. at system capacity. The solenoid enclosure shall be NEMA 1 and have electrical characteristics as shown on the drawings. Valve shall be Underwriters Laboratories labeled. Valves shall be ASCO, Singer, or Fisher.

C. Plug Valves: Valves shall have iron body (semi-steel) lubricated type cast bronze plug, and threaded ends rated for 175 psig W.O.G. working pressure. Plug valves shall be Rockwell, Walworth, or Powell.

D. Shutoff Valves: Valves 2 inches and smaller shall be ball valves. Valves shall have threaded inlet and outlet connections, two-piece brass body, meeting MSS-SP110, full or standard port, blowout-proof stem and adjustable packing nut independent of handle. Valves shall be ASME B16.44 and UL listed for use with gas. Valve shall be rated for 250 psi, 600 CWP. Valves shall be by Maxitrol, Apollo, Hays, Milwaukee, Nibco, or Watts.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SYSTEM:

A. General: Comply with the requirements of the Section 22 0310 for installation of basic piping materials. Install piping products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to insure that products serve the intended function.

B. Use sealants on metal gas piping threads which are chemically resistant to natural gas. Use sealants sparingly and apply to only male threads of metal joints.

C. Remove cutting and threading burrs before assembling piping.

D. Do not install defective piping or fittings. Do not use pipe with threads which are chipped, stripped or damaged.

E. Plug each gas outlet, including valves with a threaded cap or plug immediately after installation and retain until continuing piping or equipment connection is completed.

F. Ground gas piping electrically and continuously within project, and bond to grounding electrode. Buried bare metal piping is acceptable as a grounding electrode.

G. Install drip-legs in gas piping at regulator station and other low points in the system.

H. Grade horizontal lines 1/4 inch in 15 ft. to drip-legs.

I. Support piping in accordance with the following schedule:

Pipe Size	Maximum Support Spacing
up to ½ inch	6 ft.
3/4 - 1 inch	8 ft.
over 1 inch	10 ft.

J. Plastic pipe joints shall be made using the heat-fusion method.

K. For welded pipe, the contractor shall provide test weld piping coupons for review and approval by the owner’s representative prior to commencing welding of gas piping.

L. Protection of Gas Piping Against Corrosion: Protect metal gas piping in contact with the earth, or other corrosive material, against corrosion. Protect pipe with corrosion-resistant pipeline coating over a rubber-based primer by Polyken. Joints shall be primed and wrapped with Foster Cold-Applied Pipeline Joint Tape.

M. Install underground piping with a minimum 18 inches of cover. Trench shall be graded to provide a firm, continuous bearing for pipe. Connections between plastic pipe and steel pipe shall be made only outside, underground, and with approved transition fittings.

N. Coordinate with gas utility company as necessary to interface gas distribution piping with gas service supply work.

O. Painting: All exposed metal gas piping shall be primed and painted with dark gray enamel.

3.2 EQUIPMENT CONNECTIONS:

A. General: Connect gas piping to equipment in accordance with the equipment manufacturer's instructions. Provide ground joint union and accessible cut-off valve at each connection to equipment.

3.3 FIELD QUALITY CONTROL:

A. Fuel Gas Piping Tightness Test: Prior to initial operation, test gas distribution piping system with air or inert gas at 3 psig or two times operating line pressure, whichever is greater. Do not use oxygen for tests.

B. Repair or replace fuel gas piping as required to eliminate leaks and retest as specified to demonstrate compliance.

END OF SECTION 22 14 10

SECTION 22 16 10 – PLUMBING PIPING SYSTEM INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE:

A. Plumbing piping systems to be insulated include:
   1. Domestic Hot and Cold Water Piping, Above Ground
   2. Horizontal Roof Drain Piping and Drain Bodies Above Floor (including secondary system)

1.3 QUALITY ASSURANCE:

A. Manufacturers: Provide insulation products produced by one of the following for each type and temperature range of insulation.
   1. Certainteed
   2. Knauf
   3. Manville
   4. Owens-Corning
   5. Pittsburgh Corning
   6. Manson

B. Flame/Smoke Ratings: Provide composite piping insulation (insulation, jackets, covering, sealers, mastics and adhesives) with flame-spread rating not exceeding 25 and smoke developed rating not exceeding 50, as tested by ASTM E 84 (NFPA 255) method and UL 723.

1.4 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties for all items.

PART 2 - PRODUCTS

2.1 PIPE INSULATION:

A. Fiberglass Insulation: Insulation shall be preformed, two-piece, heavy density fiberglass with self sealing ASJ jacket conforming to ASTM C 547. Valves and fittings shall be insulated with fiberglass insulation of the same material thickness as insulation on adjacent pipe and having a molded PVC jacket. Jackets shall be Certainteed, Knauf, or Zeston. Insulation thickness shall be as follows:
   1. Domestic Cold Water Piping: 1 inch thick for all sizes.
   2. Domestic Hot Water Piping: 1 inch thick for all sizes up to and including 1¼" in size.
   3. Domestic Hot Water Piping: 1½ inch thick for all sizes greater than 1¼" in size.
   4. Horizontal Roof Drain Piping: 1 inch thick for all sizes.

B. Aluminum Jacket: Corrugated, embossed or smooth sheet, .016 inch nominal thickness, ASTM B 209, temper H14, type 3003, 5005 or 5010. Provide stainless steel bands, minimum width of ½ inch.

PART 3 - EXECUTION

3.1 APPLICATION REQUIREMENTS:

A. General: Insulate all above ground domestic hot and cold water piping except do not insulate supplies to fixtures unless specifically required. Insulate horizontal waste lines receiving the discharge from HVAC drains. Insulate the underside of all roof drains and all roof drain piping installed above conditioned spaces.
B. Aluminum jackets shall be provided on all exterior insulated pipes.
C. In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens and mechanical rooms aluminum jackets shall be provided. Pipe insulation to the 6 foot level shall be protected.

3.2 INSTALLATION OF PIPING INSULATION:

A. General: Install insulation products in accordance with the manufacturer's written instructions, and in accordance with recognized industry practices to ensure that the insulation serves its intended purpose. Do not use cut pieces or scraps abutting each other.
B. Insulation shall be applied on clean dry surfaces. All insulation shall be continuous through wall and ceiling openings and sleeves. Insulation on all cold surfaces, where vapor barrier jackets are used, will be applied with continuous unbroken vapor seal. Seal off ends of insulation on cold piping systems with white vapor barrier coating at valves, flanges, supports and exposed ends. Supports that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.
C. Pipe covering protection shields shall be provided around exterior of pipe insulation at pipe hangers which fit around pipe insulation. Shields shall be 12 inches long by 180 degrees and shall be 18 gauges galvanized steel sheet. High density isolation inserts shall be provided at pipe saddles.
D. Unions shall not be insulated.
E. Cover valves, flanges, fittings and similar items in each piping system.
F. Extreme care shall be taken to insure a neat, uniform exterior surface on insulation applied to exposed pipes. Insulation in finished areas shall be painted in accordance with the paint specifications.
G. The body (underside) of roof drains shall be insulated with blanket type fiberglass insulation. Overlap ends of insulation a minimum of 2". Overlap bottom of insulation a minimum of 3" at pipe connection. Adhere insulation to roof drain with 100% coverage of fire retardant adhesive. Tape all joints with 3" wide foil reinforced kraft tape.

3.3 PROTECTION AND REPLACEMENT:

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
B. Protection: The Installer of the insulation shall advise the Contractor of required protection for the insulation work during the remainder of the construction period, to avoid damage and deterioration.

END OF SECTION 22 16 10

SECTION 22 17 10 - PLUMBING SEISMIC CONTROL

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. Furnish all labor, materials, tools and equipment and perform all work necessary to complete the installation of the plumbing [vibration and] seismic control systems required by these specifications and as detailed on the drawings.

B. All foundations and supports required for the installation of plumbing equipment shall be furnished by the plumbing contractor shall unless specifically specified otherwise.

C. The following criteria applies to all mechanical systems and components:

1. Seismic Design Category: C
2. Typical Importance Factor: 1.0
3. Gas Piping Importance Factor: 1.5

D. Based on the criteria listed above, seismic restraints are required for Natural Gas only.

1.2 RELATED DOCUMENTS:

A. The drawings and general provisions of this division of the Contract, including the General and Special Conditions and Division 1 Specifications, apply to this Section.

1.3 QUALITY ASSURANCE:

A. Codes and Standards: The installation of the plumbing systems shall be installed in accordance with the following codes and standards. All seismic restraint systems such as sway bracing, cable restraints, seismic snubbers, seismic restraints, and vibration isolators shall also meet the requirements as set forth in the following standards and codes.

1. 2018 International Building Code (IBC)
2. ASHRAE
3. SMACNA Seismic Restraint Manual
4. ASTM 488 Anchor Locations
5. FEMA Standards

B. The plumbing seismic control products shall be sized and provided by the manufacturers listed below. The manufacturer shall have tested all seismic products provided for the specific intended use and installation.

C. Kinetics Noise Control is the Basis of Design manufacturer. Equivalent equipment by AeroSonics, Mason, Vibration Eliminator, Vibro-Acoustics and Vibration Mountings and Controls that meets performance, capacity, space and other requirements of the design documents shall be acceptable.

D. Submittals:

1. The contractor shall submit for approval by the engineer all products intended to be used to meet the requirements of these specifications. Submittal data shall include manufacturer's data and cut sheets of the specific seismic control materials
2. The contractor shall submit for approval by the engineer, seismic anchorage requirements for all equipment. Anchorage calculations shall be prepared by a registered engineer and in the state where the project will be constructed. The engineer shall stamp calculations. Anchorage requirements shall be submitted for all base mounted equipment, suspended equipment, and roof mounted equipment. Seismic anchorage calculations shall include an "anchorage schedule" for the contractor's use. Anchorage schedule shall list the equipment, the size and quantity of fasteners and the minimum embedment depth of

anchors. Calculations may be combined for similar types of equipment provided the size and weight does not vary more than 15% and the installation manner are similar.

PART 2 - PRODUCTS

2.1 GENERAL:

A. All equipment shall be mounted or suspended from approved foundations and supports as specified herein or as detailed on the drawings.

2.2 ISOLATOR TYPES:

A. Type 5 - Floor Mounted Equipment (seismic): Vibration isolators shall be seismically rated and consist of large diameter laterally stable steel springs assembled into formed or welded steel housing assemblies designed to limit vertical movement of the supported equipment and the horizontal movement. Housing assembly shall be formed or fabricated steel members and shall consist of a top-load plate complete with adjusting and leveling bolts, isolation washers and a bottom plate with non-skid noise stop pads and holes provided for anchoring to supporting structure. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. Isolator shall be designed to allow replacement of the spring element without removing the spring isolator housing.

B. Type 10 - Suspended Equipment and Piping: Vibration Isolators shall consist of a steel spring and neoprene element in series mounted in a stamped or welded steel bracket for insertion into the hanger rod assembly. The elastomer insert shall be neoprene, molded from oil resistant compounds and shall be color coded to indicate load capacity and selected to operate within its published load range. The steel spring shall consist of large diameter laterally stable steel springs assembled into formed or welded steel housing assemblies designed to limit movement. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. The steel bracket shall be fabricated from steel and provided with a corrosion resistance finished. The hanger bracket shall be designed to carry a 500% overload without failure and to allow a support rod misalignment through a 30-degree arc without metal-to-metal contact or other short circuit. The hanger bracket shall incorporate spring caps with indexed steps, which correspond to the washer diameter of the hanger rod to keep the rod centered in the spring cap.]

2.3 SEISMIC CONTROL:

A. The mechanical systems serving the building shall be installed to meet the minimum requirements of the International Building Code regarding seismic protection and control. These specifications and the drawings indicate the minimum requirements and general intent. The actual requirements shall be determined by the seismic engineer and supplier and submitted for approval by the Mechanical Engineer.

B. The seismic engineer shall be a registered engineer in the state in which the facility is constructed and whose principal area of practice is seismic engineering and related fields.

C. All equipment installed either floor or pad mounted or suspended from the structure shall be restrained and anchored unless exempt as hereinafter indicated.

D. Where pipes or other plumbing systems cross the seismic isolation interface between two seismically isolated structures, the systems shall have flexible pipes to accommodate the seismic displacement of the two structures. Flexible pipes shall be installed on one side of the interface.

E. The following plumbing components are exempt from seismic bracing or restraints:

1. All components in seismic design category D, E, and F, weighing 20 lbs or less when the importance factor = 1.0.
2. Piping installed 12" or less from the point of connection to the supporting structure and the top of the pipe when the importance factor = 1.0.
3. Equipment installed less than 4'-0" above the floor and weighing less than 400 lbs when the importance factor = 1.0.
4. Any piping installed in a structure when the Seismic Design Category is A or B.
5. Any piping installed in a structure when the Seismic Design Category is C and the importance factor = 1.0.

F. Where systems are specified to have spring isolation hangers, the hangers shall be installed as close as possible to the supporting structure.

G. Seismic restraint cables or seismic restraint braces shall be installed on piping systems and suspended equipment. Seismic restraint cables shall be stranded steel cable provided with mounting hardware for connection to the equipment hanger rod, to the equipment housing or trapeze hangers. The stranded steel cables and hardware shall be the product of a single manufacture and shall have been tested for the intended use. Published data shall be available and submitted to identify the load limitations of the proposed restraint hardware. As a minimum the following cable sizes shall be used on piping and equipment:
   1. Piping 1" to 2 ½": 1/16" steel cable
   2. Piping 3" to 8": 3/16" steel cable
   3. Piping 10" and larger: 1/4" steel cable
   4. Equipment weighting 400 lbs or less: 3/16" steel cable
   5. Equipment weight 401 lbs and higher: 1/4" steel cable

H. Anchorage of equipment to concrete floors and pads shall be in-accordance with the submitted anchorage calculations.

I. Connections of seismic restraint cable hardware shall be in-accordance with the submitted anchorage calculations.

PART 3 - EXECUTION

3.1 GENERAL:

A. If the equipment provided is not furnished with integral structural steel supports, mounting feet or lifting lugs, the contractor shall provide miscellaneous steel shapes as required to install or suspend the equipment and attach the vibration isolation or seismic restraints as specified herein.

B. Support steel shall include but not be limited to rails, brackets, angles, channels, and similar components.

C. All seismic restraint products shall be installed as outlined in the manufacturer's printed installation instructions.

END OF SECTION 22 17 10

SECTION 22 22 10 – WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. Industry Standards:

1. Provide electric water heaters which have been listed and labeled by Underwriters' Laboratories.
2. Comply with National Electrical Code (NFPA 70) as applicable to installation and connection to electric water heaters.
3. Provide water heaters which have been listed and labeled by National Sanitation Foundation (NSF).
4. Provide water heaters with safety relief valves bearing ASME valve markings, all heaters.
5. Comply with American Gas Association (AGA) as applicable to certification of gas-fired water heaters.
6. Heaters(s) shall meet the requirements of ASHRAE 90.1-2013, state energy requirements, and the BOCA Energy Conservation Code.

1.3 SUBMITTALS:

A. Provide manufacturer's data, test reports, certifications and product warranties on all items.

PART 2 - PRODUCTS

2.1 GAS-FIRED WATER HEATERS:

A. Instantaneous Gas Water Heaters (WH-C1):

1. Water heater shall be direct fired, fully condensing, water-tube design. Power burner shall have full modulation. The minimum firing rate shall not exceed 30,000 BTU/Hr input. Water heaters that have an input greater than 30,000 BTU/Hr at minimum fire will not be considered equal. The water heater shall have the capability of discharging into a positive pressure vent. Water heater thermal efficiency shall increase with decreasing load (output), while maintaining set point. Water heater shall have an operational set point capability of 90 ºF to 185 ºF and shall maintain the outlet temperature within an accuracy of +/- 2 ºF during load changes of up to 100% rated capacity. Heater shall operate quietly, less than 55 dba. Water heater shall be factory-fabricated, factory-assembled and factory-tested, water-tube condensing water heater with heat exchanger sealed pressure-tight, built on a steel base, including a sealed insulated sheet metal enclosure that acts as combustion-air intake plenum.
2. Heat Exchanger: The heat exchanger shall be constructed with 316L stainless steel helical water tubes, fully floating with no welded joints in the exchanger. The exchanger will have a single-pass combustion gas flow design. The water tubes shall be 3/4" ID, with no less than 0.0469" wall thickness.
3. Hybrid Tank: The shell assembly of the hybrid tank vessel shall have a maximum water volume of less than .6 gallon. The water heater water connections shall be 3/4 inch Flanged O Ring connections. The shell assembly shall be constructed of 316L stainless steel of 0.0488 inch wall thickness or above.

4. Modulating Air/Fuel Valve and Burner: The water heater burner shall be capable of a 7 to 1 turndown ratio of the firing rate without loss of combustion efficiency or staging of gas valves. The burner shall be stainless fiber mesh covering a stainless steel body with spark ignition and flame rectification. All burner material exposed to the combustion zone shall be of stainless steel construction. There shall be no moving parts within the burner itself. A modulating air/fuel valve shall meter the air and fuel input. A variable frequency drive (VFD), controlled pre-mix blower shall be used to ensure the optimum mixing of air and fuel between the air/fuel valve and the burner.
5. The exhaust manifold shall be of PVC, CPVC, polypropylene, stainless steel (AL29-4C) with a 3 inch diameter flue connection.
6. Ignition: Ignition shall be via spark ignition with 100 percent main-valve shutoff and electronic flame supervision.
7. The water heater control system shall be a masterless cascading design. Lead Lag – master / slave control systems will not be permitted. The entire system shall be ETL recognized.
8. Condensate traps, manufactured from only non-corrosive materials.
9. Water heaters shall be by:
    1. Intellihot
    2. A.O. Smith
    3. Triangle Tube

2.2 ELECTRIC WATER HEATERS:

A. Point-of-use tankless Water Heater (3-10 KW): Provide a thermostatically controlled tankless instantaneous type electric water heater sized for low flow constant temperature requirements. Unit shall have an ABS UL rated 94V0 cover, integral flow switch, replaceable cartridge insert type heating element, high temperature limit switch with automatic reset, replaceable cold water inlet filter, and compression fittings located on top or bottom of unit. Unit shall be wall mountable, UL Listed and have a minimum 5 year (heater) / 1 year (parts) warranty. Flow switch shall activate heating element only on demand with a maximum turn on of 0.3 GPM. Unit shall operate at 25 psi minimum and 150 psi maximum. Provide with integral flow controller and faucet aerator. Units schedule as dual lavatory shall be provided with two faucet aerators. Refer to the schedule for application type and heater size. Refer to electrical drawings for voltage and phase requirements. Instantaneous water heater shall be by:
    1. EEMAX
    2. RHEEM
    3. CHRONOMITE

B. Point-of-use tankless Water Heater (Greater than 20 KW): Provide a thermostatically controlled tankless instantaneous type electric water heater. Unit shall regulate power to required flow. Unit shall have three replaceable cartridge insert type heating elements, high temperature limit switch with automatic reset, replaceable cold water inlet filter, and compression fittings located on bottom of unit. Unit shall be wall mountable, UL Listed and have a minimum 5 year (heater) / 1 year (parts) warranty. Flow switch shall activate heating element only on demand. Unit shall operate at 25 psi minimum and 150 psi maximum. Refer to the schedule for application type & heater size. Refer to electrical drawings for voltage and phase requirements. Instantaneous water heater shall be by:
    1. EEMAX
    2. RHEEM
    3. CHRONOMITE

2.3 ACCESSORIES:

A. Domestic Hot Water Circulation Pump: Pump shall be the in-line centrifugal type designed for 125 psi working pressure with bronze body and impeller, mechanical seals and stainless steel impeller shaft. The pump motor shall be the open drip-proof design with sleeve bearings, built-in thermal over-load protectors, and shall operate at 1750 RPM. Pump shall have the capacities as shown on the drawings. Pump shall be:
   1. Bell & Gossett - Booster Series
   2. Taco - Circulation Series
   3. Thrush - Circulator Series
   4. Grundfos - UP Circulator Series

B. Thermal Expansion Tanks: Provide bladder type captive air expansion tanks with tank volume as indicated on the drawings. The shell shall be fabricated steel designed and constructed per ASME Section VIII. Tanks shall be suitable for potable water systems and maximum working pressure of 125 psig and a maximum operating temperature of 240 degrees F. Tanks shall be by Taco, Amtrol, Watts, Proflo or Wheatley.

C. Vacuum Relief Valve: Provide a vacuum relief valve for automatic venting of a closed system to atmosphere when a vacuum is created. Valve shall be tested and rated under ANSI Z21.22. Vacuum relief valve shall be a Watts LFN36, Cash-Acme FRM-V, or Wilkins VR10XL.

D. Temperature Control Valve: Assembly shall be a Hi-Low Thermostatic Water Mixing Valve with large mixing valve with solid bimetal thermostat directly linked to valve porting, adjustable limit stop, color coded scale: Hot to Cold, wall support, inlet union angle stainer checkstops, outlet volume control/shutoff, pressure regulating valve with pressure gauges, small Mixing Valve, integral checkstops, solid bimetal thermostat, adjustable limit stop, color coded scale; Cold to Hot, wall support outlet volume control/shutoff dial thermometer (range: 0 to 140 degrees F, -10 to 60 degrees C), rough bronze finish, and inlet piping manifold with unions. Unit shall be FACTORY ASSEMBLED AND TESTED. Temperature control valve shall be LEONARD TM-186-12520 PRV-D-LTR or equivalent by Powers or Lawler.

E. Temperature Control Valve: Valve shall be a thermoscopic mixing valve with chrome finish, a maximum operating pressure of 125 PSIG and maximum operating temperature of 110ºF at 45 PSIG equal supply pressures. Valve shall be provided with spring loaded angle union integral check stops, integral strainers and "Fail Safe" shutdown. Valve shall control temperature at ±1ºC and shall have minimum and maximum flow rates of 1 gallon per minute and 26 gallons per minute respectively. Temperature Control Valve shall be RADA Model 20 or equal by Leonard, Symmons or Powers.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install water heaters and accessories where shown, in accordance with equipment manufacturer's written instructions and with recognized industry practices. Comply with requirements of state and local codes and applicable NFPA and ASME Boiler and Pressure Vessel Code Standards.

B. Flush water heaters upon completion of installation in accordance with manufacturer's instructions.

C. Start-up water heaters in accordance with manufacturer's written procedures, upon completion of heater installation and demonstrate compliance with requirements.

3.2 FIELD QUALITY CONTROL:

A. Test assembled water heater and accessories in accordance with applicable sections of ASME Boiler and Pressure Vessel Code.

END OF SECTION 22 22 10

SECTION 22 31 10 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. Industry Standards: Comply with ANSI Standards pertaining to plumbing fixtures and systems.
B. Comply with ANSI A117.1 standard pertaining to plumbing fixtures for handicapped.
C. Comply with standards established by Plumbing and Drainage institute (PDI) pertaining to plumbing fixture supports.
D. Comply with applicable Federal Standard FS WW-P-541/Series sections pertaining to plumbing fixtures.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES:

A. General: Provide factory-fabricated fixtures of the type, style and material indicated. For each type of fixture, unless otherwise specified, provide fixture manufacturer's standard trim, carrier seats and valves as indicated by their published product information, either as designed and constructed, or as recommended by the manufacturer, and as required for a complete installation. Where more than one type or manufacturer is indicated, selection is Installer's option.

2.2 MATERIALS:

A. General: Unless otherwise specified, comply with applicable Federal Specification WW-P-541/series sections pertaining to plumbing fixtures, fittings, trim, metals and finishes. Comply with requirements of WW-P-541/specification relative to quality of ware, glazing, enamel, composition and finish of metals, air gaps and vacuum breakers, even though some plumbing fixtures specified in this section are not described in WW-P-541.
B. Unless otherwise specified, faucets shall comply with National Sanitation Foundation International NSF Standard 61, and where applicable NSF Standard 61, Section 9. Faucets shall be NSF certified, and bear the NSF mark.
C. Provide materials which have been selected for their surface flatness and smoothness. Exposed surface which exhibit pitting, seam marks, roller marks, foundry sand holes, stains, discoloration or other surface imperfections on finished units are not acceptable.
D. Where fittings, trim and accessories are exposed or semi-exposed, provide bright chrome-plated or polished stainless steel units.
E. Vitreous China: High quality, free from fire cracks, spots, blisters, pinholes and speck; glaze exposed surfaces and test for crazing resistance in accordance with ASTM C 554.
F. Vitreous China and Enamel Iron Fixtures shall be white unless specified otherwise.
G. Comply with additional fixture requirements contained in the fixture schedule.
H. In addition to the manufacturers list below, the following manufacturers are approved for all lavatory, service sink, can wash and sink faucets: Kohler, American Standard, Eljer, Chicago, Zurn, T & S Brass, Symmons, Speakman, Elkay and Just.
I. In addition to the manufacturers list below, the following manufacturers are approved for all

vitreous china and cast iron plumbing fixtures: Zurn and Sloan.

J. Flush valves shall be the size, roughing height, and flow rate specified hereinafter for each fixture. Flush valve shall be piston or diaphragm actuated type with chrome plated exterior, angle stop with cover, vacuum breaker, adjustable tailpiece, and cast escutcheon with setscrew. Where shown on the drawings provide a trap primer connection in the valve tailpiece. All flush valves specified to be 24" roughing shall be provided with wall brace. In addition to the manufacturers list below, Sloan is the preferred flush valve manufacturer.

K. All low voltage wiring, sensors, and transformers shall be provided under this section with the hardwired flush valves and/or faucets.

L. Toilet seats shall be same color as fixture. Seats shall be open front without cover, and solid molded plastic with self-sustaining check hinge. Seats shall be for elongated bowl unless specified otherwise.

M. Carriers shall be commercial grade and selected to match the fixtures for which they are used. Carriers shall be floor mounted and designed to transfer any fixture loading to the floor and not the wall unless specified otherwise. Carriers provided for wall hung urinals shall be two plate type. Carriers for wall hung water closets and urinals shall be provided with chrome plated mounting hardware.

N. Fixture stops shall be provided for all fixtures and shall be chrome plated with cast escutcheons with set screws. Stops for flush valves shall be by the flush valve manufacturer. Stops for shower valves shall be either angle or straight type and shall be concealed behind the shower cover plate. Stops for lavatories and sinks shall be loose key or wheel handle type as specified for each fixture, and stops shall be only from those manufactures listed for each fixture. Zurn stop-valves are not allowed.

O. Fixture drains shall be by the same manufacturer as the lavatory and sink faucets, with a matching finish. Lavatory and sink drains shall be pop-up, grid, or crumb cup type as specified for each fixture. Drains shall be chrome plated brass or stainless steel unless noted otherwise. Drain tailpieces shall be minimum 17 gauge chrome plated cast brass.

P. All p-traps, continuous wastes and fixture drain piping shall be 17 gauge chrome plated cast brass and of the size indicated in the fixture schedule on the plumbing drawings.

Q. Insulation kits shall be provided for all handicap lavatories and sinks with exposed supply and waste piping. Insulation kits shall include covers for fixture drains, p-traps and supplies.

2.3 PLUMBING FIXTURE SCHEDULE:

A. Water Closet P-1A: shall be a floor mounted, floor outlet, vitreous china, siphon jet water closet with elongated bowl (designed for 1.28 gallon flush), 1-1/2" top spud, floor bolts, bolt caps, and outlet gasket. The water closet shall be fitted with a white seat and 1-1/2" (11-1/2" roughing) flush valve. Water closet and trim shall be:

Water Closet:	AMERICAN STD.	KOHLER	ZURN
Flush Valve:	SLOAN	DELANY	ZURN
Seat:	PLUMBTECH	BEMIS	ZURN

B. Water Closet P-1B: shall be an ADA compliant floor mounted, floor outlet, vitreous china, siphon jet water closet with elongated bowl (designed for 1.28 gallon flush), 1-1/2" top spud, floor bolts, bolt caps, and outlet gasket. The water closet shall be fitted with a white seat and 1-1/2" (11-1/2" roughing) flush valve. Water closet and trim shall be:

Water Closet:	AMERICAN STD.	KOHLER	ZURN
Flush Valve:	SLOAN	DELANY	ZURN
Seat:	PLUMBTECH	BEMIS	ZURN

C. Urinal P-2A: shall be a wall hung, vitreous china, washout urinal (designed for 0.125 gallon flush), 2" outlet, 3/4" top spud and wall hangers. The urinal shall be fitted with a 3/4" (11-1/2" roughing) flush valve and back plate. Urinal shall be:

Urinal:	AMERICAN STD.	KOHLER	ZURN
Flush Valve:	SLOAN	DELANY	ZURN

D. Urinal P-2B: shall be the same as urinal P-2A except for the mounting height. Refer to plumbing fixture schedule for mounting height.

E. Lavatory P-3A: shall be a wall hung, 20" x 18" vitreous china lavatory with back splash and punched for 4" centers. The lavatory shall be fitted with a chrome plated ADA compliant pushbutton metering faucet, thermostatic mixing valve, perforated offset grid drain, 1-1/4" p-trap, loose key angle supplies, chair carrier with concealed arm supports and insulation kit. Lavatory and trim shall be:

Lavatory:	AMERICAN STD.	KOHLER	ZURN
Faucet:	CHICAGO	ZURN	MOEN COMM
Mixing Valve:	CHICAGO	ZURN	MOEN COMM
Drain:	McGUIRE	ZURN	WATTS
P-trap:	McGUIRE	ZURN	WATTS
Supplies:	McGUIRE	BRASS CRAFT	WATTS
Insulation Kit:	McGUIRE	TRUEBRO	SKAL-GUARD
Carrier:	J.R. SMITH	JOSAM	ZURN

F. Lavatory P-3B: shall be a wall hung, 20" x 18" vitreous china lavatory with back splash and punched for 4" centers. The lavatory shall be fitted with a chrome plated ADA compliant center-set faucet with single lever handle and low flow aerator (0.5 gpm), thermostatic mixing valve off-set perforated grid drain, 1-1/4" p-trap, loose key angle supplies, chair carrier with concealed arm supports and insulation kit. Lavatory and trim shall be:

Lavatory:	AMERICAN STD.	KOHLER	ZURN
Faucet:	CHICAGO	ZURN	MOEN COMM
Mixing Valve:	CHICAGO	ZURN	MOEN COMM
Drain:	McGUIRE	ZURN	WATTS
P-trap:	McGUIRE	ZURN	WATTS
Supplies:	McGUIRE	BRASS CRAFT	WATTS
Insulation Kit:	McGUIRE	TRUEBRO	SKAL-GUARD
Carrier:	J.R. SMITH	JOSAM	ZURN

G. Mop Sink P-4: shall be a 24" x 24" molded stone mop basin with 10" high sides and integral 3" chrome plated dome drain. The mop sink shall be fitted with vinyl bumper guards, a chrome plated faucet with vacuum breaker, a hose with hose bracket, and stainless steel wall guards. Mop sink shall be white and the faucet shall be mounted on the wall 36 inches above the floor. Mop basin shall be:

	FIAT	SWAN	ZURN
Basin:	MSB 2424	MS 2424-3	Z-1996-24
Bumperguards:	E-77-AA	MS-2408	BV
Faucet:	830-AA	MS-5811	Z843M1-XL
Hose/Bracket:	832-AA	MS-2405	HH

Wall Guards:	MSG2424	WG

H. Washing Machine Connection Box P-5: shall be a recessed flush mounting plastic or painted steel box with ¼ turn cold and hot water angle valves with hose thread outlets and water hammer arrestors, and plugged 2" drain outlet. Washer box shall be:

OATEY	GUY GRAY	WATER TITE
38655	T200TPCPVCHA	W2700 HA

I. Condensate Drain Box P-7: shall be a recessed flush mounting painted steel box with plugged 2" drain outlet. Box shall have a stainless-steel cover with latch and approved for installation in rated walls (if applicable). Condensate Drain Box shall be GUY GRAY, OATEY, PLASTIC ODDITIES, or SIOUX CHIEF.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install plumbing fixtures of types indicated where shown and at indicated heights or where not shown in accordance with manufacturer's written instruction, roughing-in drawings and with recognized industry practices.

B. Install all low voltage wiring, sensors, and transformers furnished with the hardwired flush valves and/or faucets. 120V power connections for the low voltage transformers shall be connected by the Division 26 contractor in accordance with specification section 261010. All low voltage wiring and needed pathways shall be provided under this section. Provide needed pathway/chase to form an accessible pathway from each sensor location to a point within 6" of low voltage transformer, and terminate with insulated throat bushing. Wiring installed in an open plumbing chase can be installed without conduit.

C. Fasten plumbing fixtures securely to indicated supports or building structure, and ensure that fixtures are level and plumb and tight against mounting surface.

D. Seal the outer perimeter of wall mounted lavatories and urinals and water closets to the wall and floor mounted water closets to the floor with a smooth bead of white silicone compound.

E. All fixtures provided under another division of the specifications shall be roughed-in and connected under this section. Provide individual shut-off valves or supply stops to all fixtures with a water or gas supply. Provide p-traps and extensions to waste stack in wall or to drain, as shown on the drawings, if not provided by the fixture supplier. Supply stops and p-traps shall be McGUIRE, EBC, or BRASS-CRAFT.

F. Provide and install undercounter mixing valves for all sinks and lavatories except those in commercial kitchens.

3.2 FIELD QUALITY CONTROL:

A. Upon completion of installation of plumbing fixtures and after units are water pressurized, test and adjust fixtures for proper operation.

END OF SECTION 22 31 10

SECTION 22 32 10 – ELECTRIC WATER COOLERS & DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. Industry Standards:

1. Provide drinking-water coolers which have been listed and labeled by Underwriters' Laboratories (UL399)
2. Provide drinking-water coolers which are rated and certified in accordance with Air Conditioning and Refrigeration Institute (ARI) Standard 1010.
3. Provide wheelchair water coolers which comply with ANSI A117.1-2003 and ADA guidelines.
4. Provide drinking-water coolers which are manufactured using lead-free components and solder in all waterways.

1.3 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties as applicable.

PART 2 - PRODUCTS

2.1 ELECTRIC WATER COOLER "EWC-1":

A. Provide wall mounted wheelchair type water coolers with integral water chiller capable of delivering 7.5 gph of 50 degrees water at 90 degrees F ambient temperature and 80 degrees F entering water temperature. Units shall have hermetically sealed refrigerant system complete with 120V/1PM/60HZ compressor and air cooled condenser. Cabinet, receptor, and back shall be stainless steel. Bubbler operator shall be a soft touch vandal proof bar full across the front of the unit. The water cooler shall be fitted with cast brass p-traps, a valved 1/2" cold water supply, a NEMA5-20P rated plug with 3 feet (min.) chord, and chair carrier. Provide with deck mounted sensor operated bottle filler accessory. Units shall be OASIS P8AM, HALSEY-TAYLOR HAC-8FS, SUNROC NWCA-8, MURDOCK A171.8 or ELKAY EZS8. Chair carrier shall be J.R. Smith, Josam or Zurn.

2.2 ELECTRIC WATER COOLER "EWC-2":

A. Water cooler shall be the same as "EWC-1" without the deck mounted bottle filler. Refer to drawings for mounting ht.

2.3 ELECTRIC WATER COOLER "EWC-C1":

A. Provide modular bi-level wall mounted unit with recessed refrigeration system. The unit shall be ADA compliant and have a heavy gauge galvanized steel wall mounting frame, stainless steel basins with bottom covers, and stainless steel wall cover plate(s). The refrigeration system shall be hermetically sealed with 115 Volt, 1 phase, 60 hertz compressor and air cooled condenser. The unit shall deliver a minimum of 8 gph of 50 degrees F water at 90 degrees F ambient and 80 degrees F entering water temperatures. Each basin shall have a chrome plated brass drain with removable strainer, and self-closing push button/bar. The water cooler shall be fitted with (2) cast brass p-traps and a valved 1/2" cold water supply. Provide with integral sensor operated bottle filler accessory. Unit shall be a HALSEY-TAYLOR OVL-II or equivalent by OASIS, SUNROC, MURDOCK or ELKAY.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: Install water coolers in accordance with manufacturer's written instructions and in accordance with the National Electrical code and recognized industry practices.

B. After water coolers are mounted on wall, bolt a 1-1/2 inch steel angle bracket to bottom of unit and attach to wall. Paint to match wall.

3.2 FIELD QUALITY CONTROL:

A. Test operates installed water coolers to demonstrate compliance with the requirements.

END OF SECTION 22 32 10

SECTION 23 01 10 – MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

B. It is recognized that separate sub-contracts may be instituted by THIS CONTRACT'S GENERAL CONTRACTOR with others. It is the responsibility of THIS CONTRACT'S GENERAL CONTRACTOR to completely inform, coordinate and advise those sub-contractors as to all of the requirements, conditions and information associated with providing and installing their portion of the total job.

1.2 IMPOSED REGULATIONS:

A. Applicable provisions of the State and Local Codes and of the following codes and standards in addition to those listed elsewhere in the specifications are hereby imposed on a general basis for mechanical work. In each case, the prevailing edition shall be the current adopted edition of the state where the project is located.

1. *International Mechanical Code.*
2. *International Gas Code.*
3. *International Energy Conservation Code.*
4. *International Fire Code.*

1.3 SCOPE OF WORK:

A. Provide all labor, materials, equipment and supervision to construct complete and operable mechanical systems as indicated on the drawings and specified herein. All materials and equipment used shall be new, undamaged and free from any defects.

1.4 EXISTING SERVICES AND FACILITIES:

A. Damage to Existing Services: Existing services and facilities damaged by the Contractor through negligence or through use of faulty materials or workmanship shall be promptly repaired, replaced, or otherwise restored to previous conditions by the Contractor without additional cost to the Owner.

B. Interruption of Services: Interruptions of services necessary for connection to or modification of existing systems or facilities shall occur only at prearranged times approved by the Owner. Interruptions shall only occur after the provision of all temporary work and the availability of adequate labor and materials will assure that the duration of the interruption will not exceed the time agreed upon.

C. Removed Materials: Existing materials made unnecessary by the new installation shall be removed, shall remain the property of the Owner and shall be stored at a location and in a manner as directed, or, if classified by the Owner's authorized representative as unsuitable for further use, shall become the property of the Contractor and shall be removed from the site.

1.5 WARRANTIES:

A. Provide manufacturer's standard printed commitment in reference to a specific product and normal application, stating that certain acts of restitution will be performed for the Purchaser or Owner by the manufacturer, when and if the product fails within certain operational conditions and time limits. Where the warranty requirements of a specific specification section exceed the manufacturer's standard warranty, the more stringent requirements will apply and modified manufacturer's warranty shall be provided. The Contractor shall provide a (2) year warranty on all parts and labor. The warranty shall begin at the Material Completion date.

1.6 PRODUCT SUBSTITUTIONS:

A. General: Materials specified by manufacturer's name shall be used unless prior approval of an alternate is given by addenda. Requests for substitutions must be received in the office of the Architect at least 10 days prior to opening of bids.

PART 2 - PRODUCTS

2.1 GENERAL MECHANICAL PRODUCT REQUIREMENTS:

A. Standard Products: Provide not less (quality) than manufacturer's standard products, as specified by their published product data. In addition to the indication that a particular product/model number is acceptable, comply with the specified requirements. Do not assume that the available off-the-shelf condition of a product complies with the requirements; as an example, a specific finish or color may be required.
B. Uniformity: Where multiple units of a general product are required for the mechanical work, provide identical products by the same manufacturer, without variations except for sizes and similar variations as indicated
C. Product Compatibility, Options: Where more than one product selection is specified, either generically or proprietarily, selection is Purchaser's or Installer's option. Provide mechanical adaptations as needed for interfacing of selected products in the work.
D. Equipment Nameplates: Provide a permanent operational data nameplate on each item of power operated mechanical equipment, indicating the manufacturer, product name, model number, serial number, speed, capacity, power characteristics, labels of tested compliance, and similar essential operating data.
E. Locate nameplates in easy-to-read locations. When product is visually exposed in an occupied area of the building, locate nameplate in a concealed position (where possible) which is accessible for reading by service personnel.

PART 3 - EXECUTION

3.1 PRODUCT INSTALLATION, GENERAL:

A. Except where more stringent requirements are indicated, comply with the product manufacturer's installation instructions and recommendations, including handling, anchorage, assembly, connections, cleaning and testing, charging, lubrication, startup, test operation and shut-down of operating equipment. Consult with manufacturer's technical experts, for specific instructions on unique product conditions and unforeseen problems.
B. Protection and Identification: Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged or protected to prevent deterioration during shipment, storage and handling. Store in a dry, well ventilated, indoor space, except where prepared and protected by the manufacturer specifically for exterior storage.
C. Permits and Tests: Provide labor, material and equipment to perform all tests required by the governing agencies and submit a record of all tests to the Owner or authorized representative. Notify the Architect five days in advance of any testing.

END OF SECTION 23 01 10

SECTION 23 0120 - MECHANICAL STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. Industry Standards: It is a general requirement that mechanical work comply with applicable requirements and recommendations of standards published by listed agencies and trade associations, except to the extent more detailed and stringent requirements are indicated or required by governing regulations.

B. Listing of Associations, Standards, and Abbreviations:

1. AGA *American Gas Association*
   1515 Wilson Blvd.
   Arlington, VA 22209
2. AMCA *Air Movement & Control Association*
   30 W. University Dr., Arlington Heights, IL 60004
   302/394-0150
3. ARI *Air-Conditioning and Refrigeration Institute*
   4301 North Fairfax Drive, Suite 425, Arlington, VA 22203
   703/524-8800
4. ASHRAE *American Society of Heating, Refrigerating & Air Conditioning Engineers, Inc.*
   1791 Tullie Circle, NE, Atlanta, GA. 30329
   404/636-8400
5. AWS *American Welding Society, Inc.*
   2501 NW 7th St., Miami, FL 33125
   305/642-7090
6. CISPI *Cast Iron Soil Pipe Institute*
   2020 K. St., NW, Washington, DC
   202/233-4536
7. NEBB *National Environmental Balancing Bureau*
   1611 North Kent St.,
   Arlington, VA 22209
8. NEC *National Electrical Code* by NFPA
9. NEMA *National Electrical Manufacturers Association*
   1300 N 17th Street, Suite 1847
   Rosslyn, VA 22209
   703/841-3200
10. NFPA *National Fire Protection Association*
    407 Atlantic Ave.,
    Boston, MA 02210
    617/482-8755
11. SMACNA *Sheet Metal & Air Conditioning Contractors National Association, Inc.*
    8224 Old Courthouse Rd., Tysons Corner
    Vienna, VA 22180

703/790-9890

12. TIMA *Thermal Insulation Manufacturers Association*
7 Kirby Plaza
Mt. Kisco, NY 10549
912/241-2284

13. UL *Underwriters' Laboratories, Inc.*
207 East Ohio St.,
Chicago, IL 60611
312/642-6969

PARTS 2 AND 3 - PRODUCTS AND EXECUTION

A. Not applicable.

END OF SECTION 23 0120

SECTION 23 02 10 - MECHANICAL COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:
A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:
A. Mechanical Coordination Plans: Prepare a set of coordination plans showing the coordination of the major elements, components and systems of the mechanical work, and showing the coordination of mechanical work with other work. Prepare plans at accurate scale and sufficiently large to show locations of every item, including clearances for installing, maintaining, insulating, breaking down equipment, replacing motors and similar requirements. Prepare plans to include plans, elevations, sections and details as needed to conclusively show successful coordination and integration of the work. Submit plans for review by the Architect/Engineer. Coordination plans shall be submitted for the following areas: All mechanical equipment rooms.
B. Coordinate the actual location of all mechanical work visible in finished spaces with the Architect/Engineer. This includes air distribution devices, exposed ductwork, thermostats, humidistats, switches, sensors, etc.
C. Mechanical Coordination Affidavit: Prior to ordering materials, provide the Coordination Affidavit required by Section 23 0220.

PART 2 - PRODUCTS

2.1 MECHANICAL PRODUCT COORDINATION:
A. Power Characteristics: Refer to the electrical sections of the specifications and the electrical drawings for the power characteristics available for the operation of each power driven item of equipment. The electrical design was based on the typical power requirements of the equipment manufacturers scheduled or specified. Any modifications to the electrical system which are required due to the use of an approved equivalent manufacturer shall be made at no additional cost to the owner. All changes must be clearly documented and submitted for review by the Architect/Engineer prior to purchasing equipment. Coordinate purchases to ensure uniform interface with electrical work. The mechanical contractor shall furnish a detailed list of equipment electrical characteristics to the electrical contractor for the purpose of preparing the coordination affidavit required by Division 26.
B. Filters: Disposable HVAC filter shall conform to SCCPSS approved sizes. Contact SCCPSS Facility Department for approved list.
C. Coordination of Options and Substitutions: Where the contract documents permit the selection from several product options, and where it becomes necessary to authorize a substitution, do not proceed with purchasing until coordination of interface of equipment has been checked and satisfactorily established.
D. Firestopping: Refer to architectural drawings for the locations of all fire rated ceilings, floors and walls. The contractor shall furnish detailed shop drawings of all firestopping details to be used for both piping and ductwork. All firestopping details shall be U.L. listed and subject to approval by the State Fire Marshal.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION:
A. Substrate Examination: The Installer of each element of the mechanical work must examine the condition of the substrate to receive the work, and the conditions under which the work

will be performed, and must notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

B. Do not proceed with the installation of sleeves, anchors, hangers, roof penetrations and similar work until mechanical coordination drawings have been processed and released for construction. Where work must be installed prior to that time in order to avoid a project delay, review proposed installation in a project coordination meeting including all parties involved with the interfacing of the work.

3.2 CUTTING AND PATCHING:

A. Structural Limitations: Do not cut structural framing, walls, floors, decks and other members intended to withstand stress, except with the Architect's or Engineer's written authorization.

B. Where authorized, cut opening through concrete (for pipe penetrations and similar services) by core drilling or sawing. Do not cut by hammer-driven chisel or drill.

C. Other work: Do not endanger or damage other work through the procedures and processes of cutting to accommodate mechanical work. Review the proposed cutting with the Installer of the work to be cut, and comply with recommendations to minimize damage. Where necessary, engage the original Installer or other specialists to execute the cutting in the recommended manner.

D. Where patching is required to restore other work, because of either cutting or other damage inflicted during the installation of mechanical work, execute the patching in the manner recommended by the original Installer. Restore the other work in every respect, including the elimination of visual defects in exposed finishes, as judged by the Architect. Engage the original Installer to complete patching of the following categories of work:
   1. Exposed concrete finishes and exposed masonry.
   2. Waterproofing and vapor barriers.
   3. Roofing, flashing and accessories.
   4. Interior exposed finishes and casework, where judged by the Architect to be difficult to achieve an acceptable match by other means.

3.3 COORDINATION OF MECHANICAL INSTALLATION:

A. General: Sequence, coordinate and integrate the various elements of mechanical work so that the mechanical plant will perform as indicated and be in harmony with the other work of the building. The Architect/Engineer will not supervise the coordination, which is the exclusive responsibility of the Contractor. Comply with the following requirements:
   1. Install piping, ductwork and similar services straight and true, aligned with other work and with overhead structures and allowing for insulation. Conceal where possible.
   2. Arrange work to facilitate ease of maintenance and repair or replacement of equipment and filters. Locate items requiring more maintenance such as valves, etc. in front of items requiring less maintenance. Connect equipment for ease of disconnecting, with minimum of interference with other work.
   3. Equipment located above ceilings shall be installed in a position and elevation which allows complete and adequate maintenance access through the ceiling grid or access panel while standing safely on a ladder. If this is not possible, a suitable maintenance platform must be provided per IMC.
   4. Give the right-of way to piping systems required to slope for drainage (over other service lines). Piping shall be located to avoid interference with ductwork and light fixtures.
   5. Store materials off the ground and protected from standing water and weather.

B. Drawings: Conform with the arrangement indicated by the contract documents to the greatest extent possible, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, comply with the Architect's decision on resolution of the conflict.

C. Electrical Work: Coordinate the mechanical work with electrical work, and properly interface

with the electrical service. In general, and except as otherwise indicated, install mechanical equipment ready for electrical connection. Refer to electrical sections of the specifications for electrical connection of mechanical equipment.

D. Duct Smoke Detectors: In buildings equipped with a fire alarm system, all HVAC duct smoke detectors, including smoke detectors for smoke dampers, shall be furnished by Division 26 and installed by Division 23. All duct smoke detectors must be compatible with the fire alarm system and must be connected to the fire alarm system for notification. All fire alarm wiring and associated devices shall be furnished and installed by the fire alarm system installer. In buildings not equipped with a fire alarm system, all HVAC duct smoke detectors and accessories shall be furnished and installed by Division 23. Each duct smoke detector must have a remote device where actuation of the duct smoke detector shall activate a visible and an audible signal in an approved location. Duct smoke detector trouble conditions shall activate a visible or audible signal in an approved location and shall be identified as "Air Duct Detector Trouble." Each smoke detector shall be wired into the respective fan control circuit to automatically shut down the fan upon sensing products of combustion.

E. Utility Connections: Coordinate the connection of mechanical systems with exterior underground utilities and services. Comply with the requirements of governing regulations, franchised service companies and controlling agencies. Provide a single connection for each service except where multiple connections are indicated.

3.4 COORDINATION OF MECHANICAL START-UP:

A. Seasonal Requirements: Adjust and coordinate the timing of mechanical system start-ups with seasonal variations, so that demonstration and testing of specified performance can be observed and recorded. Exercise proper care in off-season start-ups to ensure that systems and equipment will not be damaged by the operation.

B. Painting and Air Distribution: Coordinate the initial cleaning and start-up of the air distribution system, to occur prior to preparatory cleaning and general interior painting and decorating on the project. The HVAC system should not be operated until drywall work is completed. Drywall dust must not be allowed to contaminate the interior of air handing units and ductwork. Use high efficiency temporary filters until project closeout.

END OF SECTION 23 02 10

SECTION 23 02 20 - MECHANICAL SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUBMITTAL FORMS AND PROCEDURES:

A. The purpose of submittals is to demonstrate to the Architect/Engineer that the Contractor understands the design concept. The Architect/Engineer's review of such drawings, schedules, or cuts shall not relieve the Contractor from responsibility for deviation from drawings or specifications unless he has, in writing, called the Architect/Engineer's attention to such deviations at the time of submission, and has received from the Architect/Engineer, in writing, permission for such deviations. All submittals must be completely checked by the Contractor prior to submission for review.

B. Hard Copy Submittals: Submittal data shall be placed in one or more hard-back 3-ring binders, arranged and labeled according to specification section. Each binder shall contain a title page and table of contents. Provide separator tabs, and label by specification section. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor’s Name, Division 23 Superintendent’s name, Suppliers and point of contact for each, and date. Except as otherwise indicated in other sections, submit 5 complete copies. Quantity indicated does not include copies required for regulatory agencies.

C. Electronic Submittals: If the Architect agrees to allow electronic submittals via an on-line information management product such as “Submittal Exchange,” etc., all electronic submittal files shall be organized to match the bid documents for specification section and name. Each submittal file shall be complete for each specification section. Multiple partial submittals per specification section will be rejected. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor’s Name, Division 23 Superintendent’s name, Suppliers and point of contact for each, and date.

D. Submittals shall be made for all items contained in the Mechanical Submittal List in PART 3 - EXECUTION.

E. Response to Submittals: A Mechanical Submittal Review Report shall be issued by the Engineer with the following classifications for each item:

1. "No Exceptions Taken": No corrections, no marks. Contractor shall submit copies for distribution.
2. "Make Corrections Noted": A few minor corrections. Items may be ordered as marked up without further resubmission. Submit copies for distribution.
3. "Revise and Resubmit": Minor corrections. Item may be ordered at the Contractor's option. Contractor shall resubmit drawings with corrections noted.
4. "Rejected": Major corrections or not in accordance with the contract documents. No items shall be ordered. Contractor shall correct and resubmit drawings.

PART 2 – PRODUCTS

2.1 SUBMITTAL REQUIREMENTS:

A. General: Each specification section shall list the required submittal items. All submittal items shall conform to the requirements listed below. For each major section of submittal data, include a summary page which lists items and model numbers for each piece of equipment.

B. Shop Drawings: Prepare mechanical shop drawings to accurate scale except where diagrammatic representations are specifically indicated. Show clearance dimensions of critical locations and show dimensions of spaces required for operation and maintenance of equipment. Show piping connections and other service connections and show interface with other work

including structural support. Indicate by note, the portions of mechanical work shown on the shop drawings which deviated from the indication of work in the contract documents and explain the reasons for the deviations. Show how such deviations coordinate with interfacing deviations on shop drawings for other portions of the work, currently or previously submitted.

C. Manufacturer's Data: Where pre-printed data is submitted for more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided. Delete or mark-out significant portions of preprinted data which are not applicable. Where operating ranges are shown, mark data to show portion of range required for project application. Expansion or elaboration of standard data to describe a non-standard product must be processed as a shop drawing submittal. For each product include the manufacturer's production specifications, installation or fabrication instructions, nearest source of supply (including telephone number), sizes, weights, speeds, operating capacities, piping and service line connection sizes and locations, statements of compliance with required standards and governing regulation (include manufacturer's signed statements if not covered in printed data), performance data (where applicable) and similar information needed to confirm compliance with the requirements.

D. ATTACHMENT NO. 1 (Mechanical Coordination Affidavit):

1. The intent of Attachment Number 1 is to ensure that the electrical requirements for mechanical equipment have been reviewed and coordinated by the Contractor. No mechanical equipment shall be ordered, nor shall rough-in begin, before this coordination has taken place. This document shall be returned appropriately marked whether or not any changes are deemed to be necessary by the contractor.

PART 3 - EXECUTION

3.1 MECHANICAL SUBMITTAL LIST:

23 0210 – Mechanical Coordination:

Mechanical Coordination Plans.
Mechanical Coordination Affidavit (see Attachment No. 1 below)

23 0230 – Mechanical Identification:

Pipe Markers.
Pipe Tape.
Engraved Nameplates.
Valve Tags.
Valve Charts.

23 0240 – Mechanical Work Closeout:

Record Plans.
Maintenance Manuals.
Mechanical TAB Report.
Owner Training Videos.

23 0310 – Mechanical Pipe, Tube, and Fittings:

Black Steel Pipe, Schedule 80.
Black Steel Pipe, Schedule 40.
Black Steel Pipe, Schedule 10.
Galvanized Steel Pipe, Schedule 40.

Galvanized Steel Pipe, Schedule 10.
Copper Tube.
Cast Iron Threaded Fittings.
Welded Fittings.
Cast Iron Flanged Fittings.
Gasket for Flanged Joints.
Soldering Materials.
Mechanical Couplings.
PVC Cement.
Pipe Sleeves.
Fire Caulk.

23 0320 – Mechanical Hangers and Supports:

Refrigerant Pipe Hangers.
Hot Water Pipe Hangers (Roller Type).
Hot Water Pipe Hangers (Clevis Type).
Chilled Water Pipe Hangers (Clevis Type).
HVAC Drain Pipe Hangers (Clevis Type).
Pipe Supports, Guides, Shields, and Saddles.
Piping Roof Supports.
Pipe Portals.
Roof Equipment Support Rails.

23 1110 – Mechanical Water Piping System:

Shutoff Valves.
Check Valves.
Drain Valves.
Manual Balancing Valves.
Automatic Balancing Valves.
Triple Duty Valves.
Hose Kits.
Pressure Reducing Valves.
Pressure Relief Valves.
Backflow Preventers.
Wye Strainers.
Basket Strainers.
Suction Diffusers.
Air Separators.
Expansion Loops.
Expansion Tanks.
Flexible Hoses.
Flexible Pump Connectors.
Automatic Air Vents.
Manual Air Vents.
Flow Metering Stations.
Thermometers.
Pressure Gauges.
Heat Trace Tape.
Underground Steel Pipe Protection.
Painting.

23 1210 – Mechanical Piping and Equipment Insulation:

Fiberglass Insulation and Fittings.
Cellular Glass Insulation and Fittings.
Closed Cell Elastomeric Insulation and Fittings.
Aluminum Jackets.

23 1310 – Pumps:

All equipment in PUMP SCHEDULE and/or plans and/or specifications.

23 1410 – Water Treatment:

Chilled Water System.
Hot Water System.
Mechanical Room Plans and Piping Diagrams.

23 2110 – Ductwork:

Duct Construction Standards.
Black Steel Ducts.
Galvanized Steel Ducts.
Stainless Steel Ducts.
Grease Duct and Fittings.
Single Wall Round Spiral Seam Ducts and Fittings.
Double Wall Round Spiral Seam Ducts and Fittings.
Flexible Ducts.
Fabric Ducts.
Flexible Connectors.
Manual Balancing Dampers.
Automatic Balancing Dampers.
VAV Dampers.
Round Takeoff Fittings.
Rectangular Takeoff Fittings.
Fire Dampers.
Smoke Dampers.
Combination Fire/Smoke Dampers.
Duct Access Doors.
Dryer Box.
Flexible Duct Elbow Support.
Duct Wrap Type 'A'.
Duct Wrap Type 'B'.
Duct Liner Type 'A'.
Duct Liner Type 'B'.
Duct Board.
Fire Rated Duct Wrap.
Duct Insulation Accessories.
Duct Insulation Compounds.
Duct Sealant.
Weatherproof Duct Sealant.

23 2120 – Duct Cleaning:

Duct Cleaning Company Qualifications.
IAQ Quality Control Assurance Program.

23 2210 – Air Distribution:

All devices in AIR DISTRIBUTION SCHEDULE and/or plans and/or specifications.

23 2310 – Fans:

All equipment in FAN SCHEDULE and/or plans and/or specifications.

23 2410 – Air Handling Units:

All equipment in AIR HANDLING UNIT SCHEDULE and/or plans and/or specifications.

23 2420 – Terminal Units:

All equipment in TERMINAL UNIT SCHEDULE and/or plans and/or specifications.

23 2430 – Fan Coil Units:

All equipment in FAN COIL UNIT SCHEDULE and/or plans and/or specifications.

23 3110 – Electric Heaters:

All equipment in ELECTRIC HEATER SCHEDULE and/or plans and/or specifications.

23 3230 – Makeup Air Units and Accessories:

All equipment in MAKEUP AIR UNIT SCHEDULE and/or plans and/or specifications.

23 3320 – Condensing Boilers and Accessories:

All equipment in CONDENSING BOILER SCHEDULE and/or plans and/or specifications.

23 4110 – Air-Cooled Chillers:

All equipment in AIR-COOLED CHILLER SCHEDULE and/or plans and/or specifications.

23 4320 – Air Treatment Systems:

All equipment in noted in equipment schedules and/or plans and/or specifications.

23 5310 –Air Conditioners:

All equipment in AIR CONDITIONER SCHEDULES and/or plans and/or specifications.

23 6110 – Heat Pumps:

All equipment in HEAT PUMP SCHEDULES and/or plans and/or specifications.

23 8310 – EMCS (Energy Management Control System):

All controls equipment, sequences, control diagrams, etc. in plans and/or specifications.

23 9110 – Mechanical Sound, Vibration, Wind, and Seismic:

Wind Calculations for all roof mounted equipment.
All equipment in plans and/or specifications.

23 9210 – Mechanical TAB (Test, Adjust, Balance):

Qualifications package.
Testing procedures.
Instrument list.
Sample test forms.

END OF SECTION 23 02 20

ATTACHMENT NO. 1

SHOP DRAWING COORDINATION AFFIDAVIT

I, the Division 23 Superintendent, certify that I have reviewed the mechanical shop drawings for electrically driven equipment and that the accompanying mechanical shop drawings reflect the requirements of the actual equipment to be furnished for use on this project. In addition, the electrical requirements of said equipment have been coordinated with the Division 26 contractor.

NOTE: If no deviations are required please indicate by circling the appropriate answer above your signature.

PROJECT: _____ DEVIATIONS: Yes / No

COMPANY:_____

TITLE: _____ SIGNATURE: _____

TELEPHONE: _____DATE:_____

FAILURE TO PERFORM THE WORK REQUIRED BY THIS AFFIDAVIT, PRIOR TO ORDERING MATERIALS OR ROUGHING-IN, MAY RESULT IN IMPROPER CONNECTIONS BEING PROVIDED. THE EXPENSE OF CORRECTIVE MEASURES, IF REQUIRED, SHALL BE BORNE BY THE CONTRACTOR.

SECTION 23 02 30 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:
A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:
A. Manufacturers: Firms regularly engaged in the manufacture of identification systems required for this product.
B. Submittals: Submit manufacturer's data on materials and submit a sample of each type required.

PART 2 - PRODUCTS

2.1 MECHANICAL IDENTIFICATION MATERIALS:
A. Pipe Markers:
1. General: Product manufacturer's standard pre-printed, flexible or semi-rigid, permanent, color-coded, plastic-sheet pipe markers, complying with ANSI A13.1.
2. Small Pipe: For external diameters less than 6 inches (including insulation, if any), provide full band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
a. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
b. Adhesive lap joint in pipe marker overlap.
c. Laminated or bonded application of pipe marker to pipe (or insulation).
d. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4 inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inch.
3. Large Pipes: For external diameters of 6 inches and larger (including insulation, if any), provide either full-band or strip-type pipe markers, but not narrower than 3 x letter height (and of required length), fastened by one of the following methods:
a. Laminated or bonded application of pipe marker to pipe (insulation).
b. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2 inches wide: full circle at both ends of pipe marker, tape lapped 3 inches.
4. Lettering: Comply with piping system names as specified, scheduled or shown, and abbreviate only as necessary for each application length.
5. Arrows: Print each pipe marker with arrow indicating direction of flow, either integrally with piping system service lettering or as separate unit of plastic (to accommodate both directions).
6. Install pipe markers on the following systems:

Chilled Water Supply and Return Piping
Hot Water Supply and Return Piping
Refrigerant Piping
HVAC Drain Piping

B. Pipe Tape: Manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.
1. Width: Provide 1-1/2 inches wide tape markers on pipes with outside diameters including insulation of less than 6 inches, 2-1/2 inches wide tape on larger pipes.
2. Color: Comply with ANSI A13.1.
C. Engraved Plastic-Laminate Labels:
1. General: Provide engraving stock melamine plastic laminated, complying with FS L-P-387,

in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core, letter color, except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

2. Thickness: 1/16 inch, except as otherwise indicated.
3. Fasteners: Self-tapping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate the substrate.
4. Install engraved equipment labels on all mechanical equipment. Match equipment names as scheduled.
5. Install "Permanent Label of Equivalent Length" in each laundry area near the clothes dryer. Label shall match the example shown in 2018 IMC, Section 504. The contractor shall fill in the actual equivalent length for each dryer exhaust duct.

D. Valve Tags:
1. Valve tags shall be 18 gauge (minimum) brass with 1-1/4" (minimum) height and width. Identification letters and numbers shall be stamped in tag and shall be filled with black paint
2. Valve tags shall be attached to valve using cable ties. Cable ties shall be self-locking nylon ties.
3. Valve tags shall be installed at all shut-off, balancing, metering, and drain valves. Valve tag shape and designations shall be as follows:

Identification System	Shape	Numbers
Chilled Water	Round	CH-1, 2, 3, ...
Hot Water	Square	H-1, 2, 3, ...

E. Valve Charts:
1. Valve charts shall be provided for mechanical systems. Charts shall be located [in the main mechanical room] [where shown on the drawings] [in each mechanical room].
2. Valve charts shall be typed listing all valve tags. List shall include identification number, valve location in system (e.g., Corridor 123, Chilled Water Pump CWP-1, etc.) and its function (e.g., shut-off, balancing, drain, etc.). Charts shall be mounted in [a wooden frame with glass cover] [an aluminum frame with plastic cover].

2.2 LETTERING AND GRAPHICS:

A. General: Coordinate names, abbreviations and other designations used in the mechanical identification work, with the corresponding designations shown, specified or scheduled. Provide numbers, lettering recommended by manufacturers or as required for proper identifications and operation/maintenance of the mechanical systems and equipment.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION:

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting and other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering or painting.

B. All equipment, dampers, filters, valves, etc. located above ceiling grids shall be located with an engraved marker permanently attached to the ceiling grid. The marker shall describe the item located above the ceiling.

C. Piping System Identification:
a. General: Install pipe markers on each system indicated to receive identification, and include arrows to show normal direction of flow.

D. Locate pipe markers as follows wherever piping is exposed to view in mechanical rooms, accessible maintenance spaces (including accessible areas above ceilings) and exterior non-concealed locations:

a. Near each valve and control device.
b. Near each branch, excluding short take-offs for fixtures. Mark each pipe at branch, where there could be a question of flow pattern.
c. Near locations where pipes pass through walls or ceilings, or enter non-accessible enclosures.
d. Near major equipment items and other points of origination and termination.
e. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment.

E. Do not mark piping exposed in finished occupied spaces.
F. Mechanical Equipment Identification: Install an engraved plastic laminate label on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Each label shall include the equipment name, room number and electrical panel name. Confirm installed final room numbers and electrical panel names prior to ordering labels.
G. Valve tags shall be attached to the valve handwheel with cable ties.

END OF SECTION 23 02 30

SECTION 23 02 40 - MECHANICAL WORK CLOSEOUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:
A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DOCUMENTATION PROCEDURES:
A. Signed Commitments: Do not proceed with transfer of mechanical plant to the Owner for operation until warranties, performance certifications and similar commitments to be signed by Contractor and other entities have been executed and transmitted to Architect (for Owner's records).

PART 2 – PRODUCTS

2.1 RECORD PLANS:
A. Explanation: Except where otherwise indicated, mechanical plans (contract plans) prepared by Engineer are diagrammatic in nature and may not show locations accurately for various components of mechanical systems. Shop drawings, including coordination plans, prepared by Contractor shall show certain portions of work more accurately to scale and location, and in greater detail.
B. General Recording Procedure: Maintain a white-print set, blue-line or black-line, of mechanical contract plans and shop drawings in clean, undamaged condition, for mark-up of actual installations which vary substantially from the work as shown. Mark-up whatever plans are most capable of showing the installed conditions accurately; however, where shop drawings are marked, record a reference note on appropriate contract drawing. Mark with erasable pencil and use multiple colors to aid in the distinction between work of separate mechanical systems. In general, record every substantive installation of mechanical work which previously is either not shown or shown inaccurately, but in any case record the following:
1. Underground and aboveground piping, both exterior and interior, drawn to scale and fully dimensioned.
2. *"Mechanical Project Record"* shall be maintained as part of the *"Project Record"* specified in Division 1.

2.2 MAINTENANCE MANUALS:
A. Organize each copy of the required system maintenance manuals to include an index followed by thumb-tab marked sections for each of the following:
1. Operating Instructions: Submit manufacturer's operating instructions for each item of mechanical equipment and supplement with additional project application instructions where necessary. Prepare and submit specific operating instructions for charging, start-up, control or sequencing of operation, phase or seasonal variations, shut-down, safety and similar operational instructions. Prepare in typewritten form in completely explained and easily understood English language
2. Emergency instructions including addresses and telephone numbers of service sources.
3. Regular system maintenance procedures including lubrication.
4. List of all filters required for each unit.
5. Spare parts listing and stocking recommendations.
6. Inspection, adjusting, rebalancing, cleaning, parts replacement, and similar maintenance instructions and recommendations, including the proper use of tools and accessories.
7. Valve schedule and control diagram for each system.
8. Manufacturer's data and test reports for each operating item in each system.
9. Manufacturer's product warranties and guarantees relating to the system and equipment

items in the system.

10. Corrected or approved issues of submittal items relating to the system.

B. Bind each maintenance manual in one or more vinyl-covered, 2", 3-ring binder, plus pocket-folder type binders for folded drawings, and mark the back spine of each binder with system identification and volume number.

C. Certifications: Where specifically indicated, submit with notarized execution.

D. Test Reports: Submit test reports which have been signed and dated by the firm performing the test and prepared in the manner specified in the standard or regulation governing the test procedures as indicated.

E. Manufacturer's Product Warranties: Where pre-printed and published warranty includes substantial deviation from required warranty (as judged by the Architect or Engineer), product is automatically disqualified from use on the project, except where manufacturer prepares and issues a specific product warranty on the product, stating that it is in lieu of the published warranty, and is executed by an authorized officer, and complies with the requirements. Warranties shall comply with the requirements of individual specification section where those requirements exceed the manufacturer's standard warranty.

F. Guarantees: Where indicated as "Certified", provide guarantee which, in addition to execution by an authorized officer of each guarantor, is attested to by the Secretary of each guarantor and bears the corporate seal

2.3 MECHANICAL TEST, ADJUST, BALANCE REPORT

A. See Section 23 9210.

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES:

A. General Coordination: Sequence closeout procedures properly, so that work will not be endangered or damaged, and so that every required performance will be fully tested and demonstrated.

B. System Performance Test Run: At the time of mechanical work closeout, check each item in each system to determine that it is set for proper operation. With Owner's representative and Architect/Engineer present, operate each system in a test run of appropriate duration to demonstrate compliance with performance requirements. During or following test runs, make final corrections or adjustments of system to refine and improve performances wherever possible, including noise and vibration reductions, elimination of hazards, better response of controls, signals and alarms, and similar system performance improvements. Provide testing or inspection devices as may be requested for Architect's/Engineer's observation of actual system performances. Demonstrate that controls and items requiring service or maintenance are accessible. Test run shall be scheduled to coincide with Engineer's final inspection of the mechanical work.

C. Cleaning and Lubrication: After final performance test run of each mechanical system, clean system both externally and internally. Clean dirt and debris from air handling systems and install new filters. Flush piping system by operating drains and similar means, and clean strainers and traps. Lubricate both power and hand operated equipment and remove excess lubrication. Touch-up minor damage to factory painted finishes and other painting specified as mechanical work; refinish work where damage is extensive.

D. General Operating Instructions: In addition to specified training of Owner's operating personnel specified in individual mechanical sections, and in addition to preparation of written operating instructions and compiled maintenance manuals specified, provide general operating instructions for the total mechanical plant. Conduct a walk-through explanation and demonstration for orientation and education of Owner's personnel to be involved in continued operation of building and its mechanical plant.

1. Describe each basic mechanical system and how its control system functions, including

flow adjustments, temperature control and similar operations.

2. Explain and point out identification system, displayed diagrams, signals, alarms and similar provisions of the work.
3. Describe basic sequencing requirements and interlock provisions for system start-up, phasing, coast-down, shut-down and seasonal operations.
4. Emphasize emergency procedures and safety provisions for protection of equipment and safety of occupants during equipment malfunction, disasters, power failures and similar unusual circumstances, and describe system limitations and precautions including weather adjustments.
5. Outline basic maintenance procedures.

E. Demonstrate what adjustments have been made and can continue to be made to reduce noise and vibration, improve system output, decrease energy consumption and similar performance improvements.

F. Point out operational security provisions, safety, unavoidable hazards and similar operator limitations. Display and conduct a "thumb-through" explanation of maintenance manuals, record drawings, meter readings and similar service items.

G. All training sessions shall be digitally recorded (audio/video) and submitted to the Owner.

H. Construction Equipment: After completion of performance testing and Owner's operating instructions and demonstrations, remove installers tools, test facilities, construction equipment and similar devices and materials used in execution of the work but not incorporated in the work.

3.2 CONTINUED SYSTEM OPERATIONS:

A. Final Acceptance: At time of substantial completion of mechanical work, Owner's operating personnel will take over operation of mechanical systems. However, until time of final acceptance, respond promptly with consultation and services on whatever operation or maintenance problems may remain or arise in continued operation of mechanical plant.

END OF SECTION 23 02 40

SECTION 23 03 10 – MECHANICAL PIPE, TUBE AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:
A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:
A. Industry Standards:
1. Qualify welding procedures, welders and operators in accordance with ASME B31.1 for shop and project site welding of piping work.
2. Certify welding of piping work using the *Standard Procedure Specifications* by, and welders tested under supervision of, the *National Certified Pipe Welding Bureau*.
3. Where plastic piping is indicated to transport potable water, provide pipe and fittings bearing approval label by the *National Sanitation Foundation* (NSF).
B. SUBMITTALS:
1. Submit manufacturer's data, welding certifications, test reports, and product warranties as applicable for all piping materials.
2. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and be specifically identified with the applicable style number.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:
A. General: Provide pipe and tube of the type, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements and comply with governing regulations and industry standards.
B. Black Steel Pipe: ASTM A 53, Schedule 40, Schedule 1.
C. Galvanized Steel Pipe: ASTM A 53, Schedule 40, Schedule 10.
D. Copper Tube: ASTM B88 Type L as indicated for each service; hard drawn temper, except as otherwise indicated. Solder for use on domestic water piping shall be lead free type.

2.2 PIPE/TUBE FITTINGS:
A. General: Provide factory-fabricated fittings of the type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube valve or equipment connections in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.
B. Cast-Iron Threaded Fittings for Steel Pipe: ASTM A 126-84 Class 125, plain or galvanized to match pipe.
C. Welded Fittings for Steel Pipe: ASTM A234.
D. Cast-Iron Flanged Fittings for Steel Pipe: ASME B16.1, including bolting. Class 125, plain or galvanized to match pipe.
E. Gaskets for Flanged Joints: ASME B16.21; full-faced for cast-iron flanges.
F. Soldering Materials: Except as otherwise indicated, provide soldering materials as determined by the Installer to comply with installation requirements.
1. Tin-Antimony Solder: ASTM B 32, Grade 95TA.
G. Mechanical Couplings for IPS Pipe: Coupling housings shall be ductile iron (ASTM A536). Bolts and nuts shall be carbon steel track-type (ASTM A183), minimum tensile 110,000 psi. Gaskets shall be Grade "E" EPDM, for water services from -30° to +230□F. At joints allowing controlled movement, expansion, contraction of deflection, flexible couplings with shall be

used. At all joints not requiring flexibility, a rigid coupling shall be used. Fittings for pipe 2 inches and smaller shall be the mechanical compression type. Mechanical couplings shall be by *Victaulic*, *Anvil* or *Grinnell*.

1. Rigid Type: Coupling housings cast with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with ANSI B31.1 and B31.9.
2. Flexible Type: Use in locations where vibration attenuation and stress relief are required.
3. Flange Adapter: Flat face, for direct connection to ANSI Class 125 or 150 flanged components.

H. Mechanical Couplings for Steel Pipe: Fittings shall be ductile iron (ASTM A536) forged steel (ASTM A234); or fabricated from carbon steel pipe (ASTM A53); with pre-grooved ends for use with mechanical couplings of the same manufacturer.

I. Mechanical Couplings for Hard Copper Tube: Coupling housings shall be ductile iron (ASTM A536), coated with copper colored alkyd enamel and cast with angle-pattern bolt pads for system rigidity. Bolts and nuts shall be carbon steel track-type (ASTM A183), minimum tensile 110,000 psi. Gaskets shall be Grade "E" EPDM FlushSeal® type, for water services from -30 to +230□F. Mechanical couplings shall be by *Victaulic*, *Anvil* or *Grinnell*.

J. Mechanical Couplings for Copper Pipe: Fittings 2"-4" size shall be wrought copper (ASTM B75 C12200 or ASTM B152 C11000 and ANSI B 16.22). Fittings 5" - 8" size shall be bronze sand casting (ASTM B584-87) or copper alloy CDA844 (81-3-7-9) (ANSI B 16.18). Fittings shall have pre-grooved ends for use with mechanical couplings of the same manufacturer. Fittings shall be manufactured to copper tubing sizes. (Flaring of tube and fitting ends to IPS dimensions is not allowed.)

K. Pipe Sleeves:
1. Iron Pipe Sleeves: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
2. Sheet Metal Pipe Sleeves: Fabricate from galvanized sheet metal closed with lock-seam joints. For following pipe sizes provide gauge indicated: 3 inch pipe and smaller, 20 gauge; 4 to 6 inch pipe, 16 gauge; over 6 inch pipe, 14 gauge.
3. Pipe Sleeve Caulking: *3M Fire Barrier Caulk*, *STI* or *Grabber*.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: Install pipe, tube and fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with a minimum of joints and couplings, but with adequate and accessible unions for disassembly and maintenance/ replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16" misalignment tolerance.
1. Comply with ASME B31.1 Code for Pressure Piping.
2. Comply with ASME B31.9 Code for Building Services Piping.

B. Locate piping runs as indicated on the drawings. Route vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown, or described by diagrams, details and notations or, if not otherwise indicated, run piping in the shortest route which does not obstruct usable space or block access for servicing the building and its equipment. Where possible, locate insulated piping for 1.0" clearance outside insulation. Changes in direction shall be made with fittings.

C. Piping System Joints: Provide joints of the type indicated in each piping system.

D. Threaded Joints: Thread pipe in accordance with ANSI B2.12; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

E. Welded Joints: Weld pipe joints in accordance with recognized industry practice and as

follows: Weld pipe joints only when ambient temperature is above 0 degrees F. where possible. Bevel pipe ends at a 37.5 degree angle where possible, smooth rough cuts and clean to remove slag, metal particles and dirt. Install welding rings for butt welded joints. Use pipe clamps or tack-weld joints with 1.0" long welds; 4 welds for pipe sizes to 10". Build up welds with a stringer-bead pass, followed by a hot pass, followed by a cover or filler pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow holes and non-metallic inclusions. Do not weld-out piping system imperfections by tack-welding procedures; refabricate to comply with requirements. Install forged branch-connection fittings wherever branch pipe is indicated, or install regular "T" fitting (at Contractor's option).

F. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

G. Mechanical Coupling Joints: Square cut pipe ends and deburr. Roll-groove pipe ends to manufacturer’s specifications. Lubricate gaskets completely on interior and exterior using a non-petroleum based lubricant. Slide gasket over pipe ends between grooves. Engage coupling housing into grooves and tighten until housing bolt pads are in full contact on each side of joint. For pipes 2 inches and smaller, no groove is required. Mark pipe ends for proper insertion into couplings and fittings. Engage piping into fitting to full depth, indicated by marked pipe ends. Align pipe ends, position compression tool and press trigger until assembly cycle is complete. All grooved couplings, fittings, valves and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Grooved coupling manufacturer’s factory trained field representative shall provide on-site training for contractor’s field personnel in the proper use of grooving tools, application of groove and installation of grooved piping products. Factory trained representative shall periodically inspect the product installation. Contractor shall remove and replace any improperly installed products.

H. Soldered Joints: Solder copper tube and fitting joints where required, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings with steel wool. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens. Use a non-corrosive paste flux and wire solder composed of 95 percent tin and 5 percent antimony.

I. Insulating (Dielectric) Nipples: Comply with manufacturer's instructions for installing nipples in a manner which will prevent galvanic action and stop corrosion where the joining of ferrous and non-ferrous piping occurs.

J. Pipe Sleeves: Install pipe sleeves of the types specified wherever piping passes through the walls, floors or structural members of the work. Provide sleeves of adequate size, accurately centered in pipe runs. Size sleeves so that piping and insulation will have free movement in the sleeve, including allowance for thermal expansion. Where insulation includes a vapor barrier covering provide sleeve with sufficient clearance for installation of vapor barrier. Install length of sleeve equal to thickness of construction penetrated, except extend floor sleeves 0.25 inches above floor finish. Provide temporary support of sleeves during placement of concrete and other work around sleeves and provide temporary closure to prevent concrete and other materials from entering pipe sleeves.
   1. Sleeve Type: At interior partitions and ceilings, install sheet metal sleeves.
   2. Sleeve Type: At exterior penetrations both above and below grade, install iron pipe sleeves.
   3. Sleeve Type: Except as otherwise specified, install steel pipe sleeves.

4. Caulk pipe sleeves at exterior penetrations and at other locations where indicated. Provide sufficient quantities of oakum and lead to make permanent weather-tight closure between sleeve and piping, slightly recessed at exposed surface.

K. PVC piping exposed to sunlight shall be coated with water-based latex white paint to prevent UV light degradation.

3.2 CLEANING, FLUSHING AND INSPECTING:

A. General: Clean exterior surfaces of installed piping systems of superfluous materials and prepare for application of specified coatings.

B. Flush out piping system with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

3.3 PIPING TESTS:

A. General: Provide temporary equipment for testing, including pump and gages. Test piping systems before insulation is installed wherever feasible, and remove control devices before testing. Test each natural section of each piping system independently, but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating.
   1. Required test period is 2 hours

B. Unless otherwise specified for specific systems, hydraulically test each pressurized piping system at 150% of operating pressure indicated, but not less than 100 psig test pressure.

C. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.

D. Repair piping systems sections which fail the required piping test, by disassembly and re-installation, using new materials to the extent required to overcome leakage. Do not use chemicals, stop-leak compound, mastics, or other temporary repair methods. Drain test water from piping systems after repair work and retesting has been completed.

END OF SECTION 23 03 10

SECTION 23 03 20 – MECHANICAL HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties on all items.

PART 2 - PRODUCTS

2.1 HANGERS AND SUPPORTS:

A. General: Except as otherwise indicated, provide factory-fabricated piping hangers and supports of the type specified complete with bolts and washers. Comply with the manufacturer's published product information. Size hangers and supports properly for piping and weight of the medium being transported. Provide insulation shields for all insulated piping.

B. Hangers for refrigerant lines shall be copper plated band type with adjusting nut; *Anvil* Fig. CT-69, *B-Line* Fig. B3170CT, or equivalent by *Erico Caddy*, *PHD Manufacturing* or *Hubbard Enterprises/Holdrite*.

C. Hangers for mechanical hot water piping [and steam and condensate piping] 2-1/2" and larger shall be roller type *B-Line* Fig. B 3111 for overhead support of single lines, *B-Line* Fig. B3117 or Fig. B3118 roller chair for base mounted hangers. Hangers for hot water piping 2" and smaller shall be the standard clevis type Figure B3100. Equivalent by *Anvil*, *Erico Caddy*, *PHD Manufacturing* or *Hubbard Enterprises/Holdrite* are acceptable.

D. Hangers for chilled water piping [and condenser water piping] [and HVAC drain piping] shall be the standard clevis type *B-Line* Fig. B3100 or equivalent by *Anvil*, *Erico Caddy*, *PHD Manufacturing* or *Hubbard Enterprises/Holdrite*.

E. Piping installed above a roof shall be supported on pre-fabricated, non-penetrating supports by *Pipe Pier, B-Line* or *Cooper*. Provide matching adjustable elevation kits and method for positive attachment to roof.

F. Piping roof penetrations shall be made with a factory-built pipe portal assembly with minimum 20-year warranty. The pipe portal shall be aluminum construction with removable lid, UV protected powder coating, full thermal break interior with gaskets and insulation, stainless steel fasteners and exit seal locater/starter dimples. The roof curb shall be aluminum construction with full thermal break interior. Exit seals shall be injection molded ABS. All pipe penetrations shall be through housing walls, not the lid. Select housing size in accordance with number of pipe penetrations needed. Pipe portal shall be by *Alta, Roof Penetration Housings, Pate, Thybar,* or *RPS.*

G. Equipment rails for roof mounted equipment shall be 18 gauge galvanized steel construction with integral base plate, continuous welded corner seams, pressure treated wood nailer and counterflashing with screws. Equipment support rails shall be by *Aladdin, Pate, Thybar* or *RPS*.

PART 3 - EXECUTION

3.1 HORIZONTAL PIPING SUPPORT:

A. Minimum spacing of hangers and supports for above-ground horizontal pipe and tubing shall be as follows:

1. Steel Pipe:

Nominal Pipe Size (inches)	Support Spacing (feet)
1-1/4 and smaller	7
1-1/2	9
2	10
2-1/2	11
3 & larger	12

2. Copper Tubing:

Tubing Size (inches)	Support Spacing (feet)
3/4 and smaller	5
1 to 2-1/2	6
3	10
4 and larger	12

3. Plastic Pipe:

Nominal Pipe Size (inches)	Support Spacing (feet)
3/4	3.0
3/4 to 1	3.5
1-1/4 to 1-1/2	4.0
2 to 2-1/2	4.5
3 and larger	5.5

B. Prevent electrolysis in the support of copper tubing by the use of hangers and supports which are copper plated, or by other recognized industry methods.
C. Branch piping located in walls, partitions or pipe chases shall be rigidly supported inside the wall or chase.

3.2 VERTICAL PIPING SUPPORT:
A. Plastic Piping: Support at 8 feet maximum intervals and near each joint.
B. Copper Tubing: Support at riser tops and 5 feet maximum on center for pipe 1-1/2" and larger and 4 feet on center for pipe 1-1/4" and smaller. Use copper plated pipe clamps.
C. Steel Pipe: Supports at top and bottom of riser and on 10 feet maximum centers.

3.3 ADJUSTMENT OF HANGERS AND SUPPORTS:
A. Adjust hangers and supports to bring piping to proper level, elevations and slopes.

END OF SECTION 23 03 20

SECTION 23 11 10 - MECHANICAL WATER PIPING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. The extent of mechanical water piping work is indicated by the drawings and by the requirements of this section and includes the following:
   1. Chilled Water Supply (CHWS); Chilled Water Return (CHWR)
   2. Hot Water Supply (HWS); Hot Water Return (HWR)
   3. HVAC Drain Piping (D)
   4. Makeup Water Piping

1.3 SUBMITTALS:

A. Submit manufacturer's data, test reports, and product warranties as applicable for all items.

PART 2 – PRODUCTS

2.1 PIPING MATERIALS:

A. General: Comply with Section 230310 for product requirements of piping materials. For each service, provide the piping materials indicated including pipe, fittings, hangers, supports, anchors, valves and accessories. Where more than one type is indicated, selection of one type is Installer's option. Where type is not otherwise indicated, provide materials in accordance with industry standards or governing regulations.

2.2 CHILLED WATER PIPING, HOT WATER PIPING, CONDENSER WATER PIPING, HEAT PUMP WATER PIPING:

A. Above Ground Pipe: Pipe sizes larger than 2 inches shall be schedule 10 steel. Pipe sizes 2 inches and smaller shall be schedule 40, 10 steel or hard drawn Type L seamless copper.

B. Fittings: Wrought steel welding type, cast iron flanged type, cast iron threaded type, mechanical groove joint couplings, mechanical compression joints, or sweat connections as applicable. Mechanical compression joints may be used with schedule 10 pipe 2 inches and smaller.

2.3 HVAC DRAIN PIPING:

A. All Pipe Sizes: Hard drawn Type L seamless copper tubing.

B. Fittings: Hard drawn wrought copper with sweat connections.

2.4 MAKEUP WATER PIPING:

A. All Pipe Sizes: Hardrawn Type L seamless copper tubing.

B. Fittings: Hard drawn wrought copper with sweat connections.

2.5 ACCESSORIES:

A. General: Provide factory-fabricated piping accessories recommended by the manufacturer for use in the service indicated. Provide products of the type and pressure-rating specified for each service or, if not specified, provide proper selection as determined by the piping system Installer to comply with installation requirements. Provide sizes and connections matching pipe, tube, valve, and equipment connections. For piping systems requiring up to 2" of insulation, provide an extended valve handle that offers a vapor seal, adjustable memory stop and valve packing maintenance without disturbing the insulation.

B. Shutoff Valves: Valves 2 inches and smaller shall be ball valves. Valves shall have two-piece bronze or brass body, meeting MSS-SP110, full or standard port, blowout-proof stem and adjustable packing nut independent of handle. Valves shall be rated for 150 SWP, 600 CWP. Valves shall be by *Apollo*, *Hays, Milwaukee*, *Nibco*, *Victaulic* or *Watts*.
C. Shutoff Valves: Valves 2.5 inches and larger shall be lug or grooved-end type butterfly valves with ten-position handles. Valves shall have minimum pressure rating of 150 WOG with cast iron, ductile iron or bronze body; bronze alloy, offset electroless nickel-plated ductile iron or elastomer encapsulated ductile iron disc, stainless steel stem, and replaceable EPDM seat and shall have a two-inch extended neck. The valve liner design shall be such that it shall serve as a flange seal and no separate gasket shall be required. Valves shall be installed with grooved joint couplings or between ASA 150 steel slip-on flanges. Valves shall be by *Hays, Milwaukee*, *Nibco*, *Victaulic* or *Watts*.
D. Check Valves: Valves 2 inches and smaller shall be all bronze with threaded connections, swing check type, TFE disc, Class 150, meeting MSS-SP80. Valves shall be by *Milwaukee*, *Nibco* or *Watts*.
E. Check Valves: Valves 2.5 inches and larger shall be iron body with flanged connections, swing check type, Class 125, meeting MSS-SP71. Valves shall be by *Milwaukee*, *Nibco* or *Watts*.
F. Drain Valves: Valves shall be bronze construction ball type with TFE seats, angle body, hose end connection with cap and chain. Valves shall be by *Apollo*, *Hays, Nibco*, *Victaulic* or *Watts*.
G. Manual Balancing Valves: Valves shall have a low loss/high signal venturi flow measuring element and a ball type balancing valve with grid and memory stop. Valves shall be bronze/brass construction rated at 150 psig with sweat, threaded or flanged connections as applicable. Provide two test plugs with a matching portable readout meter for system balancing in GPM. Valves shall be as manufactured by *Bell & Gossett*, *Hays, Patterson, Preso, Wheatley, Taco* or *Tour and Anderson*.
H. Automatic Balancing Valves: Valves shall automatically control flow rates to cooling and heating coils with +-5% accuracy. Valve control mechanism shall consist of a stainless steel cartridge with a ported cup and coil/helical spring to avoid corrosion. The valves shall be available in four PSID control ranges. The manufacturer shall provide independent laboratory tests verifying accuracy of performance. Valves shall be supplied with temperature/pressure test valves and shall be permanently marked to show direction of flow. Valves shall be by *Bell & Gossett, Griswold*, *Hays* or *Tour and Anderson*.
I. Triple Duty Valves: Provide a triple duty valve in the discharge piping of each base mounted pump. Valve shall consist of a non-slam check valve with a spring-loaded weighted contoured disc and a calibrated adjustment feature permitting regulation of pump discharge flow and shut-off. Valves shall be designed to permit repacking under full pressure. Valve body shall be cast iron construction suitable for maximum working pressure of 175 psig and maximum operating temperature of 300 degrees F. Triple duty valves shall be as manufactured by *Bell & Gossett*, *Patterson, Peerless*, *Taco*, *Wheatley* or *Victaulic*.
J. Hose Kits: Water connections to coils may be made using U.L. Listed self-balancing hose kits suitable for 200 psig working pressure. Each hose shall have a flame retardant stainless steel sheath and swivel ends. Each hose shall be 24 inches long with diameter same size as unit connections. Valves, strainers, and accessories required for each individual installation shall be as shown on the drawings and shall be the products of a single manufacturer. Equipment shall be as provided by *Griswold*, *Hays* or *Victaulic*.
K. Pressure Reducing Valves: Valves shall be bronze body construction with renewable seats and integral check valve and strainer. Pressure reducing valves shall be by *Armstrong, Bell & Gossett*, *Taco* or *Watts*.
L. Pressure Relief Valves: Valves shall be bronze construction engineered in accordance with the requirements of Section IV of the *ASME Boiler and Pressure Vessel Code for Heating Boilers*. Capacities shall be certified by the *National Board of Boiler and Pressure Vessel Inspectors*. Valves shall be by *Armstrong, Bell & Gossett*, *Taco* or *Watts*.
M. Back Flow Preventer: Units shall be the reduced pressure principle type. Units shall consist of

two spring-loaded check valves with an automatic pressure differential relief valve located between the two check valves. The units shall include shut off valves located at each end and properly located test cocks. Maximum allowable pressure drop through the assembly is 8 psig. Back Flow Preventer shall be by *Febco, Watts* or *Wilkins*.

N. Wye Strainers: Provide self cleaning type wye strainers where indicated. Strainers shall be the iron body type rated for 175 psig W.O.G. Screen shall be monel mesh or perforated metal as recommended by the manufacturer. Provide connections as required. Blowoff outlets shall be equipped with a shut-off valve. Strainers shall be by *Hays, Mueller*, *Nibco*, *Watts*, *Wheatley* or *Victaulic*.

O. Basket Strainers: Provide self-cleaning type basket strainers where indicated. Strainers shall be the iron body type rated for 200 psig W.O.G. Screen shall be 304 stainless steel with 0.125" openings. Provide a flanged, bolted cover with compressed fiber gasket. Bottom blowoff outlet shall be equipped with a shut-off valve. Strainers shall be by *Hays, Mueller*, *Nibco*, *Watts*, *Wheatley* or *Victaulic*.

P. Suction Diffusers: Units shall consist of an angle type body with inlet vanes and combination diffuser-strainer with 3/16 inch diameter perforations. Unit shall be equipped with a disposable fine mesh start up strainer which shall be removed after system start up. the cast iron body shall fit the pump and connecting pipe size and shall be suitable for maximum working pressure of 175 psig and maximum operating temperature of 250 degrees F. The units shall be equipped with an adjustable support foot to carry piping weight. Suction Diffusers shall be as manufactured by *Armstrong, Bell & Gossett*, *Patterson, Peerless*, *Taco*, *Wheatley*, *Wood* or *Victaulic*.

Q. Air Separators: Provide external type air separation units consisting of a steel tank with flanged connections. Separators shall have a bottom blow-down connection and top connection for venting air. Units shall be constructed in accordance with *ASME Boiler and Pressure Vessel Code* and stamped 125 psig design pressure. Air separator shall be as manufactured by *Armstrong, Bell & Gossett*, *Patterson, Peerless*, *Taco*, *Wheatley* or *Wood*.

R. Expansion Loops: Provide units constructed of materials and with proper end connections to match adjoining pipe. The expansion device shall be capable of minimum 1.5 inch movement. Units shall be suitable for 40 degrees F temperature range and 150 psig working pressure and 200 psig test pressure. Pipe guides shall be furnished, located, and installed in accordance with manufacturer's recommendations. Expansion loops and guides shall be as manufactured by *Metraflex*, *Flexicraft, Southeastern Hose* or *Twin City Hoses*. For pipe sizes 2-1/2 inches and larger, a series of flexible mechanical couplings may be used instead of expansion loops.

S. Expansion Tanks: Provide captive air expansion tanks with removable bladder and tank volume as indicated on the drawings. The shell shall be fabricated steel designed and constructed per ASME Section VIII. Tanks shall be suitable for a maximum working pressure of 125 psig and a maximum operating temperature of 240 degrees F. Tanks shall be by *Armstrong, Bell & Gossett*, *Patterson, Peerless*, *Taco*, *Wheatley* or *Wood*.

T. Flexible Hoses: Provide flame retardant flexible hoses at all water coil connections. Hoses shall be of reinforced, lined rubber with stainless steel sheath and rated for a minimum working pressure of 200 psig. Provide swivel end connections at the coils. Hoses shall be 24" long minimum and shall be by *Hays, Metraflex, Southeastern Hose*, *Twin City Hoses* or *Victaulic*.

U. Flexible Pump Connectors: Provide flexible connectors at pump connections where indicated. Flexible connectors shall be of bronze construction with corrugated inner tubing, braided outer shield, and forged flanged ends suitable for water service at 40 degrees F to 240 degrees F temperature range, 125 psig working pressure, and 200 psig test pressure. Connectors shall be as manufactured by *Metraflex*, *Patterson, Southeastern Hose* or *Wheatley*. Flexible mechanical couplings may be substituted for flexible connectors.

V. Automatic Air Vents: Provide automatic float type air vents in locations indicated on the drawings. Units shall be suitable for a maximum working pressure of 75 psig and a maximum operating temperature of 240 degrees F. Automatic air vents shall be as manufactured by

Armstrong, Bell & Gossett, *Patterson, Peerless*, *Taco*, *Wheatley* or *Wood*.

W. Manual Air Vents: Vents shall consist of a 1/4 inch gauge cock with softdrawn copper discharge tube.

X. Flow Metering Stations: Stations shall be a pitot tube probe with double-tube construction and double-averaging operation. The probe shall have 304 stainless steel tube with brass block and valves. Maximum temperature shall be 250 degrees F and maximum pressure shall be 200 psig. Provide a matching differential pressure gauge and conversion chart. Flow metering station shall be by *J.W. Sweet, Patterson, Preso*, or *Taco*.

Y. Thermometers: Piping system thermometers shall be the bi-metal type with silicon liquid fill, 5 inch dial, and adjustable angle. The case shall be stainless steel, hermetically sealed, with stainless steel ring. The window shall be double strength glass. The dial shall be white finished aluminum with black and blue markings in degrees F and degrees C. The pointer shall be balanced aluminum with a black finish. Provide an external recalibrator, 1% accuracy of full scale, stainless steel ½ inch NPT connection and stainless steel stem. The scale range for each gauge shall be selected so that the normal operating point for each application falls in the approximate midpoint of the gauge range. Thermometers shall be by *Trerice*, *Weiss* or *Wika*.

Z. Pressure Gauges: Gauges shall be connected to the piping system with threaded chrome-plated brass pipe and fittings. Gauges shall be the flangeless liquid-filled type and shall have 4-1/2 inch dials, cast aluminum cases, stainless steel heavy duty rotary gear movements, phosphor bronze bourdon tubes, forged brass rod sockets and tips, 1/2% accuracy of scale range, plexiglass dial covers, and 1/4 inch lower connections. Each gauge shall be provided with chrome plated brass lever handle cock and a stainless steel pulsation dampener. Provide compound gauges for locations which are under negative pressure. Range for pressure gauges shall be selected so that the normal operating point for each application falls in the approximate midpoint of the gauge range. Gauges shall be by *Trerice*, *Weiss* or *Wika*.

AA. Heat Trace Tape for Freeze Protection: Freeze protection tape shall be provided for all above ground water piping outside the building and selected to match pipe size, insulation thickness, and 0 degree F ambient temperature in accordance with the manufacturer's instructions. Tape shall maintain 40 degrees F minimum water temperature and shall be self regulating type. Tape shall be by *Chromalox, Raychem* or *Watts*.

PART 3 – EXECUTION

3.1 INSTALLATION OF PIPING:

A. General: Comply with requirements of Section 230310 for installation of basic piping materials.

B. Air Vents: Install manual air vents at high points in the system and as shown on the drawings.

C. Take-Offs: Branch take-offs from the supply mains shall be made from the top of the main.

D. Drains: Install drain connections at the bottom of risers as necessary to permit complete system drainage. Piping slopes shall be as indicated on the drawings.

E. Painting: Surface preparation and painting shall be in accordance with the Painting Section of the specifications. Apply a minimum of two coats of paint. All steel piping not insulated shall be painted. All Natural Gas piping in the Mechanical Room shall be painted yellow.

3.2 INSTALLATION OF ACCESSORIES:

A. Install premanufactured accessories in accordance with the manufacturer's instructions and recommendations.

3.3 INSPECTION:

A. Each length of pipe shall be inspected prior to installation. Ends of open pipe shall be temporarily capped to prevent entry of foreign material prior to connections to other piping or equipment.

3.4 TESTING:

A. Comply with requirements of Section 230310.

3.5 FLUSHING:

A. Comply with requirements of Section 231410.

END OF SECTION 23 11 10

SECTION 23 1210 – MECHANICAL PIPING AND EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:
A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE:
A. Piping and equipment to be insulated include:
1. Chilled Water Piping
2. Hot Water Piping
3. Makeup Water Piping
4. HVAC Drain Piping
5. Refrigerant Piping
6. Chilled Water Pumps
7. Hot Water Pumps
8. Boiler Pumps
9. Air Separators
10. Expansion Tanks
11. Storage Tanks

1.3 QUALITY ASSURANCE:
A. Manufacturers: Provide insulation products produced by one of the following for each type and temperature range of insulation.
1. *Certainteed*
2. *Knauf*
3. *Manville*
4. *Owens-Corning*
5. *Pittsburgh Corning*
6. *Manson*
7. *Armacell*
8. *Aeroflex USA*
9. *K-Flex USA*
B. Flame/Smoke Ratings: Provide composite piping insulation (insulation, jackets, covering, sealers, mastics and adhesives) with flame-spread rating not exceeding 25 and smoke developed rating not exceeding 50, as tested by ASTM E 84 (NFPA 255) method and UL 723.

1.4 SUBMITTALS:
A. Provide manufacturer's data, test reports, and product warranties for all items.

PART 2 - PRODUCTS

2.1 PIPE INSULATION:
A. Fiberglass Insulation: Insulation shall be preformed, two-piece, heavy density fiberglass with self sealing ASJ facing conforming to ASTM C 547. Insulation on valves, elbows and fittings shall be pre-formed fiberglass with PVC covers and same material thickness as adjacent pipe. Insulation thickness shall be as follows:
1. Hot Water Piping: 1 inch thick up to 3/4 inch diameter. 1-1/2 inches thick for 1 inch diameter and up.
2. Makeup Water Piping: 1 inch thick for all sizes.
B. Cellular Glass Insulation: Cellular glass insulation shall comply with ASTM C 552, Type II. Jacketing for indoor applications shall be all purpose type of *Kraft* paper/aluminum foil/vinyl

coating construction. Jacketing for outdoor applications shall be .016 inch aluminum. Insulation on valves, elbows and fittings shall be pre-formed cellular glass with PVC covers and same material thickness as adjacent pipe. Insulation thickness shall be as follows:

1. Chilled Water Piping: 1-1/2 inches thick for pipe sizes up through 4 inch diameter. 2 inches thick for pipe sizes 5 inch through 12 inch diameter.
2. HVAC Drain Piping: 1-1/2 inches thick for all sizes.

C. Aluminum Jacket: Corrugated, embossed or smooth sheet, .016 inch nominal thickness, ASTM B 209, temper H14, type 3003, 5005 or 5010.

2.2 EQUIPMENT INSULATION:

A. Insulation for all equipment shall be cellular glass complying with ASTM C 552, Type II. Insulation thickness shall be 2 inches. Secure with stainless steel bands. Finish with mastic reinforced with white open weave membrane with maximum mesh opening of 10x10 per inch.
B. Insulation for all equipment shall be closed cell elastomeric insulation complying with ASTM C 534, Type II, Sheet Grade 1. Insulation thickness shall be 2 inches. Jacketing for outdoor applications shall be .016 inch aluminum.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING INSULATION:

A. General: Install insulation products in accordance with the manufacturer's written instructions, and in accordance with recognized industry practices to ensure that the insulation serves its intended purpose. Do not use cut pieces or scraps abutting each other.
B. Insulation shall be applied on clean dry surfaces. All insulation shall be continuous through wall and ceiling openings and sleeves. Insulation on all cold surfaces, where vapor barrier jackets are used, will be applied with continuous unbroken vapor seal. Seal off ends of insulation on cold piping systems with white vapor barrier coating at valves, flanges, supports and exposed ends. Supports that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.
C. Pipe covering protection shields shall be provided around exterior of pipe insulation at pipe hangers which fit around pipe insulation. Shields shall be 12 inches long by 180 degrees and shall be 18 gauge galvanized steel sheet. High density isolation inserts shall be provided at pipe saddles.
D. Unions shall not be insulated except for unions in chilled water lines which shall be insulated.
E. Cover valves, flanges, fittings and similar items in each piping system.
F. Extreme care shall be taken to insure a neat, uniform exterior surface on insulation applied to exposed pipes. Insulation in finished areas shall be painted in accordance with the paint specifications.
G. Heat tracing of piping shall be as specified in Section 23 1110. Insulation shall be oversized one pipe size to allow installation over heat trace tape.
H. Aluminum jackets shall be provided on exterior insulated pipes where noted on the plans.

3.2 INSTALLATION OF EQUIPMENT INSULATION:

A. General: Apply equipment insulation suitable for temperature and service in rigid board to fit as closely as possible to equipment. Groove or score insulation where necessary to fit the contours of equipment. Stagger end joints where possible. Bevel the edges of the insulation for cylindrical surfaces to provide tight joints. Fill joints with insulating cement conforming to ASTM C 195. Bevel insulation around name plates, ASME Stamp, and access plates. For insulation on equipment that must be opened periodically for inspection, without damage. Protect exposed insulation corners with corner angles under wires and bands.

3.3 PROTECTION AND REPLACEMENT:

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor

barrier damage and moisture saturated units.

B. Protection: The Installer of the insulation shall advise the Contractor of required protection for the insulation work during the remainder of the construction period, to avoid damage and deterioration.

END OF SECTION 23 12 10

SECTION 23 13 10 - PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:
A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK:
A. The applications of general-use centrifugal pumps required for the project include the following:
1. Chilled Water Pumps
2. Hot Water Pumps
3. Boiler Pumps

1.3 QUALITY ASSURANCE:
A. *Bell and Gossett* is the Basis of Design manufacturer. Equivalent name brand equipment manufactured by *Armstrong, Aurora, Grundfos, Patterson, Peerless, Taco* and *Thrush* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.
B. Industry Standards: Provide electric motors and products which have been listed and labeled by *Underwriters Laboratories* and comply with NEMA Standards. Pumps shall be tested and rated in accordance with ANSI/HI 1.6-1994.

1.4 SUBMITTALS:
A. Submit manufacturer's data, test reports, and product warranties on all items.

PART 2 - PRODUCTS

2.1 GENERAL:
A. Except as otherwise indicated, provide pumps with manufacturer's standard materials and components in sizes, capacities and ratings indicated, complying with manufacturer's published product information and designed and constructed by manufacturer for applications indicated.

2.2 FLEXIBLY-COUPLED END SUCTION PUMPS:
A. Pumps shall be flexibly-coupled, base mounted, single stage, end suction design with a frame mounted volute to allow servicing of the impeller and bearing assembly without disturbing piping connections. Pump volute shall be Class 30 cast iron with integrally cast pedestal support feet. The impeller shall be cast bronze enclosed type, dynamically balanced, keyed to the shaft and secured by a locking capscrew. The liquid cavity shall be sealed off at the pump shaft by an internally-flushed mechanical seal with ceramic seal seat and carbon seal ring, suitable for continuous operation at 225 degrees F. A replaceable bronze shaft sleeve shall completely cover the wetted area under the seal. Pump shall be rated for minimum of 175 psig working pressure. Volute shall have gauge tappings at the suction and discharge nozzles and vent and drain tappings at the top and bottom. Baseplate shall be of structural steel or fabricated steel channel with fully enclosed sides and ends, and securely welded cross members. Grouting area shall be fully opened. A flexible type, center dropout design coupler, capable of absorbing torsional vibration, shall be employed between the pump and motor. Coupler shall be shielded by a coupler guard securely fastened to the base. Pump and motor shall be factory aligned, and shall be realigned by contractor after installation. The pump shall be thoroughly cleaned and painted with at least one coat of high grade machinery enamel prior to shipment.
B. Motors shall meet NEMA specifications and shall be of the size, voltage and enclosure called for

on the plans. Motors connected to variable frequency drives with 460v/3ph power shall be rated for 1600 peak volts.

2.3 CLOSE-COUPLED END SUCTION PUMPS:

A. Pumps shall be close-coupled, base mounted, single stage, end suction design with a frame supported volute to allow servicing of the impeller and pump motor without disturbing piping connections. Pump and motor shall be mounted on a channel or structural steel base, adequately reinforced against deflection. Motor shall be mounted in such a way to allow back pull-out of the motor assembly. Pump volute shall be Class 30 cast iron. The impeller shall be cast bronze enclosed type, dynamically balanced, keyed to the shaft and secured by a locking capscrew. The liquid cavity shall be sealed off at the pump shaft by an internally-flushed mechanical seal with ceramic seal seat and carbon seal ring, suitable for continuous operation at 225 degrees F. A replaceable bronze shaft sleeve shall completely cover the wetted area under the seal. Pump shall be rated for minimum of 175 psig working pressure. Volute shall have gauge tappings at the suction and discharge nozzles and vent and drain tappings at the top and bottom. Baseplate shall be of structural steel or fabricated steel channel with fully enclosed sides and ends, and securely welded cross members. Grouting area shall be fully opened. The pump frame shall extend the entire length of the pumping unit. The pump shall be thoroughly cleaned and painted with at least one coat of high grade machinery enamel prior to shipment.

B. Motors shall meet NEMA specifications and shall be of the size, voltage and enclosure called for on the plans. Motors connected to variable frequency drives with 460v/3ph power shall be rated for 1600 peak volts

2.4 IN-LINE PUMPS:

A. Pumps shall be in-line type, close-coupled, single-stage design, for installation in vertical or horizontal position, and capable of being serviced without disturbing piping connections. Pump casing shall be of Class 30 cast iron. The impeller shall be of cast bronze, enclosed type, dynamically balanced, keyed to the shaft and secured by a locking capscrew. The liquid cavity shall be sealed off at the motor shaft by an internally-flushed mechanical seal with ceramic seal seat and carbon seal ring, suitable for continuous operation at 225 deg. F. A bronze shaft sleeve shall completely cover the wetted area under the seal. Pumps shall be rated for minimum of 175 psi working pressure. The pump case shall have gauge tappings at the suction and discharge nozzles and shall include vent and drain ports. Motor shall meet NEMA specifications and shall be the size, voltage and enclosure called for on the plans. It shall heavy-duty grease lubricated ball bearings, completely adequate for the maximum load for which the pump is designed. Each pump shall be factory tested. It shall then be thoroughly cleaned and painted with at least one coat of high-grade machinery enamel prior to shipment.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Installer must examine areas and conditions under which pumps are to be installed and notify the Contractor in writing of those conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.2 INSTALLATION OF PUMPS:

A. Install pumps where shown, in accordance with manufacturer's written instructions, and with recognized industry practices, to ensure that pumps comply with requirements and serve intended purposes. Comply with NEMA standards and requirements of NEC.

3.3 ELECTRICAL CONNECTIONS:

A. Ensure that pump units are wired properly, with rotation in direction indicated and intended for proper pump performance. Provide positive electrical pump and motor grounding.

3.4 FIELD QUALITY CONTROL:

A. Upon completion of installation of pumps and after motors have been energized with normal power source, bleed air from pump casings and test pumps to demonstrate compliance with requirements. Where possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

END OF SECTION 23 13 10

SECTION 23 14 10 - WATER TREATMENT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

A. Provide water treatment systems for the following piping systems:
   1. Chilled Water System
   2. Hot Water System

B. The work shall include the furnishing of all labor, material, equipment, and services required for the proper installation of the water treatment systems. The entire chilled water system and hot water system shall be completely flushed and cleaned. All systems shall be refilled with water and proper levels of chemical treatment.

1.3 QUALITY ASSURANCE:

A. The water treatment systems as herein specified shall be furnished and installed in their entirety by a single water treatment company. The water treatment company shall be a recognized specialist in the field of water treatment for at least 10 years and have regional water analysis laboratories and technical representatives located within a 75 mile radius of the job site.

B. *Chem-Aqua* is the Basis of Design manufacturer. Equivalent name brand equipment manufactured by *Anderson, Culligan* and *Mogul* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.

1.4 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties for all items as applicable.

B. Provide ½ inch scale shop drawings showing the layout of water treatment equipment and piping in the mechanical room. Also provide a piping schematic for the complete system.

PART 2 - PRODUCTS

2.1 GENERAL:

A. The water treatment system for the [chilled water system] [hot water system] [heat pump water system] shall consist of a by-pass type pot feeder.

2.2 POT FEEDER:

A. Provide a pot feeder with 3-1/2 inch fill opening and two pipe taps. The feeder shall have a minimum capacity of 5 gallons and shall be designed to meet the pressure requirements of the system.

2.3 WATER TREATMENT CHEMICALS:

A. Furnish one year's supply of the recommended formulas for scale and corrosion protection of the closed loop water systems.

2.4 TEST EQUIPMENT:

A. Furnish basic water test equipment, including carrying case and spare reagents for maintaining control of program standards in the condenser water system and closed loop systems. Test kits will include the following:

1. Reagents and apparatus for determination of corrosion inhibitor level.
2. Reagents and apparatus for determination of pH, P & M alkalinity and chlorides.

PART 3 - EXECUTION

3.1 SYSTEM CLEANOUT:

A. All mechanical water lines and related equipment shall be thoroughly flushed out with precleaning chemicals designed to remove deposition such as pipe dope, oils, loose rust and mill scale and other extraneous materials. Add recommended dosages of precleaner chemical products and circulate throughout the water systems. Drain, fill and flush water systems until no foreign matter is observed and total alkalinity of the rinse water is equal to that of the make-up water.

3.2 INSTALLATION:

A. Pot Feeder: Feeder shall be wall mounted in a conveniently accessible location adjacent to the system served. Feeder shall be piped between the suction and discharge piping in the vicinity of the system pumps. Bypass piping shall be 3/4 inch diameter standard weight steel with cast iron screwed fittings. Provide a shut-off valve in the supply and return lines to the feeder, the funnel fill line, and the drain line. Also provide unions in the supply and return lines.

3.3 SERVICE PROGRAM:

A. The water treatment company shall provide all consulting services for a period of one year from start-up of the cooling system which will include:
   1. Installation and system start-up procedure recommendations
   2. System cleanout procedure supervision,
   3. Initial water analysis and recommendations
   4. Training of operating personnel on proper feeding and control techniques.
   5. A monthly field service and consultation meeting with the owner's representative present.
   6. Any necessary log sheets and record forms
   7. Any required laboratory and technical assistance

B. All services will be provided by a qualified, full-time representative of the water treatment company.

END OF SECTION 23 14 10

SECTION 23 21 10 - DUCTWORK AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. Industry Standards:

1. Comply with SMACNA *(Sheet Metal and Air Conditioning Contractor's National Association)* recommendations for fabrication, construction and details and installation procedures, except as otherwise indicated.
2. Comply with ASHRAE *(American Society of Heating, Refrigerating and Air Conditioning Engineers)* recommendations, except as otherwise indicated.
3. Provide composite ductwork insulation (insulation, coverings, sealers, mastics and adhesives) with flame-spread rating of 25 or less and a smoke-developed rating of 50 or less, as tested by ASTM E84 (NFPA 255) method.
4. Provide duct connectors which comply with applicable portion of UL 181 and bear label of *Underwriter's Laboratories*.

1.3 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties as applicable for all items.

PART 2 - PRODUCTS

2.1 ABOVE GROUND DUCTWORK:

A. General: Galvanized steel ductwork shall be used for all supply, return, exhaust, and ventilation ducts except as indicated otherwise by the contract documents. Black steel ductwork shall be used for kitchen hood exhaust. Stainless steel duct shall be used for dishwasher exhaust. Preinsulated flexible duct shall be used to make final concealed connections to diffusers, registers, and grilles. Length of flexible duct shall not exceed five feet.

B. Galvanized Steel Ductwork: Ducts shall be fabricated from G90 galvanized sheet steel complying with ASTM A653, lock-forming quality. Concealed round ducts from Air Handling Units to Terminal Units shall be the spiral seam type with matching fittings. Concealed round ducts downstream of Terminal Units shall be the spiral seam type or snap-lock type with matching fittings. Exposed round supply ducts shall be the double wall spiral seam type with solid inner wall, 1" thick internal insulation, matching fittings and paint grip finish.

C. Black Steel Ductwork: Kitchen hood exhaust ducts shall be fabricated from 16 gauge black steel.

D. Stainless Steel Ductwork: Exposed ducts shall be fabricated from Type 316 stainless steel, sheet form, with No. 4 finish.

E. Flexible Ducts: Flexible ducts shall be U.L. Listed as Class 1 Flexible Air Duct Material and shall comply with NFPA Standards 90A and 90B. Duct shall be a factory fabricated assembly composed of a polymeric liner duct bonded permanently to a coated spring steel wire helix and supporting a fiberglass insulating blanket with a minimum R-value of 6.0. Low permeability outer vapor barrier of fiberglass reinforced film laminate shall complete the assembly. Duct shall be suitable for low and medium pressure systems and shall carry a full 5-year warranty. For all flexible duct connections to diffusers, registers and grilles, provide rigid elbow brace accessory with one duct diameter centerline radius. Flexible duct shall be by *Atco*, *Flexmaster*, *Genflex* or *Thermaflex*.

F. Fabric Ducts: Duct material shall be polyester, UL classified as an air distribution device in accordance with the flammability requirements of NFPA 90A. Provide discharge nozzles in the fabric that throw air perpendicular to the length of the duct. Fabric shall be heat set and permeability stabilized, and shall not shrink more than 0.5% when washed per the manufacturer's instructions. Fabric duct must be suitable for continuous operation at a temperature range of -40°F to +140°F. Provide duct in sections connected by zippers, with lengths optimized to fit in commercial washing machines. Zippers must provide complete closure around the circumference with minimum 1" overlap. Provide matching mounting hardware system including extruded aluminum rails, integral flexible cords, snap-on suspension pieces, and adjustable threaded rods. Provide matching full length cylindrical tensioning accessory to keep ductwork taut and fully round at all times and to prevent sudden inflation damage. Provide stainless steel duct inlet clamp. Fabric duct color shall be selected by the architect from the manufacturer's standard colors. Fabric ducts shall be by *DuctSox*, *Prihoda, KE Fibertec* or *FabricAir*.

2.2 DUCTWORK ACCESSORIES:

A. General: Except as otherwise indicated for each ductwork accessory, provide metal type, gauge, weight, construction and reinforcing as required by size limitations, and applicable SMACNA standards, including fittings, supports and appurtenances.

B. Flexible Connectors: Provide flexible connectors between supply and return duct connections to equipment and as otherwise indicated on the drawings. Flexible connector shall be constructed of neoprene permanently attached to 3" wide metal bands. Connector shall be UL listed and shall be by *Durodyne*, *Ventfabrics, Cain* or *Ductmate*.

C. Manual Balancing Dampers: Provide single blade dampers for round ducts and rectangular ducts less than 12" as indicated on the drawings. Dampers shall be constructed of galvanized steel. Damper shall be installed complete with locking quadrants. For rectangular ducts 12" and wider, provide opposed-blade type dampers constructed of galvanized steel mounted in a galvanized steel channel frame. Blade spacing shall not exceed 6" and the top and bottom edges of the blades shall be crimped to stiffen the blades. Damper blades shall be interconnected by rods and linkages to provide simultaneous operation of all blades. Damper shall be provided with an extended rod to permit installation of a damper regulator. Dampers shall be by *Air Balance*, *Arrow*, *Dowco*, *Jer-Air*, *Nailor, National Controlled Air*, *Ruskin*, *Phillips-Aire*, *Safe-Air* or *United*.

D. Automatic Balancing Dampers: Automatic balancing dampers shall be suitable for supply and exhaust applications and shall respond automatically to changes in duct pressure without the need for a power supply. Dampers shall be tested, rated and labeled in accordance with the latest edition of UL Standard 2043 for heat and visible smoke release and UL Standard 555 for fire. Each damper assembly shall be UL rated and approved. Dampers shall incorporate a hand-operated manual set point adjustment feature that allows for field adjustment without the use of tools. All set points shall operate within +/- 10% of airflow set point. Individual set points shall be laboratory calibrated and tested in accordance with AMCA 500-D-12. Damper frame and blades shall consist of reinforced UL 94 thermoplastic resins, infused with anti-microbial agent. Bearings shall be hydraulic blsde dampener. Outer damper seal shall be removeable rubber gasket around damper circumference. Damper spring shall be stainless steel leaf type. Dampers shall be rated for pressures from 0.2" to 2.0" wg, airflow from 25 cfm – 275 cfm, and temperatures from 25 F – 150 F. Provide the following accessories where noted on the plans: flanged wall sleeve, wall grille, UL 555 rated 1 ½ or 3 hour static fire damper, adaptor ring. Dampers shall be by *Greenheck, Ruskin* or *Automatic Airflow Balancing.*

E. VAV Dampers: VAV dampers shall consist of a minimum 22 gauge galvanized steel damper blade mounted in a minimum 18 gauge galvanized steel housing with crimped ends and a 24 VAC reversible motor. Provide a 120V/24V control transformer. A matching remote adjustable space temperature sensor and integral entering air temperature sensor shall control the

damper position to maintain room setpoint. Provide all accessories for complete, stand-alone operation. Dampers shall be by *Carrier*, *Trane, Johnson* or *Young Regulator*.

F. Round Take-Offs: Round take-offs shall be made using collars constructed of galvanized steel equipped gasket flange and manual balancing damper with 2" handle standoff. Do not furnish extractors or air scoops. Takeoffs from medium pressure ducts to air terminal units shall have a conical entry. Take-offs from low pressure rectangular trunk ducts shall have 45° entry. Takeoffs shall be by *Celcon*, *Crown*, *Flexmaster*, *Jer-Air*, *Metalcraft*, *Sheet Metal Connectors*, *Thermaflex* or *United*.

G. Rectangular Take-Offs: Rectangular take-offs shall be made using collars constructed of galvanized steel equipped with gasket flange and manual balancing damper with 2" handle standoff. Do not furnish extractors or air scoops. All takeoffs shall have 45° entry. Takeoffs shall be by *Celcon*, *Crown*, *Flexmaster*, *Jer-Air*, *Metalcraft*, *Sheet Metal Connectors*, *Thermaflex* or *United*.

H. Fire Dampers (Walls and Floors): Provide curtain type, hinged blade, vertical and/or horizontal mounting fire dampers, suitable for duct penetration or opening protection as required on the drawings. Style 'A' dampers shall be used at wall register/grille locations. Style 'B' dampers shall be used at duct penetrations. Dampers shall meet the requirements of NFPA 90A and UL-555. Frame shall be minimum 20 gauge galvanized steel with 165°F fusible link. Blades shall be minimum 24 gauge galvanized steel. Dampers shall be by *Air Balance*, *Greenheck*, *Nailor*, *National Controlled Air*, *Phillips-Aire*, *Prefco*, *Ruskin*, *Safe-Air* or *United*.

I. Ceiling Radiation Dampers: Provide butterfly type, hinged blade, radiation fire dampers suitable for ceiling opening protection as required on the drawings. Dampers shall meet the requirements of NFPA 90A and UL-555C. Frame shall be minimum 20 gauge galvanized steel with 165°F fusible link. Blades shall be minimum 22 gauge galvanized steel with UL Classified insulation as required by the damper diameter for round dampers and area for rectangular dampers. Lay-in diffusers installations shall also be equipped with UL Classified insulating blanket. Provide with extended frame for flexible duct connection. Dampers shall be by *Air Balance*, *Greenheck*, *Nailor*, *National Controlled Air*, *Phillips-Aire*, *Prefco*, *Ruskin*, *Safe-Air* or *United*.

J. Smoke Dampers: Provide UL Classified Low Leakage smoke dampers suitable for duct penetration or opening protection as required on the drawings. Dampers shall meet the requirement of NFPA 90A and UL-555S. Frame shall be minimum 16 gauge galvanized steel. Blades shall be minimum 14 gauge galvanized steel airfoil design with silicon rubber edge seals, Leakage Class 1. The assembly shall include a 120 VAC 2-position actuator, power-to-open, spring-to-close. Interlock with the building fire alarm system to close on an alarm condition. Smoke detectors will be furnished and installed by Division [26] [27]. Dampers shall be by *Air Balance*, *Greenheck*, *Nailor*, *National Controlled Air*, *Phillips-Aire*, *Prefco*, *Ruskin*, *Safe-Air* or *United*.

K. Combination Fire/Smoke Dampers: Provide UL Classified Low Leakage fire/smoke dampers suitable for duct penetration or opening protection as required on the drawings. Dampers shall meet the requirement of NFPA 90A, UL-555 and UL-555S. Frame shall be minimum 16 gauge galvanized steel. Blades shall be minimum 14 gauge galvanized steel airfoil design with silicon rubber edge seals, Leakage Class 1. The assembly shall include a 120 VAC 2-position actuator, power-to-open, spring-to-close. Interlock with the building fire alarm system to close on an alarm condition. Smoke detectors will be furnished and installed by Division [26] [27]. Damper shall also have a controlled closure device actuated at 165°F. Dampers shall be by *Air Balance*, *Greenheck*, *Nailor*, *National Controlled Air*, *Phillips-Aire*, *Prefco*, *Ruskin*, *Safe-Air* or *United*.

L. Duct Access Doors: Duct access doors shall be provided at all fire dampers, smoke dampers, combination fire/smoke dampers, and at control items mounted within ducts. Access doors shall be the double-wall insulated type constructed of galvanized steel not less than 24 gauge for the door and 22 gauge for the frame. Insulation shall be 1 inch thick and shall be rigid and

self-sealing. Doors shall have cam locks on at least two sides. Frame shall have knockover edges for attachment to duct by preening and a vinyl gasket shall be provided between duct and frame. Doors shall match the pressure rating of the ductwork system and be as large as possible and as close as possible to the item served. Door shall be by *Air Balance*, *Greenheck*, *Nailor*, *National Controlled Air*, *Phillips-Aire*, *Prefco*, *Ruskin*, *Safe-Air* or *United*.

M. Dryer Box: Residential clothes dryer exhaust shall discharge into a UL Classified dryer box recessed in the wall behind the dryer. Box shall be 22 gauge aluminized steel with depth suitable for wall thickness. Box shall have extension rim, mounting holes, tapered sides, paintable surface and 4" exhaust duct opening. Dryer box shall be by *In-O-Vate Technologies* or equal approved by the Engineer.

N. Flexible Duct Elbow Support: Support shall be a radius forming composite polymer brace designed to form flexible duct into a 90° elbow. Support shall be UL approved for use in a return air plenum and sized to accommodate 4" to 16" flexible ductwork. Support shall be by *FlexRight*, *Thermaflex*, *Titus*, *Malco*, or *ThermoFlo*.

2.3 DUCTWORK INSULATION:

A. General: Refer to the mechanical plans for duct insulation types and locations. Insulation shall be by *Certainteed*, *Knauf*, *Manville* or *Owens Corning*.

B. Duct Wrap: Type "A" Duct wrap shall be 2" thick, 0.75 pcf density, blanket type fiberglass insulation with vapor barrier and minimum R-Value of 6.7.

C. Duct Wrap: Type "B" Duct wrap shall be 2" thick, 1.5 pcf density, blanket type fiberglass insulation with vapor barrier and minimum R-Value of 8.0.

D. Duct Liner: Type "A" Duct liner shall be 1" thick, 1.5 pcf density, flexible black fiberglass with minimum R-Value of 3.6.

E. Duct Liner: Type "B" Duct liner shall be 2" thick, 1.5 pcf density, flexible black fiberglass with minimum R-Value of 8.0.

F. Duct Liner: Internal insulation for exposed single wall spiral seam ductwork shall be 1" thick elastomeric foam insulation with minimum R-Value of 4.2 for single wall spiral seam ducts (AP/Spiralflex or equal).

G. Duct Board: Exterior board type insulation shall be 2" thick, 3 pcf density with minimum R-Value of 8.0. Insulating board shall be faced with foil reinforced *Kraft* (FRK) vapor barrier.

H. Fire Rated Duct Wrap: All kitchen hood exhaust ductwork shall be insulated with two layers of flexible fire-rated duct wrap suitable for zero clearance to combustibles.

I. Ductwork Insulation Accessories: Provide mechanical fasteners as recommended by the insulation manufacturer.

J. Ductwork Insulation Compounds: Provide cement, adhesives, wire wrap, coatings, sealers, protective finishes, and similar compounds as recommended by the insulation manufacturer for the applications indicated.

2.4 MISCELLANEOUS MATERIALS:

A. General: Provide miscellaneous materials and products of the types and sizes indicated and where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Duct Sealant: Duct Sealant for above ground ductwork shall be a mastic suitable for the pressure classification in accordance with SMACNA *HVAC Duct Construction Standard*". All joints and seams shall be sealed.

C. Ductwork Support Materials: Provide hot-dipped galvanized steel rods, fasteners, anchors, straps, angles and trim for support of ductwork. Wires shall not be acceptable. Ductwork installed above a roof shall be supported on pre-fabricated, non-penetrating supports by *Pipe Pier* or approved equal. Provide matching adjustable elevation kits.

D. Weatherproof Duct Sealing: Ductwork exposed outside shall be completely covered by pre-fabricated self-adhering, sheet-type protective membrane suitable for metal ductwork and

thermal insulation. The outer layer shall be an embossed UV-resistant aluminum weathering surface. All longitudinal and circumferential joints shall be lapped and securely sealed. Alternatively, insulate exterior ductwork with "Techna-Duc" pre-manufactured, interlocking, insulated panel system by *PTM Manufacturing* or equal.

2.5 DUCT FABRICATION:

A. Shop fabricate ductwork in 4', 8', 10' or 12' lengths, unless otherwise indicated or required to complete runs. Pre-assemble in the shop to the greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to the extent necessary for shipping and handling. Match-mark sections for re-assembly and coordinated installation.
B. Fabricate ductwork with joints, seams and reinforcements as required in the latest edition of SMACNA *HVAC Duct Construction Standards*, 2" static pressure rating.
C. Fabricate duct fittings to match adjoining ducts and to comply with duct requirements as applicable to fittings. Elbows shall be either the curved radius type or the square type with 4" single-wall turning vanes. Double-wall turning vanes are not allowed. Provide stacked single-wall turning vanes for larger ducts. Curved radius elbows shall have a centerline radius equal to 1.5 times the duct width. Curved radius elbows with square throats shall not be acceptable.
D. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Where ducts are specified to lined, make allowances for the thickness of the liner. Duct sizes shown on the drawings are clear, inside dimensions.
E. Kitchen hood exhaust ductwork, dishwasher exhaust ductwork and fume hood exhaust ductwork joints and seams shall have liquid-tight continuous external weld per NFPA-96.

PART 3 - EXECUTION

3.1 INSTALLATION OF DUCTWORK:

A. General: Assemble and install ductwork in accordance with the latest edition of SMACNA *HVAC Duct Construction Standards* and with recognized industry practices which will achieve air tight noiseless systems, capable of performing each indicated service. Install each run with a minimum of joints. Align ductwork accurately at connections, and with internal and external surface smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of the type which will hold ducts true-to-shape and prevent buckling. Hanger locations shall be coordinated with the building structure and finish conditions.
B. Complete fabrication of work at the project as necessary to match shop fabricated work and accommodate installation requirements.
C. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by plans, diagrams, details and notations or, if not otherwise indicated, run ductwork in the shortest route which does not obstruct usable space or block access for servicing the building and its equipment. Coordinate the layout with piping, lighting layouts and similar finished work and plumbing risers. Duct layouts shown are diagrammatic and actual location of duct shall be field verified and coordinated by the duct fabricator prior to beginning fabrication of duct systems.
D. Duct collars shall be provided where ducts pass through walls and partitions which extend full height to the underside of the roof structure. Collars shall be fabricated from 22 gauge galvanized steel sheet. Duct collars shall be provided on both sides of walls and partitions, except collar shall be omitted on that side of the wall where registers and grilles are installed. Flanges shall be installed tight against the wall. The space between the duct and the wall shall be packed with mineral wool.
E. Coordinate duct installations with installation of accessories, dampers, equipment, controls and other associated work of the ductwork system.
F. Route kitchen hood and dishwasher exhaust ductwork as directly as possible. Horizontal ductwork must slope minimum ¼" per foot to drain toward the hoods. Do not create dips and

traps which can collect residue. Branch ducts bottoms must connect flush to main duct bottoms. Provide NFPA-96 removable duct access doors every twelve feet and at changes in direction. Access doors shall be sized to permit duct cleaning. Conform to NFPA-96 for locations and installation details. At each exhaust fan, install an approved flexible duct connection.

3.2 INSTALLATION OF INSULATION:

A. Duct Wrap: Wrap shall be wrapped around duct work with all circumferential joints butted and longitudinal joints overlapped a minimum of 2". Adhere insulation to duct with 4" strips of fire resistant adhesive at 8" on centers. On circumferential joints, the 2" flange on the facing shall be taped with minimum of 3" wide foil reinforced *Kraft* tape. On longitudinal joints the overlap shall be taped with a minimum 3" wide foil reinforced Kraft tape. On ends of insulation use 3" wide foil reinforced *Kraft* tape to fasten insulation ends to duct. For duct widths 24" and greater, provide additional mechanical fasteners on 18" centers on the bottom of the duct to prevent sagging. Insulate that part of the supply diffusers above the ceiling so that there is no uncovered metal surface subject to condensation. Provide taped-on 12"x12" squares of insulation over damper regulators located above ceilings. All duct wrap shall also be wrapped with wire. All duct insulation installed on duct exterior shall have joints and seams taped and covered with mastic, including connections to equipment.

B. Duct Liner: Liner shall be applied to the flat sheet with 100% coverage of fire resistant adhesive. The duct liner shall be cut to assure snug corner closing joints. The black surface of the liner shall face the air stream. On horizontal runs, tops of ducts over 12" in width and sides over 16" in height shall be additionally secured with welded pins and speed clips or gripnails spaced on a maximum of 16" pin centers. On vertical runs, welded pins and speed clips or gripnails shall be spaced on maximum 16 inch pin centers on all widths over 12". Pins shall start within 2" of the leading edge of each section. Pins shall be cut close to the speed clip. Clips shall be drawn flush only and not so as to compress the liner. Coat all exposed edges and the leading edge of all cross joints with fire resistant sealant.

C. Duct Board: Board shall be applied using mechanical fasteners such as weld pins or stick clips on 12" centers and not less than 3" from each edge or corner of the board. Apply additional pins or clips where required to hold the insulation tightly against the duct surface. Apply round vapor seal FRK pressure-sensitive patches to each fastener. Apply 5" wide pressure-sensitive joint sealing tape to match jacket at all insulation edges and butt joints. All duct insulation installed on duct exterior shall have joints and seams taped and covered with mastic, including connections to equipment.

3.3 CLEANING AND PROTECTION:

A. Clean ductwork internally, unit-by-unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of the metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

B. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at the time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent the entrance of dust and debris.

END OF SECTION 23 21 10

SECTION 23 21 20 - DUCT AND EQUIPMENT CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 WORK REQUIRED:

A. Work required under this section consists of providing all labor, equipment, materials and supervision necessary to perform HVAC remediation, Quality Control Assurance (QCA) protocols designed herein and the techniques specifically required for the removal of agents potentially deleterious to human health, removal of visible surface contaminants and the cleaning of air-side surfaces of all air intakes, air handlers, coils, dampers, terminal units, diffusers and duct systems, as specified herein, including but not limited to, all adjunct components in strict accordance with these specifications.

B. All decontamination procedures shall be accomplished by an indoor environmental company whose personnel have specialized knowledge and expertise in the methods required for the removal and disposal of visible surface contaminants, agents potentially deleterious to human health, and bulk materials which have been contaminated by such agents.

C. Organization will have at least one (1) "Certified Air Duct Cleaning Specialist" on staff that has passed the *National Air Duct Cleaners Association* certification exam and is verifiable with their current status.

D. Provide Owner with a proactive IAQ Quality Control Assurance (QCA) program to assure remediation work is performed by a disciplined standard. The Contractor is to provide a designated person who has the training and has been given the responsibility to take necessary measures to assure compliance with OSHA's proposed 1910.1033 *Indoor Air Quality Program*.

E. *Occupational Health and Safety Administration* (OSHA) standards must be complied with. These include, but may not be limited to the Personal Protection Program (PPP), the Respiratory Protection Program (RPP) 1910.134, the Confined Space Program (CSP) 1910.146, and the Hazard Communications Program (HCP) 1910.1200. These programs must be established. The Contractor also shall provide all necessary training and equipment required by the programs for their personnel.

F. The Contractor shall assure that its employees have received safety equipment training, medical surveillance programs, individual health protection measures, and manufacturer's product and material safety data sheets (MSDS) required for the work described by this Contract Document.

G. The Contractor shall maintain a copy of all current MSDS documentation and safety certifications at the site at all times, as well as comply with all other site documentation requirements of the OSHA programs and this specification.

H. All cleaning procedures shall be accomplished by an indoor environmental company with personnel that have specialized knowledge and expertise in the methods required for the removal of such materials.

I. *Occupational Health and Safety Administration* (OSHA) general industry standard for respiratory protection 29 CFR 1910.134 requires that a respiratory protection program be established. In order to perform remediation, employee certification and an in-house Respiratory Protection Program (RPP) documentation must be submitted.

J. The Contractor shall assure that its employees have received the necessary training, medical surveillance programs, safety equipment, individual health protection measures, and manufacturer's product and material safety data sheets required for the work described by this Contract Document 3.10. The term "antimicrobial coating product" used in the following specifications refers to an antimicrobial formulation developed, tested and registered for HVAC

ductwork and air handler applications. The antimicrobial coating product shall be an EPA registered, non-toxic, water soluble solution with supporting efficacy and MSDS data. Application of the antimicrobial coating products shall be in accordance with manufacturer's minimum millage surface application rate standards for effectiveness.

K. List of personnel and their experience and projects performed.

L. Bids shall be considered only from firms which are regularly engaged in the environmental business with emphasis on HVAC decontamination and/or ductwork remediation.

1.3 PERFORMANCE OF WORK - BASELINE CONDITIONS QCA:

A. Pre and Post-remediation IAQ QCA.

B. QCA shall be limited to the areas specified herein, and the specific zone/air handling system to be remediated. No other areas shall be monitored or other tests conducted without the authorization of the Owner.

C. Personnel performing bulk (surface) QCA must be trained in IAQ. All cultures shall be quantified and qualified for microbial content in a laboratory with a minimum staff of a Ph.D. in Mycology/Microbiology Laboratory.

D. QCA of the existing HVAC parameters shall be done in each zone/air handling unit system area prior to any remediation work in that area.

E. Testing shall include: (minimum):

Test protocol	Indoor (Before) (Occupied Space)	Indoor (After) (Occupied Space)	Outdoor Sample
Temperatures Drybulb (Pre/Post Coil)	X	X	X
Temperatures Wetbulb	X	X	X
Relative Humidity (Pre/Post Coil)	X	X	X
Bulk Sample Microbial Analysis	X	X	-
NADCA Vacuum Test (Nuisance Dust Protocol)	X	X	-
Videographic Imaging and Still Photos	X	X	-
Air Flow Differential Manometer	X	X	-

F. Contractor must be capable of conducting IAQ/HVAC video imaging and still photos to be provided both before and after mechanical remediation. Both the 'before' video tape and still photos shall be available to the Owner before remediation. IAQ/HVAC imaging is to be completed utilizing VHS video capabilities before and after remediation. Optionally, a narrated and edited tape will be provided to the Owner.

G. Microbiological bulk sampling, when performed, shall follow nationally recognized chain of custody protocols for data gathering. Culture shall be performed to identify bacteria and fungi on appropriate media.

H. Cultures are to be characterized to quantify and qualify microbial content. Microbiological evaluations shall include fungal and bacterial cultures.

I. Initial air flow and differential pressure readings are to be performed by the Contractor using manometer equipment. Pressure differentials shall be measured across each coil, with filtration in place.

J. Verification of Air Conveyance Systems (ACS) decontamination will be determined by the NADCA vacuum test. The weight of the debris collected by the nuisance duct protocol shall not exceed 1.0mg/100 cm^2.
K. Provide Owner with QCA Report, including: VHS video, photographs and report of degraded areas of HVAC system, Microbial results, and air flow and pressure differential results.
L. All QCA requirements and procedures shall be completed for post-remediation quality analysis in accordance with the post remediation table provided in this document.
M. In addition, the following will be required to complete the post-remediation QCA:
N. Provide Owner with a QCA Report including: Remediation Progress Report summary, a compilation of daily progress reports of work performed, all correspondence during remediation of work performed, HVAC parameter study, bulk analysis, IAQ/HVAC video imaging, differential pressure readings, NADCA vacuum test results, wet and dry thickness (millage) analysis of antimicrobial coating applications, and documentation of any deficiencies.
O. Provide Owner with records of compliance after the completion of the remediation project. This QCA analysis is to be provided to the Owner for verification of the Contractors ability to meet performance criteria as defined by sections 6.1 to 6.3.1 of NADCA standard 1992-01 or current version.

1.4 CORRECTION OF WORK:
A. The Contractor shall re-execute any work that fails to conform to or meet requirements of the Contract, and which appears during the progress of the project, and shall remedy any defects due to faulty materials or workmanship which appear within a period of one year from the date of final acceptance of the work by the Owner. The provisions of this article apply to work completed by subcontractors as well as to work completed by employees of the Contractor.

1.5 QUALITY ASSURANCE/ QUALIFICATIONS OF BIDDER:
A. NADCA Standard 1992-01 must be followed with no modifications or deviations being allowed to provide the maximum safety for the occupants in the building.
B. The Contractor selected should have at a minimum three years membership with the *National Air Duct Cleaners Association* (NADCA) and be able to verify three cleaning projects in which the NADCA standards have been used.
C. All cleaning procedures shall be accomplished by an indoor environmental company with personnel specializing in HVAC systems. Contractor shall have knowledge and expertise in the methods required for the removal of microbiological contaminants from within an HVAC system. Qualified Contractor shall be capable of performing mechanical, electrical, plumbing and control work as necessary to accomplish this scope of work. Contractor is required to be state licensed.
D. Contractor stipulates that their work performance has been in accordance with specifications and general techniques in regard to HEPA vacuums and the application of antimicrobial products to duct systems.
E. Contractor must have a minimum of five years experience in commercial ductwork decontamination. Additionally, the Contractor must have experience with air sampling techniques as outlined in this Scope of Work on a minimum facility of 75,000 square feet. This project must have been cleaned with a 4,000 to 6,000 + CFM HEPA vacuum and an application of an antimicrobial coating product to the duct system.
F. List and give a brief description of similar work completed with locations, names, phone numbers and address of each.
G. Bids shall be considered only from firms which are regularly engaged in HVAC maintenance and in the environmental business with emphasis on air duct decontamination.

1.6 WORK SCHEDULE:
A. Unless otherwise specified, this job is specified for 1st or 2nd shift work.
B. All office equipment and furniture shall be covered and protected from any dust or debris in

each work area.

C. All systems shall be back on line and operating at full capacity, and all areas will be ready for occupancy no later than the time agreed upon with the facilities manager.
D. Schedules and progress reports shall be faxed or delivered on a daily basis.

1.7 MATERIALS, EQUIPMENT AND PERSONNEL:

A. Except as otherwise noted, the Contractor shall provide and pay for all materials, labor, tools, and equipment necessary to complete the work.
B. The Contractor shall furnish, for approval, all samples as directed. The work shall be in accordance with approved industry sampling protocols.
C. All material shall be new, and both workmanship and materials shall be of a high standard of quality, approved by the Owner's Representative.
D. All workmen and subcontractors shall be skilled in their trades.

1.8 REQUIREMENTS FOR SPECIFIC MODIFICATIONS OF CLEANING AND DECONTAMINATION OF AIR HANDLERS & ZONE DAMPERS:

A. The Contractor shall clean all types of air conveyance systems (i.e., sheet metal ducts, masonry, etc.) so that mold, mildew, lint, hair, fungi, dirt and other foreign materials and residues are properly removed.
B. The cleaning procedures shall be accomplished by the utilization of specialized equipment as required (i.e., high suction vacuums utilizing HEPA filters, high pressure washers, air compressors, duct brushes, etc.). (SEE EQUIPMENT SPECIFICATIONS)
C. Special attention shall be taken during cleaning to prevent high levels of micro-organisms from becoming airborne and then disseminated into occupied areas. All effluents shall be removed and disposed of by the Contractor. Cleaning shall be in accordance with NADCA Standard 1992-01.
D. Contractor shall, during decontamination, maintain certified respirators, safety glasses and clothing according to OSHA respiratory protection standard 29-CFR-1910.134.

1.9 ROYALTIES AND PATENTS:

A. The Contractor shall pay all royalties and patent fees for any material or processes which require the use of proprietary patented systems and/or methods. The Contractor also agrees to hold the Owner harmless of all such claims if such issues of intellectual property arise.

1.10 PROTECTION OF WORK, PROPERTY AND PERSONS:

A. The Contractor shall adequately protect the Owner's property and occupants. The Contractor shall be responsible for the cost arising out of any damage or injury due to his act or neglect.

1.11 ACCESS TO WORK:

A. The Contractor shall permit and facilitate observation of the work by the Owner and his agents and public authorities at all times.

1.12 CHANGES IN THE WORK:

A. The Owner may order changes in the work, the Contract Sum being adjusted accordingly. All such orders and adjustments shall be in writing. Claims by the Contractor for extra cost must be supported by accurate cost breakdowns, and must be approved by the Owner before executing the IAQ work involved.
B. Any changes to the original work order contract will be executed as agreed upon utilizing labor and material rates. These IAQ remediation personnel rates will apply to any changes to the scope of the work order.
C. Provide all receipts to the Owner and Architects for change orders, as requested.

1.13 PLAN ERRORS, OMISSIONS, AND SPECIFICATION MODIFICATIONS:

A. Claims of Plan and/or Specification errors by the Contractor for extra cost must be supported by subject documents in error, field inspection and accurate breakdowns, and approved by the Owner before Contractor will continue with the contract work. Consequently, the Owner may order changes in the work, the Contract Sum being adjusted accordingly. All such orders and adjustments shall be in writing. All procedures from this point shall be handled as normal change orders.

1.14 CONTRACTOR RESPONSIBILITIES:

A. CONTRACTOR IS NOT RESPONSIBLE FOR PROBLEMS RESULTING FROM PRIOR INAPPROPRIATE OR CARELESS CLEANING TECHNIQUES OF OTHERS.
B. Insure that any air conveyance systems' interior acoustical lining materials receive careful attention to prevent damage to airside surfaces. Any acoustical or insulating liner, interior or exterior that is cut, tooled or damaged during any procedures shall be repaired in accordance with industry specifications
C. Reports will be made of all motor damage, deteriorating ductwork and insulation to the Owner for inspection and decision as to remedies needed. Most repairs shall be made upon discovery to maintain progress.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 DUCTS - ACCESS OPENINGS OPTIONS:

A. The Contractor shall provide and install access openings in the ducts and air handlers as required for proper cleaning at various points of the duct system for physical and mechanical entry. The openings shall be provided at various points and adjacent to the in-line components (i.e. turning vanes, dampers, etc.) that tend to entrap contaminants.
B. When already installed in the HVAC system, the Contractor shall utilize the existing access openings for remediation where possible.
C. Access openings shall be resealed with matching gauge galvanized plates with outside frame sealed and screwed to the ductwork. Patches will have an application of mastic by an approved UL listed product and shall be used in accordance with SMACNA standards.
D. Sheet Metal Door Option:
    1. The door shall be eighteen (18) gauge metal with ½-inch insulation on the inside. Door edges shall be twice turned in ½-inch over the insulation. They will have a hand-type latch designed to tightly secure them and prevent air leakage yet permit re-access at future times. Doors shall be marked for easy identification.
E. Rigid Fiberglass Ductboard Panel Option:
    1. Rigid fiberglass ductboard duct systems shall be resealed in accordance with NAIMA specification. Only closure techniques which comply with UL181 or UL181a are suitable for fibrous glass duct system closures. Openings will be created using either a ship lap tool or the 45° angle protocol.
    2. The Contractor shall insure that all motorized and manually operated dampers and splitter-damper positions are marked to identify the original position before commencing work to assure they are returned to the original setting after completion of the cleaning process.
    3. All dampers needing repair or replacement shall be brought to the attention of the Owner.

3.2 MATERIALS, CHEMICALS AND EQUIPMENT:

A. The Contractor shall use materials, chemicals and equipment which are specified herein and preapproved by the Owner or his representative. All sanitizers and disinfecting agents or products with an antimicrobial effect must be EPA registered for the specific application and usage.

3.3 ANTI-MICROBIAL TREATMENT, SANITIZERS & COATINGS:

A. Contractors must have verification of similar projects for applying a short term residual antimicrobial solution intended for use in HVAC systems when directed and specified by consulting building hygienists (Oxine is a registered product for this purpose).
B. Surfaces shall have been cleaned using source removal processes prior to use of any chemical sanitizer and/or coating application. Coating will be a long term residual EPA registered product designed for HVAC systems.
C. Sanitizers, when used, shall be applied per manufacturer's instructions, and will be used prior to coating application. System shall be thoroughly dried out after application of sanitizers.
D. HVAC anti-microbial coating shall be applied according to manufacturers instructions. Coating shall be sprayed directly onto interior ductwork surface, rather than "fogged" downstream onto surfaces. A continuous film must be achieved by the coating application. Application thickness shall meet the manufacturer's recommendations.
E. Spray fumes shall be controlled by negative air equipment and proper filtration during application, exhausting volatiles to the outside. Negative pressure should be maintained for at least a two-hour period after coating application to remove volatiles from the system. Maximum outside air must be brought in through the system for at least 48 hours after application of coating. Note: The porosity of the surface will determine the square feet per gallon coverage, which will be at a spread of 200 square feet per gallon to 400 square feet per gallon.

3.4 WORKMANSHIP:

A. The Contractor shall use materials, chemicals and equipment which are in their original containers. No open or used containers will be allowed.
B. The cleaning process and deposit removal shall be accomplished by personnel skilled and trained in the specific discipline. The access, preparation and dismantling of equipment for such work shall be performed by qualified HVAC personnel.
C. The Contractor shall exercise special care to prevent any damage to the equipment, electrical motors of systems, ceiling tiles and to the building from water and/or chemicals resulting from the cleaning process. All interior equipment, furniture, files and material shall be adequately covered and protected as necessary to prevent damage. Any damaged fixtures, equipment or systems shall be repaired, if possible, or replaced with equal equipment at no cost to the Owner.

3.5 RESPIRATOR PROTECTION PROGRAM (RPP):

A. *Occupational Health and Safety Administration* (OSHA) general industry standard for respiratory protection 219 CFR 1910.134 requires that a respirator protection program be established. In order to perform remediation work, an OSHA Respiratory Protection Program (RPP) Certificate of Completion by each remediation employee and an in-house RPP must be submitted.

3.6 CONTRACTORS RESPONSIBILITIES:

A. The Contractor Shall:
    1. Be responsible for unclogging HVAC components of the herein contracted air conveyance system including; coils, supply registers, dampers, turning vanes, etc., fouled by dust and other contaminants.
    2. Report all damaged or deteriorating ductwork and/or air handler insulation to the Owner for his inspection and decision as to remediation.
    3. Authorized unsupervised nights. A "Progress Report" is to be faxed or delivered to the Owner within 12 hours of work completion.

3.7 IAQ/HVAC REMEDIATION EQUIPMENT:

A. Minimum equipment requirements are as follows:
   1. Indoor portable, HEPA filtered negative vacuum system at 4,000 to 6,000 CFM. HEPA filtered vacuum shall be fitted with minihelic gauges reading in "inches of water gauge" to insure proper negative pressure is maintained, thus preventing escape of debris removed during the cleaning process into the inhabited area.
   2. All negative vacuums shall be HEPA filtered and shall meet with all NADCA Standard 1992-01 equipment requirements.
   3. Efficiency of HEPA vac filtration to be a minimum of 99.97% at .3 microns.
   4. Duct brushes to vary in size from 3" to 18" and designed of light nylon bristles.
   5. Portable air compressor rated at 150 to 200 PSI and 15 to 17 CFM.
   6. Pressure washer rated at 800-1500 psi.

3.8 DUCT SYSTEM REMEDIATION:
A. The Contractor shall clean all components of air conveyance system (i.e. sheet metal ducts, rigid fiberglass ductboard, flex duct, masonry, etc.). Cleaning will properly remove lint, hair, fungi, dirt and other foreign materials and residues.
B. The cleaning procedures shall be accompanied by the use of specialized equipment, i.e., high efficiency vacuum system utilizing HEPA filters, high pressure washers, duct brushes etc., as required.
C. Special attention shall be taken while cleaning to prevent high levels of microbial contaminants from becoming airborne and disseminated into occupied areas. All effluent shall be removed and disposed of by the Contractor.
D. The Contractor shall, during decontamination, maintain certified respirators, safety glasses and clothing according to the OSHA respiratory protection standard 29-CFR-1910.134.
E. The Contractor shall be responsible for unclogging and thoroughly cleaning HVAC duct system components including reheat coils, supply registers, dampers, VAV boxes, turning vanes, etc., fouled by dust and other contaminants.
F. The Contractor shall insure that all damper and splitter-dampers are marked to identify the original position before commencing work. All components will be returned to their original setting upon completion of the cleaning process.
G. Manually operated dampers shall be firmly reset in their original position after cleaning.
H. Dampers requiring repair or replacement shall be brought to the Owner's attention.

3.9 DAMPER REPAIR OR REPLACEMENT IS NOT PART OF THIS CONTRACT, BUT IS AVAILABLE AS AN OPTION:
A. Return air ducts are to be cleaned and decontaminated if ducted returns are used in the subject HVAC systems. Open plenums above ceilings and utility chases used for return air purposes shall not be cleaned unless requested and handled as an additional work order.
B. The Contractor shall wash all terminals, grills and diffusers with a non-toxic, disinfecting solution.
C. When requested or specified, Contractor must be capable, prior to reinstalling terminals, to treat with a long-term antimicrobial product.

3.10 AIRSIDE SURFACE TREATMENT (OPTIONAL):
A. If indicated in the detailed bid specifications, once modifications and cleaning have been accomplished, the Contractor shall apply an EPA registered antimicrobial application designed specifically for HVAC ducts to all airside surfaces of the air conveyance systems(s) selected above.
B. The antimicrobial product shall be sprayed directly onto the airside surface of the ductwork system. It shall not be sprayed from a distance of more than 30". Fumes resulting from the antimicrobial treatment shall be contained within the enclosed

3.11 POST REMEDIATION IAQ TESTING (SEE *CORRECTION OF WORK*):
A. Bioaerosol surface sampling to be performed by trained personnel. Cultures shall be quantified

to identify bacteria and fungi.

B. Cultures of surface testing to be characterized by a Microbiologist to quantify and qualify microbial content. Microbial evaluations will include bacterial and fungal protocols.
C. An Indoor Environmental Report is to be provided with documentation to include a report of the HVAC systems which relates to air handlers and ductwork. This shall include air flow measurements before and after remediation, and documentation of any deficiencies.
D. Final air flow and differential pressure readings are to be performed by the Contractor using manometer equipment.

3.12 WARRANTY:

A. Contractor is to issue warranty on workmanship and material for a period of one year from completion of work.

END OF SECTION 23 21 20

SECTION 23 22 10 - AIR DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. *Titus* is the Basis of Design manufacturer for grilles, registers and diffusers. Equivalent equipment by *Carnes, Krueger, Metalaire, Nailor, Price* and *Tuttle & Bailey* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.

B. *Greenheck* is the Basis of Design manufacturer for louvers. Equivalent equipment by *Airolite, Nailor, Pottorff, Ruskin* and *United Enertech* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.

C. Industry Standards: Comply with *National Fire Protection Association* Standard No. 90A, as applicable to construction and installation of required devices.

1.3 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties for all items as applicable.

B. Provide standard color selection charts for all air distribution devices. All colors shall be selected by the Architect during Submittal Review.

PART 2 - PRODUCTS

2.1 GRILLES, REGISTERS, AND DIFFUSERS:

A. Ceiling Diffusers: Square ceiling diffusers shall be the plaque face type with round neck and one-way, two-way, three-way, or four-way throw as indicated. Diffusers shall be of stamped aluminum construction. Provide T-bar lay-in frame for grid ceilings. Provide radial blade damper. Provide manufacturer’s molded backpan R-6 insulation.

B. Ceiling Diffusers: Round ceiling diffusers shall be the adjustable core type, aluminum construction, with removable core and radial blade damper. Each removable core shall have a safety chain secured to the ductwork. Provide flanged frame for surface mounting. Provide manufacturer's molded backpan R-6 insulation where located in ceilings.

C. Perforated Face Diffusers: Diffusers shall be the square type, all aluminum construction, with removable face. Diffusers shall have fully adjustable, 3-way or 4-way pattern control element and opposed blade damper. The face shall fit into a 2'x2' T-bar ceiling grid. Provide manufacturer’s molded backpan R-6 insulation.

D. Ceiling Return/Exhaust Grilles: Eggcrate grilles shall be all aluminum construction with ½” square eggcrate louvers, 1” deep. All 1'x2', 2'x2', and 2'x4' grilles in lay-in ceilings shall be the lay-in type. All other sizes shall have a flanged frame.

E. Wall Return/Exhaust Grilles: Horizontal fixed-blade grilles shall be of extruded aluminum construction with 45 degrees blades on 3/4 inch centers.

F. Heavy Duty Return/Exhaust Grilles : Heavy duty grilles shall have minimum 18 gauge steel border and 16 gauge steel blades on 1/2 inch centers at 38 degree deflection. Provide support bars on 6" centers.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: Install devices as detailed on the drawings and in accordance with manufacturer's

written instructions and in accordance with recognized industry practices.

B. Coordinate with other work, including ductwork and ductwork accessories and ceiling system as necessary to interface installation of grilles and diffusers properly with other work.

C. Ceiling mounted devices to be installed in lay-in tile ceilings shall be compatible with 2'x2' or 2'x4' T-bar grid as applicable. Refer to Architectural Reflected Ceiling Plans for exact locations of grilles, registers and diffusers. For flush mounted devices in T-bar ceilings, special care shall be taken to install devices in the center of ceiling tiles. Sagging will not be permitted. Provide rear sheet metal angle bracing.

END OF SECTION 23 22 10

SECTION 23 23 10 - FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:
A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:
A. *Greenheck* is the Basis of Design manufacturer unless noted otherwise. Equivalent name brand equipment manufactured by *Acme, Carnes, Cook, Penn, Stanley* and *Twin City* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.
B. Industry Standards:
1. Provide fans which bear *Air Movement and Control Association* (AMCA) certified performance rating seals.
2. Provide fan components which have been listed and labeled by *Underwriters' Laboratories*.
3. Comply with applicable portion of *National Electrical Manufacturer's Association* standards for motors.

1.3 SUBMITTALS:
A. Provide manufacturer's data, test reports, and product warranties on all items.

PART 2 - PRODUCTS

2.1 CEILING EXHAUST FANS:
A. Provide ceiling exhaust fans, in types and sizes indicated; locate where shown. Provide direct-driven fans with permanently lubricated, continuous duty, thermally protected, ball bearing motor. Construct fan housing of sheet steel with enamel finish, lined with sound absorbing acoustical insulation securely fastened to walls of housing. Provide a true centrifugal wheel with air outlet perpendicular to inlet and with statically and dynamically balanced wheel. Provide a white ceiling grille.
B. Equip motor with integral thermal overload protection and with terminal box mounted on housing with cord, plug and receptacle inside housing. Reuse existing wall outlet.

2.2 WALL CENTRIFUGAL EXHAUST FANS:
A. Wall mounted centrifugal fans shall be the direct drive type with heavy gauge spun aluminum housing and shall be weatherproof. Fan wheels shall be backwardly curved non-overloading centrifugal design, statically and dynamically balanced. Housing shall have rubber grommet internal wiring passage and shall be designed to discharge air in a 360 degree pattern away from the building. Fans shall have integral attachment collar or angle ring to receive wall sleeve provided in the field.
B. Provide ECM motor, disconnect switch, [matching wall grille,] and wheel guard.

2.3 ROOF CENTRIFUGAL EXHAUST FANS:
A. Provide roof mounted centrifugal fans of the size and type as scheduled on the drawings. Fans shall be constructed with watertight housing and shall be direct or belt-driven as indicated. Motor shall be in a compartment out of the air stream. Housings shall be minimum 16 gauge spun aluminum. Fan wheel shall be of aluminum, dynamically and statically balanced, non-overloading backward-curved blades mounted on steel shaft. Equip with self-aligning heavy-duty bearings designed for end thrust and lubricated for a minimum of 10 years usage at operating temperatures of -65 to 100 degrees F. Provide vibrationless lubricated ball bearing motor with integral thermal overload protection and electrical disconnect switch under

ventilator cap.

B. Provide ECM motor, aluminum bird screen and backdraft dampers. Provide matching roof curbs suitable for the roof slope. Curbs shall extend minimum 8 inches above roof surface. Fans shall be capable of resisting wind loads specified in 239110.

C. Fans noted on the plans to be 'explosion-proof" shall have explosion-proof motor enclosure, explosion-proof wiring, NEMA-7 disconnect, hinged base, stainless steel fasteners, aluminum rub ring, curb seal and polyester coating. Do not furnish backdraft damper.

2.4 INLINE CENTRIFUGAL FANS:

A. Provide an inline centrifugal fan of the size and type as scheduled on the drawings. Fan housing shall be heavy-gauge painted steel. Fans shall be direct or belt-driven as indicated with aluminum centrifugal wheels with backwardly inclined, non-overloading blades. Inlets shall be deep spun for nonturbulent entrance. Provide a 100% gasketed panel to permit access to interior, and provide an internal terminal box mounted on the exterior.

B. Provide ECM motor, disconnect switch, [insulated housing,] [backdraft damper] and hanger brackets with vibration isolators.

2.5 ROOF INTAKE/RELIEF AIR HOODS:

A. Roof mounted intake/relief air hoods shall be constructed of heavy gauge aluminum with hinged housing. Vertical seams shall be continuously welded with lock formed seams on hood ends. Hoods shall be stressed and sloped for drainage. Provide aluminum insect screen. [Provide matching [barometric relief] [motorized] damper.] Provide matching roof curbs suitable for the roof slope. Curbs shall extend minimum 8 inches above roof surface. Hoods shall be capable of resisting wind load specified in 239110.

2.6 KITCHEN HOOD EXHAUST FANS:

A. The exhaust fan shall be U.L. listed for grease duct use and shall be the upblast type of spun aluminum construction with belt-driven fan with backward-inclined or airfoil blades only, containing a built-in grease trough and having a completely isolated motor compartment and hinged frame. Provide ECM motor where available. No birdscreens or backdraft dampers will be permitted per NFPA 96. Furnish an 18 gauge galvanized curb, minimum 18 inches high, to raise fan discharge 40 inches minimum above the roof surface. Provide matching roof curbs suitable for the roof slope. Fans shall be capable of resisting wind load specified in 239110.

B. The exhaust fan shall be U.L. listed for grease duct use and shall be the upblast utility set type with belt-driven fan with backward-inclined blades, containing a built-in grease trough and having a completely isolated motor compartment and removable cover. Provide ECM motor where available. No birdscreens or backdraft dampers will be permitted per NFPA 96. Provide exhaust discharge extension to raise fan discharge 40 inches minimum above the roof surface. Furnish support rails suitable for the roof slope with sufficient height to coordinate with required exhaust duct location. Fans shall be capable of resisting wind load specified in 239110.

C. Provide a variable frequency drive to vary the speed of the fan in response to the Kitchen Hood Demand Control Ventilation System furnished with the kitchen hood. Fan motor shall be suitable for inverter duty. Provide external disconnect switch in weathertight enclosure, dual drive grooves, one set of spare belts, stainless steel fasteners, stainless steel shaft, wiring pigtail and non-stick wheel coating.

D. *CaptiveAire* is the Basis of Design manufacturer. Equivalent name brand equipment manufactured by *Accurex, Greasemaster* and *Greenheck* and shall be acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION OF FANS:

A. General: Except as otherwise shown or specified, install fans in accordance with

manufacturer's written instructions and in accordance with National Electrical Code (NEC) and recognized industry practices.

B. The mounting height of each wall mounted thermostat or temperature sensor shall comply with ADA for maximum side reach. The thermostat or sensor shall be at 48" maximum above the floor.

3.2 TESTING:

A. After installation of fans has been completed, test each unit to demonstrate proper operation at performance requirements specified, including, but not limited to, proper rotation of impeller. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

END OF SECTION 23 23 10

SECTION 23 24 10 - AIR HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:
A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:
A. *JCI/York* is the Basis of Design manufacturer. Equivalent name brand equipment by Carrier, or *Trane* that meets performance, capacity, space and other requirements of the design documents shall be accepted. New AHU's must match the dimensions of the existing AHU's.
B. Industry Standards:
1. Comply with applicable provisions of NFPA Standard 90A pertaining to construction and installation of air conditioning systems.
2. Provide electrical components which are UL listed and labeled.
3. Air handling unit performance shall be certified in accordance with AHRI Standard 430.
4. Fan performance shall be rated per AHRI 430 and AMCA 210.
5. Coil performance shall be rated per AHRI 410.
6. Filter efficiency shall be rated per ASHRAE 52.

1.3 SUBMITTALS:
A. Provide manufacturer's data, test reports, and product warranties.

PART 2 – PRODUCTS

2.1 INDOOR MODULAR AIR HANDLING UNITS:

A. General: Air handling units shall be the modular central station type complete with fan section, coil section(s), and all accessories as specified and indicated on the drawings.

B. Coils: Cooling coils shall be the chilled water type. Heating coils shall be the hot water type. The coils shall be an extended surface fin and tube type construction of copper tubes with aluminum fins. Coil casings shall be constructed of galvanized steel panels reinforced with galvanized steel angle framework. Coils shall be proof tested to 300 psig and leak tested to 200 psig air pressure underwater. All coils shall be completely enclosed in a coil section and have a drain pan. Coils shall be mounted on tracks for ease of removal. Panel disassembly for coil removal is not acceptable.

C. Fans: Fans shall be the double width, double inlet, multi-blade type of steel construction. Fans shall be forward curved (FC), backward inclined (BI), or backward inclined airfoil (AF) as required for stable operation. Provide spring isolators for the fan and motor assembly, and a flexible canvas connection between the fan scroll and the casing. Fans shall be V-belt driven with adjustable sheaves to provide not less than 20 percent fan speed adjustment. The sheave size shall be selected so that the fan speed at the approximate midpoint of the sheave adjustment will produce the specified air quantity. The fan motor and drive assembly shall be mounted on the interior of the cabinet, and the drive assembly shall be provided with a fan drive guard. Bearings shall be grease lubricated and shall be provided with fittings for lubrication. Bearings shall have L-50 200,000 hour minimum life, and shall be the self-aligning anti-friction pillow block type. Internal bearings shall have extended lubrication lines. All grease fittings shall be so located that bearings can be greased while the unit is operating. Fan motors shall have drip proof enclosure. Motors connected to variable speed drives with 460v/3ph power shall be rated for 1600 peak volts. Variable frequency drives (VFD) for

variable air volume applications shall be furnished and installed under Section 23 8310. Provide inverter duty rated motors with maintenance free, conductive microfiber shaft grounding ring to meet NEMA MG-1 requirements. Grounding rings shall be provided and installed by the motor manufacturer or contractor and shall be installed in accordance with the shaft grounding ring manufacturer's recommendations.

D. Unit Casings: All casing panels shall be constructed of 2" thick double wall insulated galvanized sheet steel panels reinforced with galvanized steel angle framework. The casings shall have a galvanized finish and shall be provided with removable access panels located for access to all parts of the equipment. The IAQ drain pan shall be one-piece construction extending under the complete coil section. Drain pans shall be sloped, double wall stainless steel with insulation. The casing must be able to withstand up to 6" positive and 4" negative static pressure. Access doors shall be full sized with metal hinges, safety handles and continuous gasketing. Insulation for air unit casings shall be 2" thick with minimum R-8.0.

E. Filters: Filters shall be mounted in the air handling unit filter section and shall be 2" thick pleated MERV 13 filters. Filters shall be listed by UL as Class 2. Initial resistance at 500 fpm velocity shall not exceed 0.30" W.G. The media support shall be a welded wire grid. The filter housing shall be provided with a dial type magnehelic gauge for measuring airflow resistance through the filter. Filter section construction shall be identical to unit casings. Filters shall conform to SCCPSS approved sizes. Contact SCCPSS Facility Department for approved list.

F. Dampers: Custom outside air/return air dampers shall be provided to modulate the volume of outside and return air. Outside air intakes shall be sized for the scheduled outside air flow rate to provide a velocity between 300-500 fpm. Dampers shall be of airfoil design and shall be either parallel or opposed blade type with metal compressible jamb seals and extruded vinyl blade edge seals on all blades. Blades shall rotate on stainless steel sleeve bearings. Leakage rate shall not exceed 5 cfm/sf at 1" wg. For VAV applications, the dampers shall be modulated by the EMCS as needed to provide a constant outside air cfm under all supply air conditions. Damper module construction shall be identical to unit casings. Where mixing boxes or filter/mixing boxes are indicated, damper shall be integral to the box module.

2.2 OUTDOOR AIR HANDLING UNITS:

A. General: Air handling units shall be the outdoor central station type complete with fan section, coil section(s), external pipe cabinet w/ access doors to house the control valves, discharge plenum w/ perforated inner wall, metal floor grate over bottom return air opening, and all other accessories specified or indicated on the drawings.

B. Coils: Cooling coils shall be the chilled water type. Heating coils shall be the hot water type. The coils shall be an extended surface fin and tube type construction of copper tubes with aluminum fins. Coils casings shall be constructed of galvanized steel panels reinforced with galvanized steel angle framework. Coils shall be proof tested to 300 psig and leak tested to 200 psig air pressure underwater. All coils shall be completely enclosed in a coil section and have drain pan. Coils shall be mounted on tracks for ease of removal. Panel disassembly for coil removal is not acceptable.

C. Fans: Fans shall be the double width, double inlet, multi-blade type of steel construction. Fans shall be forward curved (FC), backward inclined (BI), or backward inclined airfoil (AF) as required for stable operation. Provide spring isolators for the fan and motor assembly, and a flexible canvas connection between the fan scroll and the casing. Fans shall be V-belt driven with adjustable sheaves to provide not less than 20 percent fan speed adjustment. The sheave size shall be selected so that the fan speed at the approximate midpoint of the sheave adjustment will produce the specified air quantity. The fan motor and drive assembly shall be

mounted on the interior of the cabinet, and the drive assembly shall be provided with a fan drive guard. Bearings shall be grease lubricated and shall be provided with fittings for lubrication. Bearings shall have L-50, 200,000 hour minimum life, and shall be the self-aligning anti-friction pillow block type. Internal bearings shall have extended lubrication lines. All grease fittings shall be so located that bearings can be greased while the unit is operating. Fan motors shall have drip proof enclosure. Motors connected to variable frequency drives with 460v/3ph power shall be rated for 1600 peak volts. Variable frequency drives (VFD) for variable air volume applications shall be furnished and installed under Section 23 8310.

D. Unit Casings: Casing shall be designed and built specifically for outdoor installation. Weatherized indoor air handlers are not acceptable. Wall panels shall be constructed of 2" thick double**-**wall galvanized sheet steel panels welded to a galvanized steel frame. All seams shall be welded or bolted and sealed with rubber based mastic. External vertical seams shall be covered with a "U" clip welded in place. Use of sheet metal screws to fasten side walls to framework is not permitted. The floor and roof shall be double-wall galvanized construction. The roof shall be pitched for drainage and shall overlap all four sides of the casing. The roof shall be gasketed and secured with zinc plated screws. Casing insulation shall be 2" thick with minimum R-13.0. Provide matching roof curbs suitable for the roof slope. Curbs shall extend minimum 8 inches above roof surface. AHU shall be capable of resisting wind loads specified in 23 9110.

E. Roof panel section joints shall be gasketed and bolted together, with a "C" clip over panel joints. All exterior surfaces shall have weatherproof finish. The insulated floor under the fan/motor section shall be sloped to drain into the IAQ drain pan under the coil section. The steel drain pan shall be insulated. Access doors shall be double-wall construction. Provide an outside air inlet hood with sine wave moisture eliminators and a wire mesh bird screen.

F. Filters: Filters shall be mounted in the air handling unit filter section shall be 2" thick pleated MERV 13. Filters shall be listed by UL as Class 2. Initial resistance at 500 fpm velocity shall not exceed 0.30" wg. The media support shall be a welded wire grid. The filter housing shall be provided with a dial type magnehelic gauge for measuring airflow resistance through the filter. Filters shall conform to SCCPSS approved sizes. Contact SCCPSS Facility Department for approved list.

G. Dampers: Outside air/return air dampers shall be provided to modulate the volume of outside and return air. Outside air intakes shall be sized for the scheduled outside air flow rate to provide a velocity between 300-500 fpm. Dampers shall be of airfoil design and shall be either parallel or opposed blade type with metal compressible jamb seals and extruded vinyl blade seals on all blades. Blades shall rotate on stainless steel sleeve bearings. Leakage rate shall not exceed 5 cfm/sf at 1" wg. For VAV applications, the dampers shall be modulated by the EMCS as needed to provide a constant outside air cfm under all supply air conditions.

H. Electrical: The fan section, access sections, and filter/mixing box section shall be provided with overhead heavy duty lights supported from the ceiling. The light shall be wired through electrical conduit to a weatherproof junction box located near the motor electrical wiring junction box. The weatherproof box shall contain a weatherproof light switch and 115 volt convenience outlet. Units larger than 8 feet in width must have 2 lights. Unit shall have a factory sized, mounted, and wired disconnect with NEMA Type 4 enclosure. The fan motor shall be wired to the disconnect in liquid tight conduit and junction boxes. Wiring methods must comply with NEC and NFPA 70.

3.1 INSTALLATION:

A. Install air handling units where shown, in accordance with equipment manufacturer's written instructions and recognized industry practices, to insure that units comply with requirements and serve intended purposes.

B. Coordinate with other work, including structural, ductwork, piping and electrical work, as necessary to interface installation of units with other work.

3.2 TESTING:

A. Upon completion of installation of units and connection to the completed ductwork and piping systems, start-up and test equipment in accordance with the manufacturer's recommendations. Operate units to demonstrate capability and compliance with requirements. Where possible, field-correct malfunctioning units, then retest to demonstrate compliance.

END OF SECTION 23 24 10

SECTION 23 24 20 - TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. *Titus* is the Basis of Design manufacturer. Equivalent name brand equipment by *Carrier*, *EnviroTech*, *Johnson Controls, Krueger*, *Price*, or *Trane* that meets the performance, capacity, space, and other requirements of the design documents shall be accepted.

B. Industry Standards:

1. Insulation and adhesive shall meet NFPA-90A requirements for flame spread and smoke generation and UL-181 requirements for anti-erosion, corrosion and fungus properties.
2. Hot water coils, when specified, shall be factory tested for leakage at a minimum of 300 psig with the coil submerged in water.
3. Hot water coil performance data shall be based on tests run in accordance with ARI Standard 410.
4. Fan powered units shall be designed to comply with UL Standard 883 or UL Standard 1995 and shall be UL or ETL listed as a complete assembly.
5. Sound power levels shall be ARI certified in accordance with the requirements of ARI-880-89.

1.3 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties.

PART 2 - PRODUCTS

2.1 FAN-POWERED VAV TERMINAL UNITS:

A. General: Factory assembled, externally powered, horizontal fan-powered mixing box with a variable air volume primary control damper and induction fan installed in series or parallel as scheduled. Unit shall be complete with a damper assembly, flow sensor, fan, motor, externally mounted volume controller, collars for duct connection, hanger brackets and all required features. Control box shall be clearly marked with an identification label that lists such information as nominal cfm, maximum and minimum factory-set airflow limits, and coil type and coil hand, where applicable.

B. Unit Cabinet: Constructed of 20-gauge galvanized steel with round primary air inlet connection and centered rectangular discharge suitable for flanged duct connection. Provide top and bottom access panels.

C. Insulate with 1 inch thick foil faced natural fiber insulation which complies with ASTM C739 and NFPA 90A. The liner shall comply with ASTM G21 and G22 for fungi and bacterial resistance. All exposed edges shall be coated with NFPA approved sealant to prevent entrainment in the airstream.

D. Damper Assembly: The damper assembly shall be composed of multiple or single 18-gage minimum damper blades, utilizing steel damper linkages and mounted on nylon self lubricating blade bearing. Dampers shall have a closed cell foam damper seal affixed to the blade, providing a maximum of 2 percent leakage of the maximum rated capacity with an inlet pressure of 3 inches wg. Damper assembly will consist of one or more blades with a 90 degree travel, and shall provide uniform air delivery over the entire face of the unit at all flows.

E. Fan(s): Fan wheel shall be a direct driven, double inlet type with forward curved blades, constructed of painted steel. Fan housing shall be steel and mounted to the unit discharge. Fan motor shall be ECM type, multi-voltage (120, 208/240, or 277 vac) design, and shall

incorporate an integral automatic reset thermal overload protection. The motor blower assembly shall be capable of being removed from the unit without disassembly of the blower from the motor shaft, through the side or bottom of the unit. Motor shall be mounted to the inlet rings with a torsion flex mounting, on rubber bushings. Motor shall have sleeve type bearings with over-sized oil reservoirs to ensure lubrication. Capacitors shall be selected to provide maximum anti-backward rotation protection. Provide a gasketed backdraft damper at the fan discharge for parallel flow units. Provide fans with SCRs (Speed Control Regulators).

F. Electrical Requirements: Unit shall have single point power connection with voltage and phase in accordance with the electrical plans. Provide built-in disconnect switch and control voltage transformer.
G. Controls:
   1. Units shall have pressure-independent digital controls capable of maintaining required airflow set points +- 5% of the unit's capacity at any inlet pressure up to 6 inch wg. The controllers shall be capable of resetting between factory or field-set maximum and minimum (>350 fpm inlet duct velocity) set points to satisfy the room thermostat demand.
   2. Provide damper assembly with integral flow sensor. Flow sensor shall be provided regardless of control type. Flow sensor shall be a multi-point, averaging, ring or cross type. Bar or single point sensing type is not acceptable.
H. Hot Water Heating Coil: Coil shall be mounted in a galvanized steel casing and factory mounted on the base unit as shown on the equipment drawings. Number of rows and circuits shall be selected to provide performance as indicated on equipment schedules. Coils shall have:
   1. Aluminum fins bonded to the 3/8 inch minimum OD copper tubes by mechanical expansion.
   2. Right-or left-hand fittings with sweat connection sizes as indicated on equipment drawings.
I. Filters (Disposable): Galvanized filter frame and filters shall be factory furnished and installed on the induction openings. The filters shall be disposable type, MERV 7. Filters shall conform to SCCPSS approved sizes. Contact SCCPSS Facility Department for approved list.

2.2 SINGLE DUCT VAV TERMINAL UNITS:

A. General: Factory-assembled, externally powered, variable air volume control terminal. Unit shall be complete with a damper assembly, flow sensor, externally mounted volume controller, collars for duct connection, hanger brackets and all required features. Control box shall be clearly marked with an identification label that lists such information as nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil hand, where applicable.
B. Unit Cabinet: Constructed of 22-gauge galvanized steel with round or rectangular primary air inlet collar and centered rectangular discharge for flanged duct connection.
C. Insulate with 1 inch thick foil faced natural fiber insulation which complies with ASTM C739 and NFPA 90A. The liner shall comply with ASTM G21 and G22 for fungi and bacterial resistance. All exposed edges shall be coated with NFPA approved sealant to prevent entrainment in the airstream.
D. Damper Assembly: The damper shall be composed of multiple or single 18-gage minimum damper blades located in an 18-gage minimum damper frame. Dampers shall have an open cell foam damper seal affixed to the blade, providing a maximum of 2% leakage of the maximum rated capacity with dampers closed with an inlet pressure of 3 in. wg. Damper assembly will consist of one or more blades with 90 degree travel, and shall provide uniform air delivery over the entire face of the unit at all flows.
E. Controls:
   1. Units shall have pressure-independent digital controls capable of maintaining required airflow setpoints +-5% of the unit's capacity at any inlet pressure up to 6 inch wg. The controllers shall be capable of resetting between factory or field-set maximum and minimum (>350 fpm inlet duct velocity) set points to satisfy the room thermostat demand.
   2. Provide damper assembly with integral flow sensor. Flow sensor shall be provided

regardless of control type. Flow sensor shall be a multi-point, averaging, ring or cross type. Bar or single point sensing type is not acceptable.

F. Hot Water Heating Coil: Coil shall be mounted in a galvanized steel casing and factory mounted on the base unit as shown on the equipment drawings. Number of rows and circuits shall be selected to provide performance as indicated on equipment schedules. Coils shall have:
   1. Aluminum fins bonded to the 3/8 inch minimum OD copper tubes by mechanical expansion.
   2. Right-or left-hand fittings with sweat connection sizes as indicated on equipment drawings.

PART 3 - EXECUTION

3.1 INSTALLATION:
   A. General: Except as otherwise shown or specified, install units in accordance with manufacturer's written instructions and in accordance with *National Electrical Code* (NEC) and recognized industry practices.
   B. Air valve actuators furnished and installed by Section 238310.

3.2 TESTING:
   A. After installation of units has been completed, test each unit to demonstrate proper operation at performance requirements specified, including, but not limited to, proper rotation of fan. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

END OF SECTION 23 24 20

SECTION 23 24 30 - FAN COIL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:
A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:
A. *Carrier* is the Basis of design manufacturer. Equivalent name brand equipment by *Greenheck*, *Price*, *Titus, Trane* and *Johnson* that meets the performance, capacity, space and other requirements of the design documents shall be accepted.
B. Industry Standards:
1. Unit capacities shall be certified under *Industry Room Fan-Coil Air Conditioner Certification Program* in accordance with ARI Standard 440.
2. Units must be UL Listed as a Fan Coil Unit and comply with UL 883 and UL 94.
3. Units shall be sound rated in accordance with ARI Standard 350.
4. Unit shall comply with the *National Electric Code*.
C. Submittals: Submit manufacturer's data, test reports, product warranties, and available choices of cabinet finish.

PART 2 - PRODUCTS

2.1 FAN COIL UNITS:
A. General: Fan coil unit types shall be as scheduled with 4-pipe cooling and heating. Units shall consist of a cabinet, chilled and hot water coils as applicable, main drain pan, filter, fan, motor, thermal/acoustical insulation and accessories listed below.
B. Horizontal Exposed Cabinet Units:
1. Units shall be the exposed type as scheduled. Cabinets shall be minimum 18 gauge galvanized steel. Exposed front panels shall be minimum 16 gauge with tamperproof fasteners. Exposed corners shall have all rounded edges. All visible surfaces shall have a factory-applied baked powder coat finish. Cabinet insulation shall be closed cell type or foil-faced insulation in accordance with ASHRAE 62-89R and shall meet UL 94-5V.
2. Exposed units shall have a front discharge bar grille. Recessed units shall have a supply duct connection. All units shall have a bottom inlet stamped return air grille and hinged bottom access panel with filter rack and MERV 7 filters. Filters shall conform to SCCPSS approved sizes. Contact SCCPSS Facility Department for approved list.
3. Coils shall consist of evenly spaced aluminum fins mechanically bonded to copper tubes. Coils shall be designed for a maximum working pressure of 300 psig and entering air temperature range of 35 to 200 degrees F. Coils shall be factory burst tested at 450 psig and leak tested at 100 psig underwater.
4. Drain Pans shall be non-corrosive material with positive slope per ASHRAE 62-89R. Insulation shall not be inside the pan. The pan shall extend under the valve package.
5. Fans shall be centrifugal type with forward-curved, double-width, double inlet, corrosion resistant wheels, statically and dynamically balanced, direct drive. Fans shall be constructed of metal with metal housing and be located in the blow-thru position.
6. Motors shall be resiliently mounted, ECM type with sleeve type bearings and integral overload protection and shall operate satisfactorily at 90% of rated voltage on all speed settings. The speed switch shall be mounted inside the cabinet and shall provide OFF-HI-MED-LOW-AUTO positions. Provide a factory installed disconnect switch for all units.
7. Valve Package: For each unit, provide a factory installed valve package consisting of the following: flexible hoses, 3-way, 2-position, 24 VAC control valves for chilled water and hot water; manual air vent in each circuit; ball valves in supply and return connections;

automatic balancing valves with test ports in return lines; union connections for all lines; strainers with drain valves in supply lines; and insertion test ports in both supply lines. Install a manual ball valve in all bypass pipes. Factory piping and valves shall be tested to coil conditions. All valve package items must be easily accessible.

8. Controls: All control shall be accomplished by the EMCS system specified in Section 23 8310. The unit manufacturer shall provide a 120/24 VAC transformer rated for 50 VA and shall factory install and factory wire a DDC control module inside each unit in an accessible location. Modules and wiring diagrams shall be furnished by the EMCS manufacturer.

C. Vertical Sloped Top Units:
1. Units shall be factory assembled and consist of fans, motor and drive assembly, coils, damper, plenums, filters, stainless steel condensate pans and accessories. All unit chassis shall be fabricated of heavy gauge galvanized steel panels able to meet 125 hour salt spray test per ASTM B-117. All unit chassis panels shall be insulated with Elastomeric Closed Cell Foam Insulation. Insulation shall conform to UL 181 for erosion and NFPA 90A for fire, smoke and melting, and comply with a 25/50 Flame Spread and Smoke Developed Index per ASTM E-84 or UL 723. Additionally, insulation shall comply with Antimicrobial Performance Rating of 0, no observed growth, per ASTM G-21. Polyethylene or Fiberglass insulation is not acceptable.
2. All exposed units shall have exterior panels fabricated of not less than 20 gauge galvannealed steel with a 16 gauge front panel on exposed units. The front panel shall be attached with quarter turn quick open fasteners to allow for easy removal and access for service. Side panels shall be removable for access to controls and piping within the end pockets. Top panel shall be removable from fan coil without the need to disconnect piping or electrical wiring. Provide a grille in the return air opening. All exposed units shall include a recessed stamped louver discharge grille. Louver discharge grille shall be reverse stamped.
3. All units shall be furnished with a minimum 1" pleated MERV 13 filter. Filters shall be tight fitting to prevent air bypass. Filters shall be easily removable from the return air opening without the need for tools. Filters shall conform to SCCPSS approved sizes. Contact SCCPSS Facility Department for approved list.
4. Coils shall consist of evenly spaced aluminum fins mechanically bonded to copper tubes. All coils shall be tested at 325 PSIG air pressure under water, and rated for a maximum 300 PSIG working pressure at 200°F. Coils shall be circuited for counter flow to maximize unit efficiency.
5. Drain Pans shall be stainless steel with positive slope per ASHRAE 62-89R. The primary drain pan shall be externally insulated with a fire retardant, elastomeric closed cell foam insulation.
6. Fans shall be direct drive centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor drive assembly, and support structure and equipped with formed steel channel base for integral mounting of fan, motor, and casing panels. Mount fan with interior neoprene vibration isolation. The fan assembly shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower.
7. Motors shall be ECM type, resiliently mounted with sleeve type bearings and integral overload protection and shall operate satisfactorily at 90% of rated voltage on all speed settings. Provide quiet noise rating and maximum ambient temperature rating of 120 degrees F.
8. Valve Package: For each unit, provide a valve package consisting of the following: flexible hoses, 3-way, 2-position, 24 VAC control valves for chilled water and hot water; manual air vent in each circuit; ball valves in supply and return connections; automatic balancing valves with test ports in return lines; union connections for all lines; strainers with drain valves in supply lines; and insertion test ports in both supply lines. Install a manual ball valve in all bypass pipes. Factory piping and valves shall be tested to coil conditions. All valve package items must be easily accessible.

9. All control shall be accomplished by the EMCS system specified in Section 23 8310. The unit manufacturer shall provide a 120/24 VAC transformer rated for 50 VA and shall factory install and factory wire a DDC control module inside each unit in an accessible location. Modules and wiring diagrams shall be furnished by the EMCS manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install fan coil units where shown, in accordance with equipment manufacturer's written instructions and recognized industry practices, to insure that units comply with requirements and serve intended purposes.
B. Coordinate with other work, including structural, ductwork, piping and electrical work, as necessary to interface installation of units with other work.
C. For all units, furnish and install a new set of filters after all construction is 100% complete.

3.2 TESTING:

A. Upon completion of installation of units and connection to the completed ductwork and piping systems, start-up and test equipment in accordance with the manufacturer's recommendations. Operate units to demonstrate capability and compliance with requirements. Where possible, field-correct malfunctioning units, then retest to demonstrate compliance.

END OF SECTION 23 24 30

SECTION 23 31 10 - ELECTRIC HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. *QMark* is the Basis of Design manufacturer. Equivalent name brand equipment by *Berko, Chromalox, Markel, Neptronic, Reddi, Raywall* and *Warren* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.

B. Industry Standards: Each unit shall be U.L. listed.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT:

A. Wall Heaters: Wall heaters shall be the surface mounted fan-forced type. Provide accessory mounting kits as applicable. The heating section shall consist of a steel chassis with heating element, fan and motor, fan control, thermostat, and thermal cutout. Heater section shall be completely prewired. The element shall be the fin-tube type enclosed in a steel sheath. The fan motor shall be impedance protected, permanently lubricated type totally enclosed motor. Fan control shall be bi-metallic, snap-action type delay switch. Thermal cutout shall also be bi-metallic, snap-action type. The front cover shall be heavy gauge steel with a baked enamel finish. Heaters shall have built-in thermostat and disconnect switch.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install heaters in accordance with the manufacturer's instructions.

END OF SECTION 23 31 10

SECTION 23 32 30 – MAKEUP AIR UNITS AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:
A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:
A. *Greenheck* is the Basis of Design manufacturer. Equivalent name brand equipment by *Accurex, CaptiveAire, Hastings, Jackson & Church, Modine, Reznor, Sterling* and *Trane* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.
B. Industry Standards: Units shall be design-certified by CSA International (CSA).

1.3 SUBMITTALS:
A. Provide manufacturer's data, test reports, and product warranties for all items.

PART 2 – PRODUCTS

2.1 MAKEUP AIR UNITS:
A. Makeup Air Unit shall be the outdoor type with direct-fired gas heat and shall be ETL listed. Unit shall be horizontal downblast type as shown on drawings. Unit shall be of internal frame type construction with G90 galvanized steel frames and panels. Metal-to-metal surfaces exposed to weather shall be sealed. All components shall be accessible through removable or hinged doors. Unit casing shall be insulated with 1 inch fiberglass liner in accordance with NFPA 90A and tested to meet UL 181 erosion requirements. Secure insulation with waterproof adhesive and permanent mechanical fasteners.
B. Provide filter rack with pleated minimum MERV 7 filters. Do not exceed 550 PFM face velocity. Disposable HVAC filter shall conform to SCCPSS approved sizes. Contact SCCPSS Facility Department for approved list. Provide weather hood with birdscreen mounted at the intake. Provide automatic two-position damper. Provide downturn plenum with duct flanges. Provide matching roof curbs suitable for the roof slope. Curbs shall extend minimum 8 inches above roof surface. Units shall be capable of resisting wind loads specified in 239110.
C. Centrifugal fans shall be double width, double inlet. Fan and motor shall be mounted on a common base with vibration isolators. Fan wheels shall be statically and dynamically balanced. Ground and polished steel fan shafts shall be mounted in permanently lubricated ball bearings or ball bearing pillow blocks. Bearings shall be selected for minimum L10 life in excess of 100,000 hours at maximum cataloged speeds. Motors shall comply with EPAct standards for ODP and TE enclosures. Motors shall be permanently lubricated, heavy-duty type, matched to the fan load. Drives shall be sized for a minimum of 150% driven HP. 10 HP and less shall have an adjustable drive pulley. Provide built-in variable frequency drive and inverter duty fan motor for VAV operation.
D. All internal electrical components shall be prewired for single point power connection. Control center shall include a motor starter, control circuit fusing, control transformer for 120 VAC circuit, integral door interlocking disconnect switch and terminal strip. Provide adjustable overload protection and single phase protection.
E. Direct-fired natural gas system shall have a draw-through design and field adjustable burner baffles. Gas trains up to 400,000 Btu/hr shall include a direct spark ignition system. Gas trains greater than 400,000 Btu/hr shall include a pilot ignition system with digital coded fault indicator. Dual safety valves shall be industrial duty and use 120VAC control signals. Temperature control shall incorporate an electronic modulation control system. On a call for heat from a unit mounted ductstat, controls shall modulate the burner between 50% and

100%, as required. EMCS shall be capable of remotely changing heating set point of ductstat. See specification section 238310 for further information. All controls and sensors required for a complete, operable system shall be furnished and installed under section 238310.

2.2 ACCESSORIES:

A. General: Gas vents shall be U.L. listed corrosion resistant construction by *Metalbestos*, *Metalvent*, *Metalfab*, *Ampo*, or *Stacks*.

B. Indoor Gravity Vented Equipment: Gas vents shall be Type B double wall construction. Provide flashing, storm collar, vent cap, and all other required accessories for a complete installation.

C. Indoor Power Vented Equipment: Gas vents through heated areas shall be single wall construction of minimum 24 gauge galvanized steel. Vents shall be through the roof or wall as indicated on the drawings. Provide flashing, storm collar, vent cap, wall thimble, and all other required accessories for a complete installation. Gas vents routed through unheated areas shall be Type B double wall construction.

D. Outdoor Equipment: Gas vents for all outdoor equipment shall be integral to the equipment.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: Except as otherwise indicated, install units, including components required, in accordance with the International Gas Code, NFPA, and the manufacturer's instructions. Locate each unit accurately in the position indicated in relation to other work. Position unit with sufficient clearance for normal service and maintenance.

B. Control wiring and devices for complete, operable systems shall be provided and installed under the mechanical specifications. Wiring shall be installed in conduit furnished and installed under the electrical specifications.

C. Interlock unit operation with kitchen hood fan switch and kitchen hood fire safety controls.

END OF SECTION 23 32 30

SECTION 23 33 10 – CONDENSING BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:
A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:
A. *Lochinvar* is the Basis of Design manufacturer. Equivalent name brand equipment manufactured by *Precision*, *Raypak*, *RBI, Riverside Hydronics* and *Teledyne Laars* that meets the performance, capacity, space, and other requirements of the design documents shall be accepted.
B. Industry Standards:
1. Provide boilers which are listed and labeled by *Underwriters' Laboratories*.
2. Provide boilers which are built in accordance with *ASME Code Section IV* for heating boilers.
3. Boilers shall be stamped for 160 PSIG working pressure and 200 PSIG test pressure.
4. Comply with *American Gas Association* as applicable to certification of gas-fired water boilers.

1.3 SUBMITTALS:
A. Provide manufacturer's data, test reports, and product warranties.

PART 2 - PRODUCTS

2.1 CONDENSING GAS-FIRED BOILERS:
A. The boiler shall bear the ASME "H" stamp for 160 psi working pressure and shall be National Board listed. There shall be no banding material, bolts, gaskets or "O" rings in the header configuration. The 316L stainless steel combustion chamber shall be designed to drain condensation to the bottom of the heat exchanger assembly. A built-in trap shall allow condensation to drain from the heat exchanger assembly. The complete heat exchanger assembly shall carry a ten (10) year limited warranty. Provide matching condensate neutralizer accessory.
B. The boiler shall be certified and listed by C.S.A. International under the latest edition of the harmonized ANSI Z21.13 test standard for the U.S. and Canada. The boiler shall comply with the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard and the minimum efficiency requirements of the latest edition of the BTS2000 Standard. The boiler shall operate at a minimum of 93% thermal efficiency at full fire on 399,999 and 500,000 Btu/hr models and at a minimum 94% thermal efficiency at full fire on 600,000, 700,000 and 800,000 Btu/hr models. All models shall operate up to 98% thermal efficiency with return water temperatures at 100°F or below. The boiler shall be certified for indoor installation. The boiler's Thermal Efficiency shall be verified through third party testing by the Hydronics Institute Division of AHRI and listed in the AHRI Certification Directory.
C. The boiler shall be constructed with a heavy gauge steel jacket assembly, primed and pre-painted on both sides. The combustion chamber shall be sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal. A burner/flame observation port shall be provided. The burner shall be a premix design and constructed of high temperature stainless steel with a woven metal fiber outer covering to provide modulating firing rates. The boiler shall be supplied with a gas valve designed with negative pressure regulation and be equipped with a variable speed blower system, to precisely control the fuel/air mixture to provide modulating boiler firing rates for maximum efficiency. The boiler shall operate in a safe condition at a derated output with gas supply pressures as low as 4 inches of water column. The boiler shall be equipped with leveling legs.
D. The boiler shall utilize a 24 VAC control circuit and components. The control system shall have an electronic display for boiler set-up, boiler status, and boiler diagnostics. All components shall be easily accessed and serviceable from the front and top of the jacket. The boiler shall be equipped

with; a temperature/pressure gauge, high limit temperature control certified to UL353, ASME certified pressure relief valve, outlet water temperature sensor, return water temperature sensor, a UL 353 certified flue temperature sensor, outdoor air sensor, low water flow protection and built-in adjustable freeze protection.

E. The boiler shall feature the "Smart System" control with a Multi-Colored Graphic LCD display with Navigation Dial and Soft Keys for, password security, three loop temperature setpoints with individual outdoor air reset curves, pump delay with adjustable freeze protection, pump exercise,and USB PC port connection. The boiler shall be capable of controlling a variable speed boiler pump to keep a constant Delta T at all modulation rates. The boiler shall have the capability to accept a 0-10 VDC input connection for EMCS control of modulation or setpoint, enable /disable of the boiler, variable system pump signal and a 0-10VDC output of boiler modulation rate. The Boiler shall have a built-in "Cascade" with sequencing options for "lead lag" or "efficiency optimized" modulation logic, with both capable of rotation while maintaining modulation of up to eight boilers without utilization of an external controller. Supply voltage shall be 120 volt / 60 hertz / single phase.

F. The boiler shall be equipped with two terminal strips for electrical connection. A low voltage connection board with 42 data points for safety and operating controls, i.e., Auxiliary Relay, Auxiliary Proving Switch, Alarm Contacts, Runtime Contacts, Manual Reset Low Water Cutoff, Flow Switch, High and Low Gas Pressure Switches, Tank Thermostat, Three Wall Thermostat/Zone Controls, System Supply Sensor, Outdoor Sensor, Building Management System Signal, Modbus Control Contacts and Cascade Control Circuit. A high voltage terminal strip shall be provided for supply voltage. The high voltage terminal strip plus integral relays are provided for independent pump control of the System pump, the Boiler pump.

G. The boiler shall be installed and vented as follows:
   1. Vertical Vent with Sidewall Air system with a vertical rooftop termination of the vent with the combustion air being drawn horizontally from a sidewall. The flue shall be PVC, CPVC, Polypropylene or Stainless Steel sealed vent material terminating at the roof top with the manufacturers specified vent termination. A separate pipe shall supply combustion air directly to the boiler from the outside. The air inlet may be PVC, CPVC, ABS, Polypropylene or Stainless Steel sealed pipe. The air inlet must terminate on a sidewall using the manufacturers specified air inlet cap. The boiler's total combined air intake length shall not exceed 100 equivalent feet. The boiler's total combined exhaust venting length shall not exceed 100 equivalent feet.

H. The boiler shall have an independent laboratory rating for Oxides of Nitrogen (NO_x) of 20 ppm or less corrected to 3% O_2. The manufacturer shall verify proper operation of the burner, all controls and the heat exchanger by connection to water and venting for a factory fire test prior to shipping. The boiler shall be suitable for use with polypropylene glycol, up to 50% concentration without contingencies.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install boilers and accessories where shown, in accordance with the equipment manufacturer's written instructions, and with recognized industry practices. Comply with requirements of state and local codes, and applicable NFPA and ASME Boiler and Pressure Vessel Code Standards. Flush boilers upon completion of installation in accordance with manufacturer's instructions.

3.2 TESTING:

A. Startup boilers in accordance with manufacturer's procedures and demonstrate compliance with requirements. Test assembled boiler and accessories in accordance with applicable sections of *ASME Boiler and Pressure Vessel Code*.

B. Obtain installation approval from the *State Department of Labor*.

END OF SECTION 23 33 10

SECTION 23 41 10 – AIR-COOLED CHILLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:
A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:
A. *JCI/York* is the Basis of Design manufacturer. Equivalent name brand equipment by Carrier, and *Trane* that meets performance, capacity, space and other requirements of the design documents shall be accepted.
B. Industry Standards: The unit shall be designed, fitted, tested, and rated in accordance with ARI 550/590-98. The unit shall also meet all the requirements of ASHRAE 15 and ASHRAE 90.1. Unit shall be U.L. Listed.
C. Extended Warranty: In addition to the standard one-year warranty on all components, compressors shall bear an additional four-year manufacturer's warranty against material and design defects.

1.3 SUBMITTALS:
A. Provide manufacturer's data, test reports, and product warranties for all items as applicable.

PART 2 - PRODUCTS

2.1 AIR-COOLED CHILLER:
A. General: Water chiller shall be a completely factory assembled one piece packaged air cooled type factory charged with HFC refrigerant. All factory wiring and piping shall be contained within the unit. The unit shall come complete with a steel frame with a factory applied enamel finish. Steel louvered panels shall cover condenser coils. Wire mesh shall cover compressor and evaporator area. Provide neoprene isolators between the unit and support structure. The entire unit shall receive an additional spray-on corrosion protection coating.
B. Compressor and Motor: Units shall have hermetic scroll compressors or semi-hermetic screw compressors complete with capacity control, vibration isolators, oil sump heater, and differential pressure refrigerant oil flow system. Each refrigerant circuit shall include a compressor suction and discharge service valve, liquid line shutoff valve, refrigerant isolation valve, removable core filter drier, liquid line sight glass with moisture indicator, charging port and an electronic expansion valve. Motors shall be thermally protected. Provide a matching flexible sound attenuation blanket for each screw compressor.
C. Evaporator: Shell shall be carbon steel plate designed, tested and stamped in accordance with ASME Code for refrigerant side working pressure of 300 psig. All tube sheets shall be carbon steel. Tubes shall be individually replaceable and shall be seamless copper with internal fins. Copper tubes shall be mechanically expanded into the tube sheets. Waterside shall be hydrostatically tested at 1.5 times the working pressure but not less than 215 psig. The shell will have a vent, drain and fittings for temperature control sensors. Insulate evaporator shell and suction lines with a 3/4" thick layer of closed-cell foam plastic. Provide built-in heat tape with thermostat to protect the evaporator down to -20 degrees F ambient.
D. Condenser and Fans: Air-cooled condenser coils shall have epoxy coated aluminum fins mechanically bonded to internally finned seamless copper tubing. The condenser coil shall have an integral subcooling circuit and shall provide oil cooling for the compressor bearing and injection oil. Condensers shall be factory proof and leak tested at 500 psig minimum. Fans shall be low sound vertical discharge propeller type, dynamically balanced, with permanently lubricated ball bearing and internal thermal overload protection. Unit will start and operate down to 25 degrees F ambient.
E. Control Panel: Provide a factory-mounted microprocessor-based control panel in weathertight

enclosure. Automatic shutdown protection with manual reset shall be provided for low evaporator refrigerant temperature and pressure, high condenser refrigerant pressure, loss of condenser water flow, high motor temperature, low oil flow, motor current overload, phase reversal, phase loss, and severe phase imbalance. Automatic shutdown with automatic reset shall be provided for loss of chilled water flow, high compressor discharge temperature, over/under voltage and momentary power loss. The over/under voltage device shall protect the entire chiller, including control circuits. Provide chilled water reset based on return water temperature. Provide a button keypad for operator input and a "clear language" display. Provide a module to accept generic digital input for current limit setpoint and chilled water setpoint via 2-10 VDC or 4-20 mA.

F. Electrical: Provide a unit-mounted starter inside a weathertight enclosure with 3-phase solid state overload protection. Scroll compressor starters shall be across-the-line type. Screw compressor starters shall be wye-delta type. Provide factory-installed individual system circuit breakers and a factory-installed and wired control voltage transformer to supply all control power. Provide built-in disconnect switch and convenience outlet.

PART 3 – EXECUTION

3.1 EQUIPMENT AND COMPONENTS:

A. Equipment and components shall be completely installed in a manner to insure proper operation of the equipment and controls. Chiller shall be installed in accordance with manufacturer's instructions. Equipment shall be located so that manufacturer's minimum recommended service clearances are provided.

B. Unit start-up shall be performed, at no additional cost, by a factory-trained service engineer who, at completion, shall issue a signed report certifying proper operation of the unit.

END OF SECTION 23 41 10

SECTION 23 43 20 - AIR TREATMENT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 REFERENCED CODES & STANDARDS:

A. The following codes and standards are referenced throughout. The edition to be used is that currently enforced by the Authority Having Jurisdiction (AHJ) or in absence of such direction that referenced by the current enforceable IMC code or as indicated by the contract documents, except where specifically referenced by this section of the specifications.
   1. ASHRAE Standards 62 & 52
   2. National Electric Code NFPA 70
   3. UL 867 including ozone chamber test

1.3 QUALITY ASSURANCE:

A. *Global Plasma Solutions* is the Basis of Design manufacturer. Equivalent name brand systems manufactured by *BioClimatic, Phenomenal Aire* and *Plasma Air* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.
B. A qualified representative from the manufacturer shall be available to inspect the installation of the air treatment system to ensure installation in accordance with manufacturer's recommendations.
C. Technologies that do not address gas disassociation such as UV lights, powered particulate filters and/or polarized media filters shall not be considered. Uni-polar ion generators shall not be acceptable. "Plasma" particulate filters shall not be acceptable.
D. Projects designed using ASHRAE Standard 62, IAQ Procedure shall require the manufacturer to provide Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1-2007 to validate acceptable indoor air quality at the quantity of outside air scheduled with the technology submitted. The manufacturer shall provide independent test data on a previous installation performed within the last two years and in a similar application, that proves compliance to ASHRAE 62 and the accuracy of the calculations.
E. Air Treatment Systems shall have been tested by UL or Intertek/ETL to prove conformance to UL 867-2007 including the ozone chamber testing and peak ozone test for electronic devices. Manufacturers that achieved UL 867 prior to December 21, 2007 and have not been tested in accordance with the newest UL 867 standard with the ozone amendment shall not be acceptable. All manufacturers shall submit their independent UL 867 test data with ozone results to the engineer during the submittal process. All manufacturers shall submit a copy with their quotation. Contractors shall not accept any proposal without the proper ozone testing documentation.
F. The maximum allowable ozone concentration per the UL 867-2007 chamber test shall be 0.007 PPM. The maximum peak ozone concentration per the UL 867-2007 peak test as measured 2 inches away from the electronic air cleaner's output shall be no more than 0.0042 PPM. Manufacturers with ozone output exceeding these ozone values shall not be acceptable.

1.4 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties. The following information shall be included in the submittal:
   1. Schedule of air treatment systems indicating unit designation and number of each type required for each unit/application.
   2. Data sheet for each type of air treatment systems and accessories furnished indicating construction, sizes, and mounting details.
   3. Performance data for each type of air treatment system furnished.

4. Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1 to validate acceptable indoor air quality at the quantity of outside air scheduled.
5. Product drawings detailing all physical, electrical and control requirements.
6. Copy of UL 867 independent ozone test.
7. Operating & Maintenance Data: Submit O&M data and recommended spare parts lists.

1.5 WARRANTY:

A. Equipment shall be warranted by the manufacturer against defects in material and workmanship for a period of eighteen months after shipment or twelve months from Owner acceptance, whichever occurs first. Labor to replace equipment under warranty shall be provided by the Owner or installing contractor.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT:

A. General: Air Treatment Systems shall be the needle-point, bi-polar ionization type. Provide an air treatment system for every HVAC unit scheduled on the plans unless noted otherwise on the plans.

B. The Bi-Polar Ionization system shall be capable of:
   1. Effectively killing microorganisms downstream of the bi-polar ionization equipment (mold, bacteria, virus, etc.).
   2. Controlling gas phase contaminants generated from human occupants, building structure and furnishings.
   3. Reducing static space charges.
   4. Increasing the interior ion levels, both positive and negative.
   5. Self-cleaning requiring no maintenance or replacement parts (where specified).
   6. Producing the specified minimum ions/cc.
   7. When mounted to the air entering side of a cooling coil, keep the cooling coil free from pathogen and mold growth.
   8. All manufacturers shall provide documentation by an independent NELEC accredited laboratory that proves the product has minimum kill rates for the following pathogens given the allotted time and in a space condition:
      a. MRSA - >96% in 30 minutes or less
      b. E.coli - > 99% in 15 minutes or less
      c. TB - > 69% in 60 minutes or less
      d. C. diff - >86% in 30 minutes or less
      e. Noro Virus -> 93% in 30 minutes or less
      f. Legionella -> 99% in 30 minutes or less
      g. SARS-CoV-2 >99% in 30 minutes or less
      h. Human Coronavirus 229E – >90% in 60 minutes or less
      i. Staphylococcus – >96% in 30 minutes or less

C. Air Treatment Systems shall operate in a manner such that equal amounts of positive and negative ions are produced. Uni-polar ion devices shall not be acceptable. Air exchange rates may vary through the full operating range of a constant volume or VAV system. The quantity of air exchange shall not be increased due to requirements of the system. The air treatment system shall not have a maximum velocity profile.

D. Air Treatment Systems shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0 - 100% shall not cause damage, deterioration or dangerous conditions within the systems. Air treatment systems shall be capable of wash down duty.

E. Flexible Strip Air Treatment Systems (Basis of Design is GPS-iRIB-18/36):
   1. Where so indicated on the plans and/or schedules, air treatment systems shall be supplied and installed. The mechanical contractor shall mount the systems and wire to line voltage subject to power available (110VAC – 240VAC). Each system shall be designed as flexible ionization strips with 18 or 36 inch length and minimum six carbon fiber cluster ion needles per foot of coil surface. Ionization strips shall be manufactured from non-metallic materials for corrosion prevention. Each system shall have power status LED and dry contacts to prove ion output is operating properly. The dry contacts shall close to prove the ion generator is working properly and may be daisy chained in series such that only one dry contact per HVAC unit is required to interface to the EMCS or the optional DDC controller. Dry contacts proving power has been applied in lieu of the ion output is actually operating, are not acceptable. Manufacturers providing multiple ion modules that have alarm status wired in parallel, and not in series, shall not be acceptable.
   2. Strips shall be attached to HVAC units with high temperature double-sided tape. The power head shall be epoxy filled.
   3. Systems shall be energized when the main unit disconnect is turned on and the fan is operating. Electrodes shall be made from carbon fiber to prevent oxidation over time. Internal circuitry shall be provided to sense air flow across the electrode output. Ionization systems requiring the use of a mechanical air pressure switch to cycle the electrodes only when the fan is operating shall not be acceptable due to high failure rates and pressure sensitivity.
   4. Ion strips shall provide a minimum of 240M ions/cc over the entire 36 inch length as measured at 1 inch, both positive and negative ions, in equal quantities. Devices providing less than 240M ions/cc/sec/inch shall not be acceptable.
   5. Each system shall be provided with an inline on/off switch.

F. Dual Electrode Air Treatment Systems Up To 2400 CFM (Basis of Design is GPS-FC24-AC):
   1. Where so indicated on the plans and/or schedules, air treatment systems shall be supplied and installed. The mechanical contractor shall mount the systems and wire to the HVAC unit control power (24VAC) as instructed by the manufacturer's instructions or line voltage subject to power available. Each system shall be designed with a molded casing, self-cleaning system, self-cleaning test button, power status LED and dry contacts to prove ion output is operating properly. The dry contacts shall close to prove the ion generator is working properly and may be daisy chained in series such that only one dry contact per HVAC unit is required to interface to the EMCS or the optional DDC controller. Dry contacts proving power has been applied in lieu of the ion output is actually operating, are not acceptable. Manufacturers providing multiple ion modules that have alarm status wired in parallel, and not in series, shall not be acceptable.
   2. Each system shall include the required number of electrodes and power generators sized to the HVAC unit capacity. A minimum of one electrode pair per 2,400 CFM of air flow shall be provided. Bi-polar ionization tubes manufactured of glass and steel mesh shall not be acceptable due to replacement requirements, maintenance, performance output reduction over time, ozone production and corrosion.
   3. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating. Electrodes shall be made from carbon fiber to prevent oxidation over time. Internal circuitry shall be provided to sense air flow across the electrode output. Ionization systems requiring the use of a mechanical air pressure switch to cycle the electrodes only when the fan is operating shall not be acceptable due to high failure rates and pressure sensitivity.
   4. Electrode pair shall provide a minimum of 160M ions/cc/sec as measured at 2 inches, both positive and negative ions, in equal quantities. Devices providing less than 160M ions/cc per electrode pair shall not be acceptable.
   5. Each system shall be provided with a self-cleaning system that is field programmable to change the number of days between the cleaning cycle. Systems without a no-maintenance, self-cleaning system shall not be acceptable.
   6. Each electrode pair shall be designed with a banana style plug such that it can be field replaced, if

necessary.

7. Each system shall be provided with an inline on/off switch, universal voltage input (24VAC to 240VAC or DC), magnets for mounting to the fan inlet, replaceable carbon fiber emitters and a programmable self-cleaning system.

G. Dual Electrode Air Treatment Systems Up To 4800 CFM (Basis of Design is GPS-FC48-AC):
   1. Where so indicated on the plans and/or schedules, air treatment systems shall be supplied and installed. The mechanical contractor shall mount the systems and wire to the HVAC unit control power (24VAC) as instructed by the manufacturer's instructions or line voltage subject to power available. Each system shall be designed with a molded casing, self-cleaning system, self-cleaning test button, power status LED and dry contacts to prove ion output is operating properly. The dry contacts shall close to prove the ion generator is working properly and may be daisy chained in series such that only one dry contact per HVAC unit is required to interface to the EMCS or the optional DDC controller. Dry contacts proving power has been applied in lieu of the ion output is actually operating, are not acceptable. Manufacturers providing multiple ion modules that have alarm status wired in parallel, and not in series, shall not be acceptable.
   2. Each system shall include the required number of electrodes and power generators sized to the HVAC unit capacity. A minimum of one electrode pair per 4,800 CFM of air flow shall be provided. Bi-polar ionization tubes manufactured of glass and steel mesh shall not be acceptable due to replacement requirements, maintenance, performance output reduction over time, ozone production and corrosion.
   3. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating. Electrodes shall be made from carbon fiber to prevent oxidation over time. Internal circuitry shall be provided to sense air flow across the electrode output. Ionization systems requiring the use of a mechanical air pressure switch to cycle the electrodes only when the fan is operating shall not be acceptable due to high failure rates and pressure sensitivity.
   4. Electrode pair shall provide a minimum of 200M ions/cc/sec as measured at 2 inches, both positive and negative ions, in equal quantities. Devices providing less than 200M ions/cc per electrode pair shall not be acceptable.
   5. Each system shall be provided with a self-cleaning system that is field programmable to change the number of days between the cleaning cycle. Systems without a no-maintenance, self-cleaning system shall not be acceptable.
   6. Each electrode pair shall be designed with a banana style plug such that it can be field replaced, if necessary.
   7. Each system shall be provided with an inline on/off switch, universal voltage input (24VAC to 240VAC or DC), magnets for mounting to the fan inlet, replaceable carbon fiber emitters and a programmable self-cleaning system.

H. Rigid Bar Air Treatment Systems (Basis of Design GPS-iMOD):
   1. Where so indicated on the plans and/or schedules, air treatment systems shall be supplied and installed. The mechanical contractor shall mount the systems and wire to the HVAC unit control power (24VAC) as instructed by the manufacturer's instructions or line voltage subject to power available. Each system shall be designed as rigid modular ionization bars available in 6-inch increments. Ionization bars shall be manufactured from non-metallic materials for corrosion prevention. Each system shall have power status LED and dry contacts to prove ion output is operating properly. The dry contacts shall close to prove the ion generator is working properly and may be daisy chained in series such that only one dry contact per HVAC unit is required to interface to the EMCS or the optional DDC controller. Dry contacts proving power has been applied in lieu of the ion output is actually operating, are not acceptable. Manufacturers providing multiple ion modules that have alarm status wired in parallel, and not in series, shall not be acceptable.
   2. Each system shall include the required length to cover the entire finned cooling coil width. Ionization bar shall only require one inch in the direction of airflow for mounting and shall attach to the cooling coil using rare earth magnets. Ion bars shall attach to coils with stainless steel frames

using nylon spacers and self-tapping sheet metal screws in lieu of rare earth magnets.

3. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating. Electrodes shall be made from carbon fiber to prevent oxidation over time. Internal circuitry shall be provided to sense air flow across the electrode output. Ionization systems requiring the use of a mechanical air pressure switch to cycle the electrodes only when the fan is operating shall not be acceptable due to high failure rates and pressure sensitivity.
4. Ion Bars shall provide a minimum of 120M ions/cc/sec/inch as measured at 2 inches, both positive and negative ions, in equal quantities. Devices providing less than 120M ions/cc/inch shall not be acceptable.
5. Each system shall be provided with an inline on/off switch, universal voltage input (24VAC to 240VAC) and replaceable carbon fiber emitters.
6. If the ionization bars are mounted immediately downstream from a humidifier, angled hat section protective rain covers shall be provided over the ionization bars deflecting any direct condensation towards the floor and off the bars. These rain covers shall be provided by and installed by the installing contractor. The design of the cover shall be confirmed with the ionization manufacturer prior to installation.

I. Electrical Requirements: Wiring, conduit and junction boxes shall be installed within housing plenums in accordance with NEC NFPA 70. The contractor shall coordinate electrical requirements with system manufacturer during submittals.

J. Control Requirements:
1. Air Treatment Systems shall have internal short circuit protection, overload protection, and automatic fault reset circuit breakers. Systems with manual fuses shall not be allowed.
2. Integral airflow sensing shall modulate the plasma output as the airflow varies or stops. A mechanical airflow switch shall not be acceptable as a means to activate the Plasma device due to high failure rates and possible pressure reversal.
3. The installing contractor shall mount and wire the systems within the HVAC units specified or as shown or the plans. The contractor shall follow all manufacturer IOM instructions during installation.
4. All systems shall have a means to interface with the EMCS system. Dry contacts shall be provided to prove ions being produced. Systems providing indication that power is applied to the system, but not directly sensing the power at the ion output, shall not be acceptable.

PART 3 - EXECUTION

3.1 GENERAL:
A. The Contractor shall be responsible for maintaining all Air Treatment Systems until the Owner accepts the building.
B. Flexible strip systems shall be used for all ductless wall air handlers (DAH).
C. Dual electrode systems shall be used for all roof air conditioners (RAC), ductless cassette air handlers (DAH), fan coil units (FCU), and downstream of all terminal units (ATU). Use multiple systems as needed based on CFM.
D. Rigid Bar systems shall be used for central station AHUs.

3.2 INSTALLATION:
A. All equipment shall be assembled and installed in a workman like manner to the satisfaction of the Owner, Architect, and Engineer.
B. Any material damaged by handling, water or moisture shall be replaced by the mechanical contractor at no cost to the Owner.
C. All equipment shall be protected from dust and damage on a daily basis throughout construction.

3.3 TESTING:

A. Provide the manufacturers recommended electrical tests.

3.4 COMMISSIONING AND TRAINING:

A. A manufacturer's authorized representative shall provide start-up supervision and training of owner's personnel in the proper operation and maintenance of all equipment.

END OF SECTION 23 43 20

SECTION 23 53 10 - AIR CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:
A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:
A. Manufacturers:
1. *JCI/York* is the Basis of Design manufacturer for Roof Air Conditioners. Equivalent name brand equipment manufactured by *Trane, Daikin and Carrier* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.
B. Industry Standards:
1. Comply with applicable provisions of NFPA Standards 90A pertaining to construction and installation of air conditioning units.
2. Provide units which shall comply with applicable portions of UL 465, and with electrical components that bear UL labels.
3. Units shall be rated and certified in accordance with ARI Standard 210 and 270 as applicable.
4. Comply with installation requirements of ANSI/ASHRAE 15; *Safety Code for Mechanical Refrigeration*.
5. Extended Warranty: In addition to the standard one-year warranty on all components, compressors shall bear an additional four-year manufacturer's warranty against material and design defects.

1.3 SUBMITTALS:
A. Provide manufacturer's data, test reports, and product warranties for all items as applicable.

PART 2 - PRODUCTS

2.1 ROOF AIR CONDITIONERS:
A. General: Units shall be one-piece construction, UL certified, complete with refrigerant and ready to operate as year-round air conditioning systems. Units shall be complete with compressors, coils, gas heat, fans, casings, filters and controls. Provide adaptive dehumidification system capable of operating in normal cooling, subcooling and hot gas reheat modes.
B. Compressor(s) shall be the scroll type and shall be provided with crankcase heaters and constant pressure lubrication. Compressor(s) shall be isolated from the frame by resilient mounts. Provide low ambient controls. Factory charge with HFC refrigerant. Systems scheduled on the plans for Staged Air Volume shall be equipped with minimum 2-stage control.
C. Indoor and outdoor coils shall be constructed of copper tubes with aluminum fins mechanically bonded to the tubes. The coils shall be factory pressure and leak tested at not less than 425 psig. Condenser coils shall receive a factory-applied corrosion protection coating.
D. Fans shall be balanced statically and dynamically, and fan bearings shall be permanently lubricated types. Fan motors shall have built-in overload protection. Outdoor fans shall be the direct-drive propeller type. Indoor fans shall be the centrifugal belt-driven type mounted on vibration isolators. Systems scheduled on the plans for Staged Air Volume shall be equipped with variable frequency drives and inverter duty fan motors.
E. Outdoor unit casings shall be constructed of galvanized sheet steel and of modular construction, rigidly braced and reinforced with steel angle framework and of sufficient strength to prevent bending during rigging. Treat surface and finish corrosive-resistant steel panels with manufacturer's standard baked seal against weather and air leakage with gaskets.

Thermally insulate the interior casing in contact with the airstream with 1 inch glass fiber. Design top panels for proper drainage. Fasten top panels to be easily individually removable for complete access to components from the top of the unit and seal the top against air and water leakage with gasketing. Provide drains on both sides of the condenser section and provide a utility connection opening within unit curb connections. Connectors occurring in wet areas such as the outdoor fan section shall be factory or field weatherproofed. Provide units with condenser coil guards and hinged access doors. Provide matching roof curbs suitable for the roof slope. Curbs shall extend minimum 8 inches above roof surface. Units shall be capable of resisting wind load specified in 239110.

F. Air filters shall be located inside the air conditioning unit casing and shall be pleated minimum MERV 13. Filters shall conform to SCCPSS approved sizes. Contact SCCPSS Facility Department for approved list.
G. Units shall come equipped with motorized outdoor air dampers. Units with SAV shall come equipped with outside air flow measuring stations and outdoor air damper controls to provide the constant scheduled outdoor air CFM under all supply air conditions.
H. Provide units with controls equipped with time-delay devices with the capability to prevent short cycling of compressor(s) and to ensure staged starting of dual compressor units. Provide units with 24 volt internal control wiring with plug-in type relays for reliability and ease of maintenance. Each unit shall have high pressure stats, low pressure stats, loss of charge protection, indoor coil freeze stats and current and temperature-sensitive overload devices. Provide power phase monitoring accessory to protect equipment from phase loss and / or phase reversal for units with 3 phase power requirements.
I. Gas-fired heaters shall be the induced draft combustion type for use with natural gas. Heat exchanger and burners shall be aluminized steel. Gas burner controls shall include automatic safety pilot, redundant automatic gas valves, manual gas cock, and pressure regulator. Ignition shall be direct spark type with intermittent pilot with 100% shutoff. Induced draft blower shall provide pre-purge and shall be provided with a proving switch to prevent burner operation if venter is not in operation. Provide fan switch and limit control to delay the fan until heat is available and to continue fan operation until heat is dispersed. Limit switch shall shut the burners down in case of failure of operating controls.
J. HVAC drain piping shall be schedule 40 PVC pipe with socket type fittings and solvent cement joints. Piping exposed above the roof shall receive two coats of white latex paint for UV protection. Provide non-penetrating neoprene roof pedestal pipe supports with clamps on maximum five foot spacing.
K. Provide a low voltage terminal strip for connection to the building EMCS.
L. See Section 23 8310 for control information. All controls shall be full DDC under section 23 8310.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Installer must examine areas and conditions under which air conditioning units are to be installed and notify the Owner in writing of conditions detrimental to the proper completion of the work. Do not proceed with the work until the unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF AIR CONDITIONERS:

A. Install units where shown, in accordance with equipment manufacturer's written instructions and recognized industry practices, to ensure that units comply with requirements and serve intended purposes.
B. Coordinate with other work, including structural, ductwork, piping and electrical work, as necessary to interface installation of units with other work. Control wiring and devices for

complete, operable systems shall be provided and installed under the Mechanical specifications. Wiring shall be installed in conduit provided and installed under the Electrical specifications.

C. Piping: Refrigerant line joints shall be brazed with silver solder. Lines shall be sized, installed and insulated in accordance with equipment manufacturer's instructions. Suction line insulation joints shall be sealed with an adhesive recommended by the insulation manufacturer. Suction and hot gas line sets shall be secured together with plastic ties. Tape or coated wire shall not be allowed. Hot gas lines located within walls shall also be insulated for vibration isolation. Bare copper piping shall not be allowed to come in contact with masonry, mortar, or steel items. All refrigerant line insulation exposed to weather shall be protected with a weatherproof coating supplied by the insulation manufacturer. Condensate lines shall be installed with traps and vents in each line. Pipe supports shall be on maximum 6 foot centers on horizontal lines. Open ends of lines and connection fittings of equipment shall be properly capped or plugged during construction to protect from damage and entry of dirt or foreign material.

D. The mounting height of each wall mounted thermostat or temperature sensor shall comply with ADA for maximum side reach. The thermostat or sensor shall be at 48” maximum above the floor.

3.3 TESTING:

A. Upon completion of installation of air conditioning units and connection to the completed air distribution system, start-up and test equipment in accordance with manufacturer's recommendations. Operate units to demonstrate capability and compliance with requirements. Where possible, field-correct malfunctioning units, then retest to demonstrate compliance.

END OF SECTION 23 53 10

SECTION 23 61 10 – HEAT PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:
A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:
A. Manufacturers:
1. *Mitsubishi* is the Basis of Design manufacturer for Ductless Heat Pumps. Equivalent name brand equipment manufactured by *Carrier, Daikin, JCI/York* and *Trane* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.
B. Industry Standards:
1. Comply with applicable provisions of NFPA Standard 90A pertaining to construction and installation of air conditioning units.
2. Provide units which shall comply with applicable portions of UL 465, and with electrical components that bear UL labels.
3. Units shall be rated and certified in accordance with ARI Standard 240, 270 or 380 as applicable.
4. Comply with installation requirements of ANSI/ASHRAE 15; *Safety Code for Mechanical Refrigeration*.
C. Extended Warranty: In addition to the standard one-year warranty on all components, compressors shall bear an additional four-year manufacturer's warranty against material and design defects.

1.3 SUBMITTALS:
A. Provide manufacturer's data, test reports, and product warranties for all items as applicable.

PART 2 - PRODUCTS

2.1 DUCTLESS HEAT PUMPS:
A. General: Indoor and outdoor units shall be a matched pair of one manufacturer rated for operation together by the manufacturer's published literature. The system shall be furnished complete with packaged indoor unit, packaged outdoor unit, refrigerant lines and all necessary controls and accessories for a complete, operational system.
B. Outdoor units shall consist of hermetic scroll compressors(s) with crankcase heaters, automatically reversible oil pump, internal and external motor protection, outdoor fan(s) of the propeller type with direct drive factory lubricated motor(s) and outdoor coil all housed in a heavy duty steel casing with baked enamel factory-applied finish. Provide units with single point power connection and condenser coil guards. Condenser coils shall have a factory-applied corrosion protection coating.
C. Indoor units (air handlers) shall be the horizontal wall mounted or ceiling cassette type as shown on the drawings. Each unit shall be complete with statically and dynamically balanced centrifugal direct drive fan, indoor coil, electric heater, standard filters, expansion valves and relays, and controls all housed in a factory-fabricated and insulated steel housing with baked enamel finish. Provide single point power connection. Provide a spare washable filter for each unit.
D. Unit controls and protective devices shall include high pressure stat, loss of charge pressure stat, suction line accumulator and pressure relief device. Motor compressors shall have a thermal and current sensitive overload device. The outdoor unit shall have short cycle

protection and safety lock-out compressor protection. Automatic defrost controls shall be provided. Factory charge with HFC refrigerant. Provide condensate overflow switch.

E. Refrigerant piping shall be hard drawn seamless copper tubing suitable for a working pressure of 600 psig. Fittings shall be wrought copper or brass suitable for use with high temperature solder and designed for 600 psig working pressure. Suction line insulation shall be plenum rated closed cell foam plastic insulation.

F. Thermostats shall be the manufacturer's digital wall mounted thermostat. Provide all necessary accessories needed to integrate with the EMCS. Interface of unit into the building management system through the EMCS controller shall permit full control and scheduling of unit and shall provide all sensed values to EMCS. See section 23 8310 for more information.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Installer must examine areas and conditions under which heat pumps are to be installed and notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with the work until the unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF HEAT PUMPS:

A. Install heat pumps where shown, in accordance with equipment manufacturer's written instructions and recognized industry practices, to insure that units comply with requirements and serve intended purposes.

B. Coordinate with other work, including structural, ductwork, piping and electrical work, as necessary to interface installation of heat pumps with other work. Control wiring and devices for complete, operable systems shall be provided and installed under the Mechanical specifications. Wiring shall be installed in conduit provided and installed under the Electrical specifications.

C. Piping: Refrigerant line joints shall be brazed with silver solder. Lines shall be sized, installed and insulated in accordance with equipment manufacturer's instructions. Suction line insulation joints shall be sealed with an adhesive recommended by the insulation manufacturer. All refrigerant line insulation exposed to weather shall be protected with a weatherproof coating supplied by the insulation manufacturer. Suction and hot gas line sets shall be secured together with plastic ties. Tape or coated wire shall not be allowed. Hot gas lines located within walls shall also be insulated for vibration isolation. Bare copper piping shall not be allowed to come in contact with masonry, mortar, or steel items. Condensate lines shall be installed with traps and vents in each line. Pipe supports shall be on maximum 6 foot centers on horizontal lines. Open ends of lines and connection fittings of equipment shall be properly capped or plugged during construction to protect from damage and entry of dirt or foreign material.

D. The mounting height of each wall mounted thermostat or temperature sensor shall comply with ADA for maximum side reach. The thermostat or sensor shall be at 48” maximum above the floor.

3.3 TESTING:

A. Upon completion of installation of heat pumps and connection to the completed air distribution system, start-up and test equipment in accordance with the manufacturer's recommendations. Operate units to demonstrate capability and compliance with requirements. Where possible, field-correct malfunctioning units, then retest to demonstrate compliance.

END OF SECTION 23 61 10

SECTION 23 83 10 - ENERGY MANAGEMENT AND CONTROL SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. Furnish and install all necessary software and hardware, wiring, and computing equipment in compliance with this specification. Any variances from this specification or related documentation shall be submitted in writing at the time of bid.

B. System Requirements:
   1. Standard Material/Products. All material and equipment used shall be standard components, regularly manufactured and available, and not custom designed especially for this project.
   2. Modular Design. The system architecture shall be fully modular permitting expansion of application software, system peripherals, and field hardware.
   3. Performance. The system, upon completion of the installation and prior to acceptance of the project, shall perform all operating functions as detailed in this specification.

C. Equipment:
   1. System Hardware: Provide the following:
      a. PC's, PDA's, server(s), routers, modems and control modules as specified.
      b. All sensing devices, relays, switches, indicating devices, and transducers required to perform the functions as listed in I/O Summary Tables.
      c. All monitoring and control wiring.
   2. System Software: Provide all software identified in Part 2 of this specification, including the EMCS Server, fully configured database, graphics, reports, alarm/events. The Graphical User Interface (GUI) shall be completely Web based as specified herein.
   3. Acceptable Manufacturers: Automated Logic Corporation / ALC Controls.

1.2 GENERAL CONDITIONS:

A. Changes in Scope of Work: Any changes in the scope of work must be authorized by a written Change Order.

B. Correction of Work:
   1. Promptly correct all work Architect/Engineer finds defective or failing to conform to the Contract Documents and bear all cost of correcting such work.
   2. During Warranty. If, within the warranty period required by the Contract Documents, any of the work is found to be defective or not in accordance with the Contract Documents, correct it promptly after receipt of a written notice from Architect/Engineer to do so. Architect/Engineer shall give notice promptly after discovery of the condition.

C. Coordination of Work During Construction: Coordinate any necessary changes in work scheduling with Architect/Engineer to minimize disruption. Coordinate with and protect the installed works by other trades. Repair any damage caused by his work to building(s) and equipment at no additional cost to the owner.

D. Warranty: Warrant, from the date of final acceptance by Architect/Engineer, that all systems, subsystems, component parts, and software are fully free from defective design, materials, and workmanship for a period of one year.

1.3 SUBMITTALS, DOCUMENTATION, ACCEPTANCE AND TRAINING

A. Submittals:

1. Shop Drawings. A minimum of four (6) copies of shop drawings shall be submitted and shall consist of a complete list of equipment, materials, manufacturer's technical literature, cut-sheets, and installation instructions. Drawings shall contain proposed layout, complete wiring, routing, schematic diagrams, tag number of devices, software descriptions, calculations, installation details, and any other details required to demonstrate that the system will function properly.
2. Graphical Programming Documentation: Provide a printout all Graphical Programs, identifying the specific HVAC or mechanical/electrical subsystem being controlled
3. Drawing Approval: Shop drawings shall be approved before any equipment is installed. Allow a minimum of fourteen (14) days for drawing approval.
4. As Built Drawings. All drawings shall be reviewed after the final system checkout and updated or corrected to provide 'as-built' drawings to show exact installation. All shop drawings will be acknowledged in writing by Architect/Engineer before installation is started and again after the final checkout of the system. The system will not be considered complete until the 'as-built' drawings have received their final approval. Deliver 2 sets of 'as-built' drawings.

B. Documentation: Operating and Maintenance (O&M) manuals for the system shall be made available electronically using Acrobat 4.x (PDF) format and include the following categories: Workstation User's Manual, Project Engineering Handbook, Software Documentation.

1. EMCS User's Manual shall contain as a minimum:
   a. System overview.
   b. Networking concepts.
   c. Launching a web browser from a networked PC/PDA and login.
   d. Graphical User Interface (GUI) screen menus and their definitions.
   e. Creating, modifying or deleting schedules.
   f. Uploading and downloading software to the field hardware.
   g. Creating historical trends, collecting trend data and generating trend graphs.
   h. Enabling and assigning alarms and messages to reporting actions/groups.
   i. Report generation and ‘third party software’.
   j. Backing up software and data files.

2. Project Engineering Manual shall contain as a minimum:
   a. System architecture overview.
   b. Hardware cut-sheets and product descriptions.
   c. Deliver six (6) sets of 'as-built' drawings. All drawings shall be reviewed after the final system checkout and updated to provide 'as-built' drawings. The system will not be considered complete until the 'as-built' drawings have received their final approval.
   d. Installation, mounting and connection details for all field hardware and accessories.
   e. Commissioning, setup and backup procedures for all control modules/accessories, EMCS server software, and database.
   f. Listing of basic terminology, alarms/messages, error messages and frequently used commands or shortcuts.

3. EMCS Software Documentation shall contain as a minimum:
   a. Provide a printout all Graphical Programs, detailing their application to specific HVAC equipment and electrical/mechanical subsystems, together with a glossary or icon symbol library detailing the function of each graphical icon. Revisions made as a result of the submittal process, during the installation, start-up or acceptance portion of the project, shall be accurately reflected in the "as-builts".
   b. Graphical representation of the mechanical equipment hierarchy for the project including all equipment controlled by the EMCS.

c. Detailed listing of all alarm and event messages programmed for designated mechanical/electrical equipment and required operator action.

C. System Training: System Use Instructions: Provide full Computer Based Training (CBT) in addition to training of designated personnel in the operation, maintenance, and programming of the system. All training sessions shall be digitally recorded (audio/video) and submitted to the Owner.

PART 2 – PRODUCTS

2.1 SYSTEM OVERVIEW:

A. The existing server communicates using ASHRAE's BACnet/IP protocol, and in addition, offer concurrent support over the same data-link of the following protocols: LonWorks and SNMP. Server shall be accessed using a web browser over the DDC system Intranet provided under this contract and remotely over the Internet. Third party manufactured and developed EMCS software is not acceptable.

B. The web browser GUI shall provide a completely interactive user interface and must offer the following features as a minimum:
1. Trending.
2. Scheduling.
3. Downloading Memory to field devices.
4. Real time 'live' Graphic Program Diagnostics for troubleshooting.
5. Tree Navigation.
6. Parameter change of properties.
7. Setpoint Adjustments.
8. Alarm / Event information.
9. Configuration of operators.
10. Execution of global commands.

C. Thin Client – Web Browser Based: The GUI shall be thin client or browser based and shall meet the following criteria:
1. Web Browser's for PC's: Only a 6.x browser (Explorer/Navigator) will be required as the GUI, and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet. A firewall shall be installed (as necessary) to protect the customer's Intranet.
2. Secure Socket Layers: Communication between the Web Browser GUI and BAS server shall be encrypted using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP).
3. PDA's: EMCS Server software must support other browsers used by Personal Digital Assistants like 3Com Palm Pilots and other Internet appliances specified herein.

2.2 WEB BROWSER GRAPHICAL USER INTERFACE – LGR:

A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application, and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser. The Web Browser GUI shall (as a minimum) provide a Navigation Pane for navigation, and a Action Pane for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic setpoint controls, configuration menus for operator access, reports, and reporting actions for events.

1. Log-in: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and password. Navigation in the system shall be dependent on the operator's role privileges, and geographic area of responsibility (see 3.2 J below).
2. Navigation Pane: The Navigation Pane shall comprise a Navigation Tree which defines a geographic hierarchy of the proposed EMCS system. Navigation through the GUI shall be accomplished by clicking on appropriate level of a navigation tree (consisting of expandable and collapsible tree control like Microsoft's Explorer program), and/or by selecting dynamic links to other system graphics. Both the navigation tree and graphic pane defined in 2.2 D shall be displayed simultaneously, enabling the operator to select a specific system or equipment, and view the graphic corresponding to the highlighted position in the navigation tree. The navigation tree shall as a minimum provide the following views: Geographic, Network, Groups and Configuration.
    a. Geographic View shall display a logical geographic hierarchy of the system including cities, sites, buildings, building systems, floors, equipment and BACnet objects.
    b. Network View shall display the hierarchy of the actual BACnet IP Intranet network. This can include Systems, Site, Networks, Routers, Half-Routers, Devices, Equipment and all the BACnet Objects in a device.
    c. Groups View shall display Scheduled Groups and custom reports.
    d. Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).
3. Action Pane: The Action Pane shall provide several functional views for each HVAC or mechanical/electrical subsystem specified. By clicking on a button, an operator shall be able to select the following system page, corresponding to the highlighted area/equipment in the navigation tree:
    a. Graphics: Using animated gifs or other graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floor-plans, equipment drawings of each individual piece of equipment with live variable statuses, active graphic setpoint controls, web content, and other valid HTML elements. The data on each graphic page shall automatically refresh at a rate defined by the operator.
    b. Properties: Shall include graphic controls and text for the following: Locking or overriding BACnet objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress a 'accept/cancel' button.
    c. Schedules: Shall be used to create, modify/edit and view schedules based on the systems geographical hierarchy (using the navigation tree) and in compliance with section 2.2.G
    d. Events: Shall be used to view alarm event information geographically (using the navigation tree), acknowledge events, sort events by category, actions and verify reporting actions.
    e. Trends: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling
    f. Logic - Live Graphic Programs: Shall be used to display a 'live' graphic programs of the control algorithm for the mechanical/electrical system selected in the navigation tree. All control outputs and inputs shall displayed on the program giving real-time statuses for use in operator troubleshooting.

B. The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to setpoints and comfort. Animated gif's, active setpoint graphic controls and valid web content (like local weather forecast) shall be used to enhance usability:
    1. Display Size: The GUI workstation software shall graphically display in 1024 by 768 pixels 24 bit True Color.

2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, which provide a visual display of temperature relative to their respective setpoints (see section 3.2 F below). The colors shall be updated dynamically as a zone's actual comfort condition changes in real-time. Locations of space sensors shall also be shown for each zone. The intent of the specification is to enable the operator to readily assess problems at a glance.
4. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability.
5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
   a. Each piece of equipment monitored or controlled.
   b. Each building.
   c. Each floor and zone controlled.
   d. Zone Setpoint Adjustments.

C. Hierarchical Schedules: Utilizing the Navigation Tree displayed in the web browser GUI, an operator (with password access) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor area. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.
   1. BACnet Schedules: Schedules shall comply with the BACnet standard, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:
      a. Types of schedule shall be Normal, Holiday or Override.
      b. A specific date.
      c. A range of dates.
      d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any).
      e. Wildcard (example, allow combinations like second Tuesday of every month).
   2. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
   3. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an 'individual tenant' group – who may occupy different areas within a building or buildings. Schedules applied to the 'tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the 'tenant group'
   4. Intelligent Scheduling: The control system shall be intelligent enough to automatically turn on any supporting equipment needed to control the environment in an occupied space.
   5. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator.
   6. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules, and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.

7. Schedule Distribution: For reliability and performance, instead of maintaining a single schedule in a field device that writes over the network to notify other devices when a scheduled event occurs, field devices will only keep their part of the schedule locally. The EMCS server software shall determine which nodes a hierarchical schedule applies to and will create/modify the necessary schedule objects in each field device as necessary.

D. Events (& Alarms): Events and alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an 'Events' view. Events, alarms, and reporting actions shall have the following capabilities:
   1. Events View: Each event shall display an Event Category (using a different icon for each event category), date/time of occurrence, current status, event report, and a URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address and other pertinent information. An operator shall easily be able to sort events, edit event templates and categories, acknowledge or force a return to normal in the Events View as specified in this section.
   2. Event Categories: The operator shall be able to create, edit or delete event categories such as HVAC, Maintenance, Fire, or Generator. An icon shall be associated with each Event category, enabling the operator to easily sort through multiple events displayed using a built-in filter.
   3. BACnet Event Templates: BACnet Event template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of event, acknowledgement requirements, high/low limit and out of range information.
   4. Event Areas: Event Areas enable an operator to assign specific Event Categories to specific Event Reporting Actions.
   5. Event Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
   6. Event Configuration: Operators shall be able to define the type of events generated per BACnet object. A 'network' view of the Navigation Tree shall expose all BACnet objects and their respective Event Configuration. Configuration shall include assignment of event, alarm, type of Acknowledgement and notification for return to normal or fault status.
   7. Event Summary Counter: The view of events in the Graphic Pane shall provide a numeric counter, indicating how many events are active (in alarm), require acknowledgement, and total number of events in the EMCS Server database.
   8. Persistent Data. The system shall allow for external systems to access the event instance data. Event data shall be stored and queried in the database in a relational manner. At a minimum, the fields to be stored in the database are:
      - Event Source
      - Event Generation Time
      - Acknowledge Required Flag
      - Delivery Priority
      - BACnet Event Type
      - Event Message Text
      - BACnet Event Parameter
      - Classification of Event
      - Event Acknowledgement Time
      - Return to Normal Time
      - Operator Comments
      - Who Acknowledged the Event
   9. Event Auto-Deletion: Events that are acknowledged and closed shall be auto-deleted from the database and archived to a text file after an operator defined period.
   10. Event Reporting Actions: Event Reporting Actions specified shall be automatically launched (under operator defined conditions) after an event is received by the EMCS server software. Operators shall be able to fully define these Reporting Actions using the Navigation Tree and Graphic Pane in the web browser GUI. Reporting Actions shall be as follows:
      a. Print: Alarm/Event information shall be printed to the EMCS server's PC or a networked printer.

b. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts.

E. Trends: Trends shall conform to the BACnet Trend Log Object specification. The system shall be able to trend and display graphically all analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.
1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.
2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server if historical trending is enabled for the BACnet object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory
3. Resolution. Sample intervals shall be as small as one (0.1) second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for display that have different trend intervals, the system will automatically scale the axis.
4. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.
5. Zoom. It shall be possible to zoom-in on a particular section of a trend for more detailed examination.
6. Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.

F. Security Access: Systems that Security access from the web browser GUI to EMCS server shall require a Login Name and Password. Access to different areas of the EMCS system shall be defined in terms of Roles, Privileges and geographic area of responsibility. Roles shall be geographically assigned using a similar expandable/collapsible navigation tree.

2.3 GRAPHICAL PROGRAMMING:

A. The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in standalone control modules. Any system that does not use a drag and drop method of graphical icon programming as described herein shall be unacceptable. GPL is a method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence of operation. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors, etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.

B. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.

C. Simulation: Full simulation capability shall be provided with the graphic programming. Operator shall be able to fully simulate the constructed control sequence prior to downloading into field control modules. Simulation capabilities shall include step-by-step, accelerated time, and operator defined simulation criteria like outside weather, demand, and communication status.

D. GPL Capabilities: The following is a minimum definition of the capabilities of the Graphic Programming software:
   1. Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
   2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.
   3. BACnet Points: Shall be points that comply with the BACnet structure as defined in the BIBB's Addendum B1/B2, and the BACnet standard.
   4. Microblocks: Shall be software devices that are represented graphically and may be connected together to perform a specified sequence. A library of microblocks shall be submitted with the control contractors bid.
   5. Wires: Shall be graphical elements used to form logical connections between microblocks and between logical I/O. Different wire types shall be used depending on whether the signal they conduct is analog or digital.
   6. Labels: Labels shall be similar to wires in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection; i.e. two points labeled 'A' on a drawing are logically connected even though there is no wire between them.
   7. Parameter: A parameter shall be a value that may be tied to the input of a microblock.
   8. Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields and shall contain 'push buttons' for the purpose of selecting default parameter settings.
   9. Icon: An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes it function.
   10. Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.

2.4 HARDWARE:

A. Input Devices:
   1. Sensors:
      a. Sensors used for mixed air application shall be the averaging type and have an accuracy of +1°F.
      b. Room temperature sensors shall have an accuracy of +0.25°F in the range of 45°F to 96°F. Room sensors shall have built-in local setpoint adjustment and timed push-button override. Provide a manual slide lever for temperature adjustment with temperature selection sticker divided into a blue area and red area. Lever movement toward blue increases cooling. Lever movement toward red increases heating.
      c. Chilled water sensors shall have an accuracy of +0.25°F in their range of application.
      d. Hot water temperature sensors shall have an accuracy of +0.75°F over the range of their application.
      e. Duct Temperature Sensors: Duct Temperature Sensors shall be 1000-ohm single point or averaging type as need. Averaging sensors shall be RTDs, or 10,000-ohm averaging thermistors. Single point sensors shall be 5,000 ohm or 10,000-ohm thermistors.
      f. Outside Air Sensors: Outside Air Sensor shall be 5,000 or 10,000-ohm thermistor, with integral PVC housing and ½" NPT conduit connector.
      g. Space and Duct Relative Humidity Sensors: Space Relative Humidity Sensors shall and have a range of 0-100% RH. The measuring accuracy shall be 2%. Where temperature sensors and RH sensors are shown side-by-side, a single combination sensor shall be provided.

   2. Pressure Instruments:

a. Sensors shall have a 4-20 MA output proportional signal with provisions for field checking. Sensors shall withstand up to 150% of rated pressure, without damaging the device. Accuracy shall be within +2% of full scale. Sensors shall be manufactured by Leeds & Northrup, Setra, Robertshaw, Dwyer Instruments, Rosemont, or be approved equal.
b. Pressure switches shall have a repetitive accuracy of +2% of range and withstand up to 150% of rated pressure. Sensors shall be diaphragm or bourdon tube design. Switch operation shall be adjustable over the operating pressure range. The switch shall have an application rated Form C, snap-acting, self-wiping contact of platinum alloy, silver alloy, or gold plating.

3. Watt-hour Transducers: Watt-hour transducers shall have an accuracy of +0.25% for kW and kWh outputs from full lag to full lead power factor. Input ranges for kW and kWh transducers shall be selectable without requiring the changing of current or potential transformers, and shall have dry contact pulse accumulation.

4. Flow Switches: Flow switches shall have a repetitive accuracy of +1% of their operating range. Switch actuation shall be adjustable over the operating flow range. Switches shall have snap-acting Form C contacts rated for the specific electrical application.

5. Voltage-to-Digital Alarm Relays: Relays shall monitor status of boiler or chiller safeties and overloads and shall be sized and connected so as not to impede the function of the monitored contacts. Switch shall have self-wiping, snap-acting Form C contacts rated for the application.

6. Current Sensing Relays: Relays shall monitor status of motor loads. Switch shall have self-wiping, snap-acting Form C contacts rated for the application. The setpoint of the contact operation shall be field adjustable.

7. Duct Smoke Detectors: Ionization type air duct smoke detectors shall be furnished as specified elsewhere by Division 27 for installation under Division 23. All Fire Alarm System wiring for air duct detectors shall be furnished and installed under Division 27. All EMCS wiring for air duct detectors shall be furnished and installed under this section.

8. Air Flow Measuring Stations: AMS shall be installed in the AHU outside air ducts. AMS shall be same size as the duct. Each station shall contain multiple total and static pressure sensors positioned at the center of equal area of the station cross-section and interconnected by their respective averaging manifolds. The casing shall be galvanized steel with welded seams, flanged duct connections, straightening grid. Provide an electronic pressure transducer to convert the pressure signals to a 0-10 VDC or 4-20 mA output signal representative of CFM. The station must be accurate to within 2% for the scheduled airflow and operate on 24 VAC. AMS shall be by Air Monitor, Ruskin or Kele.

B. Output Devices:
1. Control Relays: Control relay contacts shall be rated for 150% of the loading application, with self-wiping, snap-acting Form C contacts, enclosed in dustproof enclosure. Relays shall have silver cadmium contacts with a minimum life span rating of one million operations. Relays shall be equipped with coil transient suppression devices.

2. Solid State Relays (SSR): Input/output isolation shall be greater than 10 billion ohms with a breakdown voltage of 15 V root mean square, or greater, at 60 Hz. The contact operating life shall be 10 million operations or greater. The ambient temperature range of SSRs shall be 20°F-140°F. Input impedance shall be greater than 500 ohms. Relays shall be rated for the application. Operating and release time shall be 10 milliseconds or less. Transient suppression shall be provided as an integral part of the relays.

3. Water Control Valves: Control valves for chilled water coils and hot water coils shall be the 2-way or 3-way modulating type as indicated on the plans with equal percentage plugs. All valves shall be normally open. Valves 2 inches and smaller shall have a cast brass body, 150 PSIG, 280 degrees F, with threaded or sweat connections as applicable. Valves 2 ½ inches and larger shall have a cast iron body, 150 PSIG, 280 degrees F, with flanged connections. AHU coil control valves shall have DDC actuators, and TU coil control valves shall have DDC actuators.

4. Variable Frequency Drives:
   a. The variable frequency drives (VFD) shall be pulse width modulation (PWM) type, microprocessor controlled design by ABB.
   b. The VFD, including all factory installed options, shall have UL approval.
   c. Enclosure shall be NEMA 1 ventilated for installation as an indoor wall mounted unit and NEMA 3R ventilated for installation as an outdoor wall mounted unit as applicable. Drive shall be equipped with an input disconnect switch and electronic ground fault protection. A hand-off-automatic switch and speed potentiometer shall be mounted on the front of the enclosure. Provide built-in isolation bypass contactors.
   d. VFD shall utilize diode bridge rectifier to convert three phase AC to a fixed DC voltage. Power factor shall remain above 0.95 regardless of speed or load. VFDs employing power factor correction capacitors shall not be acceptable.
   e. Insulated gate bipolar transistors shall be used in the inverter section to convert the fixed DC voltage to a three phase, adjustable frequency, AC output. A DC line reactor shall be provided to minimize harmonic and current distortion of the input power line.
   f. The following user-modifiable adjustments shall be provided:
      1) Accel time: 2 to 300 seconds.
      2) Decel time: 20 to 300 seconds.
      3) Minimum Frequency: 0 Hz.
      4) Maximum Frequency: 65 Hz.
      5) Current limit: to 115%.
      6) V/HZ trim: 10%.
      7) Restart time delay: 0 to 255 seconds.
   g. Speed reference signal shall be user selectable for:
      1). 4-20 mA.
      2). 0-5 VDC.
      3). 0-10 VDC.
      4). 0-20 VDC.
      5). 0-20 V phase chop.
   h. The VFD shall be suitable for elevations to 3300 feet above sea level without derating. Maximum operating ambient temperature shall not be less than 104 degrees F. VFD shall be suitable for operation in environments up to 95% non-condensing humidity.
   i. The VFD shall be capable of displaying the following information on the door mounted operator interface:
      1). Percent speed.
      2). Percent load.
      3). Input kW.
      4). Output frequency.
      5). Fault identification.
      6). Output current.
   j. Provide field-mounted pressure sensor transmitters as indicated on the plans. Unit shall transmit an isolated 4-20 mA dc signal indicative of process variable to the logic controller via standard two wire 24 VDC system. The unit shall be accurate to within 0.25% of full span.
   k. Local Site Communication Network: The modules shall communicate within their

respective network with a token passing technique.

5. l. Field Testing and Programming Equipment: A portable laptop computer shall interface via standard push-in connection at an asynchronous serial port located at the control modules. This portable unit shall be capable of full global communications with all control modules connected within the respective network and shall provide functionally identical user interface to the central site, in non-graphic format. Units shall be able to interrogate all points and alter all programming. The unit shall have 80 x 25 character liquid crystal display panel.

PART 3 - APPLICATION SOFTWARE

3.1 GENERAL: The following applications software shall be provided for the purpose of optimizing energy consumption while maintaining occupant comfort:

A. Time of Day Scheduling (TOD)
B. Optimum Start/Stop (OSS)/Optimum Enable/Disable (OED)
C. Source Temperature Optimization (STO)
D. Demand Limiting (DL) - Temperature Compensated
E. Day/Night Setback (DNS)
F. Timed Local Override (TLO)
G. Space Temperature Control (STC)

PART 4 – SEQUENCE OF CONTROL

4.1 GENERAL:

A. Following are the typical sequences of operation for mechanical equipment. Within each section, each paragraph describes a specific control sequence for a component of the equipment; start/stop, status, etc. Each specific control sequence will require appropriate I/O points.

4.2 VARIABLE AIR VOLUME AHU's (AHU-1 though AHU-13):

A. When the AHU is in the Occupied Mode, the supply fan will operate continuously, the outside air and return air dampers will modulate to provide a fixed outside air CFM, and the variable frequency drive will modulate to maintain duct static pressure. When the AHU is in the Unoccupied Mode, the outside air damper will be closed, and the supply fan will operate only when there is a call for cooling or heating from an associated space sensor or upon activation of the AHU local override timer. The AHU will be shut down and alarmed due to the following safeties: smoke detector, freezestat, fan motor failure, VFD failure, static pressure high limit. The EMCS will remotely monitor and adjust the system static pressure setpoint. The EMCS will remotely monitor and adjust the VFD and fan motor. The EMCS will provide a start/stop signal to the VFD. The AHU will also shut down via the fire alarm system and shall automatically restart once the alarm is cleared.

B. Whenever the AHU is "ON", the chilled water valve and hot water valve will modulate to maintain the specified cooling coil discharge air temperature. The chilled water valve will be closed if the AHU is "OFF". The water valve actuators will be electronic. The EMCS will provide remote monitoring, alarm and setpoint adjustment for the coil discharge air temperatures. Remote monitoring and alarms shall be provided for mixed air low limit, water valve position, outside air CFM, air treatment status, and filter pressure drop. Refer to the Variable Air Volume AHU Flow Diagram on the plans.

4.3 SINGLE ZONE VARIABLE AIR VOLUME AHU (AHU-16):

A. When the AHU is in the Occupied Mode, the supply fan will operate continuously, the outside air and return air dampers will modulate to maintain the scheduled outside air flow rate, and the

variable frequency drive will modulate to maintain space temperature set point. When the AHU is in the Unoccupied Mode, the outside air damper will be closed, and the supply fan will operate only when there is a call for cooling or heating from an associated space sensor or upon activation of the AHU local override timer. The AHU will be shut down and alarmed due to the following safeties: smoke detector, freezestat, fan motor failure, or VFD failure. The EMCS will remotely monitor and adjust the VFD and fan motor. The EMCS will provide a start/stop signal to the VFD. The AHU will also shut down via the fire alarm system and shall automatically restart once the alarm is cleared.

B. Whenever the AHU is "ON", the chilled water valve and hot water preheat valve will modulate to maintain the specified cooling coil discharge air temperature. The chilled water valve and hot water valves will be closed if the AHU is "OFF". The water valve actuators will be electronic. The EMCS will provide remote monitoring, alarm and setpoint adjustment for the coil discharge air temperatures. Remote monitoring and alarms shall be provided for mixed air low limit, water valve position, outside air CFM, air treatment status, and filter pressure drop. Refer to the Variable Air Volume AHU Flow Diagram on the plans.

C. Cooling Mode: The AHU shall modulate the supply airflow between the specified maximum and minimum airflows as need while maintaining the specified cooling coil discharge air temperature of 55 F (Adjustable) in order to satisfy the room temperature setpoint. A drop in space temperature will result in the AHU modulating to provide its minimum airflow.

D. Heating Mode: Upon a drop in space temperature below heating setpoint, the fan shall go to minimum airflow and the hot water reheat valve shall reheat the supply air up to maintain desired space temperature. In this mode the leaving air temperature should not exceed 90 F. Upon a continued drop in temperature below the heating set point the AHU shall modulate its airflow while maintaining a constant discharge temperature of 90 F to maintain the room temperature setpoint.

E. If the space humidity sensor detects a room relative humidity higher than 55% (Adjustable), the AHU shall enter Dehumidification Mode, the chilled water valve shall open to 100%, AHU shall slowly move to the maximum airflow, and the reheat hot water valve shall modulate to maintain the room temperature setpoint. Whenever room relative humidity falls back below 50% (Adjustable), the system shall revert to normal operation.

4.4 SINGLE ZONE VARIABLE AIR VOLUME AHU's w/ CO2 CONTROL (AHU-14 & AHU-15):

A. When the AHU is in the Occupied Mode, the supply fan will operate continuously, the outside air and return air dampers will modulate to maintain CO2 level of 1000 ppm, and the variable frequency drive will modulate to maintain space temperature set point. When the AHU is in the Unoccupied Mode, the outside air damper will be closed, and the supply fan will operate only when there is a call for cooling or heating from an associated space sensor or upon activation of the AHU local override timer. The AHU will be shut down and alarmed due to the following safeties: smoke detector, freezestat, fan motor failure, or VFD failure. The EMCS will remotely monitor and adjust the VFD and fan motor. The EMCS will provide a start/stop signal to the VFD. The AHU will also shut down via the fire alarm system and shall automatically restart once the alarm is cleared.

B. Whenever the AHU is "ON", the chilled water valve and hot water preheat valve will modulate to maintain the specified cooling coil discharge air temperature. The chilled water valve and hot water valves will be closed if the AHU is "OFF". The water valve actuators will be electronic. The EMCS will provide remote monitoring, alarm and setpoint adjustment for the coil discharge air temperatures. Remote monitoring and alarms shall be provided for mixed air low limit, water valve position, outside air CFM, CO2 levels, air treatment status and filter

pressure drop. Refer to the Variable Air Volume AHU Flow Diagram on the plans.

C. Cooling Mode: The AHU shall modulate the supply airflow between the specified maximum and minimum airflows as need while maintaining the specified cooling coil discharge air temperature of 55 deg. F (Adjustable) in order to satisfy the room temperature setpoint. A drop in space temperature will result in the AHU modulating to provide its minimum airflow.

D. Heating Mode: Upon a drop in space temperature below heating setpoint, the fan shall go to minimum airflow and the hot water reheat valve shall reheat the supply air up to maintain desired space temperature. In this mode the leaving air temperature should not exceed 90 deg. F. Upon a continued drop in temperature below the heating set point the AHU shall modulate its airflow while maintaining a constant discharge temperature of 90 deg.F to maintain the room temperature setpoint.

E. If the space humidity sensor detects a room relative humidity higher than 55%, the AHU shall enter Dehumidification Mode, the chilled water valve shall open to 100%, AHU shall slowly move to the maximum airflow, and the reheat hot water valve shall modulate to maintain the room temperature setpoint. Whenever room relative humidity falls back below 50%, the system shall revert to normal operation.

4.5 AIR TERMINAL UNITS:

A. SERIES FAN POWERED ATUs:

1. Air Terminal Units will be electrically interlocked with their respective AHU's. When the ATU is in the Occupied Mode, the ATU's fan will operate continuously. When the ATU is in the Unoccupied Mode, the ATU fan will be off, and the ATU fan will operate only when there is a call for cooling or heating from an associated space sensor or upon activation of the ATU's local override timer. When the space temperature rises above the space temperature cooling setpoint, the ATU air valve shall modulate to maintain space temperature. A drop in space temperature will result in the ATU modulating to minimum cooling airflow. When the space temperature falls below the space heating setpoint, the ATU air valve will move to the heating cfm position, and the hot water valve will open and modulate to maintain space temperature. The air valve actuator and water valve actuator will be DDC. The DDC controller will have an on-board differential pressure transducer for monitoring airflow rate. The EMCS will remotely monitor and adjust the ATU's airflow setpoints. Monitor air treatment status.

B. SINGLE ZONE ATUs:

1. Air Terminal Units will be electrically interlocked with their respective AHU's. When the space temperature rises above the space temperature cooling setpoint, the ATU air valve shall modulate to maintain space temperature. A drop in space temperature will result in the ATU modulating to minimum cooling airflow. When the space temperature falls below the space heating setpoint, the ATU air valve will move to the heating cfm position, and the hot water valve will open and modulate to maintain space temperature. The air valve actuator and water valve actuator will be DDC. The DDC controller will have an on-board differential pressure transducer for monitoring airflow rate. The EMCS will remotely monitor and adjust the ATU's airflow setpoints. Monitor air treatment status.

4.6 FAN COILS UNITS

A. When the FCU is in the Occupied Mode, the supply fan will operate continuously. When the FCU is in the Unoccupied Mode, the supply fan will operate only when there is a call for cooling or heating from an associated space sensor. The FCU will be shut down and alarmed due to the following safeties: fan motor failure. The EMCS will provide a start/stop signal to the motor

starter.

B. The chilled water valve and hot water valve will be closed if the FCU is "OFF". The water valve actuators will be electronic. The EMCS will provide remote monitoring, alarm and setpoint adjustment for the space air temperature. Remote monitoring shall be provided for water valve position and discharge air temperature. The chilled water valve and hot water valve will be staged to maintain the space setpoint air temperature.

4.7 VARIABLE SPEED PUMPING SYSTEM:

A. The system shall consist of a pump logic controller, two VFD and two pumps in parallel for the CHW system and for the HW systems.

B. The pumping system shall start upon the transmission of a digital output "start" signal from the building EMCS. Primary and standby pumps shall automatically exchange positions every seven (7) days.

C. The pressure sensor/transmitters shall send a 4-20mA signal to the pump logic controller, indicative of process variable condition.

D. The pump logic controller shall compare the pressure signal to the independent, user-determined setpoint.

E. When all setpoints are satisfied by the process variable, the pump speed shall remain constant at the optimum energy consumption level.

F. The pump logic controller shall continuously scan and compare the process variable to its individual setpoint and control to maintain setpoint.

G. As the pressure deviates from setpoint, the pump logic controller shall send the appropriate analog signal to the VFD to speed up or slow down the pump/motor.

H. In the event of primary VFD or pump failure, the standby VFD and pump shall automatically start and a primary VFD/pump trouble signal shall be sent to the building EMCS.

I. In the event of failure to receive the process variable signal, the VFD shall maintain 100% speed, and reset shall be automatic upon correction of the failure.

J. Pump and/or VFD fault shall be continuously scrolled through the display on the operator interface until the fault has been corrected and the pump logic controller has been manually reset. Set VFD's for automatic reset and adjust window parameters to avoid nuisance trips.

4.8 CHILLED WATER SYSTEM CONTROL:

A. The chilled water system shall be directly controlled by the EMCS. The standalone microprocessor-based chiller controller shall monitor and control the chillers and pumps in a standalone mode or as directed by the chiller sequencing software. The chiller sequencing software shall perform the following control strategies, provide the points as listed in this section, and support their specified monitoring and diagnostics. The system shall start in response to a binary contact signal from the building EMCS. The chiller sequencing software will start and stop system water pumps and chillers based upon system load. When the chilled water system is enabled, the chiller system control will:
   1. Start the lead chilled water variable speed distribution pump.

2. Start the lead chilled water production pump and prove flow through the chiller.
3. Start the lead chiller after the chilled water production pump flow has been flow are proven.

B. The chiller sequencing software shall consider starting another chiller whenever there is deficit flow in the bypass line. The chiller sequencing software shall determine when there is deficit flow by measuring the system and chiller return water and bypass water flow rate. A two-way flow measuring station shall be used to determine flow and direction in the bypass line for control purposes.

C. When deficit flow exists continuously for an operator-specified length of time, the chiller sequencing software shall initiate the start of the next production pump and chiller in the sequence. Lag chillers shall start in a similar manner to the lead chiller start sequence. The chiller sequencing software will unload operating chillers prior to starting a lag chiller.

D. The chiller sequencing software shall consider stopping another chiller whenever the excess flow in the bypass line exceeds 120 percent of the next off chiller's flow. The chiller sequencing software shall determine the quantity of excess flow by measuring the system and chiller supply and return water and bypass water temperatures. Mixing equations shall then be used to calculate the deficit flow volume. When the calculated excess flow exceeds 120 percent of the next off chiller's flow continuously for 15 minutes, the chiller sequencing software shall initiate the shutdown of the next production pump and chiller in the sequence. The excess flow setpoint and duration shall be easily modifiable by the chiller systems operator. The chiller sequencing software will not shutdown the production pump until it has confirmed that the chiller compressor has shutdown.

E. The chiller sequencing software shall control individual chiller setpoints to the system supply water temperature setpoint. The system setpoint shall be 44 degrees F and shall be adjustable by the operator. Chilled water reset shall not be used. Prior to the start of another chiller, all operating chillers shall be unloaded. Following confirmation of the additional chiller operation, all chillers shall be allowed to reload. Upon sensing a chiller failure, the chiller sequencing software shall lockout that chiller and pump and immediately initiate the start of the next chiller in the rotation sequence. Automatic rotation of chiller operation will equalize chiller run time. Rotation shall be initiated based on an operator entered day interval or by the cycling of a binary point. The method of sequence shall be operator selectable. Chillers may be forced into a new rotation sequence by cycling chillers at the time of initiation. Alternatively, chiller cycling caused by normal system load fluctuations shall cause the chillers to change rotation sequence.

F. Chiller Soft Start: The chiller sequencing software will provide a user adjustable loading time at system start-up.

G. Chiller Demand Limiting: As part of the demand limiting scheme on the building, the chiller sequencing software shall be able to monitor and reduce peak power demand through the limiting of chiller system capacity.

H. Chiller Status Report: Provide an operating status report for each chiller. The report(s) shall provide the present status of all binary information and for analog information present value, today's average, and the month to date average for the following information to provide the operator with critical chiller operating data.
1. Compressor ON/OFF Status
2. Active Chiller Diagnostics of Alarms
3. System Chilled Water Supply Temperature
4. System Chilled Water Return Temperature
5. System Chilled Water Setpoint

6. System Chilled Water Flow (GPM)
7. Chiller Leaving Water Temperature
8. Chiller Entering Water Temperature
9. Chilled Water Setpoint
10. Chilled Water Flow Status
11. Operating Mode
12. Chiller Model and Serial Number
13. KW Limit Status

4.9 HOT WATER SYSTEM CONTROL:

A. The Hot Water System will be directly controlled by the EMCS. The system will consist of a constant flow hot water production piping loop and a variable flow hot water distribution piping loop. In the Occupied Mode and Unoccupied Mode, the primary variable flow hot water distribution pump will be started upon a call for heat from any control module. If the primary pump fails to provide flow, the standby distribution pump will be started, and a primary pump alarm will be generated. If the standby pump also fails to provide flow, a standby alarm will be generated, and the hot water production pumps and boilers will be shut down.

B. Every seven days, the primary and secondary distribution pumps shall automatically exchange positions. Once flow is established in the hot water distribution loop, the hot water production pumps and boilers will be staged on and off as necessary to maintain the indicated hot water supply temperature. Internal boiler controls will operate the gas burners as needed. Every seven days, the production pumps and boilers shall automatically rotate positions to equalize wear. A boiler will not be allowed to fire unless flow is proven in its production loop. Pump failure shall generate an alarm. The boilers and boiler pumps shall be staged as need to maintain the hot water loop setpoint of 130 deg F. (Adjustable.)

C. Boiler Status Report: Provide an operating status report for each boiler. The report(s) shall provide the present status of all binary information and for analog information present value, today's average, and the month to date average for the following information to provide the operator with critical boiler operating data.
   1. Boiler Firing Status
   2. Active Boiler Diagnostics or Alarms
   3. System Hot Water Supply Temperature
   4. System Hot Water Return Temperature
   5. System Hot Water Setpoint
   6. System Hot Water Flow GPM
   7. Boiler Leaving Water Temperature
   8. Boiler Water Flow Status
   9. Boiler Water Setpoint
   10. Boiler Model and Serial Number
   11. Outside Air Temperature

4.10 ROOF AIR CONDITIONERS (RAC):

A. Roof Air Conditioners shall be controlled by space temperature and relative humidity sensors. During Occupied Mode, supply fans shall run continuously, outside air dampers shall be open, and cooling and heating modes shall cycle as needed to maintain space temperature setpoint. During Unoccupied Mode, supply fans shall run intermittently, and outside air dampers shall be closed.

B. The unit shall shut down and generate an alarm upon receiving an emergency shutdown signal. The unit shall shut down and generate an alarm upon receiving a smoke detector status. The

unit shall shut down upon activation of building fire alarm. Monitor air treatment status.

C. Units shall operate in Dehumidification Mode whenever indoor relative humidity exceeds 55% (adjustable) and force the unit into full cooling until the indoor relative humidity falls below 50% (adjustable). During Dehumidification Mode, hot gas reheat shall operate to maintain the indoor setpoint. Roof Air Conditioners serving gymnasiums with wood flooring shall have relative humidity setpoints adjusted as required by the wood flooring manufacturer's warranty documents.

D. Where scheduled on the plans, provide Staged Air Volume control.

E. Units shall operate in Economizer Mode whenever outside air temperature is less than 55 F (adj.) and the outside air temperature is less than the return air temperature and the supply fan status is on. The economizer shall close whenever mixed air temperature drops from 45 F to 40 F (adj.) or on loss of supply fan status. Controller shall measure the zone temperature and modulate the economizer dampers in sequence to maintain a setpoint 2 F less than the zone cooling setpoint.

F. Outdoor Air Control:
   1. All units except those noted below shall provide Occupied Mode OA CFM at constant 100% of scheduled value regardless of unit supply airflow.

G. Provide full DDC control by EMCS.

4.11 DUCTLESS HEAT PUMPS:

A. Provide control of each ductless air handler or cassette through the manufacturer provided thermostat control interface. Interface of unit into the building management system through the EMCS controller shall permit full control and scheduling of unit and shall provide all sensed values to EMCS. Ductless systems shall run in response to room temperature setpoint. Monitor air treatment status.

4.12 ELECTRIC HEATERS:

A. Wall Heaters, Unit Heaters, and Cabinet Heaters shall be controlled by integral thermostats and shall not be connected to EMCS.

4.13 SPACE TEMPERATURE CONTROL:

A. Space Temperature Measurement: There shall be two space temperature setpoints, one for cooling and one for heating, separated by a dead band. Only one of the two setpoints shall be operative at any time.
B. The cooling setpoint is operative if the actual space temperature has more recently been equal to or greater that the cooling setpoint. The heating setpoint is operative if the actual space temperature has more recently been equal to or less than the heating setpoint.
C. There are two modes of operation for the setpoints, one for the occupied mode (example: heating = 72 degrees F, cooling = 74 degrees F) and one for the unoccupied mode (example: heating = 65 degrees F, cooling = 85 degrees F).
D. The occupied/unoccupied modes may be scheduled by time, date, or day of week.
E. Provide remote temperature setpoint limiting.
F. Provide dynamic color graphics indicative of space temperature relative to setpoint.

4.14 EXHAUST FAN CONTROL:

A. EMCS Control: Fans scheduled to be "EMCS CONTROL" shall be controlled by EMCS to run continuously during Occupied Mode and be off during Unoccupied Mode. EMCS shall monitor fan status and generate an alarm for fan failure.

B. Wall Switch: Fans scheduled to be "WALL SWITCH CONTROL" shall be controlled by a wall mounted pushbutton time-delay switch labeled "Emergency Exhaust". Wall switch shall have a maximum runtime of 30 minutes (adjustable).

C. Thermostat Control: Fans scheduled to be "THERMOSTAT CONTROL" shall be controlled by wall mounted temperature sensors. EMCS shall monitor space temperature and fan status.

D. Interlock w/ Lights: Fans scheduled to be "INTERLOCK W/ LIGHTS" shall be interlocked with the light switch and shall not be monitored by EMCS.

E. Interlock w/ Fume Hood: Fans scheduled to be "INTERLOCK W/ FUME HOOD" shall be interlocked with the fume hood switch and EMCS shall monitor fan status and generate an alarm for fan failure.

F. Fan ON/OFF status shall be monitored and alarmed for all exhaust fans.

G. KEF-1 shall be interlocked with the Kitchen Hood Demand Control Ventilation System furnished with the kitchen hood.

H. KEF-2 shall be interlocked with the Kitchen Hood Demand Control Ventilation System furnished with the kitchen hood.

4.15 SUPPLY FAN CONTROL:

A. MAU-1 shall be interlocked with the Kitchen Hood Demand Control Ventilation System associated with KEF-1. EMCS shall remotely monitor and adjust MAU-1 discharge air temperature.
B. MAU-2 shall be interlocked with the Kitchen Hood Demand Control Ventilation System associated with KEF-2. EMCS shall remotely monitor and adjust MAU-1 discharge air temperature.

4.16 MISCELLANEOUS CONTROL:

A. Provide monitoring and alarm of kitchen freezer and cooler temperatures.
B. Provide enable/disable for domestic water heaters and associated recirculating pumps.
C. Provide global phase monitoring, electric meter pulse, water meter pulse, gas meter pulse, outside air temperature, outside air relative humidity, fire alarm control panel, security alarm panel.

END OF SECTION 23 83 10

SECTION 23 91 10 - MECHANICAL SOUND, VIBRATION, WIND AND SEISMIC CONTROL

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. Furnish all labor, materials, tools and equipment and perform all work necessary to complete the installation of the mechanical sound, vibration, wind and seismic control systems required by these specifications and as detailed on the drawings.

B. All foundations and supports required for the installation of Division 23 equipment shall be furnished by the Division 23 contractor shall unless specifically specified otherwise.

C. The following criteria applies to all mechanical systems and components:

1. Wind Pressure Velocity: 136 MPH
2. Seismic Design Category: B
3. Importance Factor: 1.0

D. Based on the criteria listed above, no seismic restraints are required.

1.2 RELATED DOCUMENTS:

A. The drawings and general provisions of this division of the Contract, including the General and Special Conditions and Division 1 Specifications, apply to this Section.

1.3 QUALITY ASSURANCE

A. Codes and Standards: The installation of the mechanical systems shall be installed in accordance with the following codes and standards.:

1. *2018 International Building Code* (IBC)
2. ASHRAE

B. The mechanical vibration wind and seismic control equipment and products shall be sized and provided by the manufacturers listed below. The manufacturer shall have tested all seismic products provided for the specific intended use and installation.

C. *Kinetics Noise Control* is the Basis of Design manufacturer. Equivalent name brand equipment by *AeroSonics, Aladdin*, *IAC Acoustics, Mason, MGM Products, Vibration Eliminator, Vibro-Acoustics* and *Vibration Mountings and Controls* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.

D. The manufacturer and/or his representative shall select all vibration isolation products in-accordance with the Vibration Isolation Schedule listed in these specifications. All products shall provide the specified deflection as indicated based on the actual equipment weights and installation requirements of the approved equipment. The manufacturer shall provide installation instructions for all provided isolators, and wind restraints. Locations of vibration isolation products shall be coordinated with equipment details shown on the drawings and also as specified in these specifications for maximum support locations for piping and other equipment.

E. Submittals:

1. The contractor shall submit for approval by the engineer all products intended to be used to meet the requirements of these specifications. Submittal data shall include a proposed schedule for vibration isolation products, manufacturer's data and cut sheets of the specific vibration isolation materials. Proposed Vibration Isolation Schedule shall list all equipment specified to be isolated, the equipment weight, proposed isolator type or base type, number of isolators required, spring or isolator color, and deflection of the spring or vibration isolator based on the equipment weight.
2. The contractor shall submit for approval by the engineer, wind anchorage requirements for all equipment and curbs. Anchorage calculations shall be prepared by a registered engineer in the state where the project will be constructed. The engineer shall stamp calculations. Wind anchorage requirements shall be submitted for all curb mounted

equipment and roof mounted equipment. Fasteners shall be selected and detailed for curb connections to the building structure and also for equipment connections to the curb. Calculations shall be based on the approved equipment for the project.

PART 2 - PRODUCTS

2.1 GENERAL:

A. All equipment shall be mounted or suspended from approved foundations and supports as specified herein or as detailed on the drawings.
B. The vibration isolation products and systems shall have a deflection as recommended by the manufacturer but not less than the deflection indicated in the Vibration Isolation Schedule.

2.2 ISOLATOR TYPES:

A. Type 2 - Floor Mounted Equipment: Vibration isolators shall be neoprene, molded from oil-resistant compounds. Isolators shall consist of two layers of neoprene material. Top and bottom surfaces of each layer shall have molded ribs. Each layer shall be separated by a 16 gauge galvanized steel load plate bonded to each neoprene layer to form a sandwich arrangement. Vibration isolator size shall be coordinated with the equipment supports. Minimum size shall be 2″x2″.
B. Type 4 - Floor-Mounted Equipment: Vibration isolators shall be free standing, un-housed, laterally stable springs wound from high strength spring steel. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. Springs shall be selected to provide operating static deflections shown on the Vibration Isolation Schedule or as indicated on the project documents. Springs shall be color coded or otherwise identified to indicate load capacity. In capacities up to 5,000 lbs., springs shall be replaceable. In capacities over 5,000 lbs., springs shall be welded to the top and bottom load plate assemblies. Springs shall be assembled between a top and bottom steel load plate. The upper load plate shall be provided with steel leveling bolt lock nut and washer for attachment to the supported equipment. The lower load plate shall have a non-skid noise isolation pad bonded to the bottom and have provisions for bolting the isolator to the supporting structure.
C. Type 8 - Suspended Equipment and Ductwork: Vibration isolators shall be a hangers consisting of an elastomer-in-shear insert encased in a welded steel bracket and provided with a stamped load transfer cap. The elastomer insert shall be neoprene, molded from oil resistant compounds and shall be color coded to indicate load capacity and selected to operate within its published load range. The hanger bracket shall be designed to carry a 500% overload without failure and to allow a support rod misalignment through a 30-degree arc without metal-to-metal contact or other short circuit.
D. Type 9 - Suspended Equipment, Piping and Ductwork: Vibration isolators shall be hangers consisting of a freestanding, laterally stable steel spring and elastomeric washer in series, assembled with load transfer plates in a stamped or welded steel bracket. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity.
E. Type 10 - Suspended Equipment, Piping and Ductwork: Vibration Isolators shall consist of a steel spring and neoprene element in series mounted in a stamped or welded steel bracket for insertion into the hanger rod assembly. The elastomer insert shall be neoprene, molded from oil resistant compounds and shall be color coded to indicate load capacity and selected to operate within its published load range. The steel spring shall consist of large diameter laterally stable steel springs assembled into formed or welded steel housing assemblies designed to limit movement. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. The steel bracket shall be fabricated from steel and provided with a corrosion resistance finished.

The hanger bracket shall be designed to carry a 500% overload without failure and to allow a support rod misalignment through a 30-degree arc without metal-to-metal contact or other short circuit. The hanger bracket shall incorporate spring caps with indexed steps, which correspond to the washer diameter of the hanger rod to keep the rod centered in the spring cap.

2.3 BASES AND RAILS:

A. Type B - Concrete Inertia Bases: Bases shall consist of a concrete base cast into a welded galvanized steel-pouring frame with welded isolator brackets and steel reinforcing rods. Minimum depth shall be 6". Bases shall be specifically designed and fabricated to receive poured concrete for use in supporting the intended equipment. The concrete pouring frame shall contain ½" reinforcing rods on 8" centers each way. The isolator brackets shall be located on each corner of the pouring frame and be located so that a minimum of 1" clearance is provided in an operating condition between the bottom of the base and the support floor or base. Pouring frame shall contain a template for locating the anchor bolts for the supported equipment.

B. Type C - Roof Mounted Equipment Vibration Isolation Rails: Vibration isolation rails shall be extruded aluminum or G90 galvanized steel consisting of a lower support rail, upper support rail, steel springs located between the support rails and a continuous weatherproof seal located between the upper and lower support rails. Vibration isolation rails shall be fabricated and designed to be installed and secured on top of the equipment manufacturer's roof curb. Isolation rails shall provide continuous support for the roof-mounted equipment. Isolation rails shall be designed and engineered to provide isolation against casing radiated vibration and structure born vibration from rotating equipment. The steel springs shall consist of large diameter laterally stable steel springs that have a lateral stiffness greater than 1.0 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. Isolation rails shall have seismic restraints fabricated and attached to the isolation rail assembly to resist the horizontal forces. Seismic restraints shall be certified by the manufacturer and stamped by a registered engineer. Isolation rail assemblies shall include supply and return duct block-outs as an integral part of the isolation rail assembly. Springs must be removable and adjustable without disturbing the roof while equipment is in place.

2.4 VIBRATION ISOLATION SCHEDULE FOR MECHANICAL SYSTEMS:

Equipment Type	Isolator Type	Base Type	Deflection
Floor Mounted AHU	Type 2	Slab	0.2"
In-line Suspended Fan	Type 9	None	1.0"
Air Cooled Chiller	Type 2	Slab	0.2"
Base Mounted Pump	Type 4	Type B	1.0"
In-line Pump	Type 10	None	1.0"
Mechanical Room Piping	Type 10	None	1.0"
Roof Air Conditioner	Type 4	Type C	2.0"
Roof VHP	Type 2	Roof Curb	0.2"
Mechanical Room Ductwork	Type 8	None	0.4"
Fan Powered ATU	Type 10	None	1.0"

Notes:
1. Concrete inertia base for pump up to 30 HP shall be 6" thick.
2. Concrete inertia base for pump 40-75 HP shall be 8" thick.

PART 3 - EXECUTION

3.1 GENERAL:

A. If the equipment provided is not furnished with integral structural steel supports, mounting feet or lifting lugs, the contractor shall provide miscellaneous steel shapes as required to install or suspend the equipment and attach the vibration isolation or seismic restraints as specified herein.
B. Support steel shall include but not be limited to rails, brackets, angles, channels, and similar components.
C. All equipment specified to be isolated shall be installed and isolators shall be attached to the building structure or floor and the vibration isolators shall be adjusted and leveled so that the vibration isolators are performing properly.
D. All vibration isolation products, seismic restraint products, flexible pipe connectors and sound control products shall be installed as outlined in the manufacturer's printed installation instructions.
E. For equipment scheduled to receive external vibration isolation, all factory-installed internal vibration isolation shall be locked down.

END OF SECTION 23 91 10

SECTION 23 92 10 - MECHANICAL TESTING, ADJUSTING, BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. General: An independent test agency shall perform the TAB work as described herein. The agency shall have a minimum of 3 years of successful TAB experience on projects of similar size and scope. The name of the test agency and proof of satisfactory performance on 5 previous projects in the form of projects referenced shall be submitted to the Architect for approval within 30 days after receipt of the construction contract.

B. Test Agency: A firm with membership in the *Associated Air Balance Council* (AABC) or certified by the *National Environmental Balancing Bureau* (NEBB) in those testing and balancing disciplines similar to those required for this project, who is not the Installer of the system to be tested, and is otherwise independent of the project.

C. Compliance: Comply with AABC standards or NEBB *Procedural Standards for Testing-Adjusting-Balancing of Environmental Systems* as applicable to mechanical air systems and associated equipment apparatus.

D. Industry Standards: Comply with ASHRAE (*American Society for Heating, Refrigeration and Air Conditioning Engineers, Inc.*) recommendations pertaining to measurements, instruments, and testing, adjusting, and balancing except as otherwise indicated.

E. Pre-Qualified TAB Agencies: Subject to compliance with requirements, engage one of the following the following certified Test and Balance Agencies:

1. *Air Analysis of Atlanta*
2. *TAB Services*
3. *Commissioning Services LLC.*
4. *Thomas Balancing*
5. *Georgia Balance Company*
6. *Augusta Air Balance Company*
7. *Research Air Flo, Inc.*

1.3 SUBMITTALS:

A. Submit name of TAB Agency for approval within 60 days after Notice to Proceed.

B. Submit 5 copies of a certified test report signed by the TAB supervisor who performed the TAB work. Test reports shall be submitted prior to the final inspection of mechanical work.

1. Include identification and types of instruments used and their most recent calibration date with submission of final test report.
2. In addition to Air Balance and operational data required to be submitted, the report shall include any observation of unusual noise or vibration observed and any malfunction of adjustable devices encountered during TAB work.

C. Submit AABC National Performance Guaranty or NEBB Certificate of Conformance Certification for the project.

1.4 JOB CONDITIONS:

A. Do not proceed with testing, adjusting and balancing work until mechanical systems are complete and operable. Do not proceed until systems are clean and free from debris, dirt, and discarded building materials.

PART 2 – PRODUCTS

2.1 PATCHING MATERIALS:

A. Except as otherwise indicated, use the same products as used by original Installer for patching holes in insulation, ductwork and housing which may have been cut or drilled for test purposes, including access for test instruments, attaching jigs and similar purposes.

2.2 TEST INSTRUMENTS:

A. Utilize test instruments and equipment for the TAB work required, of the type, precision and capacity as recommended in AABC standards or NEBB Procedural Standards for Testing-Adjusting-Balancing of Environmental Systems.

PART 3 - EXECUTION

3.1 SCOPE:

A. Test, Adjust, and Balance the following:
   1. Ductless Heat Pumps and Air Handlers
   2. Split System Heat Pumps and Air Handlers
   3. Electric Heaters
   4. Make-up Air Units
   5. Roof Air Conditioning Units
   6. Fans
   7. Air Inlets and Outlets
   8. Pumps
   9. Chillers
   10. Boilers
   11. Air Handling Units
   12. Terminal Units
   13. Hot Water Coils
   14. Fan Coil Units

3.2 GENERAL REQUIREMENTS:

A. Perform total system balance in accordance with one of the following:
   1. *AABC, AABC National Standards for Total System Balance*.
   2. *NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems*.
B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work and submit Report prior to the Final Observation of the project.
C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
D. Reports shall be certified by an AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing, and Adjusting Supervisor experienced in performance of this Work.

3.3 EXAMINATION:

A. Review the contract documents for appurtenances and arrangement for balancing prior to the installation of any equipment or material. These shall include gauges, test plugs, valves, air volume balancing dampers, etc. The contractor shall be responsible for providing these in the locations recommended by the TAB agency in addition to any shown on the drawings or specified. Verify that duct layout design allows the TAB agency to perform duct pitot traverses to verify system air flows.
B. The Contractor shall notify the Architect of any omissions noted within 30 days of the Contractor's notice to proceed.
C. Verify that airside and hydronic systems are complete and operable before commencing work. Ensure the following conditions:
   1. Systems are started and operating in a safe and normal condition.

2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. All filters are clean and in place. If required, install temporary media in addition to filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place, accessible, operable, and open. Report observation on test report.
8. All dampers and operators function smoothly from shut-off to full open.
9. Air coil fins are cleaned and combed.
10. Access doors are installed at specified components are accessible, are closed and duct end caps are in place.
11. Air outlets are installed and connected.
12. Duct system leakage is minimized.
13. Piping is complete with all terminals installed.
14. Water treatment is complete.
15. Systems are flushed, filled and air purged.
16. Strainers are pulled and cleaned.
17. Control valves are functioning per the sequence of operation.
18. All shutoff and balance valves have been verified to be 100% open.
19. Pumps are started, and proper rotation is verified.
20. Pump gauge connections are installed directly at the pump inlet and outlet flange or in discharge and suction pipe prior to any valves or strainers.
21. VFD start-up is complete and all safeties have been verified for airside and hydronic systems.

D. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.

3.4 INSTALLATION TOLERANCES:

A. Air Systems: Set HVAC system's air flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
   2. Air Outlets and Inlets: Plus or minus 10 percent.
B. Hydronic Systems: Set HVAC system's water flow rates within the following tolerances:
   1. Heating-Water Flow Rate: Plus or minus 10 percent.
   2. Cooling-Water Flow Rate: Plus or minus 10 percent.
   3. Condenser Water Flow Rate: Plus or minus 10 percent.
C. Building Pressure: Ensure that installation tolerances result in each floor of the building being positively pressurized with respect to outside ambient pressure.

3.5 RECORDING AND ADJUSTING:

A. Field Logs: Maintain written logs including:
   1. Running logs of events and issues.
   2. Discrepancies, deficient or uncompleted work by others.
   3. Contract interpretation requests.
   4. Lists of completed task.
B. Ensure recorded data represents actual measured or observed conditions.
C. Permanently mark setting of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
D. Mark on the drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.6 FINAL TEST AND BALANCE REPORT:

A. The report shall be a complete record of the HVAC system performance in heating and cooling modes, including conditions of operation, items outstanding, and any deviations found during the TAB process. The final report also provides a reference of actual operating conditions for the owner and/or operations personnel. All measurements and test results that appear in the reports must be made on site and dated by the TAB technicians or test and balance engineers. Report shall contain test results, including instrumentation calibration reports, in the form recommended by the applicable standards.

B. The report must be organized by systems and shall include the following information as a minimum:

1. Title Page:
    a. Certified company name
    b. Company address
    c. Company telephone number
    d. Project identification number
    e. Location
    f. Project Architect
    g. Project Engineer
    h. Project Contractor
    i. Project number
    j. Date of report
    k. AABC or NEBB Certification Statement
    l. Name, signature, and certification number of AABC TBE or NEBB Qualified TAB Supervisor
2. Table of Contents
3. AABC National Performance Guaranty or NEBB Certificate of Conformance Certification
4. Report Summary:
    a. The summary shall include a list of items that do not meet design tolerances, with information that may be considered in resolving deficiencies.
5. Instrument List:
    a. Type
    b. Manufacturer
    c. Model
    d. Serial Number
    e. Calibration Date
6. Test and Balance Data:
    a. Provide test data for specific systems and equipment as required by the most recent edition of the "AABC National Standards" or "NEBB Procedural Standards for Testing Adjusting and Balancing of Environmental Systems".

3.7 MINIMUM REQUIRED TEST DATA FOR SYSTEMS:

A. The following test data shall be submitted for each system type in addition to what is required by the "AABC National Standards" or "NEBB Procedural Standards for Testing Adjusting and Balancing of Environmental Systems".

B. Ductless Heat Pumps and Air Handlers:

1. Identification/ Number.
2. Manufacturer model number and serial number of indoor and outdoor units.
3. Design and actual supply airflow.
4. Design and actual outside airflow.
5. Cooling mode: design entering and leaving air DB/WB.
6. Cooling mode: actual entering and leaving air DB/WB. (w/ concurrent OA temp)
7. Heating mode: design entering and leaving air DB.

8. Heating mode: actual entering and leaving air DB. (w/ concurrent OA temp)
9. Verification that air treatment device is installed and operational.
10. Record all notes pertinent to the test.

C. Split System Heat Pumps and Air Handlers:
1. Identification/ Number.
2. Manufacturer model number and serial number of indoor and outdoor units.
3. Design and actual supply airflow.
4. Design and actual outside airflow.
5. Cooling mode: design entering and leaving air DB/WB.
6. Cooling mode: actual entering and leaving air DB/WB. (w/ concurrent OA temp)
7. Heating mode: design entering and leaving air DB.
8. Heating mode: actual entering and leaving air DB. (w/ concurrent OA temp)
9. Verification that air treatment device is installed and operational.
10. Record all notes pertinent to the test.

D. Electric Heaters:
1. Identification/ Number.
2. Manufacturer model number and serial number.
3. Design supply airflow.
4. Heating coil: design entering and leaving air DB.
5. Heating coil: actual entering and leaving air DB.
6. Design and calculated KW.
7. Record all notes pertinent to the test.

E. Make-up Air Units:
1. Identification/ Number.
2. Manufacturer model number and serial number.
3. Design and actual supply airflows (Max and Min).
4. Design and actual supply fan RPM, voltage, amperage, ESP and Total SP. (@ max airflow)
5. Supply fan sheave and belt data.
6. Heating coil: design entering and leaving air DB. (@ max airflow)
7. Heating coil: actual entering and leaving air DB. (@ max airflow)
8. Design and calculated KW.
9. Record all notes pertinent to the test.

F. Roof Air Conditioning Units (Constant Volume):
1. Identification/ Number.
2. Manufacturer model number and serial number.
3. Design and actual supply fan airflow, RPM, voltage, amperage, ESP and Total SP.
4. Supply fan sheave and belt data.
5. Design and actual outside airflow.
6. Cooling coil: design entering and leaving air DB/WB.
7. Cooling coil: actual entering and leaving air DB/WB. (w/ concurrent OA temp)
8. Heating coil: design entering and leaving air DB.
9. Heating coil: actual entering and leaving air DB.
10. Design and calculated heater KW.
11. Verification that air treatment device is installed and operational.
12. Record all notes pertinent to the test.

G. Roof Air Conditioning Units (Staged Air Volume):
1. Identification/ Number.
2. Manufacturer model number and serial number.
3. Design and actual Max supply fan airflow, RPM, voltage, amperage, ESP and Total SP.
4. Design and actual Min supply fan airflow.
5. Supply fan sheave and belt data.
6. Design and actual outside airflow. (@ max and min airflow)
7. Cooling coil: design entering and leaving air DB/WB.

8. Cooling coil: actual entering and leaving air DB/WB. (@ max airflow w/ concurrent OA temp)
9. Heating coil: design entering and leaving air DB.
10. Heating coil: actual entering and leaving air DB. (@ max airflow)
11. Design and calculated heater KW.
12. Hot Gas reheat coil: design entering and leaving air DB/WB.
13. Hot Gas reheat coil: actual entering and leaving air DB/WB. (w/ concurrent OA temp)
14. Verification that air treatment device is installed and operational.
15. Record all notes pertinent to the test.

H. Fans:
1. Identification/ Number.
2. Manufacturer model number and serial number.
3. Design and actual fan airflow, RPM, voltage, amperage, ESP and Total SP.
4. Fan sheave and belt data.

I. Air Distribution Tests:
1. Air terminal number.
2. Room number/ location.
3. Terminal type and size.
4. Design air flow.
5. Actual (final) air flow.
6. Percent of design air flow.
7. Relative position of balancing damper.

J. Duct Traverses:
1. System zone/ branch.
2. Duct size.
3. Area.
4. Design velocity and air flow.
5. Actual velocity and air flow.
6. Duct static pressure.
7. Air correction factor.

K. Space Temperature and Humidity:
1. Temperature and relative humidity (whether controlled or not) of each conditioned space.
2. Set point of each controlling thermostat or humidity sensing device.

L. Pumps:
1. Identification/ Number.
2. Manufacturer model number and serial number.
3. Motor model number and serial number.
4. Motor horsepower, frame size, full load amps, and service factor.
5. Motor voltage and phase and actual operating voltage.
6. Motor nameplate amps, corrected amps, and actual operating amps.
7. Design and actual motor rpm.
8. VFD setting for Min and Max waterflow in Hz.
9. Installed impeller diameter.
10. Verification of proper impeller rotation.
11. Design and actual waterflow.
12. Shutoff suction pressure in psi and ft. hd.
13. Shutoff discharge pressure in psi and ft. hd.
14. Shutoff design and actual total dynamic head in psi and ft. hd
15. Final suction pressure in psi and ft. hd.
16. Final discharge pressure in psi and ft. hd.
17. Final design and actual total dynamic head in psi and ft. hd.
18. Hydronic system ΔP setpoint.
19. Record all notes pertinent to the test.

M. Chillers (Air Cooled):
   1. Identification/ Number.
   2. Manufacturer model number and serial number.
   3. Evaporator: Design and actual waterflow.
   4. Evaporator: Design inlet and outlet water temperatures.
   5. Evaporator: Actual inlet and outlet water temperatures. (w/ concurrent OA temp)
   6. Evaporator: Design and actual pressure drop.
   7. Design and calculated tonnage.
   8. Condenser fan quantity and motor data.
   9. Verification of condenser fan(s) proper rotation.
   10. Record all notes pertinent to the test.

N. Boilers:
   1. Identification/ Number.
   2. Manufacturer model number and serial number.
   3. Design and actual waterflow.
   4. Design inlet and outlet water temperatures.
   5. Actual inlet and outlet water temperatures.
   6. Design and actual pressure drop.
   7. Design and calculated capacity.
   8. Verification that safety and relief devices are installed and operational.
   9. Record all notes pertinent to the test.

O. Air Handling Units (AHU):
   1. Identification/ Number.
   2. Manufacturer model number and serial number.
   3. Motor model number and serial number.
   4. Motor horsepower, frame size, full load amps, and service factor.
   5. Motor voltage and phase and actual operating voltage.
   6. Motor nameplate amps, corrected amps, and actual operating amps.
   7. Design and actual motor and fan rpm.
   8. Installed wheel type and diameter.
   9. Supply fan sheave and belt data.
   10. Verification of proper wheel rotation.
   11. Filter quantity, size, type, and condition.
   12. Design and actual Max supply fan airflow, ESP and Total SP.
   13. Design and actual Min supply fan airflow.
   14. Design and actual outside airflow. (@ max and min airflow)
   15. VFD setting for Min and Max airflow in Hz.
   16. System ΔP setpoint.
   17. System static pressure profile.
   18. Heating coil: design entering and leaving air DB.
   19. Heating coil: actual entering and leaving air DB. (@ heating airflow)
   20. Cooling coil: design entering and leaving air DB.
   21. Cooling coil: actual entering and leaving air DB. (@ min and max airflow)
   22. Design and actual waterflow for each coil. (measured from Flow Verification Device)
   23. Design inlet and outlet water temperatures for each coil.
   24. Actual inlet and outlet water temperatures for each coil.
   25. Design and actual coil pressure drop for each coil.
   26. Automatic Flow Control Device manufacturer, type, and size for each coil.
   27. Automatic Flow Control Device design and actual pressure drop for each coil.
   28. Flow Verification Device manufacturer, type, and size for each coil.
   29. Flow Verification Device design and actual pressure drop for each coil.
   30. Verification that air treatment device is installed and operational.
   31. Record all notes pertinent to the test.

P. Terminal Units (Single Duct Hot Water Coil):
   1. Identification/ Number.
   2. Manufacturer model number and serial number.
   3. Design and actual Max cooling airflow.
   4. Design and actual Min cooling airflow.
   5. Design and actual heating airflow.
   6. Flow correction value.
   7. Heating coil: design entering and leaving air DB.
   8. Heating coil: actual entering and leaving air DB. (@ heating airflow)
   9. Design and actual waterflow.
   10. Design inlet and outlet water temperatures.
   11. Actual inlet and outlet water temperatures.
   12. Design and actual coil pressure drop.
   13. Automatic Flow Control Device manufacturer, type, and size.
   14. Automatic Flow Control Device design and actual pressure drop.
   15. Flow Verification Device manufacturer, type, and size.
   16. Flow Verification Device design and actual pressure drop.
   17. Record all notes pertinent to the test.

Q. Terminal Units (Fan Powered Hot Water Coil):
   1. Identification/ Number.
   2. Manufacturer model number and serial number.
   3. Motor model number and serial number.
   4. Motor horsepower, full load amps, and service factor.
   5. Motor voltage and phase and actual operating voltage.
   6. Motor nameplate amps, corrected amps, and actual operating amps.
   7. Design and actual motor and fan rpm.
   8. Verification of proper wheel rotation.
   9. Design and actual Max cooling airflow.
   10. Design and actual Min cooling airflow.
   11. Design and actual fan airflow.
   12. Design and actual heating airflow.
   13. Flow correction value.
   14. Heating coil: design entering and leaving air DB.
   15. Heating coil: actual entering and leaving air DB. (@ heating airflow)
   16. Design and actual waterflow.
   17. Design inlet and outlet water temperatures.
   18. Actual inlet and outlet water temperatures.
   19. Design and actual coil pressure drop.
   20. Automatic Flow Control Device manufacturer, type, and size.
   21. Automatic Flow Control Device design and actual pressure drop.
   22. Flow Verification Device manufacturer, type, and size.
   23. Flow Verification Device design and actual pressure drop.
   24. Record all notes pertinent to the test.

R. Hot Water Coil:
   1. Identification/ Number.
   2. Manufacturer model number and serial number.
   3. Design and actual airflow.
   4. Heating coil: design entering and leaving air DB.
   5. Heating coil: actual entering and leaving air DB. (@ heating airflow)
   6. Design and actual waterflow.
   7. Design inlet and outlet water temperatures.
   8. Actual inlet and outlet water temperatures.
   9. Design and actual coil pressure drop.

10. Automatic Flow Control Device manufacturer, type, and size.
11. Automatic Flow Control Device design and actual pressure drop.
12. Flow Verification Device manufacturer, type, and size.
13. Flow Verification Device design and actual pressure drop.
14. Record all notes pertinent to the test.

S. Fan Coil Units (FCU):
1. Identification/ Number.
2. Manufacturer model number and serial number.
3. Motor model number and serial number.
4. Motor horsepower, full load amps, and service factor.
5. Motor voltage and phase and actual operating voltage.
6. Motor nameplate amps, corrected amps, and actual operating amps.
7. Design and actual motor rpm.
8. Installed wheel type and diameter.
9. Supply fan sheave and belt data. (If applicable)
10. Verification of proper wheel rotation.
11. Filter quantity, size, type, and condition.
12. Design and actual airflow, ESP and Total SP.
13. Heating coil: design entering and leaving air DB.
14. Heating coil: actual entering and leaving air DB.
15. Cooling coil: design entering and leaving air DB.
16. Cooling coil: actual entering and leaving air DB.
17. Design and actual waterflow for each coil.
18. Design inlet and outlet water temperatures for each coil.
19. Actual inlet and outlet water temperatures for each coil.
20. Design and actual coil pressure drop for each coil.
21. Automatic Flow Control Device manufacturer, type, and size for each coil.
22. Automatic Flow Control Device design and actual pressure drop for each coil.
23. Flow Verification Device manufacturer, type, and size for each coil.
24. Flow Verification Device design and actual pressure drop for each coil.
25. Verification that air treatment device is installed and operational.
26. Record all notes pertinent to the test.

T. Energy Management and Controls System Verification:
1. Confirm that the sequences of operation are in compliance with the approved drawings.
2. Verify that controllers are calibrated and function as intended.
3. Verify that controller setpoints are as specified.
4. Verify the operation of lockout or interlock systems.
5. Verify the operation of all valve and damper actuators.
6. Verify that all controlled devices are properly installed and connected to the correct controller.
7. Verify that all controlled devices travel freely and are in the position indicated by the controller: open, closed, or modulating.
8. Verify the location and installation of all sensors to ensure they will sense only the intended temperatures, humidities, or pressures.

3.8 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS:

A. Prepare test reports for both fans and outlets. Obtain approved submittals and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare single-line schematic diagram of systems for the purpose of identifying HVAC components.

C. Determine the best locations in main and branch ducts for accurate duct-airflow

measurements.

D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
E. Verify that motor starters are equipped with properly sized thermal protection.
F. Check condensate drains for proper connections and functioning.

G. Check for proper sealing of air-handling-unit components.

3.9 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS:

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure total airflow.
      a. Set outside air, return air and relief air dampers for proper position that simulates minimum outdoor air conditions.
      b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
      c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
      d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
   2. Measure fan static pressures as follows:
      a. Measure static pressure directly at the fan outlet or through the flexible connection.
      b. Measure static pressure directly at the fan inlet or through the flexible connection.
      c. Measure static pressure across each component that makes up the air-handling system.
      d. Report any artificial loading of filters at the time static pressures are measured.
   3. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
   1. Measure airflow of submain and branch ducts.
   2. Adjust sub-main and branch duct volume dampers for specified airflow.
C. Re-measure each sub-main and branch duct after all have been adjusted.
   1. Adjust air inlets and outlets for each space to indicated airflows.
   2. Set airflow patterns of adjustable outlets for proper distribution without drafts.
   3. Measure airflow at all inlets and outlets.
   4. Adjust each inlet and outlet for specified airflow.
D. Re-measure each inlet and outlet after all have been adjusted.
E. Verify final system conditions.
F. Re-measure and confirm minimum outdoor air, return and relief airflows are within design. Readjust to design if necessary.
G. Re-measure and confirm total airflow is within design.
H. Re-measure all final fan operating data, rpms, volts, amps, static profile.
I. Mark all final settings.
J. Test system in economizer mode. Verify proper operation and adjust, if necessary.
K. Measure and record all operating data.
L. Record final fan-performance data.

3.10 PROCEDURES FOR VARIABLE AIR VOLUME SYSTEMS:

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located 2/3 of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control setpoint so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
    a. Adjust controls so that terminal is calling for maximum airflow (note some controllers require starting with minimum airflow. Verify calibration procedure for specific project).
    b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
    c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
    d. Adjust controls so that terminal is calling for minimum airflow.
    e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
    f. When in full cooling or full heating, ensure that there is no mixing of hot deck and cold deck airstreams unless so designed.
    g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
5. After all terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
    a. Set outside air, return air and relief air dampers for proper position that simulates minimum outdoor air conditions.
    b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
    c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
6. Measure fan static pressures as follows:
    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report any artificial loading of filters at the time static pressures are measured.
7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
    b. Verify all terminal units are meeting design airflow under system maximum flow.
8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure setpoint to the most energy-efficient setpoint to maintain the optimum system static pressure. Record setpoint and give to controls contractor.

9. Verify final system conditions as follows:
    a. Re-measure and confirm minimum outdoor air, return and relief airflows are within design. Readjust to design if necessary.
    b. Re-measure and confirm total airflow is within design.
    c. Re-measure all final fan operating data, rpms, volts, amps, static profile.
    d. Mark all final settings.
    e. Test system in economizer mode. Verify proper operation and adjust, if necessary. Measure and record all operating data.
    f. Verify tracking between supply and return fans.

3.11 AIR SYSTEM PROCEDURE:

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.
B. Make air quantity measurements in ducts by Pitot tube traverse if entire cross-sectional area of duct. Close openings after measurement with permanent manufactured plugs.
C. Measure air quantities at air inlets and outlets.
D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers.
F. Vary total system air quantities by adjustment of fan speeds by drive sheave adjustment. Provide drive changes required to place belt in mid-position at final RPM. Vary branch air quantities by damper regulation.
G. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions. Adjust operators on outside air dampers to ensure tight seal when shut.
H. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

3.12 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS:

A. Prepare test reports for pumps, coils and heat exchangers. Obtain approved submittals and any manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.
B. Verify that hydronic systems are ready for testing and balancing:
    1. Check liquid level in expansion tank.
    2. Check that makeup water-has adequate pressure to highest vent.
    3. Check that control valves are in their proper position.
    4. Locate start-stop and disconnect switches, electrical interlocks, variable frequency drives, and motor starters.
    5. Verify that motor starters are equipped with properly sized thermal protection.
    6. Check that air has been purged from the system.

3.14 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS:

A. Adjust pumps to deliver total design gpm.
    1. Measure total water flow.
        a. Position valves for full flow through coils.
        b. Measure flow by main flow meter, if installed.
        c. If main flow meter is not installed determine flow by pump total dynamic head (TDH) or exchanger pressure drop.
    2. Measure pump TDH as follows:
        a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.

b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
c. Convert pressure to head and correct for differences in gauge heights.
d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
e. With all valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

B. Adjust flow measuring devices installed in mains and branches to design water flows.
1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow measuring devices installed at terminals for each space to design water flows.
1. Measure flow at all terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after all have been adjusted.
4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after all flows have been balanced.

D. For systems with pressure-independent valves at the terminals:
1. Measure differential pressure and verify that it is within manufacturer’s specified range.
2. Perform temperature tests after all flows have been verified.

E. For systems without pressure-independent valves or flow measuring devices at the terminals:
1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after all flows have been verified.

F. Verify final system conditions as follows:
1. Re-measure and confirm that total water flow is within design.
2. Re-measure all final pumps' operating data, TDH, volts, amps, static profile.
3. Mark all final settings.

G. Verify that all memory stops have been set.

3.15 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS:

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

B. Adjust the variable-flow hydronic system as follows:
1. Verify that the differential-pressure sensor is located per the contract documents.
2. Determine if there is diversity in the system.

C. For systems with no diversity:
1. Follow procedures outlined in "Procedures for Constant-Flow Hydronic Systems" Article.
2. Prior to verifying final system conditions, determine the system differential-pressure set point.
3. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
4. Mark all final settings and verify that all memory stops have been set.

D. For systems with diversity:
1. Determine diversity factor.

2. Simulate system diversity by closing required number of control valves, as approved by the design engineer.
3. Follow procedures outlined in "Procedures for Constant-Flow Hydronic Systems" Article.
4. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance the terminals that were just opened.
5. Prior to verifying final system conditions, determine the system differential-pressure set point.
6. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.

7. Mark all final settings and verify that all memory stops have been set.

3.16 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS:

A. Follow general procedures for hydronic systems.
B. Balance the primary circuit flow first.
C. Balance the secondary circuits after the primary circuits are complete.

3.17 TESTING:

A. Tester must examine the installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned and is operable. Notify the Contractor in writing of conditions detrimental to the proper completion of the test-adjusting-balancing work. Do not proceed with the TAB work until unsatisfactory conditions have been corrected in a manner acceptable to Tester.
B. Airflows shown on drawings are provided as a guide to achieve uniform room temperature throughout the building. Field correct as required to suite room condition. Any substantial alteration shall be called to the engineer's attention.

END OF SECTION 23 92 10

SECTION 26 01 00 - GENERAL PROVISIONS - ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 IMPOSED REGULATIONS:

A. Applicable provisions of the State and Local Codes and of the following codes and standards are hereby imposed on a general basis for electrical work:

1. NEC, National Electrical Code (NFPA No. 70), with Georgia Amendments.
2. The Life Safety Code (NFPA No. 101), with Georgia Amendments.
3. State of Georgia ADA Accessibility Guidelines for Building and Facilities.
4. The Standard Building Code, with Georgia Amendments.
5. The National Electrical Safety Code (ANSI C2.)
6. U.L. Fire Resistance Directory.
7. U.L. Electrical Construction Materials Directory.
8. U.L. Electrical Appliance and Utilization Equipment Directory.

1.3 SCOPE OF WORK:

A. Provide all labor, materials, equipment, and supervision to construct complete and operable electrical systems as indicated on the drawings and specified herein. All materials and equipment used shall be new, undamaged, and free from any defects.

1.4 COORDINATION:

A. Coordinate work provided under this division of the specifications with work provided under other divisions of the specifications and work provided by owner, where applicable.

1.5 PROJECT STAFFING:

A. Superintendent:

1. Provide a superintendent to plan, layout, supervise and coordinate the work provided by all organizations providing work under Division 26. The superintendent shall be at the job site at any time work is being performed.

2. The superintendent shall have a minimum of 5 years of experience in educational projects of similar size and scope. The superintendent shall have a State of Georgia unrestricted electrical contractor's license.

B. Organizations Furnishing and Installing Electrical Systems:

1. Traditional electrical systems work shall be furnished and installed by organizations who have successfully completed work of similar size and scope, and who have been in business for at least 3 years.
2. Electricians, 600V and below:
   a. Electricians assigned to the project shall have proof of having completed a formal training program which certifies that they are qualified to perform electrical work of the type encountered on this project and are familiar with the building codes which apply to this project. For the purposes of this project, workers not possessing these qualifications shall be considered helpers and shall not be allowed to perform electrical work.

C. Organizations Furnishing and Installing Specialty Systems:

1. Work of Sections 266011 (Emergency Power System – Natural Gas) is specified by the name of acceptable manufacturers. Each of the systems shall be furnished and installed by an organization that:
   a. is an authorized representatives of the manufacturer, for purchase, installation and service of the specific system.
   b. stocks replacement parts for the specific system.
   c. has installation and service technicians that, in addition to the requirements specified below, have been factory-trained on the system specified.
   d. has experience on projects of similar size and scope.
   e. has been in business for at least 3 years.
2. Specialty Systems Technicians
   a. Work specified in Sections 266011 (Emergency Power System – Natural Gas) shall be installed, started (where applicable) and tested by factory trained technicians in the employ of the manufacturer or manufacturer's authorized representative.

D. Submit resumes for review and approval by the Architect prior to proceeding with any work on the project.

1.6 PERMITS AND TESTS; ELECTRICAL WORK:

A. Submit a record copy (for Owner's records) of electrical work notices, permits, licenses, inspection or test reports, and similar items obtained in response to governing and imposed codes, regulations, and standards.

1.7 ELECTRICAL DRAWINGS:

A. Do not scale the electrical drawings. Obtain all dimensions from the Architect's dimensioned drawings, field measurements and shop drawings.

B. Electrical contract drawings are diagrammatic and indicate the general arrangement and connection of equipment and devices. Review product data sheets, wiring diagrams, manufacturer's installation instructions, etc. and provide the connections required to place equipment into service. Do not rely solely on the conductor counts shown on the drawings.

C. Discrepancies shown on different drawings, between drawings and specifications or between documents and field conditions shall be brought to the attention of the Architect. **The specifications do not override the drawings or vice-versa**.

1.8 EQUIPMENT REQUIRING ELECTRICAL SERVICE:

A. Provide connections for all electrically driven equipment, in accordance with the electrical drawings and the Division of the specifications in which the equipment is specified.

1. Connection shall include circuit breaker, wiring, control and disconnecting means (where applicable) and final connection.
2. Prior to ordering materials, review approved shop drawings of equipment that will be ordered and verify the connections shown. Fill out and submit the Coordination Affidavit required by Section 26 01 20.
3. Where connection is required by other Divisions, but no connection is shown on the electrical drawings, provide connection to nearest panel of same voltage and phase based on the characteristics shown on other drawings. All added connections shall be brought to the attention of the Architect.
4. Provide 120-volt, 1 phase, 20 ampere power connection for all Division 23 control panels, whether indicated on the project drawings or not. Circuit from nearest 120/208-volt, 3 phase, 4 wire panelboard from available 20 amp, single-pole spares. Revise panelboard schedules accordingly. Document and coordinate control panel requirements and locations during preparation of the Coordination Affidavit, Attachment No. 1.

1.9 SYSTEMS REQUIRING ROUGH-IN:

A. Rough-in shall consist of all outlet boxes and covers/raceway systems/supports and sleeves required for the installation of cables/devices specified by other Divisions and by the Using Agency.

B. Review shop drawings to determine rough-in requirements; do not rely solely on the information shown on the drawings. Keep a copy of these shop drawings at the project site throughout the course of construction.

C. Systems requiring rough-in shall include, but not be limited to the following:

1. Mechanical equipment as shown in Divisions 22 and 23
2. Building equipment as shown
3. Equipment furnished by the Using Agency as shown on plans
4. Voice / data / video cabling systems.

D. Rough-in requirements are further defined in Section 26 10 10. Prior to performing any rough-in, meet with the designated representative of the trade involved to confirm device locations, mounting heights, trim ring type and orientation.

1.10 PERFORMANCE TESTING:

A. Testing specified in other sections shall be performed by authorized representatives of the system manufacturer, scheduled, and paid for by the Contractor.

1. The contractor shall provide personnel, tools, and equipment necessary to conduct the tests.
2. Provide three copies of all test results. For each system, include a cover page with the

Testing Agency letterhead, name of persons conducting the test, date(s) of tests, and an executive summary of the testing performed. Include the detailed results after this summary.

B. Notify the Architect, in writing, 48 hours in advance of any testing to be performed. Include the system, or systems to be tested. The purpose of this requirement is to allow the Architect and Using Agency time to schedule representatives to be present.

C. Schedule the work so that all tests can be conducted at one time.

D. Provide personnel and equipment necessary to make all work accessible to the testing agency.

E. A copy of the test reports will be made available to the contractor. The contractor shall remove and replace all work that does not meet specified performance parameters. The contractor shall bear the expense of retesting systems.

1.11 RECORD DOCUMENTS:

A. The electrical superintendent shall maintain a white set (blue-line or black-line) of contract documents in clean, undamaged condition, for mark-up of actual installations which vary substantially from the work as shown. Mark-up whatever drawings are most capable of showing installed conditions accurately. These documents shall be used for no other purpose. As a minimum, record the following:

1. Post all addenda prior to beginning work.
2. Post all changes in the work.
3. Document actual feeder conduit routes, both interior and exterior. For lines run below grade or slab, dimension lines off fixed surfaces.
4. Scope of each change order (C.O.), noting C.O. number.
5. Mark up all branch circuit connections.

1.12 RECORD MANUALS: (CLOSEOUT REQUIREMENTS)

Record manuals shall include the following:

A. Manufacturer's operation and maintenance manuals for:

1. Lighting Fixtures
2. Lighting Control System. Including Occupancy Sensors
3. Panelboards and circuit breakers
4. Dry Type Transformers
5. Emergency Power System (Include manufacturer's fabrication drawings)

B. Shop drawings, revised to reflect all review comments, *supplemented with the installation instructions shipped with equipment.*

C. One copy of all panelboard directories plus CD/RW with electronic spreadsheets containing directories.

D. Emergency Power System connection drawings updated to reflect as-built conditions.

E. lighting control system wiring diagrams updated to reflect as-built conditions.

F. All test results listed by specification section.

G. All required keys, tools, and spare parts.

Submit record manuals in quantities and in the format prescribed in the Division specifications, plus one copy for the Engineer.

1.13 TRAINING OF OWNERS FORCES:

A. Train Owner's personnel on the operation and maintenance of the following systems:

1. Emergency Power System - 2 hours.
2. Cafeteria Lighting Control System - 2 hours.
3. Tour of Facility - 8 hours

B. The "tour of facility" shall consist of the walk-thru of at least one space of each type. The Division 26 Superintendent shall demonstrate operation of all lighting controls, emergency shut off controls, use of receptacles, etc. The tour shall be conducted jointly with Division 27.

C. Training shall not be conducted until system has been tested by the Contractor and is 100% operational. Training shall be conducted at the project site.

D. As a minimum, the following materials shall be reviewed during the training session:

1. Owner's operation and maintenance manual.
2. Corrected shop drawings and as-built system drawings.
3. Hands-on demonstration of system features and operation.

E. Schedule the training at least two weeks in advance. At that time, provide a detailed outline of the training session.

F. Training shall be conducted by authorized representatives of the system manufacturer and the Division 27 superintendent.

1.14 REVIEW OF THE WORK BY THE ARCHITECT:

A. During the course of the project, the work will be reviewed by a representative of the Architect. Upon each visit, the Contractor shall also demonstrate that the record documents and shop drawing files are being kept current. The Division 26 Superintendent shall accompany the Architect on all reviews and shall provide all personnel, tools, ladders, etc. necessary to conduct the review.

B. Prior to reviewing of work in progress, or at the final inspection, the Contractor shall submit a letter describing the specific work to be reviewed, along with a punch-list of items that are incomplete or which require correction, based on observations made by the supervisor of the given trade. Reviews will not be scheduled until this information is submitted. The Contractor shall bear the burden of any resulting delays.

C. Construction review reports will be issued by the Architect for every review trip. Within five working days from the date of review, the Contractor shall submit a letter which addresses when corrections will be made for each deficiency in the report. Prior to subsequent review of the work, the Contractor shall submit a letter confirming that the work required by all comments on the report has been completed.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Refer to the drawings and individual specification sections for requirements.

B. All equipment shall be suitable for the environment in which it is installed. Such considerations shall include, but not be limited to characteristics of this specific project such as wet/damp/dry locations, ambient temperature / humidity, spaces used as air plenums and hazardous locations. It shall be the responsibility of the contractor to review the contract documents and order equipment based on intended use.

2.2 MATERIALS:

A. All materials and equipment used shall be new, undamaged and free from any defects.

B. Provide materials and equipment that are U.L. listed, unless listing is unavailable.

C. All equipment of the same type or of the same product category shall be the product of a single manufacturer.

D. It is the responsibility of the Contractor to determine the shipping splits for large equipment.

E. Where product is specified by catalog number, such specification is intended only to convey general characteristics. Actual product selection shall be based on catalog number, other references on the drawings / specifications and intended use. Products not listed in these specifications or shown on drawings shall not be used.

2.3 ACCEPTABLE MANUFACTURERS:

A. Provide equipment and materials which are products of the manufacturers listed on the drawings and in the specifications. Requests for substitution of other manufacturers shall comply with Division 1 and the paragraph "B" below.

B. Requests for prior approval (i.e. before the bid opening) must contain all information listed for the specific item in Section 26 01 20, including any applicable dimensioned layout drawings. Requests must be sent by mail or express delivery such that they are received in the Architect's office no later than ten working days prior to the opening of bids. Requests that are incomplete or are sent by facsimile will not be reviewed

PART 3 - EXECUTION

3.1 ROLE OF THE SUPERINTENDENT:

A. The Division 26 Superintendent's duties shall include, but not be limited to the following:

1. Preparation of submittals.
2. Planning and layout of the work.
3. Coordination with other trades and the local utility company.
4. Posting addenda and changes in the work to maintain the Record Documents and to ensure that Division 26 personnel are working from up-to-date drawings and specifications.

5. Supervision of all Division 26 personnel.
6. Ongoing review of work in place to ensure compliance with the Contract Documents.
7. Administrative duties as required to fulfill the requirements of the General Conditions, Special Conditions and Division 1 specifications.
8. Training of the Owner's personnel.

3.2 PROTECTION OF THE WORK:

A. Protect the work during the course of construction. Do not install any equipment or materials until the proper environmental conditions have been established.

B. Store materials in the manner recommended by the manufacturer until materials are installed. Materials rated for indoor use shall not be stored outdoors regardless of the packaging in which the materials are shipped.

C. Prior to the building being "dried-in", protect incomplete conduit runs, outlet boxes, equipment enclosures, etc. from the entry of water or construction debris, by installing and maintaining temporary protective covers.

D. Do not install wiring devices, equipment or panel interiors until the building is dried-in. For the purposes of this specification "dried in" shall mean the roof has been installed, all exterior openings are covered, and the interior of the building is dry.

E. Maintain temporary protective covers over equipment enclosures, outlet boxes and similar items after interiors, conductors, devices, etc. are installed, to prevent the entry of construction debris and to protect the installation during finish work performed by others. Do not install device plates, equipment covers or trims until finish work is complete.

F. Install temporary protective covers over equipment mounted on the building exterior to prevent corrosion damage during cleaning of the building exterior, by others.

G. Clean all equipment, inside and out, upon completion of the work. Scratched or marred surfaces shall be touched-up with touch-up paint furnished by the equipment manufacturer.

H. Equipment or materials that are improperly stored or are installed before the proper environmental conditions are achieved will be removed and replaced with new, at no cost to the Owner. The Contractor shall bear all consequences from any resulting delays.

I. All equipment and materials that become damaged will be removed and replaced with new, at no additional cost to the Owner.

3.3 CUTTING AND PATCHING:

A. Structural Limitations: Do not cut structural framing, walls, floors, decks, and other members intended to withstand stress, except with the Architect's written authorization. Authorization will be granted only when there is no other reasonable method for completing the electrical work, and where the proposed cutting clearly does not materially weaken the structure.

B. Cutting Concrete: Where authorized, cut openings through concrete (for conduit penetrations and similar services) by core drilling or sawing. Do not cut by hammer-driven chisel or drill.

C. Other Work: Do not endanger or damage other work through the procedures and process of cutting to accommodate electrical work. Review the proposed cutting with the Installer of the

work to be cut, and comply with his recommendations to minimize damage. Where necessary, engage the original Installer or other specialists to execute the cutting in the recommended manner.

D. Patching: Where patching is required to restore other work, because of cutting or other damage inflicted during the installation of electrical work, execute the patching in the manner recommended by the original Installer. Restore the other work in every respect, including the elimination of visual defects in exposed finished, as judged by the Architect. Engage the original Installer to complete patching of various categories of work including: concrete and masonry finishing, waterproofing and roofing, exposed wall finishes, etc.

3.4 INTERFACE OF ELECTRICAL WORK WITH OTHER TRADES:

A. Where electrical work must connect to or be incorporated into work installed by other trades, engage the services of the other trade to interface the work. Under no circumstances shall the installer performing work under this Division of the specifications modify or alter work installed by others. Such work includes, but is not limited to:

1. Roof Penetrations.
2. Any attachments to roofing system.
3. Penetrations in Vapor Barriers.
4. Exterior Insulation and Finish Systems (EIFS).

END OF SECTION 26 01 00

SECTION 26 01 20 - ELECTRICAL SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 GENERAL:

A. Submit for review by the Architect a schedule with engineering data of materials and equipment to be incorporated in the work.

1. Submittals shall be supported by descriptive materials, i.e., catalog sheets, product data sheets, diagrams, performance curves and charts published by the manufacturer, to show conformance to Specifications and Plan requirements; model numbers alone shall not be acceptable.
2. Data submitted for review shall contain all information to indicate compliance with Contract Documents. Complete electrical characteristics shall be provided for all equipment.
3. Submittals for lighting fixtures shall include Photometric Data.
4. The Architect reserves the rights to require samples of any equipment to be submitted for review.

B. Prepare submittals, including the necessary inter-division planning and coordination in accordance with the approved project schedule. Note that certain Division 26 submittals cannot be prepared until approved submittals are available from other Divisions of the work.

C. Submittal material shall be assembled and checked by the Division 26 superintendent.

D. All layout drawings shall be prepared under the supervision of and checked by the Division 26 superintendent.

E. Hard Copy Submittals: Submittal data shall be placed in one or more hard-back 3-ring binders arranged and labeled according to specification section. Each binder shall contain a title page and table of contents. Provide separator tabs, and label by specification section. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor's Name, Division 26 Superintendent's name, Suppliers and point of contact for each, and date. Except as otherwise indicated in other sections, submit 5 complete copies. Quantity indicated does not include copies required for regulatory agencies.

F. Electronic Submittals: If the Architect agrees to allow electronic submittals via an on-line information management product such as "Submittal Exchange, etc., all electronic submittal files shall be organized to match the bid documents for specification section and name. Each submittal file shall be complete for each specification section. Multiple partial submittals per specification section will be rejected. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor's Name, Division 26 Superintendent's name, Suppliers and point of contact for each, and date.

G. The fault current calculation required by Section 26 20 42-Panelboards, 26 20 44 - Separately Enclosed Circuit Breakers shall be provided after service has been installed and inspected by the Authority Having Jurisdiction.

1.3 RESPONSE TO SUBMITTALS:

A. The contractor shall review all submittals prior to submitting to ensure compliance with the contract documents. Comments made by the Design Professional do not relieve the contractor from complying with the contract documents (drawings, specifications, and addenda). The Design Professional does not approve any submittals. The Design Professional only reviews and makes observations regarding the submittals.

B. The purpose of the submittals is to demonstrate to the Design Professional that the contractor understands the design concept and that he demonstrates his understanding by indicating which equipment and materials he intends to furnish and install. Any deviation from the contract documents shall be clearly stated on the submittal data. If not clearly stated, the submittal shall be marked "Revise and Resubmit". Failure of the contractor to provide submittals during the submittal process shall make the contractor totally responsible for any and all changes to achieve compliance with the contract documents.

C. Shop drawings shall be evaluated by the Architect in accordance with the following classifications:

1. "No Exceptions Taken": No corrections, no marks. Items may be ordered.
2. "Make Corrections Noted": A few minor corrections. Items may be ordered as marked up without further resubmission.
3. "Revise and Resubmit": Minor correction. Item may be ordered at the Contractor's option. Contractor shall resubmit drawings with corrections noted.
4. "Rejected": Major corrections or not in accordance with the contract documents. No items shall be ordered. Contractor shall correct and resubmit drawings.

D. Whether resubmittals are required or not, all shop drawings shall be corrected for the record manuals specified in Section 26 01 00.

1.4 SUBMITTAL GROUPING:

A. Submittals shall be made in no more than two groups.

B. All submittals for a given system shall be submitted at the same time. For example, wiring diagrams and other detailed layout information must be submitted with equipment data sheets.

C. Submittals that do not comply with these requirements or that are deemed by the Architect to be incorrect shall be returned without review. The Contractor shall bear the burden of any resulting delays.

1.5 EQUIPMENT AND MATERIALS REQUIRING SUBMITTALS:

A. Section 26 01 00 - General Provisions

1. Superintendent's resume

2. Electricians' qualifications

B. Section 26 01 20 - Electrical Submittals

1. Equipment Layout Drawings
2. Lighting Fixture Layout Drawings
3. Attachment 1

C. Section 26 10 10 - Raceway Systems

1. Raceways and Fittings
2. Expansion Fittings
3. Wall Boxes and Covers
4. Ceiling Boxes and Covers
5. Surface Mounted Raceway System components
6. Pull Boxes
7. Troughs
8. Firestopping Materials and Installation Drawings
9. Corrosion Protection

D. Section 26 10 20 - Cable Trays for Low Voltage Systems

1. Cable Trays
2. Connectors
3. Bracing
4. Accessories

E. Section 26 20 10 - Wires and Cables

1. Conductors
2. Connectors
3. Splices

F. Section 26 20 20 - Wiring Devices

1. Receptacles
2. Switches
3. Occupancy/Vacancy Sensors & switches
4. Occupancy/Vacancy Sensor layout drawings
5. Photo-sensors
6. Daylight Harvesting layout drawings
7. Weatherproof Covers
8. Device Plates

G. Section 26 20 21 - Safety and Disconnect Switches

1. Safety Switches
2. Motor Rated Switches
3. Equipment List
4. Arc Flash Warning Labels
5. Nameplates

H. Section 26 20 30 - Lighting Fixtures

1. Lighting Fixtures

I. Section 26 20 42 - Panelboards

1. Enclosures
2. Dimensional Data
3. Locks
4. Directory
5. Circuit Breakers
6. Bussing Diagrams
7. Arc Flash Warning Labels
8. Nameplates

J. Section 26 20 44 - Separately Enclosed Circuit Breakers

1. Circuit Breakers
2. Enclosures
3. Dimensional Data
4. Control Wiring Diagrams
5. Arc Flash Warning Labels
6. Nameplates

K. Section 26 20 47 - Dry Type Transformers, 600V and Below

1. Enclosures
2. Dimensional Data
3. % Impedance
4. Temperature Rating
5. Winding Material
6. Taps
7. Sound Ratings
8. Efficiency Ratings at 25%, 50%, 75% and 100% load.
9. Wiring Diagram (including grounding and bonding)
10. Vibration Dampening Mounts
11. Arc Flash Warning Labels
12. Nameplates

L. Section 26 20 49 - Surge Suppression / EHF Filter System

1. Data sheets
2. Dimensions for each suppressor type indicating mounting arrangement and required accessory hardware. Statement that maximum lead length required to connect suppressor will not increase clamping voltages from published values.
3. Manufacturer’s letter certifying compliance with listed guidelines and standards.

M. Section 26 20 80 - Electrical Grounding, 600V and Below

1. Ground Rods
2. Conductors
3. Connectors

4. Bonding Bushings
5. Ground Rod Enclosures

N. Section 26 40 00 – Seismic Control for Electrical Equipment

1. Seismic anchorage requirements and calculations (with Registered Engineer's stamp.)
2. Seismic control devices.

O. Section 26 60 11 - Emergency Power Systems

1. Certification of site for service / warranty
2. Compliance / Labels (including EPA emissions compliance letter)
3. Maintenance Agreement
4. Rating
5. Engine
6. Generator
7. Controller
8. Instrument Panel
9. Mounting Base
10. Accessories
11. Automatic Transfer Switch
12. Automatic Transfer Switch Arc Flash Warning Label
13. Automatic Transfer Switch Nameplate

PART 2 - PRODUCTS

2.1 NOT APPLICABLE:

PART 3 - EXECUTION

3.1 MANUFACTURER'S DATA:

A. Include the manufacturer's comprehensive product data sheet and installation instructions.

B. Where operating ranges are shown, mark data to show portion of range required for project application.

C. Where pre-printed data sheet covers more than one distinct product-size, type, material, trim, accessory group, or other variations, delete or mark-out portions of the pre-printed data which are not applicable.

3.2 EQUIPMENT LIST:

A. Where more than one type of a product is being used (i.e. starters, disconnects, breakers, etc.) provide a list with each submittal correlating the type and size of product to the load served.

3.3 TEST REPORTS:

A. Submit test reports which have been signed and dated by the firm performing the tests and prepare in the manner specified in the standard or regulation governing the tests procedure as

indicated.

3.4 ELECTRICAL LAYOUT AND COORDINATION DRAWINGS:

A. Electrical Rooms: Provide layouts of all electrical rooms, using the dimensions of equipment actually furnished. Locate all ducts and piping entering or crossing these spaces.

B. Mechanical Rooms and Mechanical Equipment Yards: Provide layouts showing all mechanical equipment based on dimensions of the actual equipment provided. Show the location of all motor controls, disconnect switches, control power junction boxes and conduit stub-ups at equipment. Location of stub-ups shall be based on manufacturer's installation drawings.

C. Panel and Equipment Feeders, 60A or more: The routing of feeders is not shown on the drawings. Actual routing shall be determined by the contractor in accordance with the specifications and shall be coordinated with work by other trades. For feeders of 60A or higher rating, provide layout drawings showing proposed routes.

D. Provide dimensioned layout drawings for all pendant mounted lighting fixtures as specified in Section 26 20 30.

E. System specific drawings - Include the following:

1. Floor plans:
   a. Show all system equipment, devices, and interconnecting cabling. Provide a legend to define all devices and cable runs.
2. Details:
   a. Show the rough-in requirements and mounting height for every component Include all requirements such as outlet box size/trim/alignment and raceway requirements.
   b. Prepare in sufficient detail such that these drawings can be used to provide the required rough-in.
3. Point-to-point installation wiring diagrams of the entire system:
   a. Provide terminal diagram for every control panel.
   b. Provide wiring diagram for every device. Key these diagrams to the system diagrams.
   c. Provide wiring diagram depicting all interlocks of specific systems with other systems.
   d. Spare and unused terminals shall be marked as such. Indicate the size, type and color code of all conductors.
   e. The use of generic wiring diagrams is not acceptable. Wiring diagrams shall be prepared for this specific project.
4. Elevations:
   a. Provide an elevation drawing of the headend equipment / control panel / backboard, showing the location of all components.
   b. Indicate enclosure sizes and space available for future expansion.

F. Drawing Format:

1. Drawings shall be prepared at the following scales:
   a. Floor plans: 1/8" = 1'-0".
   b. Electrical Rooms: 1/4" = 1'-0".
   c. Mechanical Rooms / Equipment Yards: 1/4" = 1'-0".
   d. Feeder routes: 1/16 " = 1'-0".
   e. Duct Bank Profile Drawings: See Section 26 10 11.
   f. Layout drawings for pendant mounted lighting fixtures: 1/2" = 1'-0".

g. Lightning protection system layout drawings: 1/16 " = 1' - 0".

2. The scales defined above are for plan views. Device assembly drawings, wiring diagrams, etc. may be prepared "not to scale".

3. Drawings shall be titled to define Project Name, Drawing subject, date prepared and designer's name and seal. All revisions shall be marked and dated.

4. Drawings shall include all room names and numbers.

5. CAD-generated drawings are required. Upon written request, a .zip file containing the building floor plan(s) can be furnished to the contractor at a nominal cost, in AutoCAD 2015 format. By requesting these drawings, the contractor agrees to accept them "as is". It will be the responsibility of the contractor to verify the drawings for accuracy and to make all changes necessary, at no additional cost to the Owner.

6. Submit only one copy of each drawing, in reproducible format. The Architect will mark review comments on the reproducible drawing so that the contractor can make as many copies as may be required.

3.5 ATTACHMENT NO. 1:

A. The intent of Attachment Number 1 is to ensure that the electrical requirements for equipment have been reviewed and coordinated by the Contractor. No electrical equipment shall be ordered, nor shall rough-in begin, before this coordination has taken place. This document shall be returned appropriately marked whether or not any changes are deemed to be necessary by the contractor.

ATTACHMENT NO. 1

SHOP DRAWING COORDINATION AFFIDAVIT

I, the Division 26 Superintendent, certify that I have reviewed the equipment shop drawings for electrically driven equipment and that the accompanying electrical shop drawings reflect the requirements of the actual equipment to be furnished for use on this project. The following deviations from design drawings were required to serve the furnished equipment:

ITEM	CKT.	DESIG.	BKR.SIZE		CONDUIT/WIRE		DISC.SIZE		STARTER	
			New	Old	New	Old	New	Old	New	Old

NOTE: If no deviations are required please indicate by circling the appropriate answer above your signature.

PROJECT: _____ DEVIATIONS: Yes / No

COMPANY:_____

TITLE: _____ SIGNATURE: _____

TELEPHONE: _____DATE:_____

FAILURE TO PERFORM THE WORK REQUIRED BY THIS AFFIDAVIT, PRIOR TO ORDERING MATERIALS OR ROUGHING-IN, MAY RESULT IN IMPROPER CONNECTIONS BEING PROVIDED. THE EXPENSE OF CORRECTIVE MEASURES, IF REQUIRED, SHALL BE BORNE BY THE CONTRACTOR.

END OF SECTION 26 01 20

SECTION 26 10 10 - RACEWAY SYSTEMS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

A. The requirements of this section apply to all electrical raceway systems and supporting devices, installed under this contract, except for concrete encased duct banks. Electrical raceway system is defined to include, but not be limited to, all electrical raceways, boxes, fittings and similar components necessary for a continuous pathway for the installation of cables or conductors. Supports are any devices or components used to support raceways or electrical equipment.

B. Cable Trays for low voltage systems are specified in Section 26 10 20.

1.3 QUALITY ASSURANCE:

A. Submittals: Refer to Section 26 01 20 for requirements.

PART 2 - PRODUCTS

2.1 ELECTRICAL METALLIC TUBING (EMT):

A. Uses permitted:

1. Indoors concealed in walls or ceiling.
2. Concealed in slabs above grade.
3. Exposed horizontal runs installed at least 7' above finished floor.

2.2 INTERMEDIATE METAL CONDUIT (IMC) OR RIGID GALVANIZED STEEL CONDUIT (RGS):

A. Uses permitted:

1. Indoors concealed or exposed.
2. Transition from below grade nonmetallic raceway system to above grade metallic raceway system.
3. Refrigerated spaces.
4. Vertical drops serving equipment.

2.3 RIGID NON-METALLIC CONDUIT (SCHEDULE 40 PVC):

A. Uses permitted:

1. Below grade installations.
2. Grounding electrode conductor raceway.

2.4 FLEXIBLE METAL CONDUIT:

A. Uses permitted:

1. Final connection to lighting fixtures.
2. Final connection to other than Division 23 equipment located in indoor, dry locations.

2.5 LIQUID-TIGHT FLEXIBLE METAL CONDUIT:

A. Uses permitted:

1. Final connection to equipment in indoor or outdoor locations.

2.6 CABLE RUNWAY:

A. Installed where shown to support cables specified under Division 27, limited to use at backboards and above equipment cabinets. This product is not the same as the Cable Trays specified in Section 26 10 20.

B. Material: ASTM A36 steel bar:

1. Stringers: 3/8" x 2"
2. Rungs: ½" x 1" steel channel welded, @ 9" on centers
3. Runway width: 12"

C. Finish: Baked polyester powder coat, telephone gray.

D. Provide hanger kits, corner kits and other accessory fittings needed to install in the configurations specified.

E. Cable runways and accessories shall be the product of B-Line, Kindorf or Cope.

2.7 INNERDUCTS:

A. Innerducts shall be used where specifically indicated.

B. Innerducts shall be solid wall (ribbed) suitable for the use intended.

C. Provide metered tape and pull cord in all innerducts.

D. When installed within conduits, terminate conduit runs with non-metallic, corrosion-proof, water/air/gas tight triplex or quadruplex duct plugs, for the number of innerducts installed. Additionally, provide duct plugs of the same type in all runs in which conductors are not installed.

2.8 SURFACE MOUNTED NON-METALLIC RACEWAY SYSTEMS:

A. Use only on existing walls where new wiring cannot be concealed in walls, and for extension to existing flush mounted device.

B. Individual Devices:

1. Raceway shall be Panduit PD6 series or equivalent by Wiremold or Hubbell.
2. System shall consist of concealed, screw-type base, snap-on cover, wire retainers, couplings, outlet boxes, fittings and other accessories required for complete raceway system installation.
3. All fittings shall be of the type specifically intended for use with raceway system.
4. Color shall be selected by the Architect.

C. Multiple Devices:

1. Raceway shall be Wiremold Access 5000 series or equivalent by Panduit or Hubbell.
2. System shall consist of base, cover, divider wall, connector clips, wire retainers, outlet boxes, fittings and other accessories required for complete raceway system installation.
3. All fittings shall be of the type specifically intended for use with raceway system.
4. Color shall be selected by the Architect.

2.9 SLEEVES:

A. Conduit sleeves shall be RGS unless otherwise required by the through penetration firestop system selected.

B. Sleeves shall be minimum 1" and maximum 4" diameter, provided in quantities necessary to install cable systems specified in Divisions 23 and 27.

C. The contractor shall take special note that sleeve fill will be limited by the specific through penetration firestop system used. *In no case shall the fill exceed 40%*.

2.10 CONNECTORS/COUPLINGS:

A. Connectors/couplings for use with EMT conduit shall be steel compression type, except that steel, set screw type will be acceptable for EMT conduits sizes 2-1/2" and larger.

B. Connectors/couplings for use with IMC and RGS conduit shall be threaded type.

C. All connectors shall be insulated throat type.

D. Locknuts shall be of the same material as connectors.

E. All fittings shall be raintight. Fittings encased in concrete shall be concrete-tight.

2.11 CONDUIT BODIES:

A. Provide galvanized steel or cast metal conduit bodies constructed with threaded conduit ends, removable cover, and corrosion resistant screws.

2.12 CEILING OUTLET BOXES:

A. Provide 4" octagon, galvanized steel interior outlet boxes constructed with stamped knockouts in back and sides and with threaded holes with screws for securing box covers or wiring devices.

2.13 WALL OUTLET BOXES:

A. Recessed:

1. Boxes shall be galvanized steel constructed with stamped knockouts in back and sides and with threaded holes with screws for securing box covers or wiring devices.
2. Minimum box size shall be 4" square by 1-1/2" deep.
3. Boxes for GFCI outlets, Division 22, Division 23, and Division 27 devices and other locations deemed necessary, shall be 4-11/16" square by 2 1/8" deep.
4. Boxes shall have square edge tile type covers.
5. Where devices are ganged, use gang-type boxes with gang box covers.
6. The use of gangable type outlet or switchboxes is not acceptable unless required by specific device manufacturer.
7. Use masonry type boxes of equal or greater volume to those specified above, in masonry walls.

B. Surface:

1. Use cast aluminum box with threaded hubs in conjunction with metallic conduit systems.

C. Special Conditions:

1. Where box type specified herein conflicts with requirements of equipment to be installed, equipment manufacturer's requirements shall govern.

2.14 INTERIOR PULL BOXES:

A. Provide galvanized sheet steel boxes without knockouts. Provide surface boxes with screw-held covers in unfinished areas. In finished areas, including storage rooms, provide recessed boxes with screw-held cover, finished to match panelboards.

2.15 WIRING TROUGHS:

A. Troughs shall be made of code gauge galvanized steel, without knock-outs, and shall be suitable for surface mounting. Provide screw-held, removable front cover. Trough and cover shall be finished the same as panelboards. Dimensions shall be as indicated on the drawings. Provide knock-outs as required.

2.16 SUPPORTS:

A. Supporting devices shall be the products of manufacturers' specifically intended for supporting electrical raceways, devices and equipment. Makeshift supports are not acceptable. Where channel type supports are used, select complete assemblies based on the weight of the raceway(s) or equipment being supported.

B. The use of tie wire or tie wraps as a means of support for electrical raceways, devices and equipment is not permitted.

C. Plywood backboards shown in Communications Rooms or otherwise for the support of low-voltage cabling systems and/or mounting of equipment shall be fire resistant, Type AC rated. The plywood shall be painted with gray, fire resistant coating. Ensure that the plywood rating seal is left exposed after painting.

2.17 FIRESTOPPING:

A. A through-penetration firestop system shall be used to seal penetrations of electrical conduits and cables through fire-rated partitions per NEC 300-21 and NEC 800-3. The firestop system shall be qualified by formal performance testing in accordance with ASTM E-814, or UL 1479.

B. The firestop system shall consist of a fire-rated caulk type substance and a high temperature fiber insulation. It shall be permanently flexible, water-proof, non-toxic, smoke and gas tight and have a high adhesion to all solids so damming is not required. Only metal conduit shall be used in conjunction with this system to penetrate fire rated partitions. Install in strict compliance with manufacturer's recommendations. 3M, Metacaulk or Nelson.

C. Submit installation drawings for conduit penetration, cable in metal sleeve penetration and blank metal sleeve penetration for each type of wall/floor construction encountered.

D. Schedule a representative of the manufacturer to conduct a product demonstration / training session for each through-penetration firestop system to be used on this project. The session shall be held at the project site. Submit a letter to the Architect stating when the demonstration will be conducted.

PART 3 - EXECUTION

3.1 RACEWAY INSTALLATION - GENERAL:

A. Wherever possible, install horizontal raceway runs above water and drain piping. Give the right-of-way in confined spaces to piping which must slope for drainage and to larger HVAC duct work and similar services which are less conformable than electrical services. *However, ensure that all junction boxes and other points of access in raceway systems are located such that they are not rendered inaccessible.*

B. Complete the installation of electrical raceways before starting installation of cables within raceways.

C. All above grade conduits shall be routed parallel or perpendicular to the building structure.

D. Raceways shall not be installed exposed in finished spaces or on the exterior of the building. Install concealed in walls, ceilings, below slab-on-grade or embedded in slabs above grade. *Where raceway system serves surface mounted* equipment (i.e. safety switch), mount equipment over recessed outlet box.

E. All exposed raceway systems shall be painted to match the surface to which it is attached. All components of the raceway system shall be painted, i.e. conduits, boxes, supports, etc. Painting is specified under other divisions of the work.

F. Provide 200 lb. nylon pull cord in all conduits installed for cable systems specified under Division 23 and Division 27; and where conduits will be left empty for future use. Cap open ends and mark location of opposite end with black indelible marker pen.

G. Seal the inside of all conduits entering the building from outside, whether they connect to enclosures or not.

H. Do not run raceways atop the roof deck, through stairwells or elevator shafts.

3.2 BELOW SLAB AND IN-SLAB INSTALLATIONS: (within the building footprint)

A. *Do not install conduits in slabs on-grade.* Raceways shall be routed under the first floor building slab. Conduits shall be routed such that the top of the conduit is a minimum of six inches below the slab.

B. All 90 degree elbows and all stub-ups through the floor slab for all size conduits shall be corrosion protected RGS or corrosion protected IMC.

C. Raceways in slabs above grade shall be totally embedded in the slab. They shall be placed above the lower reinforcing and below the upper reinforcing. The outer edge in no case shall be less than 1" from the surface of the slab. The corners of raceways at turnups into walls shall not be exposed at the wall/floor junction.

D. Raceways for Division 27 systems shall not be installed in or below slabs unless specifically indicated.

3.3 BELOW GRADE INSTALLATIONS: (outside the building footprint)

A. Perform all excavating, trenching and backfilling to install work of this project in accordance with applicable sections of Division 2 of the specifications and ANSI C2. Bottom of trenches shall be smooth and level to provide uniform bearing for conduits.

B. Secure conduits in trench to eliminate unnecessary curvature and to prevent movement of conduits while backfilling.

C. Maintain 6" vertical separation between conduits installed one above the other. Backfill and compact each layer separately. The minimum cover requirements specified herein shall be referenced to the uppermost layer of conduits.

D. Maintain minimum 12" horizontal and 6" vertical separation between conduits of different systems and between other underground utilities.

F. Condition backfill material by either drying or adding water uniformly, to whatever extent may be necessary to facilitate compaction to the required densities. Do not backfill with frozen soil materials.

G. Backfill simultaneously on opposite sides of electrical work, and compact simultaneously; do not dislocate the work from installed positions.

H. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (percent of maximum density, ASTM Standard Proctor), using power-driven hand-operated compaction equipment.

1. Lawn/Landscaped Areas: 90%
2. Roadways: 95%
3. Paved Area, Other than Roadways: 95%

I. Backfill to elevations matching adjacent grades, at the time of backfilling excavations for mechanical work.

J. Where compaction tests indicate lower densities of backfill than specified, continue compaction (and re-excavation and backfilling where necessary) and provide additional testing as directed by the Architect/Engineer.

K. Minimum cover requirements:

1. Exterior lighting branch circuits: 18".
2. Service entrance and feeder conduits, 600V and below: 24".

L. Secondary service entrance conduits:

3. Install conduits using base, intermediate and top spacers specifically intended for non-concrete encasement. Install spacers every 5'.
4. Backfill to top of conduits with river sand to ensure that compaction around spacers is achieved.

3.4 SURFACE MOUNTED NON-METALLIC RACEWAY SYSTEMS:

A. Use Access 5000 series system to serve new receptacle and communication devices located in classrooms.

B. Engage the services of a carpenter to cut raceways / covers, and to install raceways on the walls. Raceways shall be installed level and all joints shall be true.

C. All supports shall be concealed type. Attachment screws shall have countersunk heads and shall not protrude into the raceway system.

D. Provide covers or couplings over all joints.

E. Provide end caps on all dead-end runs.

F. Provide trim plate at ceiling penetration.

G. Miter-cut surface raceway to create flat 90 degree fittings if they are not available from manufacturer.

H. Prior to ordering materials, review raceway layouts with the Architect and the Using Agency in one of each type space.

3.5 GRADE LEVEL PULL BOXES:

A. Top of boxes shall be set flush with finished grade and shall be aligned parallel or perpendicular to predominant site features (i.e. sidewalks, etc.)

B. The exact location of boxes shall be field determined based on existing conditions and coordination with other underground utilities.

C. Conduits shall enter boxes through field-made openings in the sides of box. Conduits shall not enter the bottom of box. Make and seal all openings in accordance with the box manufacturer’s recommendations.

D. Provide a 6" layer of crushed rocks beneath open-bottom type boxes.

3.6 MOISTURE PROTECTION:

A. Conduits entering refrigerated spaces - Provide sealing fitting at accessible location outside the refrigerated space. Seal raceway to prevent the entry of moisture.

B. Where conduits pass from a conditioned space to a non-conditioned space, apply insulating electrical putty inside conduit, at an accessible location, to prevent the entry of moisture.

C. Conduits and boxes installed in exterior walls shall not penetrate the vapor barrier.

D. Boxes installed on the building exterior shall have gasketed covers. All conduits entering box shall be sealed with insulating electrical putty.

3.7 CORROSION PROTECTION:

A. Corrosion protection for conduits passing through concrete slabs shall be by one of the following means:

1. Field-wrap conduits with tape, using with a 50 percent overlay. Tape shall be premium 7-mil, flame retardant, weather resistant tape. Resists temperature and moisture for splicing. Meets requirements of UL 510, HHI-595, and CSA 22.2.
2. Conduits shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating.

B. All supporting materials installed exposed on the building exterior shall be hot-dipped galvanized after fabrication or provide an equivalent level of corrosion protection. Protect exterior raceway systems from damage while the building exterior is cleaned. Replace any portions of the system showing signs of rust at the time of final inspection.

3.8 GROUNDING:

A. Metallic raceway systems shall be made electrically continuous to provide a low impedance path to ground for faults, as required by the NEC.

3.9 RACEWAY BENDS:

A. Bend radius shall comply with the NEC and the requirements of the specific cabling system installed. For television and telephone service entrance conduits, consult with the local utility.

B. All field bends shall be made with a tool specifically intended for the purpose.

C. Tools using open flames are not acceptable for bending PVC conduit. Any section of conduit discolored or deformed in any way shall be cut out and replaced.

3.10 FLEXIBLE CONNECTIONS:

A. Final connections to light fixtures may be made using 3/8" diameter flexible metal conduit not exceeding 6 feet in length.

B. ½" diameter flexible metallic conduit may be used to fish existing walls, within the limits of NFPA 70.

C. Final connections to motors and to other electrical equipment subject to movement and vibration shall be made using Liquid-tight flexible metal conduit not more than 24" long.

3.11 SLEEVES:

A. Provide sleeves of the size and quantity required to install cabling systems specified under Division 23 and Division 27. Where multiple sleeves are required, install in a rectangular array.

B. Make and seal all penetrations to maintain fire rating of member penetrated. Pay particular attention to the annular space required around the inside and outside of the penetrating item. Sealing compounds shall be re-enterable type.

C. Coordinate the exact placement of sleeves with other trades to ensure they are readily accessible and are not obstructed by pipes, ductwork, etc.

D. Sleeves shall be flush with both sides of the member penetrated unless otherwise required by the through penetration firestop system selected.

3.12 RACEWAY LAYOUT:

A. Unless noted otherwise, the layout of all raceway systems is the responsibility of the Contractor.

B. Provide pull points as required by the NEC and ensure that all such points are readily accessible and not blocked by ducts, pipes, etc.

3.13 WALL OUTLET LAYOUT:

A. The location of devices shown on the drawings is schematic. Prior to roughing-in, review the Architectural interior elevations and millwork shop drawings, to ensure that outlets will not be installed behind cabinets or otherwise inaccessible. Ensure that there is sufficient space from door jamb, cabinets, etc. to install without trimming device cover.

B. Outlets installed below countertops shall be centered in the kneespace.

C. All outlets shall be installed vertically except where space above counter back splash and other features does not permit, and when installed in baseboards. In such cases, outlets shall be installed horizontally.

D. Maintain uniform spacing of outlets shown to be side-by-side on the plans. Spacing shall not exceed 2" in framed walls. For masonry walls, install outlets in adjacent cells.

E. Gang mount switches shown in the same location, unless noted otherwise. Provide metal barrier in boxes between switches, when switches are connected to opposite phases of systems exceeding 150V to ground.

F. Mark the branch circuit identification on the cover of all outlet boxes.

G. Provide separate outlet boxes and flexible final connections for fixtures provided with both normal and emergency power connections.

3.14 SUPPORTS:

A. Raceways:

1. Support all components of the electrical raceway system using wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; by machine screws, welded threaded studs, or spring-tension clamps on steel work.
2. Support individual raceways with conduit straps or clips. Support multiple runs using trapeze-type hangers. Trapeze hangers shall consist of 1-1/2" x 1-1/2" gage steel channels, 1/2" diameter threaded steel rods and conduit clamps. Attach rods to the building structure or to 1-1/2" x 1-1/2" gage steel channels span between adjacent structural members.
3. Support conduits at distances required by the National Electrical Code. *Additional supports shall be provided at the points of tangency of all bends.*
4. Joints in conduit systems shall coincide with point of support.
5. Provide expansion joints in all raceway systems in either of the following conditions:
   a. In accordance with manufacturer's literature, based on length of run and temperature differential that will be encountered.
   b. When raceways cross expansion joints.

B. Outlet Boxes:

1. Ceiling outlet boxes shall be supported by lightweight channel attached to structure with (2)-1/4" threaded rods and braced to prevent lateral movement. Boxes used to support ceiling paddle fans shall be listed for the purpose.
2. Masonry walls:
   a. Install outlet boxes in sawcut openings.
   b. Outlet boxes shall be grouted in place, back and sides. There shall no reveals around the perimeter of the box.
3. Framed walls:
   a. Non-rated walls - Outlet boxes shall be attached to intermediate horizontal supports between vertical framing members. *Do not attach boxes to vertical members*.
   b. Framed walls rated 1-hr or 2-hr, boxes 16 square inches or less - Compartmentalize each outlet box (top, bottom and sides) using same material as wall framing. All penetrations in framing members shall be sealed. Where penetrations exceed 100 square inches per 100 square feet of wall space, install in accordance with subparagraph "c" below.
   c. Framed walls rated 1-hr or 2-hr, boxes exceeding 16 square inches - Compartmentalize boxes as specified above. Additionally, Boxes shall be covered back, top, bottom and all sides with drywall such that the rating is carried around the box. All penetrations in this envelope shall be sealed.
4. Boxes shall not be installed in walls rated more than 2-hr.
5. Do not install outlets back-to-back. Maintain 24" offset in rated walls and with no overlap in non-rated walls. Where groups of outlets are shown back-to-back, each group of outlets shall be shifted to accommodate the installation. *Exceptions: (1- Outlet boxes in non-rated masonry walls, may be installed back-to-back. Do not break webbing or connect boxes back-to-back. The use of thru-wall outlet boxes is not permitted. 2- The 24" offset may be eliminated in 1-hr and 2-hr walls when U.L. listed moldable putty is installed around box, in accordance with the U.L. Fire Resistance Directory.*)
6. Outlet boxes mounted in STC rated walls shall be sealed in accordance with Gypsum

Association Document GA-600 "Fire Resistance Design Manual, Sound Control".

7. Cover of outlets installed flush mounted in walls shall be set back no more than 1/8" from face of wall.

3.15 ROUGH-IN FOR DIVISION 27 SYSTEMS AND USING AGENCY PROVIDED TELECOM-MUNICATIONS SYSTEMS:

A. Provide all outlet and junction boxes, sleeves and raceways to form an accessible pathway from each wall or floor mounted device, and ceiling mounted devices to the IDF or MDF or headend equipment location in which the cable terminates, as specified herein and as indicated on the drawings. Cable trays are specified in Section 26 10 20.

B. Conduit sizes shall conform to the following:

1. Voice / Data / Video outlet: 1"
2. Voice / Data outlet: 1"
3. Video outlet: 1"
4. Fire alarm outlet: 3/4"
5. Other: 3/4"

C. Raceways shall be labeled to the extent necessary to allow easy identification by the cable system installers.

D. Outlet box mounting height, cover type, and alignment shall be governed by Division 27.

E. Refer to Section 27 90 10 for additional requirements. Pay particular attention to the requirement that the fire alarm system wiring shall be installed in a complete raceway system.

3.16 ROUGH-IN FOR DIVISION 23 CONTROL WIRING:

A. Provide outlet box and ¾" conduit stubbed up to above accessible ceiling from each wall mounted device. Rough-in details shall be similar to that shown for Division 27 devices. Cabling support system above accessible ceilings for division 23 control wiring shall be supplied and installed by Division 23 contractor. In areas with exposed ceilings, such as mechanical rooms, provide complete conduit pathway to the associated control equipment.

3.17 ROUGH-IN FOR DIVISION 22 PLUMBING FIXTURE SENSORS:

A. Provide outlet boxes for sensors and transformers furnished with the plumbing fixtures. Provide ½" conduit from each sensor location to a point within 6" of transformer outlet box, and terminate with insulated throat bushing.

B. Provide wiring as described in the mechanical equipment connection schedule.

3.18 SPECIAL PROVISIONS FOR DEVICES INSTALLED IN MILLWORK:

A. The millwork shall be provided with openings to accommodate device outlet boxes.

B. Serve all "islands" from concealed stubup.

1. Power wiring within millwork may be flexible metallic conduit.
2. Low voltage cables for Division 27 systems are not required to be installed in raceway

within the millwork as long as the cables are accessible.

3.19 ROUGH-IN AND CONNECTIONS FOR ELECTRONIC DOOR HARDWARE:

A. Provide raceways and 120V power connections as indicated on the drawings.

3.20 FIRESTOPPING:

A. Do not proceed with firestopping until the field demonstration has been conducted.

B. Seal all penetrations based on rating / element being penetrated. Penetrations in non-rated walls shall be rated 1–hour.

END OF SECTION 26 10 10

SECTION 26 20 10 - WIRES AND CABLES, 600V AND BELOW

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

A. The requirements of this section apply to the wire and cable work installed under this contract.

1.3 QUALITY ASSURANCE:

A. Acceptable Manufacturers: Provide wires and cables from manufacturers who have been in business for a minimum of five years.

B. Submittals: Refer to Section 26 01 20 for requirements.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be used.

B. Color Coding

1. Color shall be green for grounding conductors and green with yellow stripe for isolated grounding conductors.

2. The color of the circuit conductors shall be as follows:

120/208 volt, 3-phase	Phase A - Black Phase B -Red Phase C - Blue Neutrals – White (with stripes as specified below)
277/480 volt, 3-phase:	Phase A - Brown Phase B - Orange Phase C - Yellow Neutrals – Gray (with stripes as specified below)

C. All conductors shall be 600V copper, with 75 degrees C, THWN/THHN insulation. Minimum size shall be No. 12 AWG. Conductors within three inches of fixture ballasts shall be rated 90 degrees C. Sizes up to No. 10 AWG may be stranded; sizes No. 8 AWG and larger shall be concentric-lay-stranded. All control conductors shall be concentric-lay-stranded.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL:

A. No more than three phase conductors, each of opposite phases for a three phase WYE system, shall be combined in a single raceway without written permission from the Architect.

B. For each ungrounded conductor, provide a dedicated neutral conductor, with stripe color to match ungrounded conductor insulation color.

C. For each electrical connection/termination, provide a complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties,

D. solderless wire nuts, and other materials necessary to complete splices and terminations. Torque all connections according to installation instructions.

E. Motor connections shall be made with compression connectors forming a bolted in-line or stub-type connection. Connections shall be insulated with Raychem MCK motor connection kit.

F. Splicing of feeder conductors shall not be acceptable, unless specifically indicated on the drawing. Where splicing of feeder conductors is indicated, splices shall be made using Raychem RVS splice kit and compression type butt splice

G. Numbers 10 and 12 AWG stranded conductors shall not be directly terminated to screw-type terminals. The use of Stacon type compression connectors is required.

H. All conductors shall be installed in raceways.

I. Make connections to wiring devices using "pigtails" within outlet boxes. *Direct connection (loop) to devices is not acceptable.*

3.2 SPECIAL PROVISIONS FOR ISOLATED GROUND RECEPTACLE WIRING:

A. Provide a separate neutral for each branch circuit serving isolated ground receptacles.

B. Isolated ground receptacle branch circuits shall use No. 10 AWG conductors.

3.3 DISTANCE LIMITATIONS FOR 20A BRANCH CIRCUITS:

A. All 120 volt, 20 amp branch circuits exceeding 90 feet in length shall consist of No. 10 AWG circuit conductors. Increase conduit size accordingly.

B. All 277 volt, 20 amp branch circuits exceeding 150 feet in length shall consist of No. 10 AWG circuit conductors. Increase conduit size accordingly.

END OF SECTION 26 20 10

SECTION 26 20 20 - WIRING DEVICES

PART 1 -GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

A. The requirements of this section apply to all wiring devices installed under this contract.

1.3 QUALITY ASSURANCE:

A. Acceptable Manufacturers:

1. Provide devices by manufacturers listed for each item.

B. Occupancy/Vacancy sensor catalog numbers and locations shown on plans and specifications are for representation purposes only. Exact models and mounting locations shall be provided by sensor manufacturer. System drawings including device layout, device type, and wiring details shall be submitted for review in shop drawing phase prior to ordering. All sensors shall be dual technology.

C. Submittals: Refer to Section 26 01 20 for requirements.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Provide factory-fabricated wiring devices, in type, color and electrical rating for the service indicated. Where type and grade are not indicated, provide proper selection as determined by Installer to fulfill the wiring requirements, and complying with NEC and NEMA standards for wiring devices.

B. Device colors shall be selected by the Architect on an area-by-area basis.

2.2 GENERAL USE RECEPTACLES:

A. Tamper Resistant (Heavy Duty Specification Grade): Hubbell 5362TR, Arrow Hart TR5362, or Pass & Seymour TR5362.

B. Tamper Resistant Isolated Ground Receptacles (Heavy Duty Specification Grade): Hubbell, Arrow Hart, or Pass & Seymour.

C. Ground-Fault Tamper Resistant Receptacles (Heavy Duty Auto Grounding): Hubbell GFTRST20, Arrow Hart TRSGF20, or Pass & Seymour 2097TR.

D. Receptacles shall be 2-pole, 3-wire, grounding type, rated 20A/125V.

E. Provide weather resistant receptacles in all outdoor locations.

2.1 SPECIAL PURPOSE RECEPTACLES:

A. Provide heavy-duty type of the NEMA configuration indicated on the drawings, as manufactured by Hubbell, Arrow Hart, or Pass & Seymour.

2.2 SWITCHES:

A. Toggle (Industrial Extra Heavy Duty Specification Grade): Hubbell HBL1221, Arrow Hart AH1221, or Pass & Seymour PS20AC1. Provide single-pole, three-way and four-way switches as indicated. Catalog numbers listed herein are for single pole units. Other configurations shall be from the same product family.

B. Keyed: Key switches shall be rated same as toggle switches but shall have cylindrical locking mechanism. *Fork-type keys are not acceptable*. Provide 6 keys to the Owner at the time of final inspection.

C. Narrow-body switches for installation in door-jambs shall not be used.

D. Switches shall have ground screw.

2.3 OCCUPANCY/VACANCY SENSORS:

A. Corner Mounted: Dual technology (Ultrasonic & Infrared), ceiling or wall bracket mounted. Select based on size of space. Provide power pack and mounting hardware; suitable for switching 120 and/or 277 volt loads. Watt-Stopper DT-200 series, Hubbell LODT series, or equivalent by Cooper or Sensor Switch.

B. Ceiling Mounted: Dual technology (Ultrasonic & Infrared), ceiling mounted. Select based on size of space. Provide power pack and mounting hardware; suitable for switching 120 and/or 277 volt loads. Watt-Stopper DT-300 series, Hubbell OMNIDT series, or equivalent by Cooper or Sensor Switch.

C. The triggering of only one technology shall keep the fixtures on.

D. Power packs for sensors shall be rated for control of fractional horsepower motor loads in conjunction with the respective lighting load. Low-voltage multi-conductor cable between sensors and power packs shall be plenum rated, 22 AWG.

E. Provide auxiliary contacts in sensors where shown on the project drawings, or as otherwise required for the functionality specified in the particular building space.

2.4 WIRING DEVICE ACCESSORIES:

A. Wall Plates: Provide one piece wall plates for wiring devices, with ganging and cutouts as indicated. Provide blank plates for all unused outlet boxes. Provide with metal screws for securing plates to devices, screw heads colored to match finish of plate, and wall plates possessing the following additional construction features:

1. Material and Finish: Type 302 stainless steel in finished spaces and stamped steel in unfinished spaces.
2. Wall plates for surface raceway boxes shall be of the same width as the surface raceway

boxes.
3. All plates shall be jumbo size.

B. Weatherproof Covers: All devices installed outdoors shall be provided with weather proof covers. Covers shall be Intermatic die-cast WP series (or equivalent), single or two gang type. The assembly shall be U.L. listed for wet locations, when in use.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES:

A. General:

1. Devices of the same type shown side-by-side shall be gang-mounted and installed under a common plate unless specifically noted.
2. Do not install receptacles within 6" of the edge of sinks.
3. Provide weatherproof covers for all devices installed outdoors.
4. All receptacles installed outdoors, all kitchen receptacles, and receptacles within six feet of sinks and other interior receptacles specifically indicated shall be GFCI type.
5. All receptacles installed outdoors shall be weather resistant GFCI type.
6. Coordinate location of electric water cooler receptacles with cooler manufacturer's recommendations.

B. Connections:

1. Make connections to side terminals only. Wrap side of device with two complete turns of 600V electrical tape, to cover the exposed terminals.
2. See Section 26 20 10 for conductor requirements.

C. Labeling:

1. Provide engraved device plates where indicated. Use 1/8" high black letters.
2. Device plates for receptacles in patient care areas shall have circuit designation engraved in 1/8" high black letters.
3. Mark the branch circuit to which the device is connected on the back of each device plate, using an indelible marker pen.

3.2 OCCUPANCY/VACANCY SENSORS:

A. Corner mounted sensors shall be ceiling bracket mounted where ceiling is present and no higher than 12' AFF. Where space has no ceiling or ceiling is higher than 12' AFF, the corner mounted sensor shall be mounted 10' AFF on a manufacturer-supplied wall bracket.

B. Sensors shall be installed in locations shown on manufacturer submitted shop drawings.

C. Connect low voltage momentary switch(es) to sensor power-pack to achieve manual-on/automatic-off operation in the configuration shown on plans. Switch(es) shall allow manual-off operation as well.

D. Wall mounted sensors shall also be configured to operate manual-on/automatic-off, in configuration shown on plans.

E. Manual switches are not required in corridors, stairwells or multiple occupant restrooms. Sensors shall be automatic-on/automatic-off in these spaces.

F. Low-voltage sensor cable shall be supported by j-hooks attached to structural members, and shall be run at right angles with respect to building structure.

G. Adjust time-off delay to a minimum of fifteen minutes

H. Test all sensors to ensure that they are operating properly.

3.3 TESTING:

A. Test all devices to ensure proper polarity and grounding.

3.4 PROTECTION:

A. If painting and other finish work occurs after device installation, protect device and conductors by installing and maintaining temporary cover:

END OF SECTION 26 20 20

SECTION 26 20 21 - SAFETY AND DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

A. The requirements of this section apply to all safety and disconnect switches installed under this contract

1.3 QUALITY ASSURANCE:

A. Manufacturers: Provide products produced by one of the following (for each type of switch):

1. Square D Company
2. Cutler Hammer
3. Siemens

B. Submittals: Refer to Section 26 01 20 for requirements.

PART 2 - PRODUCTS

2.1 SAFETY AND DISCONNECT SWITCHES:

A. Switches shall be 600V heavy duty type, sheet steel enclosed safety switches, incorporating quick-break type switches, constructed so switch blades are visible in "OFF" position with the door open. Switches shall be equipped with operating handles which are an integral part of the enclosure base and whose positions are easily recognizable. Switches shall be pad-lockable in the "OFF" position. All current carrying parts shall be constructed of high-conductivity copper and silver-tungsten type switch contact. All switches shall be UL listed. Switches shall have engraved plastic nameplates indicating the load served, load rating and the branch circuit number.

Example – (not actual disconnect on project): HP-1
35.5A, 1ph, 208V
Fed from HA-2

B. Switches shall be non-fused type unless indicated otherwise or unless required by the manufacturer of the driven equipment. Where fuses are required, provide fuses of the type recommended by the equipment manufacturer.

C. Nameplates shall be screwed and glued to the enclosure.

D. Enclosures: NEMA 1 general purpose enclosures indoors, NEMA 3R enclosures where noted or shown on drawings or exposed to weather.

2.2 MOTOR RATED SWITCHES:

A. Switches shall be toggle-type, without overload protection, rated for the applied voltage and motor load.

B. Label same as specified for disconnect switches, except install label on wall adjacent to switch.

2.3 ARC FLASH WARNING LABELS:

A. All safety and disconnect switches shall have arc flash warning labels field affixed to their enclosures that comply with the requirements of NFPA 70 and NFPA 70E.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Coordinate safety and disconnect switch installation with surrounding equipment to provide clearance and workspace based on the voltage encountered, and to ensure that the switch is within sight of the controller or driven equipment.

B. Group and lace conductors within enclosure with nylon tie straps.

C. Location of safety switches shall be coordinated with the equipment installer. Do not proceed with rough-in until location has been established.

D. All switches associated with outdoor equipment shall be located as close to the equipment as possible (when equipment is in a service yard, switches shall also be in the service yard) and mounted such that the top of the switch is no more than 3'-0" above grade. All switches associated with equipment mounted above a lay-in ceiling shall also be located above the lay-in ceiling.

END OF SECTION 26 20 21

SECTION 26 20 30 - LIGHTING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION:

A. This section of the specifications is applicable to all lighting fixtures and fixture accessories.

B. Fixtures shall be furnished with ballasts installed. Lamps shall be furnished separately, from the lamp manufacturer.

1.3 QUALITY ASSURANCE:

A. CBM Label: Provide ballasts which comply with Certified Ballast Manufacturers Association standards and carry the CBM mark on the label.

B. Acceptable Manufacturer's:

1. Lighting fixtures - see fixture schedule on drawings.

C. Submittals: Refer to Paragraph 3.05 and Section 26 01 20.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES:

A. Provide lighting fixture assemblies complete with all hardware and accessories needed to install and connect, as indicated on the drawings and this section of the specifications.

B. The Contractor shall select the voltage, frame type, based on the use shown, on an area-by-area basis. These modifiers are not included in catalog numbers. (i.e. A given fixture may be required for use on more than one voltage. Determine voltage by circuit to which fixture is connected.)

C. Any fixtures that are defective or damaged shall be replaced with new. This includes, but is not limited to scratches, dents, inconsistent finishes, etc. The Architect's opinion shall be final in making the determination.

D. Lampholders and sockets shall be compatible with lamp / ballast combinations used.

2.2 LED Lamps and Fixtures:

A. General:

1. LED lamps and driver shall have a 5 year warranty or longer.

2. LED fixtures shall have minimum rated life of 50,000 hours or longer per LM 80 and LM 70 standards.
3. Replacement lamps shall have minimum efficiency of 70 lm / W per LM 79 testing.
4. Integral LED lamps shall have minimum efficiency of 90 lm / W per LM 79 testing.
5. Refer to light fixture schedule on drawings for color temperature.
6. Provide minimum Color Rendering Index, CRI, of 80.

2.3 FRAMES AND HOUSINGS:

A. Fixture catalog numbers indicate style of fixture required. Provide fixtures with proper frames for ceiling types indicated on the reflected ceiling plan.

B. Fixtures installed in inaccessible ceilings shall be U.L. approved for through wiring and all components shall be accessible from below.

2.4 PENDANT MOUNTED FIXTURES:

A. Provide fixtures of lengths indicated.

B. Provide all suspension assemblies, canopies and accessories required for complete installation.

C. Linear type fixtures shall be supported at all points with stainless steel aircraft cable or rigid stems, as indicated.

1. General:
   a. Provide only one feed point per row of fixtures, unless separate emergency power connection is required.
   b. Provide supports at every fixture junction and terminus and as stipulated by the manufacturer.
2. Aircraft cable:
   a. Provide manufacturer's stainless steel aircraft cable assembly with canopy, for the specific fixture series.
   b. Provide non-coiled cable securely attached to aircraft cable at feed points.
3. Rigid stems:
   a. Provide manufacturer's stem-canopy for the specific fixture series.

D. Circular type fixtures shall be provided with suspension assemblies specified for each fixture type.

E. Installation drawings shall be provided for each room, as specified in Section 26 01 20. Show all points of support and feed locations.

F. Provide one pint of touch-up paint for each fixture type and color.

2.5 COLORS AND FINISHES:

A. The color / finish of all surface and pendant mounted fixtures and all suspension assemblies, canopies and accessories shall be selected by the Architect, from the manufacturer's premium color / finish group. Submittals shall include color charts of the colors / finishes available.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General:

1. Do not use permanent fixtures to provide temporary construction lighting. No fixture shall be installed until the interior of the building is enclosed, conditioned, clean and free of dust.
2. Install lighting fixtures in accordance with the fixture manufacturer's written instructions
3. Fasten fixtures securely to the indicated structural support members of the building; and check to ensure that solid pendant fixtures are plumb.
4. Lay-in fixtures shall be supported independently of the suspended ceiling framing members by at least two tie wires located on opposite corners of each fixture.
5. Fixtures other than lay-in type shall be securely fastened in accordance with NEC Article No. 410-36 (B).
6. Fixtures installed in rated ceilings shall comply with the U.L. Fire Resistance Directory for the ceiling design encountered.

B. Layout:

1. Locate fixtures as indicated on the reflected ceiling plans.

C. Recessed Fixtures:

1. It is anticipated that piping and ductwork systems will be installed prior to the installation of ceiling systems and lighting fixtures. Coordinate recess depth of fixtures, on an area-by-area basis, with other trades, to ensure that sufficient recess depth is maintained.
2. Maintain clearance from thermal insulation and combustible materials as required by the NEC.

D. Pendant Mounted Fixtures:

1. Install fixtures at the heights indicated on the reflected ceiling plans. Fixtures or rows of fixtures shall be true and level.
2. Suspension assemblies shall be rigidly attached to the building structure. Suspension assemblies shall allow field adjustment of +/- 12".

E. Emergency fixtures:

1. Do not switch exit lights.

3.2 AIMING:

A. Aim adjustable fixtures to provide a uniform wash of the surface or area to be illuminated.

3.3 LAMPS:

A. Follow the manufacturers' instructions regarding the handling of lamps while installing.

3.4 CLEANING:

A. Prior to final inspection, clean lighting fixtures in a manner recommended and approved by the manufacturer.

B. Replace any components that are damaged.

C. Specific attention is directed to the appearance of pendant mounted fixtures. Field touch-up of the finish will only be acceptable when:

1. The level of damage to the finish does not require replacement of the product, in the sole opinion of the Architect.

AND

2. The Contractor ordered and took delivery of touch-up paint, as well as the manufacturer's recommendations on touch-up, at the time the product was ordered.

AND

3. The touch-up is acceptable to the Architect.

3.5 SPARE PARTS:

A. Provide 2 spare exit lights and 25' of associated raceway and conductors to connect to nearest un-switched lighting circuit. Spare signs shall be added in locations where the Authority Having Jurisdiction requires.

B. If spare equipment listed above are not needed for installation, turn over to Owner.

3.6 TESTING:

A. Test all fixtures for proper operation. Replace lamps and ballasts that are not working properly.

B. Test the emergency lighting system by opening the main circuit breaker serving the facility.
1. Schedule the test with all trades to ensure the tests will not have adverse effects on other equipment and to make sure that other systems properly shut-down and restart.
2. The test shall be conducted at night, in the presence of the Architect, Using Agency and State Fire Marshal.
3. The assembled persons will walk the project to:
   a. Verify operation of equipment installed.
   b. Review lighting levels on an area-by-area basis.

END OF SECTION 26 20 30

SECTION 26 20 42 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

A. Provide panelboards as indicated on the drawings and as specified herein.

1.3 QUALITY ASSURANCE:

A. Manufacturers: Provide products by one of the following (for each type of panelboard and enclosure).

1. Square D Co.
2. Cutler Hammer
3. Siemens

B. Compliance / Labels:

1. Equipment shall comply with the latest applicable standards of NEMA PB-1 and UL 67.
2. Where panelboards are used as service entrance equipment, they shall comply with all NEC and UL requirements for service entrance and a UL service entrance label shall be provided.

C. Submittals: Refer to Section 26 01 20 for requirements.

PART 2 - PRODUCTS

2.1 ENCLOSURES:

A. Enclosure shall be constructed of code gauge steel constructed without knock-outs. Provide manufacturer's standard light gray finish.

B. Provide double hinged door with flush metal latch/lock on inner door. Inner door shall provide access to circuit breaker operating handles only, not to energized parts. Outer continuous piano hinged door shall be mounted to the panelboard box with factory screws and shall provide access to energized parts; metal latch/lock is not permissible on outer door. Both inner and outer doors shall open in same direction. **EZ Trim doors are not permitted**

C. All locks shall be keyed alike.

D. Provide metal or lexan interior circuit directory frame with card and clear plastic covering.

E. Panelboard enclosures shall be NEMA 1 unless shown to be installed in damp or wet locations. In such locations, enclosures shall be NEMA 3R or 4X.

2.2 CONSTRUCTION:

A. Provide dead-front safety type panelboards of either Power and Distribution type or Lighting and Appliance type as defined by the NEC.

1. Power and Distribution type panelboards shall be a minimum of 32" wide by 9" deep and a maximum of 44" wide by 12" deep.
2. Lighting and Appliance type panelboards shall be a maximum of 20 inches wide by 5-3/4 inches deep.

B. Panels shall be equipped with copper bus bars, full-sized neutral bar, and an equipment ground bus. Panels serving theatrical equipment shall have a isolated ground bus in addition to the equipment ground bus.

C. Each panel shall be equipped with main lugs or main breaker, as indicated.

D. Two section panels shall be through-feed type and shall be installed with cans abutting. *Cans and covers shall be of same size, for both sections.* Divide circuits as evenly between the two sections as possible.

E. Provide with laminated plastic nameplate engraved with name of panel, voltage, ampere rating/type fault current rating, date, and feeder origination. Nameplate shall be screwed and glued to panel. Nameplates shall be black in color with white lettering. Nameplates shall have beveled edges.

Example (not actual panel on project):Panelboard HA
277/480V, 3 phase, 4W
225A Main Lugs
14,000 AIC
Fed from SWBD
9/2019

2.3 CIRCUIT BREAKERS:

A. Provide bolt-in type, heavy duty, quick-make, quick-break, thermal, magnetic molded case circuit breakers. Multi-pole breakers shall be common trip, with a single handle.

B. Main circuit breakers shall be large frame type, individually mounted, connected directly to the bus. The use of backfed breakers is not acceptable.

C. Provisions for future breakers shall be fully bussed complete with all necessary mounting hardware.

D. Devices which achieve the level of fault protection indicated by means of "series" or "integrated" rating shall not be acceptable unless specifically indicated on the drawings.

E. Breakers serving HVAC equipment shall be HACR type.

F. Circuit breakers serving fire alarm equipment shall be provided with a lock tab, red in color.

2.4 BRANCH CIRCUIT IDENTIFICATION:

A. All panelboards shall have a legend permanently posted to their exterior frontal enclosure identifying phasing and the color scheme of all ungrounded conductors in accordance with NFPA 70, Article 210.5.

2.5 SPECIAL PROVISIONS FOR PANELBOARDS SERVING KITCHEN EQUIPMENT:

A. Panelboards shall be of door-in-door construction.

B. Panelboard cover and door shall be gasketed, stainless steel.

2.6 SELECTIVE COORDINATION FOR EMERGENCY POWER SYSTEMS:

A. All emergency power system overcurrent devices shall be selectively coordinated with all supply-side overcurrent protective devices to comply with the requirements of NFPA 70 Articles 700 and 701.

B. The contractor shall furnish protective device coordination studies which shall be prepared by the equipment manufacturer. The studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems and skilled in performing and interpreting the power system studies. The Registered Professional Electrical Engineer or other qualified person shall be a full-time employee of the electrical power equipment manufacturer.

C. Protective Device Coordination Study:

1. The results of the protective device coordination study shall be summarized in a final report and submitted with the shop drawings.
2. The report shall include protective device time versus current coordination curves with associated one-line diagram identifying the plotted devices, tabulations of adjustable circuit breaker trip unit settings. Comments and recommendations for system improvements shall be provided where needed.
3. Proposed protective device coordination time-current curves shall be graphically displayed on log-log scale paper.
4. Include on each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered.
5. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
6. Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
7. Provide adequate time margins between device characteristics such that selective operation is provided while providing proper protection.

D. Field Adjustment: Adjust protective device settings according to the recommended settings table provided by the coordination study.

2.7 WARNING LABELS:

A. All panelboards shall have arc flash warning labels field affixed to their enclosures that comply with the requirements of NFPA 70 and NFPA 70E.

B. Where panelboards are used as service equipment, provide separate label to show the maximum available fault current. Label shall have blank fields to handwrite the calculated available fault current and the date calculated. After service is installed and ready to be inspected by the Authority Having Jurisdiction [Design Professional], Contractor shall submit to the Electrical Engineer the fault calculation (at the service entrance only).

PART 3 - EXECUTION

3.1 GENERAL:

A. Provide circuit directory upon completion of work. Identify load served and location (by room name and number) assigned by user, not by room numbers on floor plans. Note spares and spaces as such. Create directory using electronic spreadsheet and print in 8-1/2" x 11" format using as many pages as necessary. Fold and place in directory holder.

B. Do not splice conductors in panelboard enclosure.

C. Only one conductor shall be connected to each terminal or lug.

D. Connect circuits 1 and 2 to phase A; 3 and 4 to phase B; 5 and 6 to phase C., etc. Conductors shall be color coded in accordance with Section 26 20 10.

E. Group and lace conductors within panel enclosure with nylon tie straps.

F. Each section of two section panels shall contain only those conductors which originate in that section. Do not use panel as a wireway.

3.2 GROUNDING:

A. Ground all panels in accordance with details on the drawings and Section 26 20 80.

B. Do not bond neutral and equipment grounding conductors within panelboard unless panel is used as service equipment or are a separately derived system.

3.3 ADJUST AND CLEAN:

A. Adjust operating mechanism for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finish.

C. Clean all debris from panel interiors.

D. Clearance and Workspace: Maintain workspace and clearances as required by the NEC for the voltage encountered. No pipes or ducts shall pass above the outline of the panelboard. It shall be the responsibility of this Contractor to make sure that other trades do not encroach on this space.

END OF SECTION 26 20 42

SECTION 26 20 44 - SEPARATELY ENCLOSED CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

A. Provide circuit breakers of ratings as indicated on the drawings and as specified herein.

1.3 QUALITY ASSURANCE:

A. Acceptable Manufacturers:

1. Square D Co.
2. Cutler Hammer
3. Siemens

B. Compliance/Labels:

1. Equipment shall comply with the latest applicable standards of NEMA PB-1 and UL 67.
2. Where circuit breakers are used as service entrance equipment, they shall comply with all NEC and UL requirements for service entrance and UL service entrance label shall be provided.

C. Submittals: Refer to Section 26 01 20 for requirements.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Provide circuit breakers, enclosures and auxiliary components of types, sizes and ratings indicated. Enclosure shall be NEMA 3R outdoors and be constructed of code gauge steel constructed without knock-outs. Provide manufacturer’s standard light gray finish.

2.2 CIRCUIT BREAKERS:

A. Circuit breakers shall the same type as specified in the PANELBOARDS section.

2.3 NAMEPLATE:

A. Nameplates shall be the same as specified in the PANELBOARDS section.

2.4 ARC FLASH WARNING LABELS:

A. All separately enclosed circuit breakers shall have arc flash warning labels field affixed to their enclosures that comply with the requirements of NFPA 70 and NFPA 70E.

PART 3 - EXECUTION

3.1 GENERAL:

A. Do not splice conductors in circuit breaker enclosure.

B. Group and lace conductors within enclosure with nylon tie straps.

3.2 ADJUST AND CLEAN:

A. Adjust operating mechanism for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finish.

END OF SECTION 26 20 44

SECTION 26 20 47 - DRY TYPE TRANSFORMERS, 600V AND BELOW

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

A. Provide dry-type transformers of ratings indicated on the drawings and as specified herein.

1.3 QUALITY ASSURANCE:

A. Transformers shall be the standard product of one of the following manufacturers:

1. Square D Company
2. Siemens
3. Cutler Hammer

B. Compliance: Comply with applicable UL, NEMA and ANSI publications pertaining to dry type transformers and their installation.

C. Submittals: Refer to Section 26 01 20 for requirements.

PART 2 - PRODUCTS

2.1 TRANSFORMERS:

A. Individual dry type transformers shall be UL approved for 500 KVA and smaller, shall be sized as indicated on the drawings, shall be built in accordance with NEMA/ANSI standards, shall be self-cooled, two-winding type, and shall have totally enclosed copper windings. Transformers shall be rated for a 115 degrees C. rise above ambient. Provide weather-proof enclosures for all units mounted in locations exposed to falling or driven rain.

B. Full capacity taps shall be provided in the high voltage windings and shall have 4-2-1/2% taps below and 2-2-1/2% taps above rated primary volts. Transformer impedance value shall be manufacturer's standard for size transformer provided.

C. Transformer sound levels shall be based on NEMA-ANSI standards. *However, no audible noise shall be heard outside the rooms in which transformers are located, under all load conditions. Transformers not meeting this requirement shall be replaced.*

D. Transformers shall have efficiencies in compliance with federal law 10 CFR Part 431 standards.

2.2 ARC FLASH WARNING LABELS:

A. All dry type transformers shall have arc flash warning labels field affixed to their enclosures that comply with the requirements of NFPA 70 and NFPA 70E.

PART 3 - EXECUTION

3.1 TRANSFORMER INSTALLATION:

A. Installation of transformers shall be such that air circulation around the units is not restricted. Hold 6" off walls.

B. Under no circumstances shall transformer be hoisted into place before roof is in place and installed in such a manner that roof has to be removed to remove transformer.

C. The transformer taps shall be connected to provide proper operating secondary voltage.

D. Transformers shall be floor mounted type. Install on floor or suspend, as indicated on the drawings. Floor mounted transformers shall be installed on a 4" high concrete pad with 3" overlap on all sides. Anchor transformer to pad. *Coordinate exact placement with sprinkler system installer such that during normal operation, the heat rejected from transformer does not cause activation of sprinkler head.*

E. Transformers mounted indoors shall have neoprene, rubber or similar type vibration dampening mounts. Mounts shall be rubber-in-shear type composed of two metal parts with rubber compound in between. All raceway connections shall be made with 12 to 18 inches of flexible metallic conduit.

F. Ground transformer secondary neutral to the nearest electrode in accordance with NFPA 70, Article 250-26c.

END OF SECTION 26 20 47

SECTION 26 20 49 - SURGE PROTECTION DEVICES (SPD)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

A. Provide SPD units connected in parallel with power distribution equipment, as indicated. SPD units shall be mounted *external* to power distribution equipment. *The use of SS/EHF units integral with power distribution equipment is not acceptable.*

1.3 COORDINATION:

A. Work under this section shall be closely coordinated with power distribution equipment specified under other sections.

1.4 REFERENCE STANDARDS AND PUBLICATIONS:

A. Suppressors shall be designed, manufactured, tested and installed in accordance with the latest edition of the following guidelines and standards:

1. ANSI/IEEE C62.41.1 & C62.41.2
2. ANSI/IEEE C62.45.
3. UL 1449 Third Edition

B. Provide certification that product performance has been verified by a nationally recognized third party testing laboratory.

1.5 SUBMITTAL:

A. Refer to Section 26 01 20 for requirements.

1.6 ACCEPTABLE MANUFACTURERS:

A. This specification is based on the following:

1. Square D
2. Surge Suppression, Inc.
3. Current Technologies
4. Advanced Protection Technologies
5. Eaton
6. Liebert
7. Intermatic

PART 2 - PRODUCTS

2.1 GENERAL:

A. SPD for lighting and appliance panels:

1. Type 2 device.
2. Voltage: 120/208, 3PH, 4W, 60 Hz.
3. Modes: L-L, L-N, L-G, N-G.
4. Single pulse surge capacity per mode: minimum of 120,000 amps.
5. Noise Attenuation: 100KHz - 100MHz.
6. Nominal Discharge Current (In) shall be a minimum of 10kA

2.2 FEATURES:

A. All units shall have the following features:

1. Phase LED indicator lights.
2. Disturbance counter.
3. 10-year repair / replacement warranty from manufacturer in the name of the Owner.

2.3 ENCLOSURES:

A. SPD enclosures shall be NEMA 1 unless shown to be installed in damp or wet locations. In such locations, enclosures shall be NEMA 3R or 4X.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install adjacent to electrical equipment, ensuring that lead lengths are as short as possible to achieve the level of protection specified herein. Lead lengths longer than 12" is unacceptable. Where field conditions make this requirement impossible, contact Architect during shop drawing phase before electrical room drawings are submitted.

B. Connect to circuit breaker in electrical equipment as shown on the manufacturer's wiring diagrams.

END OF SECTION 26 20 49

SECTION 26 20 80 - ELECTRICAL GROUNDING, 600V AND BELOW

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. Provide grounding and bonding of systems and equipment as shown on the drawings, specified herein and as required by Article 250 of the NEC.

B. The grounding electrode system shall consist of:

1. Ground rods.
2. Underground metal water supply pipe, outside the building.
3. Concrete encased electrode

C. The following items shall be bonded to the grounding system:

1. Structural steel frame of the building.
2. Interior metal piping systems.
3. Equipment enclosures.
4. Device terminals.
5. Equipment grounding conductors.

1.3 QUALITY ASSURANCE:

A. Acceptable Manufacturers: Use products of manufacturer’s regularly engaged in the production of grounding systems products.

B. Standards: IEEE Green Book - Grounding.

C. Compliance / Labels: All materials shall be U.L. listed for grounding and bonding systems.

D. Submittals: Refer to Section 26 01 20 for requirements.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Where more than one type meets indicated requirements, selection is Installer's option. Where material or component is not otherwise indicated, provide products complying with U.L., NEC, and established industry standards.

2.2 GROUND RODS:

A. Rods shall be 3/4" diameter x 10' long copper-clad steel.

2.3 CONDUCTORS:

A. Grounding Electrode conductors: Bare, stranded copper electrical grounding conductors, sized as shown. When no size is shown, select from Table 250-66 of the NEC.

B. Bonding Jumper Braid: Copper braided type, sized for application.

C. Equipment Grounding conductors: Insulated, stranded copper electrical grounding conductors complying with Section 26 20 10, sized as shown. When no size is shown, select from Table 250-122 of the NEC.

2.4 CONNECTORS:

A. Connectors to rod or reinforcing steel bar electrodes shall be exothermic weld type. The use of wire ties to make rebar continuous is not acceptable.

B. Connections to pipe electrodes shall be pressure or clamp type.

C. Connections to items specified to be bonded to the grounding system may be by any U.L. listed product suitable for the application.

2.5 CAUTION TAGS:

A. Tags shall be weatherproof, custom-printed plastic type, 3-1/4" wide x 5-5/8" high, with stainless steel eye and nylon self-locking tie.

B. Tags shall be two-sided and shall have yellow background with black letters. The word "CAUTION" shall be machine-printed in boldface type at the top, with the custom message machine-printed below.

C. Provide the number of tags required, plus six spare.

D. Tags shall be Seton #12584, or equivalent. (Seton: 1-800-243-6624)

PART 3 - EXECUTION

3.1 GENERAL:

A. Ensure that metal-to-metal contact is made between grounding connectors and painted or coated surfaces of equipment enclosures, piping systems, etc.

B. Where concrete penetration is necessary, non-metallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground wire and the opening shall be sealed with a suitable compound after installation of the ground wire.

C. Metallic raceway systems shall be made electrically continuous to provide a low impedance path to ground for faults, as required by the NEC.

3.2 GROUNDING ROD ELECTRODES:

A. Install ground rods in the approximate location shown. Drive three, 10-feet rods into the earth in a triangular pattern with the rods 10 feet on center. Install rods such that the top of

each rod is 8" below finished grade.

B. Install an enclosure for each ground rod, similar to a Quasite "PC" style, open bottom box, with nominal dimensions of 17" long x 11" wide x 12" deep. Box cover shall be locking type and have the logo "GROUND".

C. The rod and exothermic connection to the grounding electrode conductor shall be accessible from within enclosure. Fill the lower 2" of enclosure with crushed rocks. Top of enclosure shall be flush with finished grade.

D. Install boxes in accordance with the manufacturers' instructions for the loading indicated. Note that full vehicular traffic rating requires the box to be encased in concrete and use of steel cover.

3.3 BUILDING PERIMETER GROUNDING ELECTRODE:

A. Make bottom rebar in concrete footing around the perimeter of the building electrically continuous. Ensure minimum of 2" of concrete encasement between earth and rebar. Ensure that the concrete footing is in direct contact with the earth. Where vapor barrier, insulation, films, or similar items are below footer, paragraph B below shall be followed instead.

B. Ground Ring. Install a No 1/0 AWG bare copper conductor around the perimeter of the building, with at least 30" cover. Install conductor as close to foundation wall as possible.

3.4 UNDERGROUND METAL WATER PIPE ELECTRODE:

A. Make connection to "street" side of water meter.

B. Install braided type bonding jumper between "street" side and "house" side piping such that removal of water meter will not interrupt ground path.

C. The connection shall be accessible.

3.5 EQUIPMENT GROUNDING CONDUCTORS:

A. Install an equipment grounding conductor in all branch circuit and feeder raceways, sized in accordance with Article 250 of NFPA 70.

B. Branch circuits serving isolated ground receptacles shall be provided with an isolated equipment grounding conductor in addition to the equipment grounding conductor.

3.6 BONDING:

A. Bond the structural steel frame of the building to the service equipment ground bus. The connection shall be accessible.

B. Bond column anchor bolts of structural steel building to building perimeter grounding electrode no less than every 100'.

C. Multiple buildings present under one electric service shall be bonded.

D. Bond each dry type transformer to nearest accessible structural steel member if present. Otherwise to nearest metallic water pipe.

E. Bond interior metal piping systems to the service equipment ground bus. The connections shall be accessible.

F. Bond metallic equipment enclosures to a lug installed within the enclosure, which is connected to an equipment grounding conductor.

G. Bond standard device grounding terminals to metallic outlet box and to equipment grounding conductor.

H. Bond equipment grounding conductor to metallic boxes where splices are made.

3.7 BONDING BUSHINGS AND LOCKNUTS:

A. Bushings and locknuts shall be required:

1. Service entrance conduit stub-ups. Interconnect with No. 1/0 AWG (bare) and bond to ground bus in the service equipment.
2. When required by the NEC for voltages in excess of 250V. Bonding conductor shall be sized per the NEC.
3. When terminating conduits in concentric or eccentric knockouts. Bonding conductor shall be sized per the NEC.
4. For all connectors that are not U.L. listed as suitable for grounding.

B. Bushings shall be connected to the respective enclosure by an equipment grounding conductor sized in accordance with Article 250 of the NEC.

3.8 LABELING:

A. Provide a waterproof "CAUTION" tag at the point of connection to each grounding electrode, which reads: "ELECTRICAL SYSTEM GROUNDING ELECTRODE - DO NOT REMOVE THIS CONNECTION. NOTIFY BUILDING MANAGEMENT IF DAMAGED OR DISCONNECTED."

B. Provide a "CAUTION" tag as specified above within the electrical service equipment where the grounding electrode conductor is terminated.

3.9 TESTING:

A. Upon completion of installation of electrical grounding system, test resistance of each ground rod installation using the "Fall of Potential" method. Ground resistance shall be measured in normally dry conditions not less than 48 hours after rainfall. Where tests show resistance to ground is over 25 ohms, take appropriate action to reduce resistance to 25 ohms or less by driving additional sections of ground rods and/or by chemically treating soil encircling ground rod; then retest to demonstrate compliance. Provide forms to record the data as the tests are conducted. Forms shall be signed by the person conducting the test.

END OF SECTION 26 20 80

SECTION 26 4000 – SEISMIC CONTROL FOR ELECTRICAL EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. Furnish all labor, materials, tools and equipment and perform all work necessary to complete the installation of the seismic control systems required by these specifications and as detailed on the drawings.

B. All foundations and supports required for the installation of Division 26 equipment shall be furnished by the Division 26 contractor unless specifically specified otherwise.

C. All concrete work, forming, framing, pouring and materials shall be furnished under Division 1 General Trades Portion of the contract documents.

1.2 RELATED DOCUMENTS:

A. The drawings and general provisions of this division of the Contract, including the General and Special Conditions and Division 1 Specifications, apply to this Section.

B. Additionally, the following sections apply to this section:

1. Section 260100 – General Provisions - Electrical
2. Section 261010– Raceway Systems and Supports

1.3 QUALITY ASSURANCE:

A. Codes and Standards: The installation of the Electrical systems shall be installed in accordance with the following codes and standards. All seismic restraint systems such as sway bracing, cable restraints, seismic restraints, etc. shall also meet the requirements as set forth in the following standards and codes:

1. The International Building Code (IBC)
2. National Electric Code, NFPA 70
3. SMACNA Seismic Restraint Manual
4. ASTM 488 Anchor locations
5. FEMA Standards

B. The seismic control equipment and products shall be sized and provided by one of the manufacturers listed below. The manufacturer shall have tested all seismic products provided for the specific intended use and installation.

C. The following list of manufacturers are acceptable manufacturers:

1. Kinetics Noise Control
2. Mason
3. Amber/Booth
4. Vibration Mountings and Controls

D. The manufacturer and/or his representative shall select all seismic control products in-accordance with these specifications and all applicable codes. All products shall provide the protection indicated based on the actual equipment weights and installation requirements of the approved equipment. The manufacturer shall provide installation instructions for all provided seismic restraints and bracing.

E. Submittals:

The contractor shall submit for approval by the engineer, seismic anchorage requirements for all equipment and raceway systems. Anchorage calculations shall be prepared by a registered engineer and in the state where the project will be constructed. The engineer shall stamp calculations. Anchorage requirements shall be submitted for all base mounted equipment, suspended equipment, & roof mounted equipment. Seismic anchorage calculations shall include an "anchorage schedule" for the contractor's use. The anchorage schedule shall list the equipment, the size and quantity of fasteners and the minimum embedment depth of anchors. Calculations may be combined for similar types of equipment provided the size and weight does not vary more than 15% and the installation manner are similar.

PART 2 - PRODUCTS

2.1 GENERAL:

A. All equipment shall be mounted or suspended from approved foundations and supports as specified herein.

B. All seismic control devices shall be listed for the intended use. It is the responsibility of the Contractor to determine the appropriate restraint methods with respect to the building type and the specific equipment used.

2.2 SEISMIC CONTROL:

A. The electrical systems serving the building shall be installed to meet the minimum requirements of the *International Building Code* regarding seismic protection and control. These specifications and the drawings indicate the minimum requirements and general intent. The actual requirements shall be determined by the seismic engineer and supplier and submitted for approval by the Electrical Engineer.

B. The seismic engineer shall be a registered engineer in the state in which the facility is constructed and whose principal area of practice is seismic engineering and related fields.

C. All equipment installed either floor or pad mounted, suspended from the structure or roof mounted on curbs shall be restrained and anchored unless exempt as hereinafter indicated.

D. Verify the following criteria with Structural as it applies to this project:

1. Site Classification: (A,B,C,…F)
2. Seismic Design Category: (A,B,C,…F)
3. Seismic Use Group: (I, II, or III)
4. Importance Factor: (1.0 or 1.5)

E. Where conduits, cable trays, or other electrical systems cross the seismic isolation interface between two seismically isolated structures, the systems shall have flexible connections to accommodate the seismic displacement of the two structures. Flexible connectors shall be installed on one side of the interface.

F. The following electrical components are exempt from seismic bracing or restraints:

1. Components in seismic design category A and B.
2. Components in Seismic Design Category C when the Ip = 1.0.
3. Electrical components in all Seismic Design Categories where Ip = 1.0, the equipment weight is less than 400 lb, the equipment is installed less than 4'-0" above the floor and flexible connections are installed between the equipment and associated conduit.
4. Electrical components located in Seismic Design Category D, E and F that weigh less than 20 lbs and Ip = 1.0, and flexible connections are installed between the component and associated conduit.

G. Cable trays and electrical conduits located in Seismic Design Category D, E and F shall be supported and seismically braced independently of the suspended ceilings.

H. Electrical equipment designated to have an Ip = 1.5 shall be designed and fabricated to withstand the horizontal forces as determined by the *International Building Code*, 2006 edition, paragraph 1621.1.4 and the manufacturer shall certify and provide certification that the equipment meets this requirement of the code.

I. All life safety systems and associated equipment and conduit installed in the building such as emergency lighting systems, exit signs, fire alarm systems, fire protection systems and smoke removal systems shall have an importance factor of 1.5. Systems having an importance factor of 1.5 shall be restrained.

J. All electrical equipment that is floor mounted and weighs 400 lbs or more shall be restrained.

K. All electrical equipment located in Seismic Design Category D, E or F and installed 4'-0" or more able the floor and weighs more than 20 lbs shall be restrained. In addition, flexible connectors shall be provided between the equipment and connecting conduit.

L. Electrical components, equipment, and conduit containing hazardous or flammable material shall have an importance factor of 1.5 and shall be restrained.

M. Components and systems needed for continued operation of essential facilities shall be restrained.

N. Anchorage of equipment to concrete floors and pads shall be in-accordance with the submitted anchorage calculations.

O. Connections of seismic restraint cable hardware shall be in-accordance with the submitted anchorage calculations.

PART 3 - EXECUTION

3.1 GENERAL:

A. If the equipment provided is not furnished with integral structural steel supports, mounting feet or lifting lugs, the contractor shall provide miscellaneous steel shapes as required to install or suspend the equipment and attach the seismic restraints as specified herein.

B. Support steel shall include but not be limited to rails, brackets, angles, channels, and similar components.

C. All seismic restraint products shall be installed as outlined in the manufacturer's printed installation instructions.

3.2 SEISMIC CERTIFICATE OF COMPLIANCE:

A. The manufacturer's representative shall be responsible for providing such assistance and supervision as necessary to assure a correct installation and adjustment of seismic control products.

B. The manufacturer's representative shall visit the installation once all installed items have been completed but prior to the installation of ceilings or walls that may conceal any devices and inspect the installation for compliance with the manufacturer's installation instructions. Upon satisfaction that all devices are installed correctly, the representative shall submit a written report outlining that the installation is in compliance with these specifications as well as the manufacturer's installation instructions.

END OF SECTION 26 4000

SECTION 26 60 11 - EMERGENCY POWER SYSTEM - NATURAL GAS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

B. Refer to Section 26 20 42 and 26 20 43 for information on the required selective coordination for emergency power system overcurrent devices. The coordination study is a requirement of NFPA 70 Articles 700 and 701.

1.2 SCOPE OF WORK:

A. The Emergency Power Systems shall provide alternate AC power source for designated loads in the event there is an interruption of normal utility power. When required, the units shall automatically transfer the full rated load from the normal power source to the standby emergency generator. Upon return of normal power, the loads shall be automatically transferred back to the normal power source and the emergency generator shall automatically shut off, after a cool down period.

B. The extent of Emergency Power Systems (EPS) work is indicated by drawings and by the requirements of this Section. Provide a complete automatically operated electric generating set of the size, type and operating characteristics described hereinafter, completely installed, tested and operative. All equipment, labor and materials necessary to accomplish this end shall be included, and the coordination of all required equipment and material shall be the responsibility of one manufacturer, who has an approved experience record in furnishing similar equipment.

1.3 QUALITY ASSURANCE:

A. Manufacturers: The following manufacturers are acceptable provided they meet all requirements of the specifications:

1. Onan/Cummings
2. MTU Onsite Energy (Detroit Diesel)
3. Generac
4. Caterpillar

B. Geographic Location:

1. The installation / service center shall be located within 75 miles.

C. Requirements:

1. The installation / service center shall be factory authorized and shall be certified, in writing, by the manufacturer, as being responsible for installation and warranty work and shall be capable of performing work on the engine, generator, battery charger, fuel system, automatic transfer switch and all accessories which make up the complete emergency power system.
2. The installation / service center shall provide on-site service within 4 hours of receipt of

service request.
3. The installation / service center shall maintain adequate levels of repair parts inventory.

D. Compliance / Labels:

1. Where a conflict between this document and NFPA 110 should arise, NFPA 110 shall govern.
2. Manufacturer Testing:
   a. Design prototype testing - Shall be performed on similar models of the unit furnished on this project.
   b. Final production testing of the engine/generator and automatic transfer switch - provide certified test reports.
   c. Field testing, by manufacturer's local representative

1.4 SERVICE / MAINTENANCE AGREEMENT:

A. The *engine / generator supplier* shall provide a service / maintenance contract covering one year of operation, from the date of Substantial Completion. There shall be no deductible costs, or other costs, to the Owner for these services. All costs shall be included in the bid for this project. *The agreement shall be made in the name of the Owner*. The service / maintenance agreement applies to the following items of equipment:

1. Engine-Generator Set.
2. Automatic Transfer Switch.

B. The *Maintenance agreement* shall include the following and also shall include services per the equipment manufacturer's applicable instruction manual:

1. Lube, oil, and filter change
2. Fuel filter change
3. Engine tune-up with parts
4. Service/replace air cleaner
5. Check coolant level
6. Test anti-freeze and adj.
7. Inspect cooling system hoses
8. Service/replace belts as required
9. Check engine heater operation
10. Check generator set for fuel, oil, and coolant leaks
11. Check air intakes and outlets
12. Drain exhaust line
13. Inspect silencer
14. Check battery charger operation and charge rate
15. Check battery electrolyte levels and specific gravity
16. Emergency system operation with load applied for one hour period
17. Frequency check/governor adj.
18. Check transfer switch and accessory operation
19. Check engine alternator charge rate
20. Check engine-generator gauge and indicator operation
21. Check generator set controller operation including shutdown functions and emergency stop
22. Check generator output voltage and adjust as necessary

C. Maintenance shall be performed at intervals stated in equipment manufacturer's applicable instruction manuals except that the minimum service visits shall be four per year, and they shall be in Jan., Apr., July, and Oct.

D. Maintenance shall be performed near the middle of the month during the owners normal working hours. Arrangements will be made with the owner prior to each service call in order to secure access to the equipment.

E. The servicing agent will supply labor, supplies, parts and test equipment, as necessary to perform the service and preventative maintenance, at no additional cost.

F. *The service agreement* shall include labor, supplies and replacement parts to restore the system to operating condition, *whether due to normal wear and tear or defects in workmanship or materials.*

1. Response to *service* calls shall be made within 4 hours.

G. Owner will maintain a regular recommended service procedure as recommended by the servicing agent. A record of these maintenance procedures will be maintained for reference.

H. The servicing agent shall maintain a complete service history and necessary drawings and service procedure data for reference in service of the equipment. The agreement does not include any expense to repair damage caused by abuse, accident, theft, acts of a third person, forces of nature, alteration of equipment, or improper operation. The servicing agent shall maintain a representative stock of replacement parts for the complete emergency system and a competent factory-trained service organization.

I. After each inspection, the owner will be furnished a written report detailing any conditions found and advising further service required, if any, to assure operating dependability of the equipment under contract.

1.01 COMPREHENSIVE WARRANTY:

A. The standby electric generating system components, complete genset and instrumentation panel shall be warranted by the manufacturer against defective materials and factory workmanship for a period of five (5) years. Such defective parts shall be repaired or replaced at the manufacturer's option, free of charge for parts, labor, and travel. The warranty period shall commence when the standby power system is first placed into service. Multiple warranties for individual components (engine, alternator, controls, etc.) will not be acceptable. Satisfactory warranty documents must be provided. Also, in the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have the necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

1.5 SUBMITTALS:

A. Refer to Section 26 01 20 for requirements.

PART 2 - PRODUCTS

2.1 GENERAL:

A. The system shall have the following characteristics:

1. 100 kW / 125 kVA @ 0.8PF for Continuous Standby Service; based on use in outdoor housing - geographic location – Savannah, GA, USA.
2. 3 phase, 4W, 480/277 Volts.
3. Provide monitoring and controls necessary to achieve the following sequence of operation:
   a. Transfer the emergency system load within the 10 second interval required by NFPA 110.
   b. After the emergency load has been stabilized, transfer the optional standby load. Time delay shall be field selectable, 1-5 minutes. Set for 1 minute.
   c. The emergency system loads shall take precedence over all other loads. An overload condition shall dump loads on the optional load standby system.

2.2 ENGINE:

A. 1800 RPM.
B. Design: 8- cylinder, water cooled, naturally aspirated.
C. Bore: 5.31" Stroke: 6.50"
D. Piston displacement: 864.71 cubic inches.
E. Valves: per cylinder, single springs
F. Crankshaft: Forged steel, counterweight-type.
G. Connecting Rods: Forged steel with I-beam design.
H. Compression ratio: 9.5:1
I. Starting: 24V negative ground
J. Cylinder block: Cast Iron.
K. 40A battery charging alternator.
L. Fuel System: Fueled by natural gas and supplied with a unit-mounted electric solenoid fuel shut-off valve, flexible fuel line and secondary fuel pressure regulator.
M. Isochronous governor capable of +.25% steady-state frequency regulation.
N. Air Cleaner: Dry element with restriction indicator.
O. Lube Oil Capacity: 12 US Quarts, API CD 15W-40
P. Lube Oil Filter: Single spin-on, full flow.
Q. Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick and oil drain.
R. Cooling system: High ambient 122 deg F unit mounted radiator, blower fan, water pump and thermostat.

2.3 GENERATOR:

A. Salient-pole, brushless, 12 lead reconnectable type; self-ventilated, drip proof housing; amortisseur rotor windings and skewed for smooth voltage waveform. NEMA Class H insulation with fungus-resistant epoxy varnish.

B. Brushless excitation system controlled by solid-state, anti-tracking voltage regulator capable of maintaining +/- 2% for any constant load from 0 to 100% of rating. Provide individual adjustments for voltage range, stability and volts/hertz operations.

C. Voltage dip not to exceed 20% with one-second recovery within 2% of rated voltage, for one-step loads 0 to 90% of rating.

D. Shall sustain at least 250% rated current for minimum of 10 seconds, based on a 3-phase symmetrical fault.

E. Integral thermal-magnetic circuit breaker on output, coordinated not to trip under the conditions described above.

2.4 CONTROLLER:

A. Set-mounted, microprocessor-based, with vibration isolation. Modular construction to allow field replacement and for field testing without starting the generator. Controller shall include:

1. Fused DC circuit
2. Complete two-wire start/stop control which shall operate on closure of remote contact device(s).
3. Speed sensing and a second independent starter motor disengagement systems shall protect against starter engagement with a moving flywheel. Battery charging alternator voltage will not be acceptable for this purpose.
4. The starting system shall be designed for restarting in the event of a false engine start, by permitting the engine to completely stop and then re-engage the starter.
5. Cranking cycler with 15-second ON and OFF cranking periods. Crank control shall provide at least two cranking periods. Each cranking attempts shall be separated by appropriate rest periods. A sensing device shall automatically disconnect the starting circuit when the engine has started. If the engine has not started at completion of the starting program, the over cranking signal shall so indicated. The engine starting controls shall be locked out and no further starting controls shall be locked out and no further starting attempts shall take place until the overcranking device has been manually reset. A selector switch shall be incorporated in the automatic engine start and stop controls. It shall include an "off" position that prevents manual or automatic starting of the engine; a "manual" or "handcrank" position that permits the engine to be started manually by the pushbutton on the control cabinet and an "automatic" position which readies the system for automatic start or stop on demand of the control system.
6. Overcrank protection designed to open the cranking circuit after 75 seconds if the engine fails to start.
7. Circuitry to shut down the engine when signal for high coolant temperature, low oil pressure, or overspeed are received.
8. Engine cooldown timer factory set at 5 minutes to permit unloaded running of the standby set after transfer of the load to normal.
9. Three-position (Automatic-OFF-TEST) selector switch. In the TEST position, the engine shall start and run regardless of the position of the remote starting contacts. In the Automatic position, the engine shall start when contact in the remote-control circuit close and stop 5 minutes after these contacts open. In the OFF position, the engine shall not start even though the remote start contacts close. This position shall also provide for immediate shutdown in case of an emergency. Rest of any fault shall also be accomplished by putting the switch to OFF position.
10. Indicating lights to signal:
    a. Auxiliary Prealarm (Yellow)
    b. Auxiliary Safety Shutdown (Red)
    c. Switch "OFF" (Flashing Red)
    d. Overcrank (Red)
    e. Emergency Stop (Red)
    f. High Water Temperature (Red)
    g. Overspeed (Red)

h. Low Oil Pressure (Red)
i. Battery Charger Fault (Red)
j. Low Battery Voltage (Red)
k. Low Fuel (Red)
l. System Ready (Green)
m. Anti-High-Water Temperature (Yellow)
n. Anti-Low Oil Pressure (Yellow)
o. Low Coolant Temperature (Red)

11. Test button for indicating lights.
12. Alarm Horn with silencer switch per NFPA 110.
13. Terminals shall be provided for each signal in 8.10 above, plus additional terminals for common fault and common prealarm.

2.5 INSTRUMENT PANEL:

A. The instrument panel shall include:

1. Dual range voltmeter 3-1/2 inch, 2% accuracy.
2. Dual range ammeter phase selector switch.
3. Voltmeter-ammeter phase selector switch.
4. Lights to indicate high or low meter scale.
5. Direct reading pointer-type frequency meter 3-1/2 inch, .5% accuracy, 45 to 65 Hz scale.
6. Panel illuminating lights.
7. Battery charging voltmeter.
8. Coolant temperature gauge.
9. Oil pressure gauge.
10. Running time meter.
11. Voltage adjust rheostat.

2.6 MOUNTING BASE:

A. The engine-generator shall be skid-mounted on two, iron "I" or "C" type channels. The design shall provide vibration isolation between the genset and the mounting base.

B. The frame design shall not inhibit easy access to the oil pan, after genset has been installed. Installations which require the use of a pump to drain the oil are not acceptable.

2.7 ACCESSORIES:

A. The following accessories shall be installed:

1. Block Heater, 120 Volt AC. Thermostatically controlled and sized to maintain engine coolant at 90°F (32°C) to meet the start-up requirements of NFPA 110, Level 1.
2. Generator strip heater, 120-volt, single phase for high humidity applications.
3. Over voltage protection will shut down the unit after one second of 15% or more overvoltage. Note: Sensitive equipment may suffer damage in less than one second of an overvoltage condition. On-line equipment requiring faster shutdown should have its own overvoltage protection.
4. Weather housing, constructed of rugged steel, cleaned, phosphated, and electrocoat painted inside and out with rust inhibiting primer and exterior coat of the manufacturer's standard color. Provide hinged, double doors on each side to give easy access to the genset, and a rear door to allow access to the control panel. All door handles shall be

key-lock type. Skid and floor design shall include a removable panel below the engine oil pan. All shelters shall come ready for job-installation. Top-mounted exhaust silencer with rain shield over the exhaust opening. Note: A 120-volt battery box heater shall be included.

5. Battery rack, battery cables, 12-volt batteries capable of delivering the required minimum cold-cranking amps required at 0°F.
6. 10-Ampere automatic float and equalize battery charger with +/- 1% constant voltage regulation from no load to full load over +/- 10% AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambients from -40°C to +60°C, 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected. Provide alarm circuit board to meet the requirements of NFPA 110 for low battery voltage, high battery voltage, and battery charger malfunction.
7. Gas-proof, seamless, stainless steel, flexible exhaust connection, and engine exhaust silencer rated for critical application. Exhaust noise shall be limited to 85 dBA as measured at 10 feet in a free-field environment.
8. 16-Light remote annunciator shall monitor all controller functions described in Paragraph 2.04.A.10 of the controller section plus line power and generator power monitoring. An integral lamp test and horn silencer switch shall be included, as required to meet NFPA 110. Provide all wiring between remote annunciator and generator set.

2.8 AUTOMATIC TRANSFER SWITCH:

A. The automatic transfer switch shall consist of a power transfer module and a control module, interconnected to provided complete automatic operation. Enclosure type shall be NEMA 1. The automatic transfer switch shall be mechanically held and electrically operated by a single solenoid mechanism energized from the source to which the load is to be transferred. The switch shall be rated for continuous duty and be inherently double throw*. The switch shall be open transition (break before make) and be mechanically interlocked to ensure only one of two possible positions - normal or emergency.* The automatic transfer switch shall be suitable for use with and supplied by the manufacturer of the standby generator to be furnished for this project. The switch shall be 4-pole, rated for use on a 480Y/277, 3-phase, 4-wire system. *Withstand rating shall be at least the same as the interrupting rating as the feeder breaker on the normal power input.* Basis of design: ASCO Series 300.

B. Automatic transfer switches utilizing components of molded-case circuit breakers, contactors, or parts thereof which have not been intended for continuous duty or repetitive load transfer switching are not acceptable.

C. All main contacts shall be of silver composition. The operating transfer time in either directions shall not exceed one-sixth (1/6) of a second.

D. The control module shall be supplied with a protective cover and be mounted separately from the transfer switch for ease of maintenance. The interconnecting wiring harness shall include a disconnect plug to disconnect all wires including both sources of control power for routine maintenance.

E. Sensing and control logic shall be solid-state and mounted on plug-in printed circuit boards. Printed circuit boards shall be keyed to prevent incorrect installation. Interfacing relays shall be industrial control grade plug-in type with dust covers.

F. All standard control features shall be contained in this control module and will be equal to ASCO Group G for 3 phase service. This group contains all of the following:

1. Voltage and Frequency Sensing
2. Time Delays
3. Engine Control Contacts
4. Test Switch
5. Indicators

G. Provide the following accessories:

1. Engine generator exercising timer with toggle switch to select load, no-load operation. Adjustable in 15-minute increments. Factory set at 20 minutes minimum each week unless otherwise specified. Equivalent to ASCO 11BE.
2. Switched neutral transfer contact.

H. Inspection of all contacts (movable and stationary) shall be possible from the front of the switch without disassembly of operating linkages and without disconnections of power conductors. A manual operating handle shall be provided for maintenance purposes.

I. The automatic transfer switch shall conform to the requirements of NEMA Standard ICS2-447 and Underwriters Laboratories UL 1008.

J. The complete automatic transfer switch shall be tested as to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements. Submittals for approval shall include wiring diagrams, dimensional data, and complete description of operation.

K. The transfer switch shall be furnished with an operator's manual providing installation and operating instructions.

2.9 GENERATOR DOCKING STATION

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. TRYSTAR, or prior approved equal.

B. Docking station shall include 16 Series Camlok Panel Mounts for use as connection to Portable Generator.

C. Entire package must be listed to ETL or UL 1008 Standards. UL listing of individual components is not acceptable.

D. Enclosures:

1. NEMA 3R rain-tight, 304 GA aluminum enclosure
   a. Pad-lockable front door shall include a hinged access plate at the bottom for entry of cables from portable generator or portable load bank. NEMA 3R integrity shall be maintained with access plate open for cable entry.
   b. Front and side through a front access panel shall be accessible for maintenance.
   c. Top, side, and bottom through a front access panel shall be accessible for permanent cabling.

2. Finishes:
   a. Paint after fabrication. Powder coated Hammertone Gray.

E. Phase, Neutral, and Ground Buses:
1. Material: Silver-plated Copper
2. Equipment Ground Bus: bonded to box.
3. Isolated Ground Bus: insulated from box.
4. Ground Bus: 50% of phase size.
5. Neutral Bus: Neutral bus rated 100 percent of phase bus.
6. Round edges on bus.

F. Temporary generator connectors shall be Camlok style mounted on gland plate.

1. Camlok shall be color coded according to system voltage
   a. A phase – Brown
   b. B phase – Orange
   c. C phase – Yellow
   d. N Neutral – White
   e. G Ground – Green

G. Temporary connectors shall include protective flip lids to prevent accidental contact.

H. Permanent connectors shall be broad range set-screw type, located behind an aluminum barrier.

I. Short Circuit & Withstand Rating

1. Shall be minimum 65KAIC unless otherwise indicated on drawings.

J. Voltage & Amperage:

1. 150A, 480Y/277V

K. Phase Rotation Monitor Device:

1. Phase monitoring relay to be Siemens 3U4512-1AR20 or equal.

L. Breaker Disconnect:

1. Must be UL 489 Listed Breaker
2. Breakers shall be removable for service and maintenance

M. Additional accessories shall be included in submittal drawings as follows:

1. Two Wire Auto Start
2. Battery Charger Receptacle 20A GFCI 125V
3. Block Heater Receptacle 30A L5-30 125V
4. Extra Depth for Bottom Conduit Access
5. Kirk Key Door Interlock
6. Listed Monitoring Device
7. Strip Heater & Thermostat
8. Surge Protection Device
9. Utility Light/Alarm

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install genset on concrete pad whose dimensions exceed the weatherproof housing by at least six inches, all sides. Pad thickness shall be 12". Concrete shall be 2500 psi , reinforced with 8 ga wire fabric. Anchor genset to concrete pad as recommended by the manufacturer.

B. Provide branch circuit wiring and necessary breakers for generator accessories.

C. Wall mount the automatic transfer switch where indicated.

D. Provide factory representative to conduct startup and testing. Testing shall comply with the requirements of NFPA 110, paragraph 5-13, "Installation Acceptance". Provide resistive load bank to conduct the tests.

E. Upon completion of testing, the factory representative shall provide 8-hours of on-site training of the Owner's designated personnel.

F. All wiring and interconnections shall be in accordance with commercial electrical standards. Installation drawings and complete wiring diagrams shall be furnished to the Owner.

END OF SECTION 26 60 11

SECTION 26 60 11 - EMERGENCY POWER SYSTEM - NATURAL GAS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

B. Refer to Section 26 20 42 and 26 20 43 for information on the required selective coordination for emergency power system overcurrent devices. The coordination study is a requirement of NFPA 70 Articles 700 and 701.

1.2 SCOPE OF WORK:

A. The Emergency Power Systems shall provide alternate AC power source for designated loads in the event there is an interruption of normal utility power. When required, the units shall automatically transfer the full rated load from the normal power source to the standby emergency generator. Upon return of normal power, the loads shall be automatically transferred back to the normal power source and the emergency generator shall automatically shut off, after a cool down period.

B. The extent of Emergency Power Systems (EPS) work is indicated by drawings and by the requirements of this Section. Provide a complete automatically operated electric generating set of the size, type and operating characteristics described hereinafter, completely installed, tested and operative. All equipment, labor and materials necessary to accomplish this end shall be included, and the coordination of all required equipment and material shall be the responsibility of one manufacturer, who has an approved experience record in furnishing similar equipment.

1.3 QUALITY ASSURANCE:

A. Manufacturers: The following manufacturers are acceptable provided they meet all requirements of the specifications:

1. Onan/Cummings
2. MTU Onsite Energy (Detroit Diesel)
3. Generac
4. Caterpillar

B. Geographic Location:

1. The installation / service center shall be located within 75 miles.

C. Requirements:

1. The installation / service center shall be factory authorized and shall be certified, in writing, by the manufacturer, as being responsible for installation and warranty work and shall be capable of performing work on the engine, generator, battery charger, fuel system, automatic transfer switch and all accessories which make up the complete emergency power system.
2. The installation / service center shall provide on-site service within 4 hours of receipt of

service request.
3. The installation / service center shall maintain adequate levels of repair parts inventory.

D. Compliance / Labels:

1. Where a conflict between this document and NFPA 110 should arise, NFPA 110 shall govern.
2. Manufacturer Testing:
   a. Design prototype testing - Shall be performed on similar models of the unit furnished on this project.
   b. Final production testing of the engine/generator and automatic transfer switch - provide certified test reports.
   c. Field testing, by manufacturer's local representative

1.4 SERVICE / MAINTENANCE AGREEMENT:

A. The *engine / generator supplier* shall provide a service / maintenance contract covering one year of operation, from the date of Substantial Completion. There shall be no deductible costs, or other costs, to the Owner for these services. All costs shall be included in the bid for this project. *The agreement shall be made in the name of the Owner*. The service / maintenance agreement applies to the following items of equipment:

1. Engine-Generator Set.
2. Automatic Transfer Switch.

B. The *Maintenance agreement* shall include the following and also shall include services per the equipment manufacturer's applicable instruction manual:

1. Lube, oil, and filter change
2. Fuel filter change
3. Engine tune-up with parts
4. Service/replace air cleaner
5. Check coolant level
6. Test anti-freeze and adj.
7. Inspect cooling system hoses
8. Service/replace belts as required
9. Check engine heater operation
10. Check generator set for fuel, oil, and coolant leaks
11. Check air intakes and outlets
12. Drain exhaust line
13. Inspect silencer
14. Check battery charger operation and charge rate
15. Check battery electrolyte levels and specific gravity
16. Emergency system operation with load applied for one hour period
17. Frequency check/governor adj.
18. Check transfer switch and accessory operation
19. Check engine alternator charge rate
20. Check engine-generator gauge and indicator operation
21. Check generator set controller operation including shutdown functions and emergency stop
22. Check generator output voltage and adjust as necessary

C. Maintenance shall be performed at intervals stated in equipment manufacturer's applicable instruction manuals except that the minimum service visits shall be four per year, and they shall be in Jan., Apr., July, and Oct.

D. Maintenance shall be performed near the middle of the month during the owners normal working hours. Arrangements will be made with the owner prior to each service call in order to secure access to the equipment.

E. The servicing agent will supply labor, supplies, parts and test equipment, as necessary to perform the service and preventative maintenance, at no additional cost.

F. *The service agreement* shall include labor, supplies and replacement parts to restore the system to operating condition, *whether due to normal wear and tear or defects in workmanship or materials.*

1. Response to *service* calls shall be made within 4 hours.

G. Owner will maintain a regular recommended service procedure as recommended by the servicing agent. A record of these maintenance procedures will be maintained for reference.

H. The servicing agent shall maintain a complete service history and necessary drawings and service procedure data for reference in service of the equipment. The agreement does not include any expense to repair damage caused by abuse, accident, theft, acts of a third person, forces of nature, alteration of equipment, or improper operation. The servicing agent shall maintain a representative stock of replacement parts for the complete emergency system and a competent factory-trained service organization.

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M. Isochronous governor capable of +.25% steady-state frequency regulation.
N. Air Cleaner: Dry element with restriction indicator.
O. Lube Oil Capacity: 12 US Quarts, API CD 15W-40
P. Lube Oil Filter: Single spin-on, full flow.
Q. Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick and oil drain.
R. Cooling system: High ambient 122 deg F unit mounted radiator, blower fan, water pump and thermostat.

2.3 GENERATOR:

A. Salient-pole, brushless, 12 lead reconnectable type; self-ventilated, drip proof housing; amortisseur rotor windings and skewed for smooth voltage waveform. NEMA Class H insulation with fungus-resistant epoxy varnish.

B. Brushless excitation system controlled by solid-state, anti-tracking voltage regulator capable of maintaining +/- 2% for any constant load from 0 to 100% of rating. Provide individual adjustments for voltage range, stability and volts/hertz operations.

C. Voltage dip not to exceed 20% with one-second recovery within 2% of rated voltage, for one-step loads 0 to 90% of rating.

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    d. Overcrank (Red)
    e. Emergency Stop (Red)
    f. High Water Temperature (Red)
    g. Overspeed (Red)

h. Low Oil Pressure (Red)
i. Battery Charger Fault (Red)
j. Low Battery Voltage (Red)
k. Low Fuel (Red)
l. System Ready (Green)
m. Anti-High-Water Temperature (Yellow)
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11. Test button for indicating lights.
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3. Over voltage protection will shut down the unit after one second of 15% or more overvoltage. Note: Sensitive equipment may suffer damage in less than one second of an overvoltage condition. On-line equipment requiring faster shutdown should have its own overvoltage protection.
4. Weather housing, constructed of rugged steel, cleaned, phosphated, and electrocoat painted inside and out with rust inhibiting primer and exterior coat of the manufacturer's standard color. Provide hinged, double doors on each side to give easy access to the genset, and a rear door to allow access to the control panel. All door handles shall be

key-lock type. Skid and floor design shall include a removable panel below the engine oil pan. All shelters shall come ready for job-installation. Top-mounted exhaust silencer with rain shield over the exhaust opening. Note: A 120-volt battery box heater shall be included.

5. Battery rack, battery cables, 12-volt batteries capable of delivering the required minimum cold-cranking amps required at 0°F.
6. 10-Ampere automatic float and equalize battery charger with +/- 1% constant voltage regulation from no load to full load over +/- 10% AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambients from -40°C to +60°C, 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected. Provide alarm circuit board to meet the requirements of NFPA 110 for low battery voltage, high battery voltage, and battery charger malfunction.
7. Gas-proof, seamless, stainless steel, flexible exhaust connection, and engine exhaust silencer rated for critical application. Exhaust noise shall be limited to 85 dBA as measured at 10 feet in a free-field environment.
8. 16-Light remote annunciator shall monitor all controller functions described in paragraph 2.4.A.10 of the controller section, line power and generator power monitoring, and docking station power monitoring. An integral lamp test and horn silencer switch shall be included, as required to meet NFPA 110. Provide all wiring between remote annunciator and generator set / docking station.

2.8 AUTOMATIC TRANSFER SWITCH:

A. The automatic transfer switch shall consist of a power transfer module and a control module, interconnected to provided complete automatic operation. Enclosure type shall be NEMA 1. The automatic transfer switch shall be mechanically held and electrically operated by a single solenoid mechanism energized from the source to which the load is to be transferred. The switch shall be rated for continuous duty and be inherently double throw*. The switch shall be open transition (break before make) and be mechanically interlocked to ensure only one of two possible positions - normal or emergency.* The automatic transfer switch shall be suitable for use with and supplied by the manufacturer of the standby generator to be furnished for this project. The switch shall be 4-pole, rated for use on a 480Y/277, 3-phase, 4-wire system. *Withstand rating shall be at least the same as the interrupting rating as the feeder breaker on the normal power input.* Basis of design: ASCO Series 300.

B. Automatic transfer switches utilizing components of molded-case circuit breakers, contactors, or parts thereof which have not been intended for continuous duty or repetitive load transfer switching are not acceptable.

C. All main contacts shall be of silver composition. The operating transfer time in either directions shall not exceed one-sixth (1/6) of a second.

D. The control module shall be supplied with a protective cover and be mounted separately from the transfer switch for ease of maintenance. The interconnecting wiring harness shall include a disconnect plug to disconnect all wires including both sources of control power for routine maintenance.

E. Sensing and control logic shall be solid-state and mounted on plug-in printed circuit boards. Printed circuit boards shall be keyed to prevent incorrect installation. Interfacing relays shall be industrial control grade plug-in type with dust covers.

F. All standard control features shall be contained in this control module and will be equal to

ASCO Group G for 3 phase service. This group contains all of the following:

1. Voltage and Frequency Sensing
2. Time Delays
3. Engine Control Contacts
4. Test Switch
5. Indicators

G. Provide the following accessories:

1. Engine generator exercising timer with toggle switch to select load, no-load operation. Adjustable in 15-minute increments. Factory set at 20 minutes minimum each week unless otherwise specified. Equivalent to ASCO 11BE.
2. Switched neutral transfer contact.

H. Inspection of all contacts (movable and stationary) shall be possible from the front of the switch without disassembly of operating linkages and without disconnections of power conductors. A manual operating handle shall be provided for maintenance purposes.

I. The automatic transfer switch shall conform to the requirements of NEMA Standard ICS2-447 and Underwriters Laboratories UL 1008.

J. The complete automatic transfer switch shall be tested as to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements. Submittals for approval shall include wiring diagrams, dimensional data, and complete description of operation.

K. The transfer switch shall be furnished with an operator's manual providing installation and operating instructions.

2.9 GENERATOR DOCKING STATION

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. TRYSTAR, or prior approved equal.

B. Docking station shall include 16 Series Camlok Panel Mounts for use as connection to Portable Generator.

C. Entire package must be listed to ETL or UL 1008 Standards. UL listing of individual components is not acceptable.

D. Enclosures:

1. NEMA 3R rain-tight, 304 GA aluminum enclosure
   a. Pad-lockable front door shall include a hinged access plate at the bottom for entry of cables from portable generator or portable load bank. NEMA 3R integrity shall be maintained with access plate open for cable entry.
   b. Front and side through a front access panel shall be accessible for maintenance.
   c. Top, side, and bottom through a front access panel shall be accessible for

permanent cabling.

2. Finishes:
   a. Paint after fabrication. Powder coated Hammertone Gray.

E. Phase, Neutral, and Ground Buses:
   1. Material: Silver-plated Copper
   2. Equipment Ground Bus: bonded to box.
   3. Isolated Ground Bus: insulated from box.
   4. Ground Bus: 50% of phase size.
   5. Neutral Bus: Neutral bus rated 100 percent of phase bus.
   6. Round edges on bus.

F. Temporary generator connectors shall be Camlok style mounted on gland plate.

   1. Camlok shall be color coded according to system voltage
      a. A phase – Brown
      b. B phase – Orange
      c. C phase – Yellow
      d. N Neutral – White
      e. G Ground – Green

G. Temporary connectors shall include protective flip lids to prevent accidental contact.

H. Permanent connectors shall be broad range set-screw type, located behind an aluminum barrier.

I. Short Circuit & Withstand Rating
   1. Shall be minimum 65KAIC unless otherwise indicated on drawings.

J. Voltage & Amperage:
   1. 150A, 480Y/277V

K. Phase Rotation Monitor Device:
   1. Phase monitoring relay to be Siemens 3U4512-1AR20 or equal.

L. Breaker Disconnect:
   1. Must be UL 489 Listed Breaker
   2. Breakers shall be removable for service and maintenance.
   3. Breaker shall have a pair of NO/NC auxiliary contacts to connect back to permanent generator remote annunciator panel.

M. Additional accessories shall be included in submittal drawings as follows:
   1. Two Wire Auto Start
   2. Battery Charger Receptacle 20A GFCI 125V
   3. Block Heater Receptacle 30A L5-30 125V
   4. Extra Depth for Bottom Conduit Access
   5. Kirk Key Door Interlock

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install genset on concrete pad whose dimensions exceed the weatherproof housing by at least six inches, all sides. Pad thickness shall be 12". Concrete shall be 2500 psi , reinforced with 8 ga wire fabric. Anchor genset to concrete pad as recommended by the manufacturer.

B. Provide branch circuit wiring and necessary breakers for generator accessories.

C. Wall mount the automatic transfer switch where indicated.

D. Provide factory representative to conduct startup and testing. Testing shall comply with the requirements of NFPA 110, paragraph 5-13, "Installation Acceptance". Provide resistive load bank to conduct the tests.

E. Upon completion of testing, the factory representative shall provide 8-hours of on-site training of the Owner's designated personnel.

F. All wiring and interconnections shall be in accordance with commercial electrical standards. Installation drawings and complete wiring diagrams shall be furnished to the Owner.

END OF SECTION 26 60 11

SECTION 27 01 00 - GENERAL PROVISIONS - COMMUNICATIONS AND ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 IMPOSED REGULATIONS:

A. Applicable provisions of the State and Local Codes and of the following codes and standards are hereby imposed on a general basis for electrical work:

1. NEC, National Electrical Code (NFPA No. 70), with Georgia Amendments.
2. The Life Safety Code (NFPA No. 101), with Georgia Amendments.
3. State of Georgia ADA Accessibility Guidelines for Building and Facilities.
4. The International Building Code, with Georgia Amendments.
5. EIA/TIA Telecommunications Standards.
6. The National Fire Alarm Code (NFPA 72), with Georgia Amendments.
7. U.L. Fire Resistance Directory.
8. U.L. Electrical Construction Materials Directory.
9. U.L. Electrical Appliance and Utilization Equipment Directory.

1.3 DESCRIPTION OF WORK:

A. Provide all labor, materials, equipment and supervision to construct complete and operable communication and alarm systems as indicated on the drawings and specified herein. All materials and equipment used shall be new, undamaged and free from any defects.

B. Outlet boxes, raceway systems, cable trays, sleeves and line voltage power connections for Division 27 systems shall be provided under Division 26.

1.4 COORDINATION:

A. Coordinate work provided under this division of the specifications with work provided under other divisions of the specifications and work provided by the Using Agency, where applicable.

1.5 PROJECT STAFFING:

A. Superintendent:

1. Provide a superintendent to plan, layout, supervise and coordinate the work by all organizations providing work under Division 27. The superintendent shall be at the job site at all times work is being performed.
2. The superintendent shall have a minimum of 5 years experience in educational projects of similar size and scope. The Superintendent shall have a State of Georgia Unrestricted Low Voltage License (LV-U).

B. Organizations Furnishing and Installing Division 27 Systems:

1. Division 27 systems are specified by the name of acceptable manufacturers. Each of the

systems shall be furnished and installed by an organization that:

a. is an authorized and certified representative of the manufacturer, for purchase, installation and service of the specific system.
b. has current State of Georgia low voltage license appropriate for the system(s) being installed.
c. stocks replacement parts for the specific system.
d. has systems technicians in their employ
e. has cable installers in their employ
f. has experience on projects of similar size and scope.
g. has been in business for at least 3 years.
h. can respond to emergency service calls within 4 hours, and routine service calls within 24 hours.

C. Systems Technicians:

1. The devices and equipment that make up each of the systems included in Division 27 shall be installed, started (where applicable) and tested by technicians in the employment of the organization furnishing the system. Technicians shall have at least one of the following:
   a. NICET Level II Engineering Technician Certificate AND manufacturer authorized training, for the specific system to be installed.
   b. State of Georgia LV-A, LV-T or LV-U license AND manufacturer authorized training, for the specific system to be installed.

D. Cable Installers:

1. Cabling systems, including devices and terminations, for each of the systems included in Division 27, shall be installed, and tested by technicians in the employment of the organization furnishing the system. Technicians shall have State of Georgia LV-G license AND manufacturer authorized training, for the specific system to be installed.

E. Helpers:

1. Persons who do not possess the qualifications described herein shall be considered helpers. Helpers may assist technicians or cable installers, but shall not be allowed to install devices, make equipment connections or perform other work for which they are not qualified.
2. Helpers shall not perform any work on the project, at any time, without supervision by the Technician.

F. Submit resumes for organizations, systems technicians and cable installers for review and approval by the Architect, prior to proceeding with any work on the project.

1.6 DIVISION 27 DRAWINGS:

A. Do not scale the drawings. Obtain all dimensions from the Architect's dimensioned drawings, field measurements and shop drawings.

B. Drawings are diagrammatic and indicate the general arrangement and connection of equipment and devices. The contractor shall review product data sheets, wiring diagrams, manufacturer’s installation instructions, etc. and provide the connections required to place equipment into service.

C. Discrepancies shown on different drawings, between drawings and specifications or between documents and field conditions shall be brought to the attention of the Architect.

1.7 PERFORMANCE TESTING:

A. The performance testing specified in other sections shall be performed by a testing agency selected and paid for by the Architect.

1. The contractor shall provide personnel, tools and equipment necessary to make all work accessible to the testing agency.
2. A copy of the test reports will be made available to the contractor. Where the test results indicate that the system or portions of the system do not meet specified performance levels, the contractor shall investigate, identify and correct those deficiencies. Upon written notification by the Contractor that deficiencies have been corrected, the Architect will schedule re-testing to the extent deemed necessary by the Testing Agency. The Contractor shall bear the cost of re-testing.

B. Testing specified in other sections shall be performed by authorized representatives of the system manufacturer, scheduled and paid for by the Contractor.

1. The contractor shall provide personnel, tools and equipment necessary to conduct the tests.
2. Provide three copies of all test results. For each system, include a cover page with the Testing Agency letterhead, name of persons conducting the test, date(s) of tests, and an executive summary of the testing performed. Include the detailed results after this summary.

C. Notify the Architect, in writing, 48 hours in advance of any testing to be performed. Include the system, or systems to be tested. The purpose of this requirement is to allow the Architect and Using Agency time to schedule representatives to be present.

1.8 RECORD DOCUMENTS:

A. The superintendent shall maintain a white set (blue-line or black-line) of contract documents in clean, undamaged condition, for mark-up of actual installations which vary substantially from the work as shown. Mark-up whatever drawings are most capable of showing installed conditions accurately. These documents shall be used for no other purpose. As a minimum, record the following:

1. Post all addenda prior to beginning work.
2. Post all changes in the work.
3. Scope of each change order (C.O.), noting C.O. number.

1.9 RECORD MANUALS:

A. Manufacturer’s operation and maintenance manuals for each Division 27 system.

B. Shop drawings, revised to reflect all review comments, *supplemented with the installation instructions shipped with equipment.*

C. As-built copy of the system specific drawings in AutoCad 2015 format, on USB flash drive.

D. Submit record manuals in quantities and in the format prescribed in the Division 1 specifications, plus one copy for the Engineer.

1.10 TRAINING OF OWNERS FORCES:

A. Train Owner's personnel on the operation and maintenance of the following systems:

1. Fire Alarm System - 2 hours
2. Card Access System - 2 hours
3. Intercom System - 2 hours
4. Voice Reinforcement systems - 2 hours
5. Intrusion Detection System - 2 hours
6. Tour of Facility - 8 hours

B. The "tour of facility" shall consist of a walk-thru of the entire facility. Demonstrate the operation of all devices, equipment and systems.

C. *Training shall not be conducted until the final inspection of the work has been conducted by the Architect and all punch list items completed.*

D. As a minimum, the following materials shall be reviewed during the training session:

1. Owner's operation and maintenance manual.
2. Corrected shop drawings and as-built system drawings.
3. Hands-on demonstration of system features and operation.

E. Notify the Architect, in writing, 10 working days in advance of each training session. Include a detailed agenda for the system. No more than two systems shall be covered in one day. The purpose of this requirement is to allow the Architect and Using Agency time to schedule representatives to be present, and is subject to the approval of the Architect.

F. Training shall be conducted at the project site by authorized representatives of the system manufacturer and the Division 27 superintendent.

G. Each training session shall be recorded using digital video recorder, saved on a CD rom. Disks shall be delivered to Owner with Record Manuals.

1.11 REVIEW OF THE WORK BY THE ARCHITECT:

A. During the course of the project, the work will be reviewed by a representative of the Architect. Upon each visit, demonstrate that the record documents and shop drawing files are being kept current.

B. The Superintendent shall accompany the Architect on all reviews and shall provide all personnel, tools, ladders, etc. necessary to conduct the review.

C. Prior to reviewing of work in progress, or at the final inspection, the Contractor shall submit a letter describing the specific work to be reviewed, along with a punch-list of items that are incomplete or which require correction, based on observations made by the supervisor of the given trade. Reviews will not be scheduled until this information is submitted. The Contractor shall bear the burden of any resulting delays.

D. Construction review reports will be issued by the Architect for every review trip. Within five working days from the date of review, the Contractor shall submit a letter which addresses when corrections will be made for each deficiency in the report. Prior to subsequent review of the work, the Contractor shall submit a letter confirming that the work required by all comments on the report have been completed.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Refer to the drawings and individual specification sections for requirements.

B. All equipment shall be suitable for the environment in which it is installed. Such considerations shall include, but not be limited to characteristics of this specific project such as wet/damp/dry locations, ambient temperature / humidity, spaces used as air plenums and hazardous locations. It shall be the responsibility of the contractor to review the contract documents and order equipment based on intended use.

2.2 MATERIALS:

A. All materials and equipment used shall be new, undamaged and free from any defects.

B. Provide materials and equipment that are U.L. listed, unless listing is unavailable.

C. All equipment of the same type or of the same product category shall be the product of a single manufacturer.

D. Where product is specified by catalog number, such specification is intended only to convey general characteristics. Actual product selection shall be based on catalog number, other references on the drawings / specifications and intended use.

2.3 ACCEPTABLE MANUFACTURERS:

A. Provide equipment and materials which are products of the manufacturers listed on the drawings and in the specifications. Requests for substitution of other manufacturers shall comply with Division 1 and the paragraph "B" below.

B. Requests for prior approval (i.e. before the bid opening) must contain all information listed for the specific item in Section 27 01 20, including any applicable dimensioned layout drawings. Requests must be sent by mail or express delivery such that they are received in the Architect's office no later than ten working days prior to the opening of bids. Requests that are incomplete or are sent by facsimile will not be reviewed.

2.4 SPECIAL REQUIREMENTS:

A. All software-based electronic equipment shall use the manufacturer's current software version as of the project bid date.

PART 3 - EXECUTION

3.1 ROLE OF THE SUPERINTENDENT:

A. The Division 27 Superintendent's duties shall include, but not be limited to the following:

1. Preparation of submittals.
2. Planning and layout of the work.
3. Coordination with other trades and the local utility companies.
4. Posting addenda and changes in the work to maintain the Record Drawings and to ensure that Division 27 personnel are working from up-to-date drawings and specifications.
5. Supervision of all Division 27 personnel.
6. Ongoing review of work in place to ensure compliance with the Contract Documents.
7. Conducting a review of the work in place and materials stored for the Architect's representative.
8. Administrative duties as required to fulfill the requirements of the General Conditions, Special Conditions and Division 1 specifications.
9. Training of the Owner's Forces.

3.2 PROTECTION OF THE WORK:

A. Protect the work during the course of construction. Do not install any equipment or materials until the proper environmental conditions have been established.

B. Store materials in the manner recommended by the manufacturer until materials are installed. Materials rated for indoor use shall not be stored outdoors regardless of the packaging in which the materials are shipped.

C. Do not install cables until the building is dried-in. For the purposes of this specification "dried in" shall mean the roof has been installed, all exterior openings are covered and the interior of the building is dry. Tape ends of all conductors to protect from damage. Coil cables and hang from the building structure. Use care not to exceed cable bending radius. *Under no circumstances shall cables be laid out on the floor.*

D. *Protect equipment and cables from being painted. Any equipment or cables that are painted shall be removed and replaced with new. Cleaning of paint from item is not an acceptable substitute.*

E. *Do not install devices, or equipment until spaces are broom clean and the building is conditioned.*

F. Install temporary protective covers over equipment enclosures, devices and similar items after interiors, conductors, devices, etc. are installed to protect the installation during finish work performed by others.

G. Clean all equipment, inside and out, upon completion of the work. Scratched or marred surfaces shall be touched-up with touch-up paint furnished by the equipment manufacturer.

H. Equipment or materials that are improperly stored or are installed before the proper environmental conditions are achieved will be removed and replaced with new, at no cost to the Owner. The Contractor shall bear all consequences from any resulting delays.

I. All equipment and materials that become damaged will be removed and replaced with new, at no additional cost to the Owner.

3.3 INTERFACE OF WORK WITH OTHER TRADES:

A. Where Division 27 work must adjoin, abut or be incorporated into work installed by other trades, engage the services of the other trade to interface the work. Under no circumstances shall the installer performing work under this Division of the specifications modify or alter work installed by others. Such work includes, but is not limited to:

    1. Roof Penetrations.
    2. Any attachments to roofing system.
    3. Penetrations in Vapor Barriers.
    4. Exterior Insulation and Finish Systems (EIFS).

END OF SECTION 27 01 00

SECTION 27 01 20 - COMMUNICATIONS AND ALARM SYSTEMS SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 GENERAL:

A. Submit for review by the Architect, a schedule with engineering data of materials and equipment to be incorporated in the work.

1. Submittals shall be supported by descriptive materials, i.e., catalog sheets, product data sheets, diagrams, performance curves and charts published by the manufacturer, to show conformance to Specifications and Plan requirements; model numbers alone shall not be acceptable.
2. Data submitted for review shall contain all information to indicate compliance with Contract Documents. Complete characteristics shall be provided for all equipment.
3. The Architect reserves the rights to require samples of any equipment to be submitted for review.

B. For each product group and type, provide a letter from the product manufacturer stating requirements for storing and handling at the job site prior to installing the product. The manufacturer shall specifically address acceptable temperature and relative humidity levels.

C. All submittals shall be prepared by the organization furnishing the system. Submittals shall be checked for compliance by the Division 27 superintendent prior to submission.

D. Hard Copy Submittals: Submittal data shall be placed in one or more hard-back 3-ring binders arranged and labeled according to specification section. Each binder shall contain a title page and table of contents. Provide separator tabs, and label by specification section. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor's Name, Division 27 Superintendent's name, Suppliers and point of contact for each, and date. Except as otherwise indicated in other sections, submit 5 complete copies. Quantity indicated does not include copies required for regulatory agencies.

E. Electronic Submittals: If the Architect agrees to allow electronic submittals via an on-line information management product such as "Submittal Exchange, etc., all electronic submittal files shall be organized to match the bid documents for specification section and name. Each submittal file shall be complete for each specification section. Multiple partial submittals per specification section will be rejected. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor's Name, Division 27 Superintendent's name, Suppliers and point of contact for each, and date.

1.3 RESPONSE TO SUBMITTALS:

A. Each item reviewed by the Architect will be marked with numerical review codes that correspond to the following:

1. "No Exceptions Taken": No corrections, no marks. Items may be ordered.
2. "Make Corrections Noted": A few minor corrections. Items may be ordered as marked up without further resubmission.
3. "Revise and Resubmit": Minor correction. Item may be ordered at the Contractor's option. Contractor shall resubmit drawings with corrections noted.
4. "Rejected": Major corrections or not in accordance with the contract documents. No items shall be ordered. Contractor shall correct and resubmit drawings.

B. Whether resubmittals are required or not, all shop drawings shall be corrected for the record manuals specified in Section 27 01 00.

1.4 SUBMITTAL GROUPING:

A. System specific drawings shall be submitted with the respective specification section.

B. Submittals that do not comply with these requirements or that are deemed by the Architect to be incorrect or incomplete shall be returned without review. The Contractor shall bear the burden of any resulting delays.

C. Resubmittals must be scheduled two weeks in advance with the Architect. Resubmittals must be accompanied by a letter from the Contractor, with a copy of the previous submittal report, stating the resubmittal has incorporated all comments made on the previous report. Resubmittals made without this information shall be returned without review. The Contractor shall bear the burden of any resulting delays.

1.5 TESTING / TRAINING SCHEDULES AND TEST RESULT SUBMITTALS:

A. Submittals shall be made for each occurrence. Each submittal shall include a cover letter with the Contractor’s letterhead.

1.6 EQUIPMENT AND MATERIALS REQUIRING SUBMITTALS:

A. Section 27 01 00 - General Provisions - Communications and Alarm Systems

1. Superintendent’s qualifications
2. Installers’ qualifications (as applicable for each system)

B. Section 27 01 20 - Communications and Alarm Systems Submittals

1. System specific rough-in details
2. Attachment 1

C. Section 27 10 10 - Intelligent Fire Alarm System

1. Draft copy of NFPA 72 Certification
2. Proof of Coordination with other trades.
3. Fire Alarm Control Panel
4. Remote annunciator / Remote trouble station
5. Power Supplies
6. Batteries
7. Calculations - Power Supply, Battery Sizing, and Wire Sizing
8. Voice Alarm Control Panel

9. Pull Stations
10. Audible and audible/visible signaling devices
11. Door Holders
12. Monitor and control modules
13. Detectors and detector bases / housings
14. Cables
15. System specific drawings, per 27 01 20, 3.04.B, plus interlock diagrams which shall include, as a minimum:
    a. Air handler shutdown.
    b. Interconnections to the electronic card entry / access system.
    c. Elevator recall and emergency shutdown.

D. Section 27 20 11 - Cable Plant Labeling

1. Product data sheets for each type label.

E. Section 27 40 10 - Intercom System

1. Headend components
2. Call Switches
3. Staff Stations
4. Administrative Stations
5. Ceiling speakers, back boxes, supports and grilles
6. Wall mounted speakers and enclosures
7. Hardware for VOIP system interface
8. Cables
9. System specific drawings
10. Line voltage surge arresters
11. Low voltage surge arresters
12. Remote terminal blocks

F. Section 27 40 40 – Cafeteria Voice Reinforcement System

1. Wall mounted amplifier and accessory modules
2. Microphones and stands
3. Speakers and accessories
4. Cables
5. System specific drawings

G. Section 27 50 10 - Intrusion Detection System

1. Control Panel
2. Digital Communicator
3. Keypads
4. Detectors
5. Door Switches
6. Cables
7. System specific drawings, per 27 01 20, 3.04.B

H. Section 27 90 10 – Wiring Methods for Communications and Alarm Systems

1. Bridle rings.

2. Cable ties.

PART 2 – PRODUCTS NOT APPLICABLE

PART 3 - EXECUTION

3.1 MANUFACTURER'S DATA:

A. For each system component, include the manufacturer's comprehensive product data sheet and installation instructions. Where operating ranges are shown, mark data to show portion of range required for project application.

B. Provide manufacturer's product data sheet for each type of cable used. Include cross-section diagram of the cable assembly.

3.2 CALCULATIONS:

A. Provide calculations to substantiate the sizing of power supplies, transformers, backup batteries and similar items.

3.3 TEST REPORTS:

A. Submit test reports which have been signed and dated by the firm performing the tests and prepare in the manner specified in the standard or regulation governing the tests procedure as indicated.

3.4 LAYOUT AND COORDINATION DRAWINGS:

A. System specific drawings - Include the following:

1. Floor plans:
   a. Show all system equipment, devices and interconnecting cabling. Cabling shall be consistent with the master cabling plan. Provide a legend to define all devices and cable runs.
   b. Show labels for each device and cable run. For addressable systems, show the point ID for each device.
2. Details:
   a. Show the rough-in requirements and mounting height for every component. Include all requirements such as outlet box size/trim/alignment and raceway requirements.
   b. Prepare in sufficient detail such that these drawings can be used to provide the required rough-in.
3. Point-to-point installation wiring diagrams of the entire system:
   a. Provide terminal diagram for every control panel, patch panels, interconnect center, etc.
   b. Provide wiring diagram for every device. Key these diagrams to the system diagrams.
   c. Provide wiring diagram depicting all interlocks of specific systems with other systems.
   d. Spare and unused terminals shall be marked as such. Indicate the size, type and color code of all conductors.
   e. The use of generic wiring diagrams is not acceptable. Wiring diagrams shall be prepared for this specific project.
4. Elevations:
   a. Provide an elevation drawing of the headend equipment / control panel / backboard,

showing the location of all components.
b. Indicate enclosure sizes and space available for future expansion.
c. Backboard elevations shall show the layout of the various systems components installed thereon.

B. System specific drawings are required for each Division 27 system.

C. Drawing Format:
1. Drawings shall be prepared at the following scales:
a. Floor plans: 1/16" = 1' - 0".
b. Details: Not to scale.
c. Wiring Diagrams: Not to scale.
d. Elevations: ½" = 1' - 0".
2. Drawings shall be titled to define Project Name, Drawing subject, date prepared and designer's name and seal. All revisions shall be marked and dated.
3. Floor plan drawings shall include all room names and numbers.
4. CAD-generated drawings are required. Upon written request, an email with a zip file attachment containing the building floor plan(s) can be furnished to the contractor. The file will be in AutoCAD 2004 format. By requesting these drawings, the contractor agrees to accept them "as is". It will be the responsibility of the contractor to verify the drawings for accuracy and to make all changes necessary, at no additional cost to the Owner.
5. Submit only one copy of each drawing, in reproducible format. The Architect will mark review comments on the reproducible drawing so that the contractor can make as many copies as may be required.

3.5 SAMPLE BOARD:

A. Provide one sample board to display the following:
1. 12" sample of every type of cable used, with connectors and cable labels. The type and function of each cable shall be identified below each sample. Connectors are required on one end only. On the opposite end, strip the outer jacket back 3".
2. One of each type faceplate, with jacks and labels.
B. Sample board will not be returned.

3.6 ATTACHMENT NO. 1:

A. Shall be filled out and returned with shop drawings. List all firms that will be providing work under Division 27.

ATTACHMENT NO. 1

The purpose of this form is to identify all organizations that will provide the work of Division 27, and describe how the work will be divided.

ORGANIZATION:

SYSTEM TO BE INSTALLED: FIRE ALARM SYSTEM

SYSTEM MANUFACTURER:

ORGANIZATION:

SYSTEM TO BE INSTALLED: INTRUSION DETECTION SYSTEM

SYSTEM MANUFACTURER:

ORGANIZATION:

SYSTEM TO BE INSTALLED: INTERCOM SYSTEM

SYSTEM MANUFACTURER:

ORGANIZATION:

SYSTEM TO BE INSTALLED: VOICE REINFORCEMENT SYSTEM

SYSTEM MANUFACTURER:

Attach a letter from each organization stating that they acknowledge and will comply with the staffing requirements of Section 27 01 00 and that the proposed subdivision of work of Division 27, among the organizations will not compromise the integrity of the systems and does not conflict with recommendations of the equipment manufacturer, or applicable codes.

END OF SECTION 27 01 20

SECTION 27 10 10 - INTELLIGENT FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION:

A. The work required under this section of the specifications consists of an analog, addressable fire and voice alarm system.

B. *This is a performance-based specification*. The system specified herein shall be designed by the manufacturer or an authorized representative of the manufacturer who is either a registered Fire Protection Engineer or a NICET Certified Engineering Technologist.

C. Work of this section requires coordination with the following trades:

1. Duct work installer.
2. Elevator installer.
3. Electrical system installer.
4. Fire water service installer.
5. Sprinkler installer.
6. Fire pump installer.
7. Electronic card access and door hardware installer(s).

D. Proof of this coordination shall be submitted with the shop drawings.

1.3 QUALITY ASSURANCE:

A. All components shall be U.L listed for their intended use as part of the Intelligent Fire Alarm System. Non-listed equipment shall not be used.

B. No equipment shall be installed nor auxiliary connections made that will inhibit proper operation or use of the system and its components, in accordance with the U.L. listings.

C. Acceptable manufacturers:

1. Notifier
2. EDS
3. Simplex

D. Submittals: Refer to Section 27 01 20 for requirements. A draft copy of the certification required by NFPA 72 shall be submitted with the shop drawings. Fill-in as much information as possible. Submittals made without this information will be rejected.

1.4 COORDINATION:

A. Coordinate control, supervisory and auxiliary functions with work provided under other Divisions.

1.5 PERFORMANCE CRITERIA:

A. When installed, the system shall comply with the requirements of the State of Georgia ADA, NFPA 72, and NFPA101.

PART 2 - PRODUCTS

2.1 GENERAL:

A. All equipment, components and software shall be new and the manufacturer's current model. Beta versions are not acceptable.

B. Provide and activate all standard alarm, trouble, control and supervisory functions. Provide special functions as specified herein.

2.2 FIRE ALARM CONTROL PANEL:

The fire alarm control panel shall comply with the manufacturer's standard design, materials, and components for an intelligent fire alarm system with addressable devices, plus the following accessories:

A. A digital alarm communicator transmitter (DACT) shall be provided for transmitting alarm and trouble conditions to an IP/GSM fire alarm communicator for cellular reporting.
B. A dedicated supervisory service LED and a dedicated supervisory service acknowledge switch, for the building sprinkler system.

2.3 FIRE ALARM COMMUNICATOR:

A. Provide a dual path IP/GSM fire alarm communicator connected to the fire alarm control panel digital alarm communicator transmitter (DACT). The system shall be capable of transmitting alarms, supervisory and trouble signals to a 3rd party monitoring company. Coordinate with owner to determine which 3rd party monitoring company is being used.
B. IP/GSM communicator shall be mounted adjacent to the fire alarm control panel.
C. GSM (cellular) communication only shall be provided for this project.
D. The communicator shall communicate to GSM networks including 2G, 3G and 4G. The multi-GSM platform technology shall automatically detects and chooses the best network in the area based on signal strength and shall self-adjusts for operation.
E. Provide an exterior building mounted antenna connected to the IP/GSM communicator when the cellular signal strength is below -70dBm at the fire alarm control panel.
F. The communication path shall be supervised at an interval of not more than 60 minutes. A failure to complete a signal transmission shall be annunciated at the fire alarm control panel and remote annunciator.
G. The equipment enclosure shall have diagnostic LEDs for signal strength and status indications.
H. The IP/GSM communicator shall be housed in a UL listed cabinet. The backbox and door shall be constructed of steel with provisions for electrical conduit connections into the sides and top.
I. Upon loss of primary (AC) power, the battery shall have sufficient capacity to power the IP/GSM communicator for required standby time (24 hours) followed by 5 minutes of alarm.
J. The communicator shall comply with requirements of NFPA Standard No. 72.
K. The communicator shall be a product of the fire alarm control panel manufacturer.

2.3 VOICE ALARM PANELS:

A. Provide voice alarm integral with the fire alarm panel.

B. Voice alarm feature shall be capable of transmitting automatic or manual messages to fire alarm speakers. However, panels shall be configured for automatic operation.

C. Provide remote microphones at locations shown on drawings.

2.4 DOCUMENTATION CABINET:

A. Provide documentation cabinet located at the fire alarm control panel. Documentation cabinet shall house all record documentation required by NFPA 72.

B. Label documentation cabinet "SYSTEM RECORD DOCUMENTS".

2.5 REMOTE ANNUNCIATOR:

A. The annunciator panel shall be recess mounted at location noted on the drawings and shall have an LCD readout. Each alarm initiating device (pull station, smoke detector, duct detector, and sprinkler system flow switch) shall be identified on the readout.

2.6 POWER SUPPLIES:

A. Provide power supplies in the quantity and size required to operate the devices connected to the system. Do not load any power supply more than 75% of its rating.

B. Group devices of the same type to the same power supply.

C. Remote power supplies are permitted providing:

1. Location is approved by the Architect.
2. A separate 20A / 120V circuit is installed to operate each remote supply.
3. Backup battery system is installed at the location of each remote power supply.

2.7 BACKUP BATTERY SYSTEM:

A. An automatic battery back-up and recharging system with volt meter and ammeter for supporting the entire system for a period of 24 hours under normal conditions with five minutes of alarm time at the end of the 24-hour period. The battery back-up shall also be able to support the one-way voice communications and tone generator under maximum normal load for 24 hours and then shall be capable of operating the system during a fire or other emergency condition for a period of 2 hours. Fifteen minutes of evacuation alarm operation at maximum connected load shall be considered the equivalent of 2 hours of emergency operation.

B. Install batteries in a separate cabinet adjacent to the control panel / remote power supply.

2.8 SIGNALING LINE CIRCUITS:

A. Circuits shall be Class B, Style 4.

2.9 NOTIFICATION APPLIANCE CIRCUITS:

A. Circuits shall be Class B, Style Y.

2.10 SYSTEM OPERATION:

A. The system shall be designed, installed and connected to receive and process signals in accordance with NFPA 72.

B. Control actions upon receipt of fire alarm signal:

1. Doors in fire walls, held open by magnetic devices, shall close, via interface with control module.
2. All doors locked by the electronic card entry/control system shall be unlocked, via interface with control module. The electronic card entry/control system is being provided by the Owner. It shall be the responsibility of the contractor to meet with the Owner's designated representative and determine the requirements.
3. Air handling units equipped with smoke detectors shall be de-energized, via interface with control module.
4. Smoke dampers in duct work shall close, via interface with control module.
5. The alarm activation of any elevator lobby, elevator shaft or elevator equipment room detector shall cause the elevator cabs to be recalled in accordance with ASME A17.1.
6. The alarm activation of any heat detectors in the elevator shaft or elevator machine room shall cause shutdown of elevator power and lighting circuits as required by ASME A17.1.
7. The activation of projected beam detectors shall initiate the actions described in the applicable sections of Division 15, for smoke removal.

C. Supervisory Functions:

1. Sprinkler system flow and tamper switches - per NFPA 72, via interface with monitor module.
2. Fire service post indicator valve - per NFPA 72, via interface with monitor module.
3. Elevator sump pump oil monitoring system.

D. Auxiliary Functions:

1. Provide fire alarm operation of the shunt-trip devices controlling the power to Cafeteria Voice Reinforcement panel.

2.11 NON-ADDRESSABLE DEVICES:

A. Audible Alarm Indicating Appliances:

1. Audible signals shall be manufacturer's standard horn or speaker, as indicated, and shall be suitable for surface mounting on the wall.
2. Horns shall have field-selectable "standard" and "high" settings.
3. Speakers shall have field-selectable taps from 1/8W to 8W.
4. Enclosure shall be white.

B. Visual Alarm Indicating Appliances:

1. Visual signals shall be manufacturer's standard, suitable for surface mounting on the

wall.
2. Devices shall have field-selectable candela settings of 15, 30, 75 or 100 cd.
3. Enclosure shall be white. Lens shall be vandal resistant.

C. Audio/Visual Alarm Indicating Appliances:

1. Combination audible / visible signals shall be manufacturers' standard, the same as defined for individual devices.

D. Door Holders:

1. Magnetic door holders shall be manufacturer's standard and shall have an approximate holding force of 35 lbs.
2. The door portion shall have a stainless steel pivotal mounted armature with shock absorbing nylon bearing. Wall unit shall be semi-flush mounted over recessed outlet box.
3. Door holders shall be 24V dc and shall be powered from the control panel.
4. Door holders shall be wall mounted type unless floor mounted type is required. Door holders shall be compatible with Architectural building features and doors specified.

E. Thermal Detector Head:

1. Detectors will be a combination rate-of-rise and fixed temperature (200ºF) type, automatically restorable. These devices shall be used only in spaces where high ambient temperatures prohibit the use of addressable devices. Unless noted otherwise, each of these devices shall be used in conjunction with a monitor module, such that point identification is maintained.

F. Waterflow Switches:

1. Flow switches are furnished and installed under Division 15 and connected under this Division.

G. Sprinkler Valve Tamper Switches:

1. Tamper switches are furnished and installed under Division 15 and connected under this Division.

H. Post Indicator Valves:

1. Post Indicator Valves are furnished and installed under Division 15 and connected under this Division.

2.12 ADDRESSABLE DEVICES:

A. Pull Stations:

1. Pull stations shall contain electronics that communicate the station's status to the control panel over two wires. Station address shall be field-selectable.
2. Stations shall be double-action type.
3. Enclosure shall be red, high-impact, vandal-resistant type.
4. Station address shall be field-selectable.

B. Thermal Detector Head:

1. They will be combination rate-of-rise and fixed temperature (135ºF) type, automatically restorable.
2. Station address shall be field-selectable.

C. Carbon Monoxide Detector / Alarm:

1. CO sensors shall communicate actual CO values to the system control panel.
2. Sensors shall be low profile.
3. Station address shall be field-selectable.
4. Set points shall be field-selectable from the control panel.
5. Sensor shall have integral test switch.
6. Sensor shall be equipped with sounder base.

D. Smoke Sensors:

1. Smoke sensors shall be of the photoelectric or ionization type and shall communicate actual smoke chamber values to the system control panel. Sensors installed in elevator shafts or pits shall be suitable for the environment.
2. Sensors shall be low profile.
3. Station address shall be field-selectable.
4. Set points shall be field-selectable from the control panel.
5. Sensor shall have integral test switch.
6. Sensor heads shall be photoelectric or ionization type, as determined by the manufacturer to best suit the environment in which the device is to be installed.

E. Addressable Duct Smoke Detector:

1. Addressable Duct Smoke Detectors shall be of the photoelectric type specified above, for mounting outside of the air stream.
2. Provide housing to allow installation on the side of air duct.
3. Provide sampling tubes.
4. Provide and install an externally mounted addressable control module for each duct mounted smoke detector shown on Division 15 plans and/or details and program system as necessary for required automatic shut-down.
5. For each duct detector location provide one remote indicator / test switch unit. The unit shall provide status of the detector (normal, alarm, and trouble). Flush mount in wall near entrance to room in which air unit is installed.

F. Addressable Monitor Modules:

1. Addressable monitor modules shall provide point-monitoring capabilities of individual non-addressable devices. Provide a separate module for each such device.
2. Locate within three feet of the device to be monitored.

G. Addressable Control Module:

1. Addressable control modules shall be used to initiate control actions and supervise initiating functions. A separate control module shall be provided for each control point. Initiation of control functions from auxiliary contacts in devices is prohibited.
2. Locate within three feet of the device to be controlled.
3. If the power requirements of the device being controlled exceed the contact rating of

control module, provide a general purpose relay, controlled by the module, with the required contact rating to support the load.

2.13 REMOTE COMMUNICATION DEVICES:

A. Provide active RS-232 port for connection of printer.

B. Provide remote LCD annunciator (non-control type) in location shown on plans.

PART 3 - EXECUTION

3.1 WIRING:

A. Refer to Section 27 90 10, Wiring Methods for Communications Systems.

B. Label each piece of equipment and each cable, using NFPA 72 requirements/ recommendations. Label each end of all cables. Labels shall be of same type as specified in Section 27 20 11.

C. Provide all wiring required to make system operable, as specified. Leave 25% spare capacity on each circuit for the future addition of devices and appliances. Voltage drop calculations shall substantiate initial load and load that can be added.

D. Install wires and cables without splices. Make connections at terminal strips in cabinets or at equipment/device terminals.

3.2 CONDUCTORS:

A. Provide cable type construction, listed and approved for fire alarm usage.

B. Cables shall comply with NEC Article 760, be red in color and be identified in all enclosures.

C. *All cables shall be installed in a metallic conduit system*, in accordance with Section 26 10 10. Minimum conduit size shall be 3/4". All junction boxes shall be painted red.

3.3 DEVICES:

A. The location of devices shown is approximate. The exact location of all devices shall be determined by the system designer.

3.4 DISCONNECT LABELING:

A. The panel and circuit number serving the control panel shall be marked with an indelible marker pen on the inside door of the control panel.

3.5 NOTIFICATION APPLIANCES:

A. The sound level and light intensity setting of notification devices shall be determined by the system designer.

3.6 DUCT MOUNTED DETECTORS:

A. Refer to the Division 23 drawings for the quantity and location of duct mounted smoke

detectors.

B. The duct work installer shall determine the method of mounting the detector housing and shall also provide an access door in the duct work on the side opposite of the detector, for inspection of the sampling tubes.

3.7 PRELIMINARY TESTS:

A. Upon completion of the installation, test the entire system for proper operation. Make all adjustments and corrections necessary. Retest until proper operation is achieved.

3.8 CUSTOMIZATION:

A. Schedule on-site meeting (allow a minimum of 4 hours) with Owner's designated representative and review system operation to:

1. Determine custom labels.
2. Customize software programming for initiation, notification and control circuits.
3. Review all adjustable features and determine setpoints.
4. Determine access levels and assign passwords.
5. Implement customization based on meeting with Owner. Document all settings and provide hard copy.

3.9 FINAL TEST:

A. After customizing system, perform an acceptance test of the system as required by NFPA 72. Upon completion of tests, print alarm history log to verify tests.

B. Upon successful completion of tests, provide written certification per NFPA 72. Submit form with record documents.

C. Review test results with Owner and Architect. Demonstrate system operation as directed.

D. Arrange final inspection with the Fire Marshal and Owner’s Insurance representative. Present copy of final test alarm log and NFPA certification to each. Demonstrate operation of system as directed.

E. Any changes made to the system after or as a result of the test shall require re-acceptance testing as required by NFPA 72.

3.10 SPARE PARTS:

A. Provide spare parts as follows:

1. Sensor heads: 12 of each type
2. Sensor bases: 12 of each type
3. Manual stations: 6
4. Notification appliances: 12 of each type
5. Control and monitor modules: 6 of each type

Deliver in unopened factory cartons at time of training. Submit receipt, signed by Owner’s representative.

END OF SECTION 27 10 10

SECTION 27 20 11 - CABLE PLANT LABELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 GENERAL:

A. Provide labels for all cables, device faceplates, equipment and equipment ports, installed on this project, as specified herein.

B. Colors for cables and devices are specified in the respective system specification section.

C. Device plate numbers within a room or space shall be assigned based on the "plan" view of the room or space, starting on the left side of the "top" wall and proceeding around the room to the "right", "bottom" and "left" walls. Any remaining devices (i.e. floor or column-mounted outlets in the middle of the room), shall be then counted from left-to-right, top-to-bottom.

1.3 QUALITY ASSURANCE:

A. Labeling materials described herein are the product of Panduit. Products of other cabling system manufacturers' listed in Specification Section 27 20 11, and complying with the requirements specified herein, are acceptable.

B. Submittals: Refer to Section 27 01 20 for requirements. Labels shall be included on layout drawings.

1.4 SYSTEM IDENTIFICATION STRINGS:

A. Fire Alarm:

1. Cable: Provide a label at each end of all cables and at any interim points of termination.

   FA-SLC-PL-01

   FA = Fire Alarm
   SLC = Signaling line circuit or NAC = Notification Appliance Circuit
   PL= Power limited circuit or NPL = Non-power limited circuit
   01 = Circuit number or loop number

2. Device: Provide a label for each device.

   ID-01-001

ID =Initiating Device, CD=Control Device, NA=Notification Appliance
01=Circuit number or loop number
001=Unique device point identification

B. One-Way Paging System:

1. Cable (at headend)

PA-01

PA	= Paging System
	= Paging zone, sequentially numbered

2. Speaker

PA-01

PA	= Paging System
01	= Paging zone, sequentially numbered
25	= Sequential speaker number on given zone

PART 2 - PRODUCTS

2.1 LABELS:

A. Cable labels shall be heat shrink type with clear protective cover. Select size and type based on individual cable characteristics. Use black letters on white background except for data / voice / IP cables that exceed the maximum design length. In such cases labels shall be red on white background.

B. Faceplate labels shall be adhesive-backed component label, compatible with label window in faceplate.

C. Equipment port labels shall be adhesive-backed component label, compatible with label area.

D. Equipment and device labels shall be adhesive-backed component label, affixed to the back side of item, or in an otherwise accessible but inconspicuous location.

E. Set lettering height for each type label to provide the largest font possible in the space available. Boldface Aerial font is preferred. However, labels shall be sized and formatted such that they can be read from a distance of 24".

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Cable labels defined herein shall not be applied until the cables have been terminated and

trimmed. Provide temporary labels at the time of cable installation. Temporary labels shall have the same information as permanent labels.

B. Use extreme caution when applying heat shrink labels.

C. Schedule computer time, with the Using Agency, to generate the labels.

D. Apply cable labels within 2" of termination, or fan-out, such that the lettering is visible without twisting or bending the cable.

3.2 AS-BUILT LABEL REPORT:

A. This report is applicable to Data / IP / Voice cable systems only.

B. Prior to system acceptance, the Contractor shall update the system layout drawings specified in Section 27 01 20, for all changes made during the installation.

END OF SECTION 27 20 11

SECTION 27 40 10 - INTERCOM SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SCOPE OF WORK:

A. Provide a complete operational system as indicated on the drawings and as specified herein.

B. *This is a performance-based specification*. The system specified herein shall be designed by the manufacturer or an authorized representative of the manufacturer. All hardware, cabling, and programming required to provide the system described below shall be provided.

1.03 QUALITY ASSURANCE:

A. Acceptable Manufacturer's/Models

1. Bogen Quantum Multicom IP
2. Rauland Borg Telecenter VI
3. Prior approved manufacturer.

B. Submittals: Refer to Section 270120 for requirements.

PART 2 - PRODUCTS

2.01 EQUIPMENT AND MATERIAL, GENERAL:

A. All equipment, components and software shall be new and the manufacturer’s current model. Beta versions are not acceptable.

2.02 FEATURES AND FUNCTIONS:

A. The integrated communications and internal program clock system shall be a comprehensive communications network with the following features and functions.

1. Capacity for the number of stations indicated on the drawings plus 20% spare. A station consists of a call device and loud speaker or a zone of speakers.

(Zones- each Class Room, each Corridor by Wing, each Administrative Office, Nurses Office, Media Center, GYM, Multipurpose/Café, and Exterior Speakers, shall constitute separate zones.)

2. One built-in network interface port for system combining and LAN station-to-station calling and district-wide all-calls

3. One built-in network interface port for first-time system configuration, Built-in Web Server for full system programming with Quantum Commander, Administrative Web-Browser Application for Programming and System Operation

4. Network Time Synchronization. The system shall be capable of periodic update/synchronization of the processor's time with a Network Time Server via the school's LAN network. Systems that do not provide Network Time Synchronization will not be deemed equivalent.

5. Three station types: Administrative Station, Enhanced Staff Station and Staff Station.

B. Built in Master Clock with 1024 events, 32 Schedules, including Daylight Savings Time, and 32 custom holiday events that can be assigned to any of the 64 multi-purpose zones

C. Telco Interface - Shall interface with the Schools phone system via a telephone interface card. (The interface shall allow any telephone via the telephone system to access the Intercom System. Access to the intercom shall support All Call Paging, Emergency Paging, Activate Emergency Tones, and Intercept Incoming Intercom Calls and make Intercom Calls to individual rooms.)

D. Audio program distribution (Am/Fm Tuner, CD Player and MP3 Player)

1. Emergency Tone Distribution - There shall be at least four Dedicated Emergency Alarm Tones. Each may be accessed by dialing a three-digit number from designated administrative display phone. These emergency tones should be separate from the time tones. Systems using external alarm generators, or having less than four emergency alarm tones shall not be acceptable.

2.03 CONFIGURATION:

A. All headend equipment shall be rack-mounted in a standard 19" free-standing cabinet.

1. The system shall be a global switching system, providing up to 512 unrestricted simultaneous private telephone paths per facility. The system shall also be capable of providing up to 512 amplified intercom paths per facility. One amplified intercom path shall automatically be provided with each increment of 24 stations of system capacity. All hardware, etc., required to achieve the necessary number of amplified-voice intercom channels for this system shall be included in this submittal. Amplified-voice intercom channels shall provide voice-activated switching. Systems requiring the use of a push-to-talk switch on administrative telephones shall not be acceptable. There shall be an automatic level control for return speech during amplified-voice communications. The intercom amplifier shall also provide control over the switch sensitivity and delay times of the VOX circuitry.

B. Program Clock (Built –in) with 1024 events, 32 Schedules, including Daylight Savings Time and 32 custom holiday events that can be assigned to 64multipurpose zones.

C. Amplified-voice intercom channels shall provide voice-activated switching. There shall be an automatic level control for return speech during amplified-voice communications. The intercom amplifier shall also provide control over the switch sensitivity and delay times of the circuitry.

D. Administrative Display Phone

1. Administrative Display Phones shall be Bogen Model MCDS4. The administrative telephone display panel shows the time of day and day of week, the current time signaling schedule, and the station numbers and call-in priority of staff stations that have called that particular station. A 3-key response is used to scroll the display, and answer or erase normal, urgent, and security calls. Depending upon the system programming, an administrative station can use display menus to activate zone pages, alarm signals and external functions, as well as select program sources and distribute or cancel a program to any or all speakers or zones.

2. Administrative Display Phones shall have the ability to dial and have the option of dialing either the loudspeaker or phone at each station location. The system shall automatically switch from phone-to-intercom communication to phone-to-phone communication when the staff handset or enhanced staff phone on the receiving end of the call is lifted.

3. The Administrative Display Phone shall display the classroom number of any station that calls 911. This feature will notify the main office when a classroom has dialed 911 emergency centers so that administrators can direct emergency personnel to the correct physical location in the building when they arrive. Systems that do not provide this feature will not be deemed equal. (Provide one Administrative Display Phone at the front desk).

E. Staff stations shall consist of wall mounted call-in switches and ceiling-mounted loudspeakers. All call-in switch locations shall be interchangeable with enhanced staff station telephones without providing additional wiring.

2.04 EMERGENCY CALLS:

A. Staff generated Emergency calls shall be treated as the highest system priority. All Emergency calls shall annunciate at the top of the call queue of the administrative telephone at the Receptionist's desk.

B. Should the Receptionist's administrative telephone be engaged in a non-emergency conversation, its conversation shall be automatically terminated, indicated with an alert tone, and then reconnected to the station which generated the Emergency call.

C. Should the administrative telephone be engaged in an Emergency conversation, successive emergency calls shall log into the call queue. Upon termination of the initial emergency conversation, the next one shall immediately ring the administrative telephone.

D. There shall be a system-wide emergency all-call feature. The emergency all-call shall be accessed by dialing by Owner-designated dialing code from all administrative phones. The Emergency all-call function shall have the highest system priority and shall override all other loudspeaker related functions including time tone distribution.

E. There shall be at least four built-in dedicated emergency alarm tones. Each may be accessed by dialing an Owner-designated number from any administrative telephone. These emergency

tones shall be distinct from the time tones.

2.05 AUXILIARY FUNCTIONS:

A. The system shall distribute audio programs generated from an AM/FM tuner, and a 5 disk compact disc player and a 3.5mm input jack for an MP3 player. The system shall be capable of distributing the programs to any one zone, combination of zones, or all zones. Program selection, distribution, or cancellation of any one of the sources shall be accomplished from a designated administrative station.

B. The system shall be bridged with all voice reinforcement systems. Each voice reinforcement system shall be connected as a separate zone within the intercom system.

C. Program Clock (Built –in) with 1024 events, 32 Schedules, including Daylight Savings Time and 32 custom holiday events that can be assigned to 64multipurpose zones.

2.06 OPERATION:

A. Administrative Stations shall operate as follows:

1. There shall be a zone-page/all-page feature that is accessible by all administrative stations.
2. There shall be a voice-intercom feature that is accessible by all administrative stations.
3. There shall be an automatic disconnect of administrative stations to prevent them from tying up communications channels. When a station goes off-hook and does not initiate a call within a prescribed interval, the station shall receive a busy signal and shall automatically disconnect.
4. Other than Emergency calls, the user shall have the ability to answer calls in random order. Emergency calls shall be responded to in the order in which they are received.
5. Administrative stations shall receive dial tone upon going off-hook. Outgoing calls are made by dialing the desired station. All administrative telephones shall permit the following operations:
   a. Direct-dial private two-way telephone communications with other administrative stations and enhanced staff stations.
   b. Direct-dial two-way amplified-voice communications with any station loudspeaker.
6. Administrative stations shall be equipped with an alphanumeric display panel. Display contrast/viewing angle shall be user-adjustable.
   a. The display shall normally show the time of day and day of week, the current time signaling schedule, and the numbers of up to four stations calling in along with the call-in status of each station (normal, emergency). There shall be an indication that there are calls above or below those presently on the display. When dialing from the administrative phone, the display shall indicate the station number and type of station being dialed.
   b. The display shall also provide menu selections to assist the operator when field-programming, or when paging.
7. Each administrative telephone shall maintain a unique queue of all stations calling that particular phone.
8. The system shall be capable of forwarding calls from one administrative station to the next. The user shall have the ability to forward their calls in the following manners - forward all calls, forward calls only when the station is busy, forward calls only when there is no answer, forward calls when there is no answer or the station is busy.

9. The system shall alert the user to additional calls pending in the call waiting queue by way of a unique sound.
10. Upon picking up the receiver and dialing a predetermined number, a menu shall appear on the display prompting the user to enter each subsequent digit. In this way, the user shall not be required to memorize complicated key sequences in order to access program distribution functions.
11. System programming, system initialization and station initialization shall be from administrative telephones, but shall be password protected.

B. Enhanced staff stations shall operate as follows:

1. Enhanced staff stations shall receive dial tone upon going off-hook. Outgoing calls are made by dialing the desired station. Incoming calls can be directed to the telephone or to the associated loudspeaker for a hands-free reply. There shall be an automatic switch-over from loudspeaker to private telephone communication should the person pick up his handset.
2. There shall be a voice-intercom feature that is accessible by all enhanced staff stations.
3. There shall be an automatic disconnect of enhanced staff stations to prevent them from tying up communications channels. When a station goes off-hook and does not initiate a call within a prescribed interval, the station shall receive a busy signal and shall automatically disconnect.
4. All enhanced staff stations shall be able to initiate an emergency call to the station at the Receptionist's desk.

C. All staff stations shall operate as follows:

1. All staff stations shall be able to initiate a call or an emergency call to the station at the Receptionist's desk.

2.07 INTERIOR CEILING-MOUNTED SPEAKERS:

A. Class Room Speakers CSD2X2VR/U - Drop-In Ceiling Speakers with integral Speaker Can. Provide an 8" permanent magnet cone type speaker having viscous-damped cone and a ceramic magnet weighing 10 oz. It shall have a frequency response of at least 95 – 20,000 Hz, a 10 watt power-handling capacity and an axial voice coil shall be 3/4" diameter with 8 ohm impedance with multi-tap transformer .25, .5, 1, 2 and 4 watts (selectable by rotary switch), at 25V. Tap all speakers in classroom at 1/2 watt. (***All classroom speakers shall have integral volume control.***

B. Corridors Speakers CSD2X2U - Drop-In Ceiling Speakers with integral Speaker Can. Provide an 8" permanent magnet cone type speaker having viscous-damped cone and a ceramic magnet weighing 10 oz. It shall have a frequency response of at least 95 – 20,000 Hz, a 10 watt power-handling capacity and an axial voice coil shall be 3/4" diameter with 8 ohm impedance with multi-tap transformer .25, .5, 1, 2 and 4 watts (selectable by rotary switch), at 25V. Tap all speakers in corridors 1watt.

C. Speakers for Sheet Rock Ceilings: The loudspeaker assembly shall be a Bogen model S86T725PG8UVR, or equivalent, 8" cone-type loudspeaker, having a frequency response of at least 50 Hz to 12 kHz. Axial sensitivity shall be 95 dB, measured at 1-watt/4 feet. The loudspeaker shall have a 6 oz. ceramic magnet and a 3/4" voice coil. A transformer, capable of

matching an 8-ohm loudspeaker to a 25-volt or 70-volt line, and providing power taps of 4, 2, 1, 1/2, 1/4, and 1/8 watts shall be included. The loudspeaker shall be assembled on a 13" steel ceiling grille, finished in bright white semi-gloss enamel. Assembly depth shall be 3-1/4. Speaker includes a recessed volume control. Provide a load bearing bridge Model No. TB8, Enclosure RE84 and a MR8 Mounting/Mud ring.

2.08 GYM and EXTERIOR SPEAKERS:

A. Provide square weatherproof enclosure with weatherproof speaker, FMH15T mounted in BBFM6 enclosure with FMHAR8 adaptor ring and SGHD8 heavy duty Grille.
Where surface mounted, use BBSM6 surface enclosure. (Tap the Speakers in GYM and exterior speakers at 7 watts minimum.)
B. Provide a keyed volume control in a common wall near the entry of the GYM to facilitate adjusting the volume of the intercom speakers.

2.09 MULTIPURPOSE ROOM / CAFE INTERCOM SPEAKERS:

A. CSD2X2VR/U - Drop-In Ceiling Speakers. (Tap the Multipurpose / Cafeteria Speakers at 2 watts minimum.) (These speakers are not part of the Sound System).
B. Provide a keyed volume control in a common wall near the entry of the space to facilitate adjusting the volume of the intercom speakers.

2.010 AM/FM TUNER:

A. Provide unit designed for continuous duty service in institutional and industrial sound systems. It shall be completely solid state, including transistors and integrated circuitry. The AM portion shall cover the entire broadcast range of 530 to 1620 KHz. The FM section shall have a tuning range of 85.5 - 108 MHZ.

2.011 MULTI COMPACT DISC (CD) PLAYER:

A. Provide unit designed for continuous duty service in institutional and industrial sound systems. It shall play any standard audio CD. The disc player shall be able to hold 5 CDs at once, and it shall be possible to add and remove discs while the unit is operating. The unit shall have a play button, a search button for locating tracks, a repeat button for repeating tracks, and a program feature to allow the programming of preferred tracks in any desired order. The Unit shall also have a 3.5mm MP Player input. (Tascam CD 200i with 3.5m MP player dock.)

2.012 POWER AMPLIFIER:

A. Provide a solid state amplifier. The harmonic distortion shall be less than .5% from 20 to 20,000 Hz and the noise level shall be at least 90 DB below rated output. Amplifier shall require not more than 500 mil volt input signal for rated output. Regulation shall be less than 2 DB from no load to full load. The amplifier shall include a 24 volt DC power supply. The unit shall have 25 and 70 volt output. Amplifier rating shall be 150% of the system load, minimum.

2.013 SURGE SUPPRESSION:

A. Provide surge protection in accordance with NEC Article 800, where conductors enter and exit buildings.

2.014 EQUIPMENT CABINET:

A. Provide freestanding, ventilated type cabinet, with front and rear doors with lock, Color shall be black. Provide 20" rack space for future expansion.

PART 3 – EXECUTION

3.01 INSTALLATION OF EQUIPMENT:

A. Install equipment where shown, in accordance with the equipment manufacturer's written instructions, and with recognized industry practices, to ensure that the equipment complies with these requirements and serves the intended purposes. Comply with the requirements of National Electrical Code an applicable portions of NECA's "Standard of Installation" pertaining to general electrical installation practices. All head-end components shall be factory installed in the equipment rack, tested and shipped as a complete unit. Ground equipment enclosures, surge arrestors and cable shields in accordance with the National Electrical Code.

3.02 WIRING:

A. Wiring is not shown on the drawings. Provide wiring of the type recommended by the system manufacturer. Wiring shall run unspliced from the headend to the hub room in each wing, where it shall then be distributed to the individual spaces. Provide punch down blocks, with covers, at the headend and all hub rooms. Install all wiring in accordance Section 279010.

B. Zone devices as indicated on the drawings. (Zones - each Class Room, each Corridor by Wing, each Lobby, each Administrative Office, Library, GYM, Multipurpose / Café, Nurses Office, and Exterior Speaker, shall constitute a separate zone.)

3.03 TESTING :

A. Upon completion of installation of equipment, test to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting until specified operation is achieved. Do not proceed with in-service training until the system is fully operational.

3.04 PROGRAMMING:

A. After system start-up and prior to final testing, schedule on-site meeting with the Owner's representative to discuss desired programming of system. Program as directed. Provide documentation and include in record manuals. Allow one 8-hour day.

END OF SECTION 27 40 10

SECTION 27 40 40 - CAFETERIA VOICE REINFORCEMENT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

A. **Provide complete, operational voice reinforcement system for the K-8 and High School Cafeterias. Two separate systems will be required.** The system shall be intelligible when the Cafetria is full or when there are only a few people present. Any devices necessary to filter out offending frequencies which cause vibrations or echoes that cause the system not to be heard and understood will be provided.

1.3 QUALITY ASSURANCE:

A. Acceptable Manufacturer's:

1. Bogen – M-Class
2. Rauland
3. Or Equal by Prior Approval

B. Submittals: Refer to Section 270120.

PART 2 - PRODUCTS

2.1 HEAD END:

A. Core Processor 12X4 – Auto Mixer / System Processor / Speaker DSP

B. Provide a 3.5mm MP3 player port/dock or Bluetooth audio interface.

C. DLC Speaker Processor

D. Amplifiers:
1. (Cafeteria Area) - Bogen M-Class Amplifier, Model M300. The amplifier shall provide a mono 70V output capable of 1200, 900 or 600 watts respectively or, it can provide two independent amplifier channels rated at 600, 450 or 300 watts/channel into 4 ohms, respectively. The amplifier shall provide 2 module bays for the installation of various input modules. A dual-channel (balanced or unbalanced), high-impedance input module shall come installed as a standard module in the amplifier. The amplifier shall be 70V Mono. The amplifier shall also include a clip limiting feature that automatically reduces amplifier clipping. The amplifier shall have three indicators that correspond to status, signal, and clip/limit. The amplifier shall allow the connection of external signal processing equipment when in Dual Mono or 70V Mono modes. The signal flow shall automatically be diverted to

external equipment when connected to the effects loop. The amplifier shall also provide both pre- and post-EQ signal feeds for distribution to other equipment. The amplifier shall be enclosed in a heavy-gauge steel chassis with recessed level control knob, which can be protected by a removable plastic cover. The amplifier shall be cooled by 2 independent continuously variable speed fans with easily removable fan filters. The amplifier shall fit into a 19" rack using two rack spaces.

E. 19” Rack with front and back door. Provide casters with locking wheels Lowell, Middle Atlantic, Atlas or equal. Include cooling fans and power strips.

F. Speaker cables shall be terminated in the cabinet wall (input plate) with female Neutrik bulkhead connectors. Provide 15 ft. patch cables between the cabinet and the speaker cable wall termination point.

G. Provide Muting interface so that an activation of the fire alarm will shutdown the sound systems output to the speakers.(The fire Alarm Contractor will provide a Fire Alarm Relay within 5 ft. of the sound equipment rack.

H. Provide muting function for interconnection between the school intercom system and the cafeteria sound system. The function shall be to mute the cafeteria sound system if there is an event that should be broadcast into the entire school area.

2.2 SPEAKERS:

A. Provide Two (2) AFI -4W speakers. Loudspeaker shall be a full range two-way speaker utilizing a 12” moisture stabilized woofer and a 1” exit Ferrofluid cooled compression driver mounted to a rotatable 90-degree horizontal by 45-degree vertical non-resonant urethane horn. The unit shall have a frequency response of 58Hz to 20kHz +/-3dB and a maximum long term SPL of 121dB with a sensitivity of 127dB. The loudspeaker shall be constructed using at least 13ply per inch void free birch plywood with an input and loop through on #8 barrier strips. The speaker shall have fourteen 3/8x16 steel backed rigging points, a bolt pattern on the rear panel to accept a third party articulating mount and two integral handles that cannot be used as fly points. (The Horn shall be field oriented for horizontal speaker positioning.) Speaker shall be white.

B. Speaker Rigging/Mounting Hardware

1. Wall Mounting: Allen Products Model MM-022 MultiMount. The universal MultiMount speaker mount supports loudspeakers weighing up to 60 lbs/27 kg, quickly attaching them to walls, ceilings, overhangs, and other structural surfaces. Speakers can be aimed and locked in almost any direction or angle through the use of independent pan, tilt, and clockwise adjustments. MultiMount-022 also adapts to both horizontally and vertically oriented standard speaker mounting patterns. Approval: Submit the loudspeaker and rigging assembly and attachments to the building structure to the Architect or Engineer who is licensed in the state where the installation is to occur for approval. Mount shall be white.

a. Speaker Cables: Terminate on a jack plate with male bulkhead connectors (Neutrik Model NL4MP) where shown on the drawings or as coordinated with the owner. Provide a 12 ft flexible patch cable between the head end cabinet and the jack plate.

2.3 MICROPHONES:

A. Wireless Microphone shall be wireless transmitter receiver type, provide two - one Bogen UDMS800HH with Hand Held and one UDMSW800BP with Body Pack. Provide battery for transmitter. Equivalent by or Equal by Sure, Peavey or TOA is acceptable.

B. Provide two (4) Bogen HDU250 Microphones - The microphone shall be a Bogen Model HDU250. It shall be a cardioid, dynamic handheld microphone with a frequency response of 50 Hz to 18 kHz and 250-ohm impedance. The sensitivity shall be -72 dB (+/- 3dB) and the signal-to-noise ratio greater than 65 dB. It shall have a sliding-type on/off switch and a rubberized black finish. The HDU250 shall have an XLR Male connector. Dimensions shall be 7" D x 2" Dia. Weight shall be 1 lb.

2.4 MICROPHONE STANDS:

A. Provide Four 5 microphone stands, one (1) for table mounting Bogen DS3 with 6” base and chrome finished tube and Four (4) for floor mounting Bogen SF4 with 10” base and chrome tube. Floor mounted stand shall have telescoping member adjustable from 34"-62".

2.5 CABLES:

A. Microphone cable:

1. Provide 20ga stranded twisted shielded cable - West Penn 25292B Plenum, W.P. 292 where installed in conduit, W.P. Aquaseal AQC292 where installed below the grade or below the slab.

2. Microphone Jacks shall be located where shown on the drawings. All microphone cables shall be consolidated on a wall mounted plate at the Head end. Provide 12 ft patch cables between the head end cabinet and the jack plate. Provide XLR jacks, bulkhead connectors and Plugs as required.

3. Provide four (6) XLR 25 foot microphone cables.

B. Speaker Cable:

1. (Cafeteria): Two conductor twisted cable stranded copper #18 AWG with color coded insulation. Insulation shall be rated for 450 volts, working voltage and colored black and white. Cables shall be manufactured by Belden, Alpha or West Penn.

2.6 ASSISTED LISTENING

A. Williams Sound Personal PA® 457, PPA T45 transmitter, with multiple digital audio input options and an OLED display with easy-to-manage menu navigation. Features three powerful microprocessors and the same high-quality audio and RF performance you’ve come to expect from Williams Sound. With an operating range of up to 1000 feet, the PPA 457 is ideal for large venues where superior coverage is essential. This complete turnkey solution includes four PPA R37 receivers, each featuring seek-button channel selection with access to 17 pre-set wideband frequencies between 72-76 MHz. The system is expandable, accommodating any number of listeners. This system shall comply with 2010 ADA guidelines for hearing assistance. The system shall be covered by a Lifetime PLUS Limited Warranty.

B. *System Include:*

(1) PPA T45 Transmitter
(4) PPA R37 Receivers
(2) NKL 001 Neck-loops
(4) EAR 013 Earphones
(1) ANT 025 Whip Antenna
(1) WCA 013 Audio Cable
(1) TFP 048 Power Supply
(1) IDP 008 ADA Wall Plaque
(8) BAT 001 AA Alkaline Batteries

PART 3 – EXECUTION

3.1 GENERAL:

A. System wiring is not shown on the drawings. Provide all wiring required to place the system into operation.

B. Wiring shall be installed in accordance with Section 279010, Wiring Methods for Communications Systems. In no case shall speaker cables and microphone cables be installed in the same raceway.

C. This System will be interconnected with the fire alarm so that during an evacuation signal the system will be muted.

D. This system will not be interconnected with the intercom system.

E. Exact positioning of speakers shall be field determined by the installer, for optimum performance. Speakers shall be supported from structure as necessary.

F. Processor, Provide appropriate audio delay in Cafeteria speakers.

G. Location of the Wireless Microphone Receiver and its Antennas shall be field determined by the installer, for optimum performance. Provide 120 volt power to receiver and cabling between amplifier and receiver, as required.

H. Location of the Wireless Assisted Listening Transmitter and its Antennas shall be field determined by the installer, for optimum performance. Provide 120 volt power to receiver and cabling between amplifier and receiver, as required.

END OF SECTION 27 40 40

SECTION 274116 – INTEGRATED AUDIO-VIDEO COMMUNICATIONS & THEATER EQUIPMENT

PART 1 - GENERAL

1.1.1 GENERAL

A. This specification outlines Presentation Systems Contractor (PSC) requirements to furnish and install presentation systems and all low voltage wiring required for completely operational auditorium production systems in the Savannah Arts Academy Addition and Renovation project. All necessary equipment for sound, theater lighting, rigging, curtains, video, and control systems shall be required and provided by the PSC for a completely operational theater production and presentation system. A separate bid for all work required in conjunction with the stated A/V package for a complete and functioning electrical package.

B. The systems shall not be considered complete until the completion of as-built documentation, final system commissioning, and facility personnel training. This facet of the services to be provided by the PSC is deemed very important to the satisfactory completion of the contract. To that end a final payment reserve of 10% of the system purchase price shall be held from payment until the documentation package and training described in Part III are delivered.

1.1.2 RELATED SECTIONS

A. Architectural
B. Electrical
C. Fire Protection
D. Mechanical

1.1.3 INTENT AND INTERPRETATIONS

A. It is the intent of the Construction Documents that the PSC shall include all items necessary for the proper execution and completion of the project, resulting in complete and fully operational system(s) ready for the Owner's use, in full compliance with all applicable standards, codes and ordinances.
    1. Work or product not specifically indicated in the Construction Documents, but which are necessary to result in complete and fully operational system(s) ready for the Owner's use, shall be provided by the PSC.
    2. The specification of certain products in the Construction Documents shall not be construed as a release from furnishing such additional products and materials necessary to furnish complete and fully operational system(s) ready for the Owner's use.

B. In the event that discrepancies exist or required items or details have been omitted in the Construction Documents, the PSC shall notify the Owner/Consultant in writing ten (10) days prior to the bid date. Failure to do so shall be construed as willingness to provide a complete and fully operational system within the amount bid by the PSC. Where such discrepancies are not brought to the attention of the Owner/Consultant, the most stringent (costly) requirements shall be construed to be the basis for the PSC's bid.

C. Drawings and Specifications are complementary. Items required by either are binding as though they are required by both. In the event of conflict between the requirements of the Drawings and the Specifications:
    1. With regards to the preparation of proposals and/or bids, the PSC shall assume the more stringent (costly) condition shall prevail. The PSC shall notify the Owner/Consultant of such a minimum ten (10) days prior to the bid date.
    2. With regards to actual construction, the PSC shall notify the Owner/Consultant and await the Owner's/Consultant's instruction prior to proceeding with procurement and installation.

D. Drawings:
   1. Drawings are diagrammatic and approximate in character, are not intended to show all features of required work, and do not necessarily indicate every required component.
   2. Symbols used on the Drawings are defined in the legend on the Drawings. Symbols indicated on the legend may not necessarily be required.

1.1.4 DEFINITIONS

A. The term "Contractor", "Supplier", or "Presentation Systems Contractor (PSC)" as used herein refers to the party responsible for supplying all services and equipment covered herein and on related drawings.
B. The term "Owner" shall refer to Savannah Chatham Public School System.
C. The term "Consultant" shall refer to the consultant who is responsible for the design of the audio, video, and control systems.
D. The term "Electrical Contractor" shall refer to the Division 26 contractor.
E. The term "provide" will mean to supply, install, verify performance and coordinate interconnection and power.
F. Specialized terms particular to technical systems and related work shall be used in the following manner, in accordance with:
   1. Captions on related drawings.
   2. Generally recognized audio engineering and production usage.
   3. Relevant usage and definitions of handbooks, guidebooks or trade group recommendations by manufacturers' associations or professional and engineering societies such as SMPTE, ICIA, UL, and NEMA.

1.1.5 RELATED DOCUMENTS

A. The PSC shall read, review and understand all documents listed below prior to bidding or proceeding with work. The PSC shall also refer to and understand all other related documents indicated herein. Failure to familiarize itself with the construction documents will not relieve the PSC of its responsibility to complete the work in accordance with the construction documents.
B. Division 1: Applicable provisions of Division 1 shall govern all work under this section.
C. Contract: In addition to the conditions and work described herein, all conditions of the Contract shall apply.
D. Presentation System Drawings
   1. EPS-L LEGEND
   2. EPS-1.1 FIRST FLOOR AV PLAN
   3. EPS-1.2 FIRST FLOOR ACOUSTIC SYSTEM PLAN
   4. EPS-1.3 FIRST FLOOR LIGHTING PLAN
   5. EPS-1.4 SECOND FLOOR LIGHTING PLAN
   6. EPS-1.5 THIRD FLOOR AV PLAN
   7. EPS-1.6 THIRD FLOOR ACOUSTIC SYSTEM PLAN
   8. EPS-2.1 FIRST FLOOR RCP
   9. EPS-2.2 FIRST FLOOR ACOUSTIC SYSTEM RCP
   10. EPS-2.3 THIRD FLOOR RCP
   11. EPS-2.4 LIGHTING RCP
   12. EPS-2.5 CURTAIN LAYOUT
   13. EPS-3.1 AUDITORIUM SECTION
   14. EPS-3.2 MOTORIZED HOIST RCP
   15. EPS-4.1 PRODUCTION PANEL DETAILS
   16. EPS-4.2 FACE PLATE DETAILS

17. EPS-4.3 LOUDSPEAKER DETAILS
18. EPS-4.4 EQUIPMENT RACK DETAILS
19. EPS-4.5 HOIST DETAILS
20. EPS-4.6 LIGHTING DETAILS
21. EPS 4.7 VIDEO SYSTEM DETAILS
22. PS-1.1 AUDITORIUM AUDIO FLOW DIAGRAM
23. PS-1.2 AUDITORIUM AUDIO FLOW DIAGRAM
24. Ps-1.3 AUDITOROIUM AUIO FLOW DIAGRAM
25. PS-1.4 AUDITORIUM AUDIO FLOW DIAGRAM
26. PS-1.5 AUDITORIUM VIDEO FLOW DIAGRAM
27. PS-1.6 AUDITORIUM CONTROL FLOW DIAGRAM
28. PS-1.7 AUDITORIUM LIGHTING CONTRL FLOW DIAGRAM
29. PS-1.7 AUDITORIUM POWER CONTROL FLOW DIAGRAM

1.6 DESCRIPTION OF SYSTEMS

A. AUDITORIUM SOUND SYSTEM

1. The auditorium shall be equipped to support presentations and productions of all sizes with high quality amplification of speech, program material content playback, and presentation audio for video playback. There will be 2 primary operational modes of the sound system.
2. The first mode will be the *Production Mode.* In this mode, primarily for theatrical productions or band / concert performances, the operator will have constant hands-on manual control of the mix and levels.
3. The second mode will be the *Presentation Mode*. In this mode, the audio levels from the laptop or other content and the presenter's microphone level will be controlled from the control system's touch panel. This system operates independently from the production equipment.
4. In the event there is a fire alarm instance, the sound system shall mute. Coordination with the fire alarm subcontractor is key to obtain a contact closure or other signal to engage the audio system accordingly.
5. The main mixing console shall have a minimum of 64 channel mixing capability. Inputs on stage shall be plugged into the mixers stage racks that are located in the equipment racks on each side of the stage. There shall be 2 locations from which to mix from, one in the control room and the other at the FOH position in the back of house. MADI connections from stage rack(s) shall be available at both locations.
6. The auditorium main loudspeaker system shall consist of a left/right configuration with subwoofers. Programmed settings such as equalization, limiting, and delay in the DSP, shall be done in a way as to keep the final room tuning settings away from normal operation and operators and shall be password protected.
7. There shall be audio inputs and outputs available on stage left, stage right, upstage and down stage floor boxes. There will be 2 wall boxes in the orchestra pit containing I/O as detailed on the drawings.
8. There shall be 4 discreet monitor mix feeds for floor wedges, side fills, or passive hotspots. Distribute the 4 monitor mix outputs to I/O plates around the stage according to flow drawings.
9. There shall be (connectivity) for wired personal in-ear mixing. In-ear to be added later by adding an optional card to the console to feed the in-ear mixers.
10. There shall be (2) audience ambient microphones to be used for live feeds to in-ear, ALS, record purposes, etc.
11. There shall be a RF based assisted listening system for the auditorium. The appropriate number of receivers shall be included in accordance with ADA regulations. Receivers shall have the ability to transmit audio to T-coil hearing aids and conventional ear-phones as well.

12. There shall be a distributed background and paging system. This system will serve lobbies, restrooms, green room, control room, foyers / lobbies, offices, workrooms, and dressing rooms. Additional content for these areas shall be a chime / tone generator to correspond to the amount of time left before curtain goes up. There shall be a paging microphone at the stage managers position and the control room.
13. A 2-channel production intercom system shall provide comfortable, intelligible communication between the various technicians, director, stage manager, and talent. Headset stations are located at the sound & lighting control positions, stage left, catwalk positions (4 ea), and will have press to talk wall-mounted stations in each dressing room. The main station will be located in the Stage Manager's Panel. In addition to these locations of intercom, there shall be intercom drops located in the dimmer rack room, stage, catwalk, and green/lobby area. Refer to drawings for all intercom drops.

B. AUDITORIUM VIDEO/PROJECTION SYSTEM

1. The auditorium shall be equipped to support lectures and productions with high definition imaging of computer and media playback sources. The projector shall be mounted on the upstage wall. There shall be a floor boxes down stage for the presenter to connect. There shall also be a feed in this floor box or stage wall panel to feed a roll-around LCD confidence monitor for the presenter. This will allow the presenter to see what's on the screen without the need to turn around.
2. There shall be a rear projection, electric screen suspended from a batten as shown on the drawings. The aspect ratio of the screen shall be 16:10.
3. Computer presentations to be conducted from both the control booth and the stage. Media playback includes a Blu-Ray, computer, or BluRay / DVD, located in control booth. System is to allow all digital inputs, HDMI, and is HDCP compliant.
4. A dedicated HD PTZ camera located on the face of the balcony will supply video to the IPTV system, (IPTV by others). IPTV will include displays in locations like the dressing rooms, offices, backstage, etc. The camera shall feed the AV system to be used for overflow, recording, or other production needs.
5. There shall be a rack mounted HD LCD monitor in the stage manager rack for previewing content and for seeing the stage from the balcony PTZ camera.

C. AUDITORIUM CONTROL SYSTEM

1. The remote-control system shall provide integration and control of key components using wired touch panels. Programming shall focus on operation of the presentation system ranging from simple podium events to manual operated productions. Menu shall include, but not limited to the following.
    1) Presentation or Production Mode
    2) Lighting pre-set recall
        a. Contractor to provide 6 lighting presets per the owners guidance.
    3) System power cycle screen
        a. All AV
        b. Projector power
    4) A/V switcher screen
        a. Source selection
            i. Stage Laptop
            ii. Booth Sources
            iii. Stage Video
            iv. Stage audio (MP3/CD)

b. Source audio volume in presentation mode
5) PTZ camera control
6) Media player commands
a. Bluray transport commands and menu functions
7) Audio Control Screen
a. Level and mute for House mic A
b. Level and mute for House wireless B
c. Route mic A to house, route mic A to backstage
d. Route wireless B to house, route wireless B to backstage

D. AUDITORIUM LIGHTING

1. The auditorium shall be equipped with a state-of-the-art lighting system to support theatrical productions, projection presentations, and presenter meetings. Refer to lighting drawings for details on placements of lighting instruments.
2. The lighting console and dimming system shall be used to control the theatrical lights and the architectural house lights in and around the auditorium area. The lighting system in the Conference Center shall be a stand-alone system and not tied to the auditorium system. All fixtures shall be supplied complete with safety cable, c-clamp, lamp, lenses, DMX, power cables and extension cables as needed.
3. The (2) dimmer racks shall be a fan cooled, freestanding, deadfront switchboard, it shall include plug in 20 AMP stage, house and work light dimmer modules. The dimmer control electronics shall be contained in one plug-in Control Electronics Module. House lights shall be controllable from walk-through entry stations at specified auditorium entrances and controls in the control booth. There shall be the capability to "lock out" the controls in the public areas once a performance is in progress.
4. Four (4) motorized stage electrics shall be equipped with connector strips, and theatrical lighting instruments for illuminating the stage and sets. Work lights are connected to dedicated work light circuits. Stage work lights by section 16. Electrician will run circuits from the dimmer to stage ceiling area for work lights.
5. There shall be 11 floor box locations on stage for lighting receptacles for portable side lights, groundrows, and practicals. Refer to drawings for exact location.
6. The Contractor is responsible for programming the following production scenes for initial commissioning.
1) Band/Choral (full stage wash)
2) Podium or Presentation Event
3) House lights and presets for remote control system to recall
4) Owner specified #1

E. CURTAINS

1. Stage curtains that travel shall be on motorized battens. 75% fullness, 20oz., synthetic material, color black.
2. Material shall be the Charisma fabric
3. Rear flat muslin cyc on a motorized batten to move when the rear projector is in use.
4. Material to be flame resistant

F. RIGGING SYSTEMS- Consult rigging drawing set. The rigging shall consist of line sets with:

1. Rigging systems contractor to remove all existing stage rigging systems, battens, curtain tracks, curtains for clear stage, grid, and stage house.
2. Motorized Rigging Set Requirements
a. Provide 10 line-shaft winch sets, each set consisting (but not limited to) the following:

i. Capacity -- 1000 LBS.
ii. Speed -- 20 FPM
iii. Truss Batten Travel -- 34 feet
iv. Drum Diameter -- 8 inches
v. Cable Size -- ¼"
vi. Number of Drums -- 4
vii. Type of Limit Switches -- 4 Position

b. General Standards
c. Paint as required under this section shall be the manufacturer's standard finish and Color as noted.
d. All equipment items shall be new and conform with applicable provisions of Underwriters' Laboratories and American Standards Association.
e. Where acceptable equipment items are specified by catalog number only, device shall meet all published manufacturer's specifications. Where quantities are not given, refer to drawings. Where two or more products are listed, contractor may use either, at his discretion. Equipment shall not be substituted without specific written approval by the Architect/Architect's Representative under the substitution paragraphs of these specifications.

3. Materials
   a. All turnbuckles, clips, tracks, chains and other items of incidental hardware shall be furnished plated or painted. Wire rope shall be galvanized. Fasteners, chains and other miscellaneous hardware shall be either cadmium or zinc plated.
   b. All materials used in this project shall be new, unused and of the latest design. Refurbished materials are not permitted.
   c. In order to establish minimum standards of safety, a minimum factor of 8 shall be used for all equipment and hardware used on this project. In addition, the following factors shall be used:
      i. Cables and fittings: 8 Safety Factor
      ii. Cable blending ratio: 30 times diameter
      iii. Max: fleet angle 1 ½ degrees
      iv. Steel: 1/5 of yield
      v. Bearings: Two times required load at full for 2000 hours
4. MOTORIZED LINESHAFT RIGGING REQUIREMENTS:
   a. Furnish and install Motorized Line-shaft winches to raise and lower the stage battens and other stage equipment as specified herein.
   b. Each winch shall operate at a fixed speed.
   c. The batten shall travel from a low trim of 4'-0" above stage floor to approximately 1'-6" below the winch assemble.
   d. Each line-shaft winch shall have drums alternately grooved for right- and left-hand winding to prevent the batten from traveling.
   e. Drums shall be supported on each side with a flange block assembly.
   f. Miscellaneous hardware such as battens, cable, etc. shall follow ANSI standards and specifications.
5. WINCH SYSTEM
   a. The gear reducer shall be a double reduction worm gear or a combination right angle helical worm gear reducer. Reducer shall have a minimum service factor of 1.25.
   b. The AC brake-motor shall be 1750 RPM horsepower as required, three phase, 60 Hz with an integral brake. The brake shall be rated for 200% of the motor torque and be sized to stop and hold the moving load within four inches. Brake shall automatically be applied in case of power failure. Motor shall have a 1.0 service factor.

c. The cable drum diameter shall be a minimum of 32 times the cable diameter. The cable drums shall be of the proper length to hold all of the cable in a single layer. The cables shall be prevented from jumping out of the grooves by two 3/8 cable retainers. The drum shall hold a minimum of the cable required for travel plus three dead wraps. Drums are to be helically grooved for the appropriately sized cable and have key-slots for the easy connection of cables. The drum hub shall be keyed directly to the continuous shaft off the reducer. Chain or belt drives are not acceptable.
d. The winch frame shall be constructed of structural steel members, compactly designed to support the winch components and load in a minimum amount of space. In the frame shall be incorporated a cable keeper bar that is located next to the grooves in each drum to prevent lines from jumping grooves and slack lines from unwinding.
e. Shaft will be a steel drive sized and of material to prevent excess twisting due to load torque. Maximum twist to be 0.25 degrees per linear foot.
f. Shaft coupling to be flange type gear, or solid couplings. Chain couplings are not acceptable.
g. The integral line-shaft frame designed to support and align each drum, shall be made of structural channel, tubing, or wide flange beams. Systems without these integral members shall not be acceptable.
h. An internal brake shall be installed to stop a runaway system at 1 ½ times the rated speed.
i. Each winch shall have an adjustable four element limit switch which stops the winch at the upper and lower extremes of travel. Two of the elements shall be back-up or over travel limits, wired such that the winch cannot be operated until the cause of normal limit failure is determined and repaired.

6. LOW VOLTAGE MOTOR CONTROL PANEL:
   a. Push Button Wall Mounted 24volt Controller.
   b. Push Button Control Station.
   c. Control stations shall be wall mounted NEMA 1 enclosure, containing hold-to-run Up and Down pushbuttons for each hoist. A key operated On/Off switch with green LED indicating "Power On" shall be provided.
   d. Provide main circuit breaker for the panel that must interlock with the panel door. Circuit breaker shall be sized to operate all motors at one time.
   e. A red, mushroom head emergency stop pushbutton shall be provided, which shall disconnect power to the hoist through a circuit meeting NFPA-79 (Electrical Standards for Industrial Machinery) requirement.
   f. Panel components including pushbuttons, key switches, switches, E-stop switches, and the like shall be industrial grade, heavy-duty components with 7/8 inch (22 mm) operators. Indicators shall be 5/16 inch (8 mm) minimum diameter.
   g. Motor drives shall be Eurodrive
7. PIPE BATTENS:
   a. Truss Pipe Battens shall be 1-1/2" in diameter schedule 40 pipe fabricated into "ladder battens" as indicated on the drawings.
   b. All battens shall be painted black to prevent rusting.
   c. Where splicing in required, an internal sleeve 21 inches long and the same diameter as the inside diameter as the pipe shall be used. This sleeve shall be held in place with no less than four (4) 3/8" diameter grade 5 bolts.
   d. Mark the center of each batten with a 1" wide yellow stripe.
   e. Paint the last 1'-0" of each end of each pipe batten yellow.

G. ACOUSTICAL ENHANCEMENT SYSTEM – BASIS OF DESIGN

1. Productions plans include drama, musical theater, dance, piano recitals, choral events, chamber music, jazz ensembles and fashion shows.
2. Given the variety of events in the space, and knowing they would benefit from different acoustic conditions, require the option of an acoustic enhancement system.
3. Yamaha has been designing and installing variable acoustic systems since the late 1980's. Yamaha's 4th generation of dedicated firmware / hardware / software designed specifically for these types of systems.
4. AFC Sub-System Elements
    i. House Early Reflection, or ER, System Elements
    ii. 4 x Cardioid microphones distributed in a line to provide coverage of the front of stage feeding one AFC engine.
    iii. ER mics mounted with capsules having line of sight as far upstage as reasonable.
    iv. ER mic height should be positioned as low as possible. Ideally, mics are within Dc of performers and the travel time to the microphones is as short as possible.
    v. ER system output will be distributed among loudspeakers distributed along the side and rear walls as well as around the proscenium opening.
    vi. The ER System output will also feed subwoofers. These subwoofers add warmth to the system, extending its bandwidth for full range enhancement.
    vii. The ER System can also matrix in signals from the stage mics and REV signals.
    viii. The sidewall ER system loudspeakers will also have movie surround signals merged with AFC signals for dual use of loudspeakers.
5. House Reverberation, or REV, System Elements
    i. 4 x Omnidirectional microphones placed at or beyond Dc from the stage feeding one AFC engine.
    ii. REV system output will be distributed among loudspeakers distributed near the ceiling, at or above the level of the clouds. REV signal may also be blended back to ER and Stage speakers.
6. Stage System Elements
    i. 4 x Cardioid microphones distributed over stage feeding one AFC4 engine.
    ii. Stage System Outputs will be distributed among loudspeakers suspended over the stage to replace the function of an orchestra shell roof.

1.7 SCOPE OF WORK

A. Provide all labor and material for the complete installation of the presentation systems as hereafter specified and shown.

B. PSC shall review the entire project package, including drawings and notes for other trades that may impact the Presentation Systems work, and make provision for such.

C. Equipment shall be new, current production, with original warranty. Demo, refurbished, used or B-stock equipment shall not be acceptable.

D. Quantities are listed for reference only. It is the PSC responsibility to verify quantities of all components.

E. All equipment must be installed in a neat and orderly fashion by competent workmen according to the manufacturer's instructions.

F. All system components shall be completely prewired with all field connections clearly labeled. All equipment shall be UL and or CE listed and shall comply with the National Electrical Code or equivalent authority and all applicable regulations of serving utilities and governmental bodies having jurisdiction.

G. Presentation equipment shall not be stored at the job site. Equipment shall be moved to the job site from a conditioned space only when scheduled for installation.

1.8 CONTRACTOR'S QUALIFICATIONS

A. The PSC shall be a company that regularly engages in the furnishing and installation of systems similar in complexity to those required for this project and meet the following requirements.
   1. The primary business of the PSC shall be the sale and installation of professional performance related sound and video systems.
   2. No less than five years of experience with equipment and systems of the specified types.
   3. Proof of successful completion, with present key staff, of five projects of the type or magnitude of that specified herein.
   4. Regular business under the same name and/or address for a period of five years.
   5. Be a franchised dealer and service facility for the major products furnished.
   6. Have technicians trained in the specific installation and maintenance of the equipment supplied.
   7. Have suitable service facilities and test equipment for providing competent service for all types of professional dimming, sound and A/V equipment.
   8. Maintain shop and office facilities within a 125-mile radius of the project site.
   9. Employ a minimum of 1 full time engineer with InfoComm International Certified Technology Specialist - Design (CTS-D) certification.
   10. Employ a minimum of 1 full time installer with InfoComm International Certified Technology Specialist - Installation (CTS-I) certification.
   11. Employ a minimum of 1 full time programmer that is a Crestron Certified Programmer.
   12. Employ a qualified "sound system and A/V production expert" with sufficient experience in production to providing training and assistance to the Owner during the initial system use period.
   13. Certifications for permanent staff members:
      a. BiAmp Audio senior level programmer
      b. Dante Level 3 Master Certification
      c. InfoComm International Certified Technology Specialist - Design (CTS-D)
      d. InfoComm International Certified Technology Specialist - Installation (CTS-I)
      e. Crestron Master Programmer
      f. Crestron Digital Media Engineer
      g. EASE training
      h. Extron AV Associate certification
      i. Extron Advanced School AV Technologies

B. At the request of the Owner, the PSC shall demonstrate to the satisfaction of the Architect and Consultant that the PSC has:
   1. Adequate facilities and equipment to complete the work.
   2. Adequate staff with commensurate technical experience.
   3. Suitable financial status to meet the obligations of the work.

C. Any other Contractor/Supplier who intends to bid this work as the prime Contractor/Supplier and does not meet the required qualifications shall employ the services of a single "Presentation Systems Contractor" who does meet the requirements noted above and is approved by the Owner. This "Presentation Systems Contractor" shall:
   1. Furnish the equipment.
   2. Shop fabricate the equipment racks and subassemblies.
   3. Make all audio, video and control connections to equipment racks, each piece of equipment, and connection panels.
   4. Continuously supervise the installation and connections of cable and equipment.

5. Program the digital signal processor, video processing systems and control system.

D. A subcontractor so employed as the "Presentation Systems Contractor" must be acceptable to the Architect and the Consultant and shall be identified on the Bid Proposal Form.

1.9 BID SUBMITTALS

A. Along with the bid price, the PSC shall include the following:
   1. Proposed team member names, certifications and biographies for each. Include names and biographies of service and technical support personnel who will be responsible for this project after completion.
   2. Equipment list noting equipment quantities, manufacturer, brief description and specification number.
   3. Statement that the bid is based on specified products.
   4. Address of staffed office within 125 miles of the job site.
   5. Statement that the Contractor has an established toll-free hot-line and will provide 24-hour/7-day-a-week phone support and on-site emergency service as necessary to correct technical failures.
   6. List of five installations completed within the last three years, which are similar in size, type and scope to the work specified in this Section. Include project name, date of installation, name of contact and phone number.
   7. Examples of typical design drawings (elevations, mounting details, millwork details, etc.)
   8. A minimum of five touch panel menu templates from projects completed by the PSC.
   9. Examples of training materials (PowerPoint slides, quick-start guide).
   10. Target project schedule with timeline, skills and labor requirements.
   11. Client reference letters.
   12. Any proposed subcontractors, their qualifications, and scope of work.

1.10 PROJECT SUBMITTALS

A. Upon award of the contract, PSC shall provide:
   1. Preliminary project schedule with timeline, skills and labor requirements.
   2. Name and qualifications of PSC personnel who shall be supervising the installation of the system. This person shall be a full-time employee of the PSC. The PSC shall submit a minimum of three (3) suitable bound sets, or electronic documents, of the following for review by the Architect and the Consultant. Refer to the General and Special Conditions for additional set(s) which may be required. All documents shall be submitted prior to ordering any materials.
   3. A complete list of all equipment and materials which are to be furnished. Accompanying the list shall be manufacturers' specification or cut sheets for all equipment.
   4. Shop drawings generated by the Contractor. The Contractor shall be provided with electronic copies of the floor plans, device layouts and room sections only for use in preparing their shop drawings. The Contractor is responsible for editing these sheets as required by these submittal requirements. The Contractor is required to generate all other sheets as required by these submittal requirements.
      a. Detailed wiring diagrams showing interconnection of components and products, wiring and cabling diagrams depicting cable types and wire numbers, and device designators.
      b. Plan view showing locations of all equipment. Plan(s) shall be properly dimensioned and all equipment labeled.
      c. Wall elevations and room sections showing all installed equipment. Elevations and sections shall be properly dimensioned, and all equipment labeled.
      d. Equipment rack layout details, including power, grounding, ventilation, and conduit/cable entry as applicable.

e. Loudspeaker system suspension schematic including hardware types and load capacity.
f. Complete drawings of custom-fabricated plates or panels. Drawings shall include dimensioned locations of components, component types, engraving information, plate material and color, and bill of material.
g. Power requirements, one-line riser diagrams, and installation circuit diagrams for electrical equipment. Show all required wire sizes and counts between all components.
h. Manufacturer's detailed shop drawings of all dimming, control and distribution equipment, and published literature for all equipment.

1.11 FINAL INSPECTION AND TESTING

A. In addition to supplying and installing the equipment as part of this contract the PSC is to aid the owner's consultant during on site observations, systems commission/performance verification, video system proof and owner training and production assistance.

B. The process of testing the system may necessitate moving and adjusting certain components such as loudspeakers and video projectors. Movement and replacement as required is to be performed at no additional expense to the Owner.

C. In the event further adjustment or Work becomes evident during testing, the Contractor shall continue his work until the system is acceptable at no additional expense to the Owner. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications, the Contractor shall pay for additional time and expenses of the Consultant and Owner at the standard rate in effect at that time.

1.12 WARRANTY

A. All equipment is to be new and warranted free of faulty workmanship and damage.

B. The total system (parts and labor) is to be warranted free of defects for a period of one year from date of final acceptance.

C. The entire system (excluding lamps and fuses) shall be fully factory tested prior to shipment and shall be guaranteed against defects in material and workmanship for one year from date of acceptance by the Owner or (18) eighteen months from the date of shipment, whichever occurs first.

D. No equipment having a shorter warranty shall be considered and equipment purchased shall be covered by this warranty. Unspecified length of warranties shall not be acceptable.

E. Contractor shall provide for replacement of defective materials and repair of faulty workmanship within (48) forty-eight hours of notification by owner guaranteed at no cost to the owner during the warranty period.

F. Contractor shall provide emergency service and support 24 hours a day and 7 days a week. This service is intended as emergency response to failures that require immediate help from a qualified systems technician. The Contractor shall provide this service through an established toll-free line. This emergency service must include a return call from a qualified systems technician within 2 hours. This emergency service must also provide an on-site visit from a qualified systems technician within 12 hours of the initial phone call, should it be deemed necessary by both parties to resolve the service issue. This emergency service and support shall be made available throughout the warranty period at no additional charge to the owner.

G. Paint and exterior finishes, fuses and lamps are excluded from the above warranties except when damage or failure results from defective materials or workmanship covered by warranty.

H. The minimum warranty provisions specified above shall not diminish the terms of individual equipment manufacturer warranties.

1.13 INSTRUCTION OF OWNER PERSONNEL

A. PSC is to provide at least ten hours (2 each five-hour sessions) of training to person(s) selected by the Owner on operation and basic maintenance of all systems and equipment. In addition to training, a representative of the Contractor knowledgeable of the system installation and operation is to be present for the first special events selected by the Owner that all or any part of the sound and video systems is used. The training and event attendance is to take place during the 30-day period after system completion.

PART 2 - PRODUCTS

2.0 GENERAL

A. It is the intention of these specifications to provide a complete and properly operating system. The major items of equipment shall be furnished in the quantity indicated by the project drawings or in the quantity specified herein. In the event of a quantity discrepancy between the drawings and specifications for an item, the PSC shall provide the greater. PSC is responsible for providing all accessories and miscellaneous equipment required to form a complete and operational system, including, but not limited to, power supplies, cabling, mounts, attachment hardware and software licenses.

B. Provide only new products, and include the manufacturer's original factory warranty, product documentation and the latest version of any software required for configuration and/or operation.

C. Where the specifications list several manufacturers for a particular major item of equipment, such as power amplifiers, the PSC shall supply all of that item of equipment from one manufacturer.

D. Equivalent products can be proposed with appropriate documentation to show equivalent specifications. Items listed below in Schedule 1 are the models used in the Basis of Design.

Minimum Specifications for Equipment – Quantity per equipment list or drawings.

2.1 DIGITAL MIXER STAGE BOXES – BASIS OF DESIGN

A. The stage box shall be a 1RU rack mountable device
B. The stage box shall connect to mixer by way of a Primary and Secondary DANTE connections
C. The stage box shall have (8) mono analog inputs
D. Acceptable manufacturers
    1. Per Pending Addendum

2.2 DIGITAL AUDIO MIXER– BASIS OF DESIGN

A. The mixer shall be capable of mixing 64 mono and 8 stereo channels
B. The mixer shall have the capability to be controlled from an iPad with the proper application loaded.
C. The mixer shall have (8) local mono inputs and (8) outputs
D. The mixer shall have (3) slots for optional modules
E. The mixer shall have as standard connections, I/O a Primary and Secondary DANTE, Ethernet, Word Clock, and AES/EBU output
F. Acceptable manufacturers
    1. Per Pending Addendum

2.3 NETWORK SWITCHES - DANTE– BASIS OF DESIGN

A. The switch shall have 16 ports minimum
B. The switch shall be an unmanaged switch

C. The switch shall be at least 1Gb speed
D. There shall be 8 ports of PoE
E. Acceptable manufacturer/model, or better than:
    1. CISCO
    2. NetGear

2.4 NETWORK SWITCHES - DANTE– BASIS OF DESIGN
A. The switch shall have 16 ports minimum
B. The switch shall be an unmanaged switch
C. The switch shall be at least 1Gb speed
D. There shall be 8 ports of PoE
E. Acceptable manufacturer/model, or better than:
    1. CISCO
    2. NetGear
    3. Yamaha

2.5 AUDIO SPEAKERS – MAIN FOH PERFORMANCE FULL RANGE (Qty per equipment list)
A. Speakers to perform and mount in a line array coverage pattern
B. Main loudspeakers are to be passive type
C. Speakers shall be flown along with subwoofers
D. Freq response of 59hz – 20khz minimum
E. Acceptable manufacturer
    1. NEXO– BASIS OF DESIGN
    2. JBL
    3. L Acoustics

2.6 AUDIO SPEAKERS – MAIN FOH SUBWOOFERS (Qty per equipment list)
A. Subwoofers to be flown next to full range speakers behind first reflector
B. Subwoofer cabinets to be a single 18” driver
C. Cabinet shall have necessary hardware necessary for flying speaker
D. Freq response of 35hz – 120hz
E. Acceptable Manufacturer
    1. NEXO– BASIS OF DESIGN
    2. JBL
    3. L Acoustics

2.7 AUDIO SPEAKERS – STAGE WEDGE MONITORS (Qty per equipment list)
A. Speakers to be passive 2-way type
B. Freq response 55hz-18khz or better
C. The speaker shall have a 12” low freq. driver
D. The speaker shall be rated at 550W continuous
E. Provide NL4 to NL4 cables, per equipment list
F. Acceptable manufacturers
    1. Yamaha– BASIS OF DESIGN
    2. JBL
    3. L Acoustics

2.8 AUDIO SPEAKERS – SURFACE MOUNT
A. Mount with manufacture’s bracket at locations on drawings
B. Speakers to be 70V with easy access to wattage tap selector switch
C. Speakers to have nominal pattern coverage of 110°
D. Speaker shall have continuous program power rating of 75W

E. Acceptable manufacturers
   1. Community
   2. Yamaha– BASIS OF DESIGN
   3. JBL

2.9 AUDIO POWER AMPLIFIER – HOUSE
   A. Amplifiers shall have either a barrier strip or XLR connector for their balanced input connections.
   B. Amplifier to have 4 independent channels or bridgeable 2x2
   C. Output wattage to be 900W per channel into 4Ω
   D. Shall have no greater than 1% THD at 1Khz at maximum power
   E. Provide adequate electrical service for max output
   F. Acceptable manufacturers
      1. Per main loudspeaker system requirements

2.10 AUDIO POWER AMPLIFIER – MONITORS
   A. Amplifier to have 4 separate channels, with built-in DSP
   B. Amplifiers shall have a 3-pin phoenix strip for each of the (4) balanced input connections.
   C. Amplifier to have phoenix strip connections for outputs
   D. Output peak wattage to be 1400W per channel into 4Ω
   E. Provide adequate electrical service for max output
   F. Acceptable manufacturers
      1. Yamaha
      2. QSC
      3. Crown

2.11 AUDIO AMPLIFIER – PAGING / BACKGROUND
   A. Amplifier shall have balanced inputs on barrier strip.
   B. Amplifier to have 8 independent 70V output channels
   C. Output wattage of each channel to be 500W minimum.
   D. Acceptable manufacturer
      1. Yamaha– BASIS OF DESIGN
      2. QSC
      3. Crown

2.12 AUDIO DIGITAL SIGNAL PROCESSOR (DSP)
   A. DSP's shall meet the following minimum criteria
      1. Ability to be networked to allow for expansion and control
      2. Shall be able to configure with the necessary input and output quantity as required per drawings.
      3. Supports standard DSP functions such as but not limited to, auto-mixing, parametric EQ, compressing, Hi-Lo band pass, muting, routing, etc.
   B. Acceptable manufacturer
      1. Yamaha MX– BASIS OF DESIGN
      2. BiAmp TesiraServer
      3. BSS London
      4. QSC Core

2.13 AUDIO MICROPHONES – WIRELESS PERFORMANCE
   A. The wireless microphones shall have the added capability of 64Mhz bandwidth of digital tuning
   B. There shall be 24-bit digital audio

C. Over 120db of dynamic range
D. Shall be easy pairing with IR scan and sync
E. Provide the necessary antenna / power distribution for all receivers
F. (Qty T.B.D.) systems; price each system with allowance for a head worn microphone for theater.
G. Acceptable manufacturer
   1. Shure
   2. Sennheiser
   3. AKG

2.14 AUDIO MICROPHONES – WIRED PERFORMANCE (Qty per equipment list)

A. Provide handheld wired vocal microphones such as Shure SM58 or SM87
B. Provide instrument microphones such as Shure SM57 or SM81
C. Provide drum microphone kit such as a Shure DMK57-52
D. Provide piano mic such as a BETA 91A or SM81
E. Provide Choir microphones such as Audix Microboom 8450
F. Acceptable manufacturers
   1. Shure
   2. Audix
   3. AKG

2.15 AUDIO MEDIA PLAYBACK

A. The audio player shall have a CD player
B. The player shall have a Bluetooth receiver to allow playback through the system from user's phones, iPad, etc.
C. The player shall have an 1/8" Aux input jack
D. Audio player shall have stereo unbalanced analog outputs
E. The player shall be remote control via Infrared control
F. Acceptable manufacturers
   1. Tascam
   2. Denon
   3. Yamaha

2.16 PRODUCTION INTERCOM

A. The production intercom system shall be the analog party line solution
B. The system master station shall be a 2-channel system
C. The master station shall be able to power up to 55 single channel beltpacks or 10 speaker stations or 12 headset stations distributed over both channels
D. The master station shall accept a line level program input
E. See associated schematic drawing to identify the type of user stations and locations
F. Provide lightweight single muff headsets with all beltpacks.
G. Acceptable manufacturer
   1. Clearcom– BASIS OF DESIGN

2.17 ASSISTIVE LISTENING SYSTEM

A. ALS transmitter to be an RF based system
B. The number of channels to be 17 wide band, 40 narrow band
C. Provide appropriate number of receivers in accordance to ADA specification.
D. The receivers shall be equipped to use the loop/lanyard for t-coil hearing aid users or the standard 3.5mm standard earphone output.
E. Acceptable manufacturer
   1. Listen Technologies– BASIS OF DESIGN

2. Williams

2.18 VIDEO PROJECTOR – MAIN PRESENTATION

A. The main presentation projector shall meet or exceed the following specifications.
   1. Native resolution: WUXGA, 1920x1200 (x3) LCD TFT Active Matrix
   2. Solid-state laser-diode light source
   3. Brightness: 12000 Lumens
   4. Contrast Ratio: 2,500,000:1
   5. Horiz and Vert Keystone correction

B. Acceptable manufacturers
   1. Epson– BASIS OF DESIGN
   2. Christie
   3. Digital Projection

2.19 PROJECTION SCREEN - AUDITORIUM

A. The screens shall meet the following specifications.
   1. The aspect ratio is to be 16:10
   2. Electric screen with 24" black drop and LV control interface
   3. The image size shall be 178"H x 285"W
   4. Screen material to be Dual Vision for rear screen Rear projector mounted on upstage wall

B. Acceptable manufacturers
   1. Dalite– BASIS OF DESIGN
   2. Draper

2.20 AUDITORIUM VIDEO PRESENTATION SWITCHER

A. Video switching and routing must be able to transmit and receive a 4K signal up to 300'
B. This signal must pass control protocol and audio. Audio to be able to be broken away separately from video path
C. The switcher to be modular and configurable depending on the size and types of formats
D. Switcher communications to support ethernet, USB, DigitalMedia, HDBaseT, HDMi
E. Acceptable manufacturer
   1. Crestron– BASIS OF DESIGN
   2. AMX
   3. Extron

2.21 CAMERA – PTZ USB

A. The camera shall have a remote controllable 12X zoom lens
B. The camera shall have a 73° field of view
C. The output resolution shall be 1080p
D. The camera shall have simultaneous uncompressed USB 3.0, HDMi, and IP (H.264) streaming.
E. Remote management by IR, Web interface, Telnet, and RS232
F. Power to be with 12VDC power supply or PoE+
G. Acceptable manufacturer / model
   1. Vaddio RoboSHOT System– BASIS OF DESIGN

2.22 BLU-RAY PLAYER

A. Shall play back Blu-ray, DVD, and CD media
B. Playback WAV, MP3, WMA, and other audio formats
C. RS-232C serial control
D. Infrared remote control included
E. Acceptable manufacturer

1. Tascam
2. Dennon
3. Sony

2.23 RIGGING

A. Refer to drawings for line set mounting locations.
B. (4) 2000lb. fixed speed hoists (electrics)
C. (6) 800lb. fixed speed hoists (mid, upstage, cyc, etc)
    1. Acceptable manufactures
        a. SRS– BASIS OF DESIGN
        b. ETC
        c. J R Clancy
D. Controller for hoists / rigging
    1. Acceptable
        a. Per Manufacture

2.24 CONTROL SYSTEM – PROCESSORS

A. The control processor shall include the necessary power supply
B. The processor shall have a Ethernet LAN connection as well as an Ethernet Control Subnet connection
C. The control processor shall have these available I/O options
    1. (8) Relay contact closures
    2. (8) Digital I/O connections
    3. (8) IR / Serial outputs
    4. (1) RS-232/422 bi-directional output
    5. (2) RS-232 Bi-directional
    6. (1) USB connection
    7. (1) Cresnet connection
D. Acceptable manufacturer
    1. Crestron– BASIS OF DESIGN

2.25 WIRED TOUCH PANELS

A. Refer to drawings to verify the location, size, and type of touch panel.
B. Display type shall be a TFT active matrix color LCD, 5-point multi-touch
C. Provide necessary mounting hardware/box for wall mounted touch panels.
D. Provide a PoE connection for power for wall mounted touch panels
E. Acceptable manufacturer
    1. Crestron– BASIS OF DESIGN

2.26 PERFORMANCE LIGHTING CONSOLE

A. The lighting console shall have internal solid-state memory
B. It shall have a 15.6” primary touch screen and a 7” secondary touch screen for control
C. 40 precision playback faders in 3 pageable groups
D. 20 programmable macro executor buttons
E. Includes 4-port managed Gigabit network switch
F. Acceptable manufacture
    1. ETC High End Systems

2.27 LIGHTING WALL BUTTON PANELS

A. Provide 1-gang 5-button panels at designated locations in the auditorium for lighting control
B. Provide 1-gang 10 button panels at designated locations in the auditorium for lighting control

C. Acceptable manufacturer
   1. ETC Heritage– BASIS OF DESIGN

2.28 LIGHTING PORTABLE TOUCH SCREEN CONTROL
A. Provide a 7" Link Connected portable touch-screen station with 15' cable
B. Acceptable manufacturer
   1. ETC Paradigm– BASIS OF DESIGN

2.29 LIGHTING DIMMER RACK
A. Dimming racks to control auditorium house and theatrical lights.
B. There shall be a dimmer rack for the theatrical lighting and one for the architectural lighting
C. Include necessary control modules and system for both racks
D. Dimmer racks to be populated with an assortment of dual 20A dimming modules and dual 20A relay modules.
E. Emergency transfer switches to be provided.
F. Acceptable manufacturer
   1. ETC– BASIS OF DESIGN

2.30 PERFORMANCE LIGHTING – LED PAR FIXTURES
A. The performance lighting par fixtures shall use LED technology
B. Light Source: 14 LEDs (quad color RGBW) 15W
C. The fixtures shall have 50,000 Hr. life expectancy
D. Illuminance: 14° 7180 lux @ 5m; 44° 737 lux @ 5m
E. Quantity: T.B.D.
F. Acceptable manufacturer
   1. Chauvet
   2. ETC

2.31 PERFORMANCE LIGHTING – LED ELLIPSOIDAL FIXTURES
A. The performance lighting ellipsoidal fixtures shall use LED technology
B. Light Source: 91 LEDs (18 Red, 18 green, 19 blue, 18amber, 18 lime green) 3W
C. The fixtures shall have 50,000 Hr. life expectancy
D. Illuminance: 14° lens 3744 lux @ 5m; 50° 513 lux @ 5m
E. Supply assortment of 19°, 26°, and 36° lens tubes as needed
F. Quantity: T.B.D.
G. Acceptable manufacturer
   1. Chauvet
   2. ETC

2.32 PERFORMANCE LIGHTING – CYC FIXTURES
A. The performance lighting cyc fixtures shall use LED technology
B. The fixture shall have 24 LED engines
C. Variable effects engine; strobe, strobe on top, strobe random
D. Hot lumen output (combined) 18,600
E. The fixtures shall have 50,000 Hr. life expectancy
F. Beam angle approximately 22°
G. Quantity: T.B.D.
H. Acceptable manufacturer
   1. Chroma-Q

2.33 PERFORMANCE LIGHTING – SPOTLIGHTS
A. The spotlight shall have a throw of 30'-150'

B. The beam angle shall be from 8° to 22°
C. Input voltages – 100V, 120V, 230V, and 250V
D. Include framing shutter option
E. Quantity: 2
F. Acceptable Manufacturer
    1. Canto USA

2.34 LIGHTING FLOOR BOXES

A. Acceptable manufacturer
    1. ETC
    2. SSRC

2.35 STAGE CURTAINS

A. Shall be classified as Class A compliant for areas of assembly
B. Stage Curtains consist of:
    1. Front Grand Drape (2) Size T.B.D.
    2. Grand Valance (1) Size T.B.D.
    3. Pleated Legs (8) Size T.B.D. on stage wings
    4. Mid Stage traveler (2) Size T.B.D.
    5. Cyclorama (1) Size T.B.D.
    6. Borders – To be split so they overlap in the middle (4) Size T.B.D.
C. Curtain fabric to be 20oz. Charisma fabric
D. Curtains shall be 75% fullness
E. 5" Bottom hems with lead weight tape encased in separate muslin for added durability
F. (3) 70' manual curtain tracks.
G. Acceptable manufacturers
    1. Charisma (Fabric)
    2. Greenville Stage (Curtains)

2.36 AV FLOOR BOXES –UPSTAGE

A. Provide large floor boxes as indicated on drawings.
B. Acceptable manufacture
    1. Ace Backstage
    2. FSR

2.37 AV FLOOR BOXES – DOWN STAGE CENTER

A. Provide floor boxes as indicated on drawings.
B. Acceptable manufacture
    1. Ace Backstage
    2. FSR

2.38 MISC SUPPORT EQUIPMENT

A. Equipment Racks
    1. Refer to drawings for location and size of equipment racks.
    2. Provide rack panel blanks and vents to best fill in unused rack spaces.
    3. Freestanding and Wall racks shall provide standard 19"W space to mount equipment.
    4. The number of rack units shall be enough to house all equipment based on the system design. Population of rack to be 75%-80% with the remainder open for future growth.
    5. Where rear access is not possible to rack, provide a sliding and swiveling rack instead.
        a. Acceptable Manufacturer

1) Middle Atlantic
2) Gator

2.39 ORCHESTRA SHELL (REVISE PER PENDING ADDENDUM)

1. Portable Orchestra Shell Towers:
   iii. * Wenger Drawing #xxxxxx
   iv. * Standard Wenger Construction
   v. * Price includes 2022 delivery and installation.
2. Forte Towers w/Painted Finish:
3. Consists of:
   vi. (2) Diva Tower 2 Doors, 10' Radius,
   vii. 8' Wide, 14' Tall
   viii. (1) Diva Tower 1 Right Door, 10' Radius,
   ix. 8' Wide, 14' Tall
   x. (1) Diva Tower 1 Left Door, 10' Radius,
   xi. 8' Wide, 14' Tall
   xii. (4) Diva Tower No Door, 10' Radius,
   xiii. 8' Wide,14' Tall
   xiv. Face Finish - Sherwin Williams Kem Aqua
   xv. Paint (Class 'A')

2.40 SCHEDULE OF BASIS OF DESIGN EQUIPMENT

This is a list of the major items used in the design. The integrator is responsible for all ancillary and accessory items needed to integrate a fully operational system as intended.

EQUIPMENT SCHEDULE – NOT SHOW. PER PENDING ADDENDUM.

PART 3 – EXECUTION

3.1 ACCURACY OF DATA

A. It shall be the sole responsibility of the Contractor to verify all dimensions, take his own field measurements, and install all work to suit conditions encountered on the job site.

B. The drawings are generally diagrammatic and except where dimensions are indicated are not intended to show exact locations of outlets, conduits, etc. All work shall be installed as nearly as possible in the locations indicated, with minor adjustments as required to avoid interferences with structure or the work of other trades.

C. Prior to beginning work, the Contractor shall carefully examine all construction drawings and the job site and report to the Owner any discrepancies or interference that may be discovered. If, during the course of construction, any such discrepancies or interferences are noted, the Contractor shall promptly report them to the Owner. Failure to report such discrepancies or interferences shall result in the correction of the same at the Contractor's expense. All work under this specification, which either interferes with the architectural or any other work or deviates from the drawings and specifications without prior approval of the Owner, shall be altered by the Contractor at his expense. These alterations shall clear such interferences or shall comply with the drawings and specifications as directed by the Owner.

3.2 MECHANICAL

A. Except for portable equipment, all other equipment must be permanently installed. This shall include equipment racks, speakers, cables, etc. Fastenings and supports must provide a safety factor of at least three times that required for safe support. Precautions must be taken to

prevent electrostatic and electromagnetic hum and radio frequency interference. All electronic equipment must be easily accessible and have adequate ventilation.

B. The rigging of loudspeaker arrays and speakers shall be performed by a rigging professional and hung and supported by approved industry standard equipment.

3.3 CONNECTIONS

A. All low voltage wiring connections must be made with rosin core solder or mechanical connectors as specified. Terminations on all cable must be dressed properly with shrink tubing. All low voltage control level connections to terminal blocks are to be made with crimp on spade lugs. All crimp on connectors must be fastened with the proper tool as specified by the manufacturer. Improper crimping will be cause for rejection. All "drain" wires on microphone and line level terminations are to be properly dressed using transparent shrink tubing to avoid the possibility of shorting "whiskers".

3.4 LABELS

A. All wiring is to be numbered on both ends with "EZ Code" type markers. Wire numbers are to be secured with transparent shrink tubing. Wire numbers are to follow a logical sequence and are to be listed on the proper document. "Brady" type labels are acceptable.

3.5 DOCUMENTATION

A. Upon final completion of the system a documentation package is to be turned over to the Owner and include the following items:

1. System signal flow diagrams (for audio, video, and control) showing all components, interconnections, and connector types and wire numbers. As-built revisions are to be noted on the submittal drawings.
2. Manufacturer instruction manuals for all electronics.
3. Product specification sheets for all equipment without instruction manuals such as microphones, loudspeakers and lighting instruments.
4. Copies of the proof of performance data. Provide one original (no photocopies) and one copy (photocopies are acceptable) of the total documentation package.
5. A single copy of the system signal flow diagram with wire numbers indicated is to be laminated and posted in the door of the sound equipment rack.
6. Special documentation is required as part of the Owner training and operation of the systems. This documentation is to consist of an instruction sheets that describe the operation of the system from the stage. Each instruction sheet is to be step by step "cookbook" with touchscreen panel screen shots with arrow indicators that describe step and function. A laminated poster version of this instruction sheet is to be mounted on the side of each equipment rack. The bullet points detailed on this sheet include:
   a. Turning on system power.
   b. Select desired source.
   c. Adjust volume levels
   d. Select lighting presets (where applicable)
   e. Recording stop/start functions (where applicable)
   f. VTC calling functions (where applicable)
   g. Other functions of the Owner control panel.

3.6 CLEAN UP

A. During construction periodically remove discarded containers and refuse from the job site. At the completion of the job the sound system components and equipment areas are to be left clean and neat and all refuse removed from the site.

3.7 SOUND SYSTEM TEST AND MEASUREMENT

A. The contractor is to conduct a performance verification test for the Owner. The contractor must complete the installation and verify that it is in working order and conforms to the following performance criteria. These performance standards are set forth as an indication of a properly installed and functioning sound system. It is implied through his action of submitting a bid that the contractor has reviewed these documents and is in agreement with the concept and execution of the design of the specified sound system. No financial adjustments will be allowed for discrepancies discovered after bid is accepted.

1. In rooms where voice lift or voice reinforcement is required, there is a programmable DSP in the system. The contractor is expected to tune the system to eliminate any hot frequencies in the room that would cause premature feedback as well as blemish the sound quality of the microphones.
2. Microphone line resistance: Less than 1.7 Ohms with short at input jack. Measured from mixer end of microphone cable. Measure with Ohm meter.
3. Maximum amp output: 100% of rated power at less than 0.25% THD. Measure with distortion analyzer.
4. Signal to noise ratio: Better than 80 dB or an absolute noise level less than 62 dBm for systems with +18 dBm maximum line operating level. Measured at amplifier input with RMS voltmeter with dB scale.
5. Audio frequency response: +/- 1 dB 50 Hz to 15 kHz control equalizer set flat and room equalizers switched out – Microphone input to amplifier output. Measure with RTA.
6. Polarity: All microphones and source equipment are to be wired so as to be in absolute polarity with the loudspeaker systems. Measure with polarity checker.
7. Synchronize delay and fill systems to within 15 milliseconds of first arrival of primary loudspeaker system as measured on Smaart or TEF measurement systems.
8. Acoustic coverage: Maximum +/- 3 dB SPL variance front to rear / side-to-side in audience area through the 4 kHz full octave band. Measure with octave band Sound Level Meter.
9. Acoustic amplitude response: With the room equalizers switched in +/- 3 dB maximum deviation from the following curve averaged from three test positions in the audience area flat 60 Hz to 2 kHz, 10 dB at 50 Hz and 12 kHz. Measure with RTA.
10. Electroacoustic gain: No less than 15 dB from 500 Hz to 4 kHz with one microphone and 12-inch source to microphone distance. Gain is to be measured 50 feet from the source. Measure with Sound Level Meter.
11. Maximum sound level: Greater than 85 dB-C for large conference spaces when amplifier occasionally clips on program peaks. Measure with Sound Level Meter.
12. Acoustic noise floor: No audible hum, hiss, or R.F. interference shall be audible under normal room conditions in audience seating area and stage or platform areas.
13. All loudspeakers are to exhibit the same acoustic polarity. Measure with Polarity Checker (Galaxy Cricket).

3.8 VIDEO SYSTEM PROOF OF PERFORMANCE

A. Verify all devices and cables match information on final drawings

B. Test all inputs on video switcher / scaler.

C. Adjust Color Temperatures on projectors to accurately reproduce NTSC and RGBHV Data Color Bars.

D. Adjust projector images to match screen size, eliminating any overscan, underscan or keystone.

E. Adjust all switching functions to eliminate sync roll or glitches upon switching.

F. Test all video sources for full operation. Test all data sources up to maximum projector frequency.

G. Test audio output of switcher scaler. Verify that all input audio levels are equal. Verify maximum audio output not to exceed +4dB.

H. Verify there are no 60hz grounding interference aka "humbars" existing in displayed images.

I. Optimize projector contrast, sharpness and brightness to avoid blooming and achieve optimal black level.

J. Commissioning of Digital Media System by certified Digital Media Engineer.

3.9 LIGHTING SYSTEM COMMISSIOINING

A. Commissioning by ETC Certified Specialist

END OF SECTION 274116

SECTION 274116 – INTEGRATED AUDIO-VIDEO COMMUNICATIONS & THEATER EQUIPMENT

PART 1 - GENERAL

1.1.1 GENERAL

A. This specification outlines Presentation Systems Contractor (PSC) requirements to furnish and install presentation systems and all low voltage wiring required for completely operational auditorium production systems in the Savannah Arts Academy Addition and Renovation project. All necessary equipment for sound, theater lighting, rigging, curtains, video, and control systems shall be required and provided by the PSC for a completely operational theater production and presentation system. A separate bid for all work required in conjunction with the stated A/V package for a complete and functioning electrical package.

B. The systems shall not be considered complete until the completion of as-built documentation, final system commissioning, and facility personnel training. This facet of the services to be provided by the PSC is deemed very important to the satisfactory completion of the contract. To that end a final payment reserve of 10% of the system purchase price shall be held from payment until the documentation package and training described in Part III are delivered.

1.1.2 RELATED SECTIONS

A. Architectural
B. Electrical
C. Fire Protection
D. Mechanical

1.1.3 INTENT AND INTERPRETATIONS

A. It is the intent of the Construction Documents that the PSC shall include all items necessary for the proper execution and completion of the project, resulting in complete and fully operational system(s) ready for the Owner’s use, in full compliance with all applicable standards, codes and ordinances.
   1. Work or product not specifically indicated in the Construction Documents, but which are necessary to result in complete and fully operational system(s) ready for the Owner’s use, shall be provided by the PSC.
   2. The specification of certain products in the Construction Documents shall not be construed as a release from furnishing such additional products and materials necessary to furnish complete and fully operational system(s) ready for the Owner’s use.

B. In the event that discrepancies exist or required items or details have been omitted in the Construction Documents, the PSC shall notify the Owner/Consultant in writing ten (10) days prior to the bid date. Failure to do so shall be construed as willingness to provide a complete and fully operational system within the amount bid by the PSC. Where such discrepancies are not brought to the attention of the Owner/Consultant, the most stringent (costly) requirements shall be construed to be the basis for the PSC's bid.

C. Drawings and Specifications are complementary. Items required by either are binding as though they are required by both. In the event of conflict between the requirements of the Drawings and the Specifications:
   1. With regards to the preparation of proposals and/or bids, the PSC shall assume the more stringent (costly) condition shall prevail. The PSC shall notify the Owner/Consultant of such a minimum ten (10) days prior to the bid date.
   2. With regards to actual construction, the PSC shall notify the Owner/Consultant and await the Owner’s/Consultant’s instruction prior to proceeding with procurement and installation.

D. Drawings:

1. Drawings are diagrammatic and approximate in character, are not intended to show all features of required work, and do not necessarily indicate every required component.
2. Symbols used on the Drawings are defined in the legend on the Drawings. Symbols indicated on the legend may not necessarily be required.

1.1.4 DEFINITIONS

A. The term “Contractor”, “Supplier”, or “Presentation Systems Contractor (PSC)” as used herein refers to the party responsible for supplying all services and equipment covered herein and on related drawings.
B. The term “Owner” shall refer to Savannah Chatham Public School System.
C. The term “Consultant” shall refer to the consultant who is responsible for the design of the audio, video, and control systems.
D. The term “Electrical Contractor” shall refer to the Division 26 contractor.
E. The term “provide” will mean to supply, install, verify performance and coordinate interconnection and power.
F. Specialized terms particular to technical systems and related work shall be used in the following manner, in accordance with:
   1. Captions on related drawings.
   2. Generally recognized audio engineering and production usage.
   3. Relevant usage and definitions of handbooks, guidebooks or trade group recommendations by manufacturers' associations or professional and engineering societies such as SMPTE, ICIA, UL, and NEMA.

1.1.5 RELATED DOCUMENTS

A. The PSC shall read, review and understand all documents listed below prior to bidding or proceeding with work. The PSC shall also refer to and understand all other related documents indicated herein. Failure to familiarize itself with the construction documents will not relieve the PSC of its responsibility to complete the work in accordance with the construction documents.
B. Division 1: Applicable provisions of Division 1 shall govern all work under this section.
C. Contract: In addition to the conditions and work described herein, all conditions of the Contract shall apply.
D. Presentation System Drawings
   1. EPS-L LEGEND
   2. EPS-1.1 FIRST FLOOR AV PLAN
   3. EPS-1.2 FIRST FLOOR ACOUSTIC SYSTEM PLAN **REVISE ADDENDUM 1**
   4. EPS-1.3 FIRST FLOOR LIGHTING PLAN
   5. EPS-1.4 SECOND FLOOR LIGHTING PLAN
   6. EPS-1.5 THIRD FLOOR AV PLAN
   7. EPS-1.6 THIRD FLOOR ACOUSTIC SYSTEM PLAN
   8. EPS-2.1 FIRST FLOOR RCP
   9. EPS-2.2 FIRST FLOOR ACOUSTIC SYSTEM RCP
   10. EPS-2.3 THIRD FLOOR RCP
   11. EPS-2.4 LIGHTING RCP
   12. EPS-2.5 CURTAIN LAYOUT **REVISE ADDENDUM 1**
   13. EPS-3.1 AUDITORIUM SECTION **REVISE ADDENDUM 1**
   14. EPS-3.2 MOTORIZED HOIST RCP
   15. EPS-4.1 PRODUCTION PANEL DETAILS
   16. EPS-4.2 FACE PLATE DETAILS
   17. EPS-4.3 LOUDSPEAKER DETAILS
   18. EPS-4.4 EQUIPMENT RACK DETAILS
   19. EPS-4.5 HOIST DETAILS

ADDENDUM NO. 1

20. EPS-4.6 LIGHTING DETAILS
21. EPS 4.7 VIDEO SYSTEM DETAILS
22. PS-1.1 AUDITORIUM AUDIO FLOW DIAGRAM **ADDED ADDENDUM 1**
23. PS-1.2 AUDITORIUM AUDIO FLOW DIAGRAM **ADDED ADDENDUM 1**
24. PS-1.3 AUDITORIUM AUDIO FLOW DIAGRAM **ADDED ADDENDUM 1**
25. PS-1.4 AUDITORIUM AUDIO FLOW DIAGRAM **ADDED ADDENDUM 1**
26. PS-1.5 AUDITORIUM VIDEO FLOW DIAGRAM **ADDED ADDENDUM 1**
27. PS-1.6 AUDITORIUM CONTROL FLOW DIAGRAM **ADDED ADDENDUM 1**
28. PS-1.7 AUDITORIUM LIGHTING CONTROL FLOW DIAGRAM **ADDED ADDENDUM 1**
29. PS-1.7 AUDITORIUM POWER CONTROL FLOW DIAGRAM **ADDED ADDENDUM 1**

1.6 DESCRIPTION OF SYSTEMS

A. AUDITORIUM SOUND SYSTEM

1. The auditorium shall be equipped to support presentations and productions of all sizes with high quality amplification of speech, program material content playback, and presentation audio for video playback. There will be 2 primary operational modes of the sound system.
2. The first mode will be the *Production Mode.* In this mode, primarily for theatrical productions or band / concert performances, the operator will have constant hands-on manual control of the mix and levels.
3. The second mode will be the *Presentation Mode*. In this mode, the audio levels from the laptop or other content and the presenter's microphone level will be controlled from the control system's touch panel. This system operates independently from the production equipment.
4. In the event there is a fire alarm instance, the sound system shall mute. Coordination with the fire alarm subcontractor is key to obtain a contact closure or other signal to engage the audio system accordingly.
5. The main mixing console shall have a minimum of 64 channel mixing capability. Inputs on stage shall be plugged into the mixers stage racks that are located in the equipment racks on each side of the stage. There shall be 2 locations from which to mix from, one in the control room and the other at the FOH position in the back of house. MADI connections from stage rack(s) shall be available at both locations.
6. The auditorium main loudspeaker system shall consist of a left/right configuration with subwoofers. Programmed settings such as equalization, limiting, and delay in the DSP, shall be done in a way as to keep the final room tuning settings away from normal operation and operators and shall be password protected.
7. There shall be audio inputs and outputs available on stage left, stage right, upstage and down stage floor boxes. There will be 2 wall boxes in the orchestra pit containing I/O as detailed on the drawings.
8. There shall be 4 discreet monitor mix feeds for floor wedges, side fills, or passive hotspots. Distribute the 4 monitor mix outputs to I/O plates around the stage according to flow drawings.
9. There shall be (connectivity) for wired personal in-ear mixing. In-ear to be added later by adding an optional card to the console to feed the in-ear mixers.
10. There shall be (2) audience ambient microphones to be used for live feeds to in-ear, ALS, record purposes, etc.
11. There shall be a RF based assisted listening system for the auditorium. The appropriate number of receivers shall be included in accordance with ADA regulations. Receivers shall have the ability to transmit audio to T-coil hearing aids and conventional ear-phones as well.
12. There shall be a distributed background and paging system. This system will serve lobbies, restrooms, green room, control room, foyers / lobbies, offices, workrooms, and dressing rooms. Additional content for these areas shall be a chime / tone generator to correspond to the amount of time left before curtain goes up. There shall be a paging microphone at the stage managers position and the control room.

ADDENDUM NO. 1

13. A 2-channel production intercom system shall provide comfortable, intelligible communication between the various technicians, director, stage manager, and talent. Headset stations are located at the sound & lighting control positions, stage left, catwalk positions (4 ea), and will have press to talk wall-mounted stations in each dressing room. The main station will be located in the Stage Manager's Panel. In addition to these locations of intercom, there shall be intercom drops located in the dimmer rack room, stage, catwalk, and green/lobby area. Refer to drawings for all intercom drops.

B. AUDITORIUM VIDEO/PROJECTION SYSTEM

1. The auditorium shall be equipped to support lectures and productions with high definition imaging of computer and media playback sources. The projector shall be mounted on the upstage wall. There shall be a floor boxes down stage for the presenter to connect. There shall also be a feed in this floor box or stage wall panel to feed a roll-around LCD confidence monitor for the presenter. This will allow the presenter to see what's on the screen without the need to turn around.
2. There shall be a rear projection, electric screen suspended from a batten as shown on the drawings. The aspect ratio of the screen shall be 16:10.
3. Computer presentations to be conducted from both the control booth and the stage. Media playback includes a Blu-Ray, computer, or BluRay / DVD, located in control booth. System is to allow all digital inputs, HDMI, and is HDCP compliant.
4. A dedicated HD PTZ camera located on the face of the balcony will supply video to the IPTV system, (IPTV by others). IPTV will include displays in locations like the dressing rooms, offices, backstage, etc. The camera shall feed the AV system to be used for overflow, recording, or other production needs.
5. There shall be a rack mounted HD LCD monitor in the stage manager rack for previewing content and for seeing the stage from the balcony PTZ camera.

C. AUDITORIUM CONTROL SYSTEM

1. The remote-control system shall provide integration and control of key components using wired touch panels. Programming shall focus on operation of the presentation system ranging from simple podium events to manual operated productions. Menu shall include, but not limited to the following.
    1) Presentation or Production Mode
    2) Lighting pre-set recall
        a. Contractor to provide 6 lighting presets per the owners guidance.
    3) System power cycle screen
        a. All AV
        b. Projector power
    4) A/V switcher screen
        a. Source selection
            i. Stage Laptop
            ii. Booth Sources
            iii. Stage Video
            iv. Stage audio (MP3/CD)
        b. Source audio volume in presentation mode
    5) PTZ camera control
    6) Media player commands
        a. Bluray transport commands and menu functions
    7) Audio Control Screen
        a. Level and mute for House mic A
        b. Level and mute for House wireless B

c. Route mic A to house, route mic A to backstage
d. Route wireless B to house, route wireless B to backstage

D. AUDITORIUM LIGHTING

1. The auditorium shall be equipped with a state-of-the-art lighting system to support theatrical productions, projection presentations, and presenter meetings. Refer to lighting drawings for details on placements of lighting instruments.
2. The lighting console and dimming system shall be used to control the theatrical lights and the architectural house lights in and around the auditorium area. **(DELETE-The lighting system in the Conference Center shall be a stand-alone system and not tied to the auditorium system)** All fixtures shall be supplied complete with safety cable, c-clamp, lamp, lenses, DMX, power cables and extension cables as needed.
3. **The existing ETC SR48 dimmer rack shall be Upgraded with the latest control electronics retrofit kit with new CEM3, backplane, fan and all new dim/relay modules. House lights shall be controllable from walk-through entry stations at specified auditorium entrances and controls in the control booth. Control will be via ACN Network out to DMX Nodes for stage lighting and 0-10V Gateways for house lighting.**
4. **Stage lighting electric distribution shall be a connector strip at FOH and plug boxes at tormentor locations. Overstage shall have 6 – 60' multi circuit drop cables with Veam 6-circuit fan-outs with stage pin connectors. Each drop cable will have counterweighted pick lines to lift the cable stack out of sight line.**
5. **There shall be wall box locations on stage for lighting receptacles for portable side lights, groundrows, and practicals. Refer to drawings for exact location.**
6. The Contractor is responsible for programming the following production scenes for initial commissioning.
   1) Band/Choral (full stage wash)
   2) Podium or Presentation Event
   3) House lights and presets for remote control system to recall
   4) Owner specified #1

E. CURTAINS

1. Stage curtains that travel shall be on motorized battens. **50%** fullness, **25oz**., synthetic material, color **TBD.**
2. Material shall be the Charisma fabric
3. Rear flat muslin cyc on a motorized batten to move when the rear projector is in use.
4. Material to be flame resistant
5. **Curtain motor for Grand Drape.**
   a. **Track mounted**
   b. **LV control to wall switch and Stage Managers AV Rack.**

F. RIGGING SYSTEMS- Consult rigging drawing set. The rigging shall consist of line sets with:

1. Rigging systems contractor to remove all existing stage rigging systems, battens, curtain tracks, curtains for clear stage, grid, and stage house.
2. Motorized Rigging Set Requirements
   a. Provide 10 line-shaft winch sets, each set consisting of (but not limited to) the following:
      i. Capacity -- 1000 LBS.
      ii. Speed -- 20 FPM
      iii. Truss Batten Travel -- 34 feet
      iv. Drum Diameter -- 8 inches
      v. Cable Size -- ¼"
      vi. Number of Drums -- 4
      vii. Type of Limit Switches -- 4 Position

b. General Standards
c. Paint as required under this section shall be the manufacturer's standard finish and Color as noted.
d. All equipment items shall be new and conform with applicable provisions of Underwriters' Laboratories and American Standards Association.
e. Where acceptable equipment items are specified by catalog number only, device shall meet all published manufacturer's specifications. Where quantities are not given, refer to drawings. Where two or more products are listed, contractor may use either, at his discretion. Equipment shall not be substituted without specific written approval by the Architect/Architect's Representative under the substitution paragraphs of these specifications.

3. Materials
   a. All turnbuckles, clips, tracks, chains and other items of incidental hardware shall be furnished plated or painted. Wire rope shall be galvanized. Fasteners, chains and other miscellaneous hardware shall be either cadmium or zinc plated.
   b. All materials used in this project shall be new, unused and of the latest design. Refurbished materials are not permitted.
   c. In order to establish minimum standards of safety, a minimum factor of 8 shall be used for all equipment and hardware used on this project. In addition, the following factors shall be used:
      i. Cables and fittings: 8 Safety Factor
      ii. Cable blending ratio: 30 times diameter
      iii. Max: fleet angle 1 ½ degrees
      iv. Steel: 1/5 of yield
      v. Bearings: Two times required load at full for 2000 hours
4. MOTORIZED LINESHAFT RIGGING REQUIREMENTS:
   a. Furnish and install Motorized Line-shaft winches to raise and lower the stage battens and other stage equipment as specified herein.
   b. Each winch shall operate at a fixed speed.
   c. The batten shall travel from a low trim of 4'-0" above stage floor to approximately 1'-6" below the winch assemble.
   d. Each line-shaft winch shall have drums alternately grooved for right- and left-hand winding to prevent the batten from traveling.
   e. Drums shall be supported on each side with a flange block assembly.
   f. Miscellaneous hardware such as battens, cable, etc. shall follow ANSI standards and specifications.
5. WINCH SYSTEM
   a. The gear reducer shall be a double reduction worm gear or a combination right angle helical worm gear reducer. Reducer shall have a minimum service factor of 1.25.
   b. The AC brake-motor shall be 1750 RPM horsepower as required, three phase, 60 Hz with an integral brake. The brake shall be rated for 200% of the motor torque and be sized to stop and hold the moving load within four inches. Brake shall automatically be applied in case of power failure. Motor shall have a 1.0 service factor.
   c. The cable drum diameter shall be a minimum of 32 times the cable diameter. The cable drums shall be of the proper length to hold all of the cable in a single layer. The cables shall be prevented from jumping out of the grooves by two 3/8 cable retainers. The drum shall hold a minimum of the cable required for travel plus three dead wraps. Drums are to be helically grooved for the appropriately sized cable and have key-slots for the easy connection of cables. The drum hub shall be keyed directly to the continuous shaft off the reducer. Chain or belt drives are not acceptable.
   d. The winch frame shall be constructed of structural steel members, compactly designed to support the winch components and load in a minimum amount of space. In the frame shall be incorporated a cable keeper bar that is located next to the

grooves in each drum to prevent lines from jumping grooves and slack lines from unwinding.

e. Shaft will be a steel drive sized and of material to prevent excess twisting due to load torque. Maximum twist to be 0.25 degrees per linear foot.
f. Shaft coupling to be flange type gear, or solid couplings. Chain couplings are not acceptable.
g. The integral line-shaft frame designed to support and align each drum, shall be made of structural channel, tubing, or wide flange beams. Systems without these integral members shall not be acceptable.
h. An internal brake shall be installed to stop a runaway system at 1 ½ times the rated speed.
i. Each winch shall have an adjustable four element limit switch which stops the winch at the upper and lower extremes of travel. Two of the elements shall be back-up or over travel limits, wired such that the winch cannot be operated until the cause of normal limit failure is determined and repaired.

6. LOW VOLTAGE MOTOR CONTROL PANEL:
   a. Push Button Wall Mounted 24volt Controller.
   b. Push Button Control Station.
   c. Control stations shall be wall mounted NEMA 1 enclosure, containing hold-to-run Up and Down pushbuttons for each hoist. A key operated On/Off switch with green LED indicating "Power On" shall be provided.
   d. Provide main circuit breaker for the panel that must interlock with the panel door. Circuit breaker shall be sized to operate all motors at one time.
   e. A red, mushroom head emergency stop pushbutton shall be provided, which shall disconnect power to the hoist through a circuit meeting NFPA-79 (Electrical Standards for Industrial Machinery) requirement.
   f. Panel components including pushbuttons, key switches, switches, E-stop switches, and the like shall be industrial grade, heavy-duty components with 7/8 inch (22 mm) operators. Indicators shall be 5/16 inch (8 mm) minimum diameter.
   g. Motor drives shall be Eurodrive
7. PIPE BATTENS:
   a. Truss Pipe Battens shall be 1-1/2” in diameter schedule 40 pipe fabricated into “ladder battens” as indicated on the drawings.
   b. All battens shall be painted black to prevent rusting.
   c. Where splicing in required, an internal sleeve 21 inches long and the same diameter as the inside diameter as the pipe shall be used. This sleeve shall be held in place with no less than four (4) 3/8” diameter grade 5 bolts.
   d. Mark the center of each batten with a 1” wide yellow stripe.
   e. Paint the last 1’-0” of each end of each pipe batten yellow.

G. ACOUSTICAL ENHANCEMENT SYSTEM – BASIS OF DESIGN
   1. Productions plans include drama, musical theater, dance, piano recitals, choral events, chamber music, jazz ensembles and fashion shows.
   2. Given the variety of events in the space, and knowing they would benefit from different acoustic conditions, require the option of an acoustic enhancement system.
   3. Yamaha has been designing and installing variable acoustic systems since the late 1980’s. Yamaha’s 4th generation of dedicated firmware / hardware / software designed specifically for these types of systems.
   4. AFC Sub-System Elements
      i. House Early Reflection, or ER, System Elements
      ii. 4 x Cardioid microphones distributed in a line to provide coverage of the front of stage feeding one AFC engine.

iii. ER mics mounted with capsules having line of sight as far upstage as reasonable.
iv. ER mic height should be positioned as low as possible. Ideally, mics are within Dc of performers and the travel time to the microphones is as short as possible.
v. ER system output will be distributed among loudspeakers distributed along the side and rear walls as well as around the proscenium opening.
vi. The ER System output will also feed subwoofers. These subwoofers add warmth to the system, extending its bandwidth for full range enhancement.
vii. The ER System can also matrix in signals from the stage mics and REV signals.
viii. The sidewall ER system loudspeakers will also have movie surround signals merged with AFC signals for dual use of loudspeakers.

5. House Reverberation, or REV, System Elements
   i. 4 x Omnidirectional microphones placed at or beyond Dc from the stage feeding one AFC engine.
   ii. REV system output will be distributed among loudspeakers distributed near the ceiling, at or above the level of the clouds. REV signal may also be blended back to ER and Stage speakers.
6. Stage System Elements
   i. 4 x Cardioid microphones distributed over stage feeding one AFC4 engine.
   ii. Stage System Outputs will be distributed among loudspeakers suspended over the stage to replace the function of an orchestra shell roof.

1.7 SCOPE OF WORK

A. Provide all labor and material for the complete installation of the presentation systems as hereafter specified and shown.

B. PSC shall review the entire project package, including drawings and notes for other trades that may impact the Presentation Systems work, and make provision for such.

C. Equipment shall be new, current production, with original warranty. Demo, refurbished, used or B-stock equipment shall not be acceptable.

D. Quantities are listed for reference only. It is the PSC responsibility to verify quantities of all components.

E. All equipment must be installed in a neat and orderly fashion by competent workmen according to the manufacturer's instructions.

F. All system components shall be completely prewired with all field connections clearly labeled. All equipment shall be UL and or CE listed and shall comply with the National Electrical Code or equivalent authority and all applicable regulations of serving utilities and governmental bodies having jurisdiction.

G. Presentation equipment shall not be stored at the job site. Equipment shall be moved to the job site from a conditioned space only when scheduled for installation.

1.8 CONTRACTOR'S QUALIFICATIONS

A. The PSC shall be a company that regularly engages in the furnishing and installation of systems similar in complexity to those required for this project and meet the following requirements.
   1. The primary business of the PSC shall be the sale and installation of professional performance related sound and video systems.
   2. No less than five years of experience with equipment and systems of the specified types.
   3. Proof of successful completion, with present key staff, of five projects of the type or magnitude of that specified herein.

4. Regular business under the same name and/or address for a period of five years.
5. Be a franchised dealer and service facility for the major products furnished.
6. Have technicians trained in the specific installation and maintenance of the equipment supplied.
7. Have suitable service facilities and test equipment for providing competent service for all types of professional dimming, sound and A/V equipment.
8. Maintain shop and office facilities within a 125-mile radius of the project site.
9. Employ a minimum of 1 full time engineer with InfoComm International Certified Technology Specialist - Design (CTS-D) certification.
10. Employ a minimum of 1 full time installer with InfoComm International Certified Technology Specialist - Installation (CTS-I) certification.
11. Employ a minimum of 1 full time programmer that is a Crestron Certified Programmer.
12. Employ a qualified "sound system and A/V production expert" with sufficient experience in production to providing training and assistance to the Owner during the initial system use period.
13. Certifications for permanent staff members:
    a. BiAmp Audio senior level programmer
    b. Dante Level 3 Master Certification
    c. InfoComm International Certified Technology Specialist - Design (CTS-D)
    d. InfoComm International Certified Technology Specialist - Installation (CTS-I)
    e. Crestron Master Programmer
    f. Crestron Digital Media Engineer
    g. EASE training
    h. Extron AV Associate certification
    i. Extron Advanced School AV Technologies

B. At the request of the Owner, the PSC shall demonstrate to the satisfaction of the Architect and Consultant that the PSC has:
   1. Adequate facilities and equipment to complete the work.
   2. Adequate staff with commensurate technical experience.
   3. Suitable financial status to meet the obligations of the work.

C. Any other Contractor/Supplier who intends to bid this work as the prime Contractor/Supplier and does not meet the required qualifications shall employ the services of a single "Presentation Systems Contractor" who does meet the requirements noted above and is approved by the Owner. This "Presentation Systems Contractor" shall:
   1. Furnish the equipment.
   2. Shop fabricate the equipment racks and subassemblies.
   3. Make all audio, video and control connections to equipment racks, each piece of equipment, and connection panels.
   4. Continuously supervise the installation and connections of cable and equipment.
   5. Program the digital signal processor, video processing systems and control system.

D. A subcontractor so employed as the "Presentation Systems Contractor" must be acceptable to the Architect and the Consultant and shall be identified on the Bid Proposal Form.

1.9 BID SUBMITTALS

A. Along with the bid price, the PSC shall include the following:
   1. Proposed team member names, certifications and biographies for each. Include names and biographies of service and technical support personnel who will be responsible for this project after completion.
   2. Equipment list noting equipment quantities, manufacturer, brief description and specification number.
   3. Statement that the bid is based on specified products.

ADDENDUM NO. 1

4. Address of staffed office within 125 miles of the job site.
5. Statement that the Contractor has an established toll-free hot-line and will provide 24-hour/7-day-a-week phone support and on-site emergency service as necessary to correct technical failures.
6. List of five installations completed within the last three years, which are similar in size, type and scope to the work specified in this Section. Include project name, date of installation, name of contact and phone number.
7. Examples of typical design drawings (elevations, mounting details, millwork details, etc.)
8. A minimum of five touch panel menu templates from projects completed by the PSC.
9. Examples of training materials (PowerPoint slides, quick-start guide).
10. Target project schedule with timeline, skills and labor requirements.
11. Client reference letters.
12. Any proposed subcontractors, their qualifications, and scope of work.

1.10 PROJECT SUBMITTALS

A. Upon award of the contract, PSC shall provide:
   1. Preliminary project schedule with timeline, skills and labor requirements.
   2. Name and qualifications of PSC personnel who shall be supervising the installation of the system. This person shall be a full-time employee of the PSC. The PSC shall submit a minimum of three (3) suitable bound sets, or electronic documents, of the following for review by the Architect and the Consultant. Refer to the General and Special Conditions for additional set(s) which may be required. All documents shall be submitted prior to ordering any materials.
   3. A complete list of all equipment and materials which are to be furnished. Accompanying the list shall be manufacturers' specification or cut sheets for all equipment.
   4. Shop drawings generated by the Contractor. The Contractor shall be provided with electronic copies of the floor plans, device layouts and room sections only for use in preparing their shop drawings. The Contractor is responsible for editing these sheets as required by these submittal requirements. The Contractor is required to generate all other sheets as required by these submittal requirements.
      a. Detailed wiring diagrams showing interconnection of components and products, wiring and cabling diagrams depicting cable types and wire numbers, and device designators.
      b. Plan view showing locations of all equipment. Plan(s) shall be properly dimensioned and all equipment labeled.
      c. Wall elevations and room sections showing all installed equipment. Elevations and sections shall be properly dimensioned, and all equipment labeled.
      d. Equipment rack layout details, including power, grounding, ventilation, and conduit/cable entry as applicable.
      e. Loudspeaker system suspension schematic including hardware types and load capacity.
      f. Complete drawings of custom-fabricated plates or panels. Drawings shall include dimensioned locations of components, component types, engraving information, plate material and color, and bill of material.
      g. Power requirements, one-line riser diagrams, and installation circuit diagrams for electrical equipment. Show all required wire sizes and counts between all components.
      h. Manufacturer's detailed shop drawings of all dimming, control and distribution equipment, and published literature for all equipment.

1.11 FINAL INSPECTION AND TESTING

A. In addition to supplying and installing the equipment as part of this contract the PSC is to aid the owner’s consultant during on site observations, systems commission/performance verification, video system proof and owner training and production assistance.

ADDENDUM NO. 1

B. The process of testing the system may necessitate moving and adjusting certain components such as loudspeakers and video projectors. Movement and replacement as required is to be performed at no additional expense to the Owner.

C. In the event further adjustment or Work becomes evident during testing, the Contractor shall continue his work until the system is acceptable at no additional expense to the Owner. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications, the Contractor shall pay for additional time and expenses of the Consultant and Owner at the standard rate in effect at that time.

1.12 WARRANTY

A. All equipment is to be new and warranted free of faulty workmanship and damage.

B. The total system (parts and labor) is to be warranted free of defects for a period of one year from date of final acceptance.

C. The entire system (excluding lamps and fuses) shall be fully factory tested prior to shipment and shall be guaranteed against defects in material and workmanship for one year from date of acceptance by the Owner or (18) eighteen months from the date of shipment, whichever occurs first.

D. No equipment having a shorter warranty shall be considered and equipment purchased shall be covered by this warranty. Unspecified length of warranties shall not be acceptable.

E. Contractor shall provide for replacement of defective materials and repair of faulty workmanship within (48) forty-eight hours of notification by owner guaranteed at no cost to the owner during the warranty period.

F. Contractor shall provide emergency service and support 24 hours a day and 7 days a week. This service is intended as emergency response to failures that require immediate help from a qualified systems technician. The Contractor shall provide this service through an established toll-free line. This emergency service must include a return call from a qualified systems technician within 2 hours. This emergency service must also provide an on-site visit from a qualified systems technician within 12 hours of the initial phone call, should it be deemed necessary by both parties to resolve the service issue. This emergency service and support shall be made available throughout the warranty period at no additional charge to the owner.

G. Paint and exterior finishes, fuses and lamps are excluded from the above warranties except when damage or failure results from defective materials or workmanship covered by warranty.

H. The minimum warranty provisions specified above shall not diminish the terms of individual equipment manufacturer warranties.

1.13 INSTRUCTION OF OWNER PERSONNEL

A. PSC is to provide at least ten hours (2 each five-hour sessions) of training to person(s) selected by the Owner on operation and basic maintenance of all systems and equipment. In addition to training, a representative of the Contractor knowledgeable of the system installation and operation is to be present for the first special events selected by the Owner that all or any part of the sound and video systems is used. The training and event attendance is to take place during the 30-day period after system completion.

PART 2 - PRODUCTS

2.0 GENERAL

A. It is the intention of these specifications to provide a complete and properly operating system. The major items of equipment shall be furnished in the quantity indicated by the project drawings or in the quantity specified herein. In the event of a quantity discrepancy between the drawings and specifications for an item, the PSC shall provide the greater. PSC is responsible for

providing all accessories and miscellaneous equipment required to form a complete and operational system, including, but not limited to, power supplies, cabling, mounts, attachment hardware and software licenses.

B. Provide only new products, and include the manufacturer's original factory warranty, product documentation and the latest version of any software required for configuration and/or operation.

C. Where the specifications list several manufacturers for a particular major item of equipment, such as power amplifiers, the PSC shall supply all of that item of equipment from one manufacturer.

D. Equivalent products can be proposed with appropriate documentation to show equivalent specifications. Items listed below in Schedule 1 are the models used in the Basis of Design.

Minimum Specifications for Equipment – Quantity per equipment list or drawings.

2.1 DIGITAL MIXER STAGE BOXES – BASIS OF DESIGN

A. The stage box shall be a 2RU rack mountable device
B. The stage box shall connect to mixer by way of a Primary and Secondary DANTE connections
C. The stage box shall have (16) mono analog inputs
D. Acceptable manufacturers
   1. Yamaha RIO1608-D2 BASIS OF DESIGN

2.2 DIGITAL AUDIO MIXER– BASIS OF DESIGN

A. The mixer shall be capable of mixing 64 mono and 8 stereo channels
B. The mixer shall have the capability to be controlled from an iPad with the proper application loaded.
C. The mixer shall have (32) local mono inputs and (16) outputs
D. The mixer shall have (3) slots for optional modules
E. The mixer shall have as standard connections, I/O a Primary and Secondary DANTE, Ethernet, Word Clock, and AES/EBU output
F. Acceptable manufacturers
   1. Yamaha QL-5 BASIS OF DESIGN

2.3 NETWORK SWITCHES - DANTE– BASIS OF DESIGN

A. The switch shall have 16 ports minimum
B. The switch shall be an unmanaged switch
C. The switch shall be at least 1Gb speed
D. There shall be 8 ports of PoE
E. Acceptable manufacturer/model, or better than:
   1. CISCO
   2. NetGear

2.4 NETWORK SWITCHES - DANTE– BASIS OF DESIGN

A. The switch shall have 16 ports minimum
B. The switch shall be an unmanaged switch
C. The switch shall be at least 1Gb speed
D. There shall be 8 ports of PoE
E. Acceptable manufacturer/model, or better than:
   1. CISCO
   2. NetGear
   3. Yamaha

2.5 AUDIO SPEAKERS – MAIN FOH PERFORMANCE FULL RANGE (Qty per equipment list)

A. Speakers to perform and mount in a line array coverage pattern
B. Main loudspeakers are to be passive type

ADDENDUM NO. 1

C. Speakers shall be flown along with subwoofers
D. Freq response of 59hz – 20khz minimum
E. Acceptable manufacturer
   1. NEXO– BASIS OF DESIGN
   2. JBL
   3. L Acoustics

2.6 AUDIO SPEAKERS – MAIN FOH SUBWOOFERS (Qty per equipment list)

A. Subwoofers to be flown next to full range speakers behind first reflector
B. Subwoofer cabinets to be a single 18" driver
C. Cabinet shall have necessary hardware necessary for flying speaker
D. Freq response of 35hz – 120hz
E. Acceptable Manufacturer
   1. NEXO– BASIS OF DESIGN
   2. JBL
   3. L Acoustics

2.7 AUDIO SPEAKERS – STAGE WEDGE MONITORS (Qty per equipment list)

A. Speakers to be passive 2-way type
B. Freq response 55hz-18khz or better
C. The speaker shall have a 12" low freq. driver
D. The speaker shall be rated at 550W continuous
E. Provide NL4 to NL4 cables, per equipment list
F. Acceptable manufacturers
   1. Yamaha– BASIS OF DESIGN
   2. JBL
   3. L Acoustics

2.8 AUDIO SPEAKERS – SURFACE MOUNT

A. Mount with manufacture's bracket at locations on drawings
B. Speakers to be 70V with easy access to wattage tap selector switch
C. Speakers to have nominal pattern coverage of 110°
D. Speaker shall have continuous program power rating of 75W
E. Acceptable manufacturers
   1. Community
   2. Yamaha– BASIS OF DESIGN
   3. JBL

2.9 AUDIO POWER AMPLIFIER – HOUSE

A. Amplifiers shall have either a barrier strip or XLR connector for their balanced input connections.
B. Amplifier to have 4 independent channels or bridgeable 2x2
C. Output wattage to be 900W per channel into 4Ω
D. Shall have no greater than 1% THD at 1Khz at maximum power
E. Provide adequate electrical service for max output
F. Acceptable manufacturers
   1. <u>NEXO – Basis of Design</u>
   2. Per main loudspeaker system requirements

2.10 AUDIO POWER AMPLIFIER – MONITORS

A. Amplifier to have 4 separate channels, with built-in DSP
B. Amplifiers shall have a 3-pin phoenix strip for each of the (4) balanced input connections.
C. Amplifier to have phoenix strip connections for outputs

ADDENDUM NO. 1

D. Output peak wattage to be 1400W per channel into 4Ω
E. Provide adequate electrical service for max output
F. Acceptable manufacturers
1. Yamaha
2. QSC
3. Crown

2.11 AUDIO AMPLIFIER – PAGING / BACKGROUND

A. Amplifier shall have balanced inputs on barrier strip.
B. Amplifier to have 8 independent 70V output channels
C. Output wattage of each channel to be 500W minimum.
D. Acceptable manufacturer
1. Yamaha– BASIS OF DESIGN
2. QSC
3. Crown

2.12 AUDIO DIGITAL SIGNAL PROCESSOR (DSP)

A. DSP's shall meet the following minimum criteria
1. Ability to be networked to allow for expansion and control
2. Shall be able to configure with the necessary input and output quantity as required per drawings.
3. Supports standard DSP functions such as but not limited to, auto-mixing, parametric EQ, compressing, Hi-Lo band pass, muting, routing, etc.

B. Acceptable manufacturer
1. Yamaha MX– BASIS OF DESIGN
2. BiAmp TesiraServer
3. BSS London
4. QSC Core

2.13 AUDIO MICROPHONES – WIRELESS PERFORMANCE

A. The wireless microphones shall have the added capability of 64Mhz bandwidth of digital tuning
B. There shall be 24-bit digital audio
C. Over 120db of dynamic range
D. Shall be easy pairing with IR scan and sync
E. Provide the necessary antenna / power distribution for all receivers
F. (Qty T.B.D.) systems; price each system with allowance for a head worn microphone for theater.
G. Acceptable manufacturer
1. Shure
2. Sennheiser
3. AKG

2.14 AUDIO MICROPHONES – WIRED PERFORMANCE (Qty per equipment list)

A. Provide handheld wired vocal microphones such as Shure SM58 or SM87
B. Provide instrument microphones such as Shure SM57 or SM81
C. Provide drum microphone kit such as a Shure DMK57-52
D. Provide piano mic such as a BETA 91A or SM81
E. Provide Choir microphones such as Audix Microboom 8450
F. Acceptable manufacturers
1. Shure
2. Audix
3. AKG

ADDENDUM NO. 1

2.15 AUDIO MEDIA PLAYBACK

A. The audio player shall have a CD player
B. The player shall have a Bluetooth receiver to allow playback through the system from user's phones, iPad, etc.
C. The player shall have an 1/8" Aux input jack
D. Audio player shall have stereo unbalanced analog outputs
E. The player shall be remote control via Infrared control
F. Acceptable manufacturers
1. Tascam
2. Denon
3. Yamaha

2.16 PRODUCTION INTERCOM

A. The production intercom system shall be the analog party line solution
B. The system master station shall be a 2-channel system
C. The master station shall be able to power up to 55 single channel beltpacks or 10 speaker stations or 12 headset stations distributed over both channels
D. The master station shall accept a line level program input
E. See associated schematic drawing to identify the type of user stations and locations
F. Provide lightweight single muff headsets with all beltpacks.
G. Acceptable manufacturer
1. Clearcom– BASIS OF DESIGN

2.17 ASSISTIVE LISTENING SYSTEM

A. ALS transmitter to be an RF based system
B. The number of channels to be 17 wide band, 40 narrow band
C. Provide appropriate number of receivers in accordance to ADA specification.
D. The receivers shall be equipped to use the loop/lanyard for t-coil hearing aid users or the standard 3.5mm standard earphone output.
E. Acceptable manufacturer
1. Listen Technologies– BASIS OF DESIGN
2. Williams

2.18 VIDEO PROJECTOR – MAIN PRESENTATION

A. The main presentation projector shall meet or exceed the following specifications.
1. Native resolution: WUXGA, 1920x1200 (x3) LCD TFT Active Matrix
2. Solid-state laser-diode light source
3. Brightness: 12000 Lumens
4. Contrast Ratio: 2,500,000:1
5. Horiz and Vert Keystone correction
B. Acceptable manufacturers
1. Epson– BASIS OF DESIGN
2. Christie
3. Digital Projection

2.19 PROJECTION SCREEN - AUDITORIUM

A. The screens shall meet the following specifications.
1. The aspect ratio is to be 16:10
2. Electric screen with 24" black drop and LV control interface
3. The image size shall be **180"H x 288"W**
4. Screen material to be Dual Vision for rear screen Rear projector mounted on upstage wall

ADDENDUM NO. 1

B. Acceptable manufacturers
   1. Dalite– BASIS OF DESIGN
   2. Draper

2.20 AUDITORIUM VIDEO PRESENTATION SWITCHER
A. Video switching and routing must be able to transmit and receive a 4K signal up to 300'
B. This signal must pass control protocol and audio. Audio to be able to be broken away separately from video path
C. The switcher to be modular and configurable depending on the size and types of formats
D. Switcher communications to support ethernet, USB, DigitalMedia, HDBaseT, HDMi
E. Acceptable manufacturer
   1. Crestron– BASIS OF DESIGN
   2. AMX
   3. Extron

2.21 CAMERA – PTZ USB
A. The camera shall have a remote controllable 12X zoom lens
B. The camera shall have a 73° field of view
C. The output resolution shall be 1080p
D. The camera shall have simultaneous uncompressed USB 3.0, HDMi, and IP (H.264) streaming.
E. Remote management by IR, Web interface, Telnet, and RS232
F. Power to be with 12VDC power supply or PoE+
G. Acceptable manufacturer / model
   1. Vaddio RoboSHOT System– BASIS OF DESIGN

2.22 BLU-RAY PLAYER
A. Shall play back Blu-ray, DVD, and CD media
B. Playback WAV, MP3, WMA, and other audio formats
C. RS-232C serial control
D. Infrared remote control included
E. Acceptable manufacturer
   1. Tascam
   2. Dennon
   3. Sony

2.23 RIGGING
A. Refer to drawings for line set mounting locations.
B. <u>(10) 1000lb. fixed speed hoists (electrics)</u>
   1. Acceptable manufactures
      a. SRS– **<u>Custom line shaft stage rigging system - BASIS OF DESIGN</u>**
      b. ETC
      c. J R Clancy
C. Controller for hoists / rigging
   1. Acceptable
      a. Per Manufacture

2.24 CONTROL SYSTEM – PROCESSORS
A. The control processor shall include the necessary power supply
B. The processor shall have a Ethernet LAN connection as well as an Ethernet Control Subnet connection
C. The control processor shall have these available I/O options
   1. (8) Relay contact closures
   2. (8) Digital I/O connections

ADDENDUM NO. 1

3. (8) IR / Serial outputs
4. (1) RS-232/422 bi-directional output
5. (2) RS-232 Bi-directional
6. (1) USB connection
7. (1) Cresnet connection

D. Acceptable manufacturer
1. Crestron– BASIS OF DESIGN

2.25 WIRED TOUCH PANELS

A. Refer to drawings to verify the location, size, and type of touch panel.
B. Display type shall be a TFT active matrix color LCD, 5-point multi-touch
C. Provide necessary mounting hardware/box for wall mounted touch panels.
D. Provide a PoE connection for power for wall mounted touch panels
E. Acceptable manufacturer
1. Crestron– BASIS OF DESIGN

2.26 PERFORMANCE LIGHTING CONSOLE

A. The lighting console shall have internal solid-state memory
B. It shall have a 15.6” primary touch screen and a 7” secondary touch screen for control
C. 40 precision playback faders in 3 pageable groups
D. 20 programmable macro executor buttons
E. Includes 4-port managed Gigabit network switch
F. Acceptable manufacture
1. ETC High End Systems

2.27 LIGHTING WALL BUTTON PANELS

A. Provide 1-gang 5-button panels at designated locations in the auditorium for lighting control
B. Provide 1-gang 10 button panels at designated locations in the auditorium for lighting control
C. Acceptable manufacturer
1. ETC Heritage– BASIS OF DESIGN

2.28 LIGHTING TOUCH SCREEN CONTROL

A. Provide a 7” Link Connected touch-screen station
B. Acceptable manufacturer
1. ETC **EchoTouch**– BASIS OF DESIGN

2.29 LIGHTING DIMMER RACK

A. Existing dimming rack to control auditorium house and theatrical lights.
B. Factory upgrade retrofit kit to make existing dimmer function as new.
C. Include necessary network and 0-10V control gateways for stage and house lighting.
D. Dimmer rack to be populated with an assortment of dual 20A dimming modules and dual 20A relay modules.
E. Emergency transfer switches to be provided.
F. Acceptable manufacturer
1. ETC– BASIS OF DESIGN

2.30 PERFORMANCE LIGHTING – LED PAR FIXTURES

A. The performance lighting par fixtures shall use LED technology
B. Light Source: 40 LUXEON Z LEDs (quad color RGBL)
C. The fixtures shall have 50,000 Hr. life expectancy
D. Max Lumens 3,039
E. Include three lens per fixture
F. Include one 10’ PowerCON Jumper per fixture

ADDENDUM NO. 1

G. Quantity: per equipment list.
H. Acceptable manufacturer
1. Chauvet
2. ETC

2.31 PERFORMANCE LIGHTING – LED ELLIPSOIDAL FIXTURES

A. The performance lighting ellipsoidal fixtures shall use LED technology
B. Light Source: 60 LUXEON Z LEDs (quad color RGBL)
C. The fixtures shall have 50,000 Hr. life expectancy
D. Max Lumens 6,932
E. Supply assortment of 19°, 26°, and 36° lens tubes as needed
F. Include one 10' PowerCON Jumper per fixture
G. Quantity: per equipment list.
H. Acceptable manufcturer
1. Chauvet
2. ETC

2.32 PERFORMANCE LIGHTING – CYC FIXTURES

A. The performance lighting cyc fixtures shall use LED technology
B. Light Source: 40 LUXEON C LEDs (Red, Green, Blue, Indigo & Green))
C. Variable effects engine; strobe, strobe on top, strobe random
D. Max Lumen 4,117
E. The fixtures shall have 50,000 Hr. life expectancy
F. Include one 10' PowerCON Jumper per fixture
G. Quantity: per equipment list.
H. Acceptable manufacturer
1. Chroma-Q
2. ETC

2.33 PERFORMANCE LIGHTING – SPOTLIGHTS

A. The spotlight shall have a throw of 30'-150'
B. The beam angle shall be from 8° to 22°
C. Input voltages – 100V, 120V, 230V, and 250V
D. Include framing shutter option
E. Quantity: 2
F. Acceptable Manufacturer
1. Canto USA

2.34 LIGHTING FLOOR BOXES

A. Acceptable manufacturer
1. ETC
2. SSRC

2.35 STAGE CURTAINS

A. Shall be classified as Class A compliant for areas of assembly
B. Stage Curtains consist of:
1. Front Grand Drape (2) Size Per drawings and equipment list
2. Grand Valance (1) Size Size Per drawings and equipment list
3. Pleated Legs (8) Size Per drawings and equipment lis
4. Mid Stage traveler (2) Size Per drawings and equipment list
5. Cyclorama (1) Size Per drawings and equipment list
6. Borders – (3) Size Per drawings and equipment list

ADDENDUM NO. 1

C. Curtain fabric to be **25oz**. Charisma fabric
D. Curtains shall be **50%** fullness
E. 5" Bottom hems with lead weight tape encased in separate muslin for added durability
F. (3) 70' manual curtain tracks.
G. Acceptable manufacturers
    1. Charisma (Fabric)
    2. Stage Decorations
    3. Greenville Stage (Curtains)

2.36 AV FLOOR BOXES –UPSTAGE

A. Provide large floor boxes as indicated on drawings.
B. Acceptable manufacture
    1. Ace Backstage
    2. FSR

2.37 AV FLOOR BOXES – DOWN STAGE CENTER

A. Provide floor boxes as indicated on drawings.
B. Acceptable manufacture
    1. Ace Backstage
    2. FSR

2.38 MISC SUPPORT EQUIPMENT

A. Equipment Racks
    1. Refer to drawings for location and size of equipment racks.
    2. Provide rack panel blanks and vents to best fill in unused rack spaces.
    3. Freestanding and Wall racks shall provide standard 19"W space to mount equipment.
    4. The number of rack units shall be enough to house all equipment based on the system design. Population of rack to be 75%-80% with the remainder open for future growth.
    5. Where rear access is not possible to rack, provide a sliding and swiveling rack instead.
        a. Acceptable Manufacturer
            1) Middle Atlantic
            2) Gator

2.39 ORCHESTRA SHELL (REVISE ADDENDUM 1 SEE APPENDIX 1.O)

1. Portable Orchestra Shell Towers:
iii. * Standard Wenger Construction
iv. * Price includes 2022 delivery and installation.
2. Legacy Towers w/Painted Finish:
3. Consists of:
v. (12) LEGACY TOWERS,
vi. 6' Wide, 13'6"' Tall
vii. Face Finish - Sherwin Williams Kem Aqua
viii. Paint (Class 'A')
7. Acoustic Ceiling Clouds with paint finish
i. Single row of 8'x8' curved reflective ceiling diffusers.

2.40 SCHEDULE OF BASIS OF DESIGN EQUIPMENT

This is a list of the major items used in the design. The integrator is responsible for all ancillary and accessory items needed to integrate a fully operational system as intended.

2.40.1 Audio Mixing Systems				
Item	Make	Model	Description	Qty
AM1	Yamaha	Rio-1608D2	16 input x 8 output mic/line interface with Dante	3
AM2	Yamaha	QL-5	64 input x 16 output digital mixing console with Dante	1
AM3	Yamaha	LA1L	LED Gooseneck Console Lamp	2
AM4	Yamaha		Cover for QL-5	1
AM5	Gator		Portable rack case for Rio-1608D	1
AM6	Tascam	CD-200iL	Professional Single CD Player iPod Dock (30-Pin & Lighting Connection) Unbalanced RCA Audio Outputs MP3 & WAV Playback, 2RU	1
2.40.2 Audio Drive Systems				
Item	Make	Model	Description	Qty
AD1	Yamaha	MRX7-D	Digital signal processor with Dante	1
AD2	Yamaha	XVM4280D	4 channel x 280W power amp (stage monitors)	1
AD3	Yamaha	XVM4280D	4 channel x 280W power amp (back-stage, control booth)	1
AD4	Nexo	NXAMP4X2MK 2	4 channelx2000W power amp (Main Loudspeakers)	2
AD5	Nexo	NXDT104MK2	Nexo, Dante Card for NXAMP - MK 2	2
AD6	Cisco	Cisco SG300-10PP	Network switch for Dante #1,#2,#3-Primary in ER2.1, ER2.2, ER3.1	3
AD7	Netgear	WNDR3400-11NAS	Wireless access point for AV systems	1
AD8	Listen Technol-ogies	LS-54-072	Listen iDSP Prime Level II Stationary RF System (72 MHz) (LT-800/LR-4200 included)	1
AD9	ListenTech	LR-4200-072	ALS receivers	20
AD10	ListenTech	LA-430	ALS Headphone/t-coil lanyard	5
AD11	ListenTech	LA-401	Universal ear speaker	20
2.40.3 Audio Loudspeaker Systems				
Item	Make	Model	Description	Qty
AS1	Yamaha	VXS5W	(Pair) 5" 2-way surface mount loud-speaker with 70V Transformer (back-stage)	2 pair
AS2	Yamaha	VXS8B	(Pair) 8" 2-way surface mount loud-speaker with 8Ohm (control booth)	1 pair
AS3	Lowell	25LVX-DW	25W wall mount volume control (backstage)	4
AS4	Lowell	150LVCS-DSB	150W wall mount volume control	1

			(control booth)	
AS5	Yamaha	CBR-12	12" 2-Way stage monitor loudspeaker	6
AS6	Rapco	H14-25N2N2	25' NL-2 stage monitor loudspeaker cable	6
AS7	Rapco	H14-10N2N2	10' NL-2 stage monitor loudspeaker cable	6
AS8	Neutrix	NL4-MMX	NL-2/4 coupler	8
AS9	Nexo	GEOM1012-I	Nexo Geo M, Geo M1012 Install Cabinet	8
AS10	Nexo	GEOM1025-I	Nexo Geo M, Geo M1025 Install Cabinet	4
AS11	Nexo	GMT-FLGM10	Nexo Acc, Pair of 120 Degree Dispersion Flanges Geo M10	4
AS12	Nexo	GMT-LBUMPM10	Nexo Acc, Light Bumper for Geo M10	2
AS13	P.S.C.	as required	Rigging accessories for Geo M10 loudspeaker arrays	TBD
AS14	Nexo	LS18	Nexo PS, 18" Subwoofer Sub Bass for PS15/GeoS12 Flyable	4
2.40.4 Audio Wireless Microphone Systems				-
Item	Make	Model	Description	Qty
AW1	Shure	QLXD124/85	24-bit Digital Combo System, w/QLXD4 Single Receiver, QLXD1 Bodypack, QLXD2 Handheld SM58 Mic Transmitter, and WL185 Cardioid Lavalier Mic, J50 Band (572-636 MHz)	1
AW2	Shure	ULXD1-G50	Digital Wireless Bodypack Transmitter w/Mini 4-Pin Connector, G50 Band (470-534 MHz)	16
AW3	Galaxy	ESM8-OB*-4SHU	headworn wireless microphone – *provide 16 beige (G) and 16 black (K).	32
AW4	Shure	ULXD4Q-G50	ULX-D Quad Digital Wireless Receiver, (470-534MHz) Includes Rackmount, 1/2 Wave Antenna, 1RU	4
AW5	Shure	Shure ULXD2/BETA87A	Handheld transmitter	8
AW6	Shure	UA844+SWB	Wideband UHF (470-952 MHz) Five-Way Active Antenna Splitter and Power Distribution System, external power supply. For QLX-D®, ULX®, ULX-D®, SLX®, and BLX® (BLX4R only) receivers. 1RU	2
AW7	Shure	UA834WB	In-Line Antenna Amplifier for Remote-Mounting 470-902 MHz	2
AW8	Shure	UA864US	Wall-Mounted Wideband Antenna (470-698 MHz)	2
AW9	Shure	Shure MX150b/C-tgg	Cardioid Lavalier Mic	16
2.40.5 Audio Microphone Systems			-	-
Item	Make	Model	Description	Qty

AM1	Shure	SM58-LC	Dynamic Handheld Cardioid Vocal Microphone. (Less Cable)	8
AM2	Shure	SM57-LC	Dynamic Handheld Cardioid Vocal Microphone. (Less Cable)	4
AM3	Shure	DMK57-52	Drum kit	1
AM4	Shure	SM81	Condenser instrument mic	2
AM5	Shure	Beta 87	Handheld condenser mic	6
AM6	Audix	MICROBOOM50	50-inch (1270mm) carbon fiber boom and clutch assembly only - no mic, no cable	4
AM7	Rapco Horizon	NBM5-10	10' Concert Series Microphone Cable - Neutrik Connectors	8
AM8	Rapco Horizon	NBM5-25	25' Concert Series Microphone Cable - Neutrik Connectors	20
AM9	Rapco Horizon	M5-50	Professional M5 Series Shielded Microphone Cable, w/ A3 (F/M) Connectors, 50' Long	12
AM10	Rapco	SP4-25	Concert Series Neutrik NL4FC to NL4FC Speaker Cable, w/Speakon Connectors, 25' Long	8
AM11	Rapco	SP4-50	Concert Series Neutrik NL4FC to NL4FC Speaker Cable, w/Speakon Connectors, 50' Long	2
AM12	ProCo Sound	DB1	Passive Direct Box, 1/4 in. Phone Input w/Loop Thru, Balance	1
AM13	Atlas Sound	MS-10CE	Mic Floor Stand Ebony Finish (Must Buy 4)	26
AM14	Atlas Sound	PB21XEB	Performer Series Microphone Boom, Adjustable Length: 25.25"-38.5", Ebony	26
2.40.6 Equipment Racks and Wall Plates				-
AR1	Middle Atlantic	SR-40-28	40-Space (70" Racking Height) Swinging Wall Rack, 26" Useable Depth	AS REQ
AR2	Middle Atlantic	VFD-40	Universal Front Door for 40-Space Rack - Vented	AS REQ
AR3	Middle Atlantic	Lace-P	6PC,45SP CABLE LACE STRIP	AS REQ
AR4	Panduit	PADC2BL6	PVC Wiring Duct Cover (2.25"W) Black, 6' Length	AS REQ
AR5	Middle Atlantic	PADG2X3BL6	Slot Wiring Duct (2.25"W x 3.12"H) Black, 6' Length	AS REQ
AR6	Middle Atlantic	MAP-HP	Rack Mount Phillips Screws w/Washers (100 Pcs.)	AS REQ
AR7	Middle Atlantic	EB-1 LOGO	1-Space Econo Flanged Blank Panel--SFPS Logo	AS REQ
AR8	Middle Atlantic	EB-1	1-Space Econo Flanged Blank Panel--Smooth Finish.	AS REQ
AR9	P.S.C.	Misc .5	Necessary Cables, Connectors, Accessories	AS REQ
AR10	Middle Atlantic	BR1	1U Brush Grommet Panel	AS REQ
AR11	Middle Atlantic	KB-SS	Keyboard Sliding Shelf with Cable	AS

			Management, 1RU	REQ
AR12	Middle Atlantic	D3	3-Space (5.25 in.) Rack Drawer, Black Anodized Finish	AS REQ
AR13	Middle Atlantic	D2	2-Space (3 in.) Rack Drawer, Black Anodized Finish	AS REQ
AR14	Middle Atlantic	EB-4	4-Space Econo Flanged Blank Panel--Smooth Finish.	AS REQ
AR15	P.S.C.	PLACEHOLDER - Generic	LT-GN-PNL Rack Light	4
AR16	P.S.C.	PLACEHOLDER - Generic	Panelcrafters Custom Rack Panel for Touch Panel & Lighting Panel	2
AR17	P.S.C.	PLACEHOLDER - Generic	Panelcrafters Custom Paging Station Rack Panel	2
AR18	Lowell Mfg.	RPC-4-CD	15A Remote Power Control Rack-Mount w/4 Duplex RU2 Panel, 6Ft. Cord & Plug	4
AR19	Lowell Mfg.	RPC-1-20A-CD	20 Amp (1-Duplex) Remote Controlled Power Relay with 6 Ft. Power Cord	18
AR20	P.S.C.	PLACEHOLDER - Generic	Gator Cases G-Tour-14-CAST	1
AR21	Middle Atlantic	D2	2-Space (3 in.) Rack Drawer, Black Anodized Finish	1
AR22	Middle Atlantic	EB-1 LOGO	1-Space Econo Flanged Blank Panel--SFPS Logo	1
AR23	P.S.C.	Misc .25	Necessary Fastening Hardware, Accessories	1
AR24	Panduit	PADC2BL6	PVC Wiring Duct Cover (2.25"W) Black, 6' Length	1
AR25	Panduit	PADG2X3BL6	Slot Wiring Duct (2.25"W x 3.12"H) Black, 6' Length	1
AR26	Middle Atlantic	BRK6	6-Space (10.5in.) KD Laminated Equipment Rack, 18In.Depth, Black Finish	1
AR27	Middle Atlantic	EB-1 LOGO	1-Space Econo Flanged Blank Panel--SFPS Logo	1
AR28	Middle Atlantic	D2	2-Space (3 in.) Rack Drawer, Black Anodized Finish	1
AR29	P.S.C.	Misc .25	Necessary Fastening Hardware, Accessories	1
AR30	Panduit	PADC2BL6	PVC Wiring Duct Cover (2.25"W) Black, 6' Length	1
AR31	Panduit	PADG2X3BL6	Slot Wiring Duct (2.25"W x 3.12"H) Black, 6' Length	1
AR32	Hosa Technology	XLR-805	8-channel XLR3F to XLR3M balanced audio snake, 5 meters in length, fan to fan.	1
AR33	Hosa Technology	XLR-805	8-channel XLR3F to XLR3M balanced audio snake, 5 meters in length, fan to fan.	2
AR34	P.S.C.	PP1.1	Rack space custom panel – panels and connectors per EPS4.1	1
AR35	P.S.C.	PP1.2	Rack space custom panel – panels	1

			and connectors per EPS4.1	
AR36	**P.S.C.**	**PP1.3**	**Rack space custom panel – panels and connectors per EPS4.1**	**1**
AR37	**P.S.C.**	**PP2.1**	**8"x8" custom panel – connectors per EPS 4.1 Lower Booth**	**1**
AR38	**P.S.C.**	**PP2.2**	**8"x8" custom panel – connectors per EPS 4.1 Under Balc.**	**1**
AR40	**P.S.C.**	**PP2.3**	**8"x8" custom panel – connectors per EPS 4.1 Stage Apron**	**1**
AR40	**P.S.C.**	**CAM 1.1**	**2G custom plate for camera connection**	**1**
AR41	**P.S.C.**	**D1.x**	**1G custom plate for lighting network**	**As req**
AR42	**P.S.C.**	**IC1.x**	**1G custom plate for production intercom**	**As req**
AR43	**P.S.C.**	**ST1.x**	**2G custom plate for loudspeaker connection**	**As req**
AR44	**P.S.C.**	**ST2.x**	**1G custom plate for loudspeaker connection**	**As req**
2.40.7 Audio Equipment Production Intercom				
Item	**Make**	**Model**	**Description**	**Qty**
Icom 1	**P.S.C.**	**PLACEHOLDER - Generic**	**Panelcrafters 1-Gang Plate w/ 2 XLR Intercom Connectors**	**5**
Icom 2	**Clear-Com**	**MS-702**	**Encore 2 Channel Headset/Speaker Main Station. Rack Mount 1RU.**	**1**
Icom 3	**Clear-Com**		**Clear-Com GM-9 Gooseneck Mic**	**1**
Icom 4	**Clear-Com**		**Clear-Com RS-702 Dual Listen Beltpack**	**11**
Icom 5	**Clear-Com**		**Clear-Com CC-40 Economy Single Ear Headset**	**11**
Icom 6	**Clear-Com**		**Intercom Wall Plate**	**11**
2.40.8 Audio Acoustic System				
Item	**Make**	**Model**	**Description**	**Qty**
AS1	**Audix**	**SCX-1-C**	**Suspended cardioid microphone**	**8**
AS2	**Audix**	**SCX-1-O**	**Suspended omni microphone**	**4**
AS3	**Yamaha**	**AFC402-E**	**AFC ENHANCE Processor for projects with up to two sub-systems - TENTATIVE PRICING PENDING APPROVAL**	**1**
AS4	**Yamaha**	**TIO1608**	**16 input x 8 output mic/line interface with Dante**	**1**
AS5	**Yamaha**	**SWR2310-28GT**	**Dante Switch ER1.1 L2 Intelligent Network Switch (28 ports) with 10G uplink**	**1**
AS6	**Yamaha**	**XMV8280D**	**8-Channel Amplifier**	**12**
AS7	**Yamaha**	**VXS-8W**	**Surface mount loudspeaker (Proscenium) (Pair) 8" 2-Way Surface Mount Speakers, White Version (Pair) 8" 2-Way Surface Mount Speakers, White Version Custom paint per architect color selection**	**3 pair**

AS8	**Yamaha**	**VXS-8W**	**Surface mount loudspeaker (Upper side walls) (Pair) 8" 2-Way Surface Mount Speakers, White Version (Pair) 8" 2-Way Surface Mount Speakers, White Version Custom paint per architect color selection**	**6 pair**
AS9	**Yamaha**	**VXS-8W**	**Surface mount over balcony (Pair) 8" 2-Way Surface Mount Speakers, White Version (Pair) 8" 2-Way Surface Mount Speakers, White Version Custom paint per architect color selection**	**4 pair**
AS10	**Yamaha**	**VXS-5W**	**Surface mount over balcony (Pair) 5" 2-Way Surface Mount Speakers, White Version Custom paint per architect color selection**	**5 pair**
AS11	**Yamaha**	**VXS-5W**	**Surface mount under balcony (Pair) 5" 2-Way Surface Mount Speakers, White Version custom paint per architect color selection**	**14 pair**
AS12	**Yamaha**	**VXL1W-8**	**Surface mount side walls - Line Source Loudspeaker, 8 Drivers, White Version. Custom paint per architect color selection**	**16**
AS13	**Yamaha**	**IS1112W**	**Surface mount subbass Custom paint per architect color selection**	**4**
AS14	**Yamaha**	**IF-2105**	**Over stage loudspeakers - supply with u-bracket**	**18**
AS15	-	**UB2205**	**U Bracket for IF2205**	**18**
AS16	**Yamaha**	**AFC TUNING**	**AFC Tuning Fee**	**1**
AS17	-	**AFC CHFEE**	**AFC TUNING Additional Fee per Channel**	**77**
2.40.9 Video & Control Equipment			-	-
Item	**Make**	**Model**	**Description**	**Qty**
V1	**Vaddio**	**Roboshot 30EQDVI**	**Camera**	**1**
V2	**Vaddio**	**Quick-Conn DVI**	**Camera Extension**	**1**
V3	**Draper Inc**	**121223**	**LVC-III/LVC-S Low Voltage Control Module w/Single Station**	**1**
V4	**Tascam**	**Tascam BD-01U Blu-Ray**	-	**1**
V5	**Crestron**	**AM-200**	**Media Player**	**1**
V6	**Comprehensive Video Group**	**BBD1694-25B**	**Premium Belden 1694A Digital Video RG6 Cable, BNC Plug to Plug, 25Ft**	**2**
V7	**Comprehensive**	**HD-HD-6PROBLK**	**Professional Series Commercial Grade CL3 Rated 26 AWG High Speed HDMI Cable with Ethernet 6' Long**	**5**
V8	**Comprehensive Video Group**	**HD-HD-15EST**	**Standard Series High Speed HDMI Cable 15Ft**	**2**
V9	**Comprehensive Video Group**	**MVGA15P-P-15HR/A**	**HR Pro Series Micro VGA HD15 Plug to Plug w/Audio Cable 15Ft**	**2**

V10	Comprehensive Video Group	CAT5-350-10BLK	Cat5e 350 Mhz Snagless Patch Cable 10ft Black	12
V11	Chief Manufacturing Inc	WMA2S	Heavy Duty Wall Mount Accessory Arm, Double Stud, Extends 13-21"	1
V12	P.S.C.	Necessary Fastening Hardware, Accessories		1
V13	P.S.C.	Epson Pro L1505UNL Projector		1
V14	P.S.C.	Epson Lens: ELPLW06/W04		1
V15	P.S.C.	Da-Lite Motorized Projection Screen 180" x 288" 27259C		1
V16	P.S.C.	Unistrut, Misc. 1-1/2In. NPS Pipe and Ceiling Mounting Hardware		1
V17	Windy City Wire	002370-WPW25234	18-03 UNS STR CMP Wht Jkt	250
V18	Platinum Tools	EZ-RJ45 Shielded Cat5e/6 Connector, 8-Cond. Modular Plug w/External Ground, Per/Unit Price		20
V19	P.S.C.	Vaddio RoboSHOT 30 Q-USB Camera System		1
V20	Crestron Electronics	DM-TX-4K-100	DigitalMedia 8G+® 4K60 4:4:4 HDR Wall Plate Transmitter, Black	3
V21	P.S.C.	Panelcrafters DM-TX Input Rack Panel		1
V22				
V23	Crestron Electronics	DM-MD8X8	8x8 DigitalMedia Switcher Requires DMC Series Input Cards & DMCO Series Output Cards 4RU	1
V24	Crestron Electronics	DMC-4KZ-CO-HD	2-Channel 4K DigitalMedia 8G+ Output Card for DM Switchers with support for HDCP 2.2	2
V25	Crestron Electronics	DMC-4K-HDO	2-Channel 4K Scaling HDMI Output Card for DM Switchers.	1
V26	Crestron Electronics	DMC-4KZ-HD-HDCP2	4K HDMI® HDCP2 Input Card for DM® Switchers	2
V27	Crestron Electronics	DMC-4K-C-HDCP2	HDBaseT Certified 4K DM 8G+ HDCP2 Input Card for DM Switcher	4
V28	Crestron Electronics	DM-RMC-4K-SCALER-C	4K DigitalMedia 8G+® Receiver & Room Controller w/Scaler	3
V29				
V30	DataVideo	TLM-102	Dual 10" Video Monitor	1
V31	P.S.C.	Panelcrafters Rack Panel for Monitor		1
V32	Extron	SMP351	60-1324-01 H.264 Streaming Media Processor	1
V33	Comprehensive	HD-HD-6PROBLK	Professional Series Commercial Grade CL3 Rated 26 AWG High Speed HDMI Cable with Ethernet 6' Long	5
V34	Comprehensive Video Group	HD-HD-15EST	Standard Series High Speed HDMI Cable 15Ft	3
V35	Comprehensive Video Group	MVGA15P-P-15HR/A	HR Pro Series Micro VGA HD15 Plug to Plug w/Audio Cable 15Ft	3
V36	BTX	CD-DB9M	DSUB 9-Pin Male sldr (requires hood)	1
V37	BTX	CD-MX915H	Hood for MaxBlox HD15 & DB9	1

ADDENDUM NO. 1

V38	West Penn	WPW 254245F/WND 555630	24 AWG.- 4 PAIR Solid bare copper conductors, Shielded with an overall jacket, Plenum. Black Jacket	1500
V40	Platinum Tools	PLT100023_X X	EZ-RJ45 Shielded Cat5e/6 Connector, 8-Cond. Modular Plug w/External Ground, Per/Unit Price	20
V40	Cisco	Cisco CBS350-XFP	Network switch #1,#2,#3 for control in ER2.1, ER2.2, ER1.1 - size ports as required	3
V41	Crestron	CP4N	control processor	1
V42	Crestron	TSW-760	Touch panel	3
V43	Netgear	WNDR3400-11NAS	Wireless Access Point for audio	1
V44	Lowell	SEQ-4	4 step sequencer	1
V45	Lowell	SEQ-8	8 step sequencer	1
V46	Lowell	RCP-20	20A relay control recepical	10
V47	Lowell	ACR-1506-LTS	Power strip	2
-	-	-	-	-
2.40.10 Curtains			-	-
Item	Make	Model	Description	Qty
C1	P.S.C.	PLACEHOLDER - Generic	ADC 2928S Motor for Grand	1
C2	ADC	#280	Complete Steel Track, Per Ft., (20 Ft. Minimum)	as req
C3	ADC	#281	Complete Steel Track, Per Ft., (20 Ft. Minimum)	as req
C4	ADC	#2928S	Curtain Motor	1
C5	Stage Decoration	PLACEHOLDER - Generic	50 x 8 Grand Valance 75% Fullness, IFR Charisma Fabric	1
C6	Stage Decoration	PLACEHOLDER - Generic	2P - 18' x 28' Grand Drape 75% Fullness Charisma Fabric	2
C7	Stage Decoration	PLACEHOLDER - Generic	54 x 5 Borders 50% Fullness 20oz Crescent Fabric	4
C8	Stage Decoration	PLACEHOLDER - Generic	8' x 19' Legs 50% Fullness 20oz. Crescent Fabric	6
C9	Stage Decoration	PLACEHOLDER - Generic	2P - 28' x 19' Mid Stage 50% Fullness 20oz Crescent Fabric	2
C10	Stage Decoration	PLACEHOLDER - Generic	2P - 28' x 19 Up Stage 50% Fullness 20oz. Crescnet Fabric	2
C11	Stage Decoration	PLACEHOLDER - Generic	46' x 19' Seamless FR Cotton Muslin Cyc	1
2.40.11 Stage Lighting - Place Holder			-	-
Item	Make	Model	Description	Qty
L1	P.S.C.	PLACEHOLDER - Generic	12/32 SO Multi Cable	as req
L2	SSRC	517	Kellums Grip (1.5In. - 1.7In.) 	8
L3	SSRC	517-1	Eye Kellums Grip (1.5In. - 1.7In.) 	8
L4	West Penn	25236B WPW	Plenum 3-Cond. 14 AWG Cable (for non-powered Unison)	2300

L5	West Penn	254246F	Plenum Rated STP, 100% Foil Shield, 4 Pair 23AWG, Cat6 Cable, Black	2400
L6	ETC	-	High End Systems Hedgehog 4	1
L7	Rapco	NBGDMX5-15	2 Pair 24 Gauge DMX Cable, Neutrik 5-pin Connector, 15Ft	as req
L8	Light Source	MAB	MegaClamp C-Clamp for 1"-2" Pipe, Black Anodized Finish	as req
L9	Rapco	NBGDMX5-15	2 Pair 24 Gauge DMX Cable, Neutrik 5-pin Connector, 15Ft	as req
L10	Light Source	MAB	MegaClamp C-Clamp for 1"-2" Pipe, Black Anodized Finish	as req
L11	Rapco	NBGDMX5-15	2 Pair 24 Gauge DMX Cable, Neutrik 5-pin Connector, 15Ft	as req
L12	ETC	-	CEM3 Retro Upgrade Kit	1
L13	ETC	-	R20 Relay Modules	48
L14	ETC	-	RSN-LV Response 0-10V Gateway	1
L15	ETC	-	RSN-DMX-0-P-4 Response MK2 Portable Gateway with C-clamp	12
L16	ETC	-	E1002 Echo Inspire 2- Button Wall Stations	2
L17	ETC	-	E1006 Echo Inspire 6 – Button Wall Station	2
L18	ETC	-	ETS EchoTouch Touch Panel Controller with Power Supply and Back Box	1
L19	Cisco	-	SG350-28MP Network Switch	1
L20	Necessary Patch Bay, Patch Cables, EtherCon Cables, DMX Cables and wall plates for working system -			1
L21	Canto	-	200 MSR Followspots 11857180	1
L22	ETC	-	9940-12BP/6-R 40’ Connector Strip	1
L23	SSRC	-	6 Cct. Grid Iron J-Box with 60’- 6 Cct. SO Cable w/ Kellums, Veam Connector, Cable Picks w/Pulley Blocks and Counter weight	6
L24	Veam	-	6 Cct., 6’ Fan-out Cables with GSP Connectors	6
L25	ETC	-	9102B-OU 2 Cct. GSP Plug Box w/ U-Bolt and Offset Bracket	2
L26	Light Source	MAB	MegaClamp C-Clamp for 1"-2" Pipe, Black Anodized Finish	30
L27	ETC	Colorsource Spot	LED stage lighting fixture with DMX. Include one 10’ PowerCON/DMX combo jumper cable per fixture	30
L28	ETC	Colorsource	10 Degree Lens Tube	10
L29	ETC	-	14 Degree Lens Tube	12
L30	ETC	-	26 Degree Lens Tube	4
L31	ETC	-	4 Degree Lens Tube	4
L32	ETC	Colorsource Par	LED stage lighting fixture with DMX. Include one 10’ PowerCON/DMX combo jumper cable per fixture	42

ADDENDUM NO. 1

L33	ETC	Colorsource Cyc	LED stage lighting fixture with DMX. Include one 10' PowerCON/DMX combo jumper cable per fixture	12
2.40.12 Stage Rigging				
Item	Make	Model	Description	Qty
Rig 1			Turnkey system as shown on EPS Drawing Set from SRS Systems.	1
Rig 2			Custom Line Shaft batten lift system	1
Rig 3			Custom Dead Hung batten system	1
Rig 4			Removal of existing grid	1
Rig 5			Contact Les Martin: lmartin@srsrigging.com	
2.40.13General list of wire and connector types:				
Item	Make	Model	Description	Qty
G1	West Penn	25291B-BK	2-Cond. 22 Awg Plenum Shielded Audio Line Level Cable with black Jacket	as req
G2	West Penn	D25430	Plenum Two Individually Shielded Pairs of 22 Ga. Conductors with Drain Wire,	as req
G3	West Penn	25225B	2-Cond. 16 Awg Plenum-Rated Speaker Cable: 70V Loudspeakers	as req
G4	West Penn	25226B	2-Cond. 14 Awg Plenum-Rated Speaker Cable: Acoustic System Loudspeakers	as req
G5	West Penn	25227B	2-Cond. 12 Awg Plenum Speaker Cable: Main Left and Right Arrays	as req
G6	West Penn	25210	2-Cond. 10 Awg Plenum-Rated Speaker Cable: Main Subbass	as req
G7	WPW	254245	Plenum-Rated Cat 5e Cable	as req
G8	Belden	9729	DMX Control Cable	as req
G9	Neutrik	NC3FDL-1-BAG-O	XLR Female Panel latchless	as req
G10	Neutrik	NC3MDL-1-BAG	XLR Male Panel	as req
G11	Neutrik	NC-3MX-BAG	XLR Female Cable	as req
G12	Neutrik	NC-3FX-BAG	XLR Male Cable	as req
G13	Switchcraft	3505F	Phono Panel	as req
G14	WECO		RJ45 Panel	as req
G15	Neutrik	NL4MP or NL4MPR	4 conductor speaker panel	as req
G16	Neutrik	NL4MX-BAG	4 conductor speaker cable	as req
G17	Proco	Plateworks	Stainless Steel	as req
G18	WECO	323-HDS/12	Eurostyle Screw Terminal Strip, 12 Circuit, Accepts 20-12 AWG Wire	as req
2.40.14 Orchestra Shell Towers - Per Appendix 1				
Item	Make	Model	Description	Qty
OT1	Wenger	Legacy	6'W x 13'6"H folding tower - painted	12
OT5	Wenger	Diva	8'x8' Curved reflective ceiling diffuser.	7

PART 3 – EXECUTION

3.1 ACCURACY OF DATA

A. It shall be the sole responsibility of the Contractor to verify all dimensions, take his own field measurements, and install all work to suit conditions encountered on the job site.

B. The drawings are generally diagrammatic and except where dimensions are indicated are not intended to show exact locations of outlets, conduits, etc. All work shall be installed as nearly as possible in the locations indicated, with minor adjustments as required to avoid interferences with structure or the work of other trades.

C. Prior to beginning work, the Contractor shall carefully examine all construction drawings and the job site and report to the Owner any discrepancies or interference that may be discovered. If, during the course of construction, any such discrepancies or interferences are noted, the Contractor shall promptly report them to the Owner. Failure to report such discrepancies or interferences shall result in the correction of the same at the Contractor's expense. All work under this specification, which either interferes with the architectural or any other work or deviates from the drawings and specifications without prior approval of the Owner, shall be altered by the Contractor at his expense. These alterations shall clear such interferences or shall comply with the drawings and specifications as directed by the Owner.

3.2 MECHANICAL

A. Except for portable equipment, all other equipment must be permanently installed. This shall include equipment racks, speakers, cables, etc. Fastenings and supports must provide a safety factor of at least three times that required for safe support. Precautions must be taken to prevent electrostatic and electromagnetic hum and radio frequency interference. All electronic equipment must be easily accessible and have adequate ventilation.

B. The rigging of loudspeaker arrays and speakers shall be performed by a rigging professional and hung and supported by approved industry standard equipment.

3.3 CONNECTIONS

A. All low voltage wiring connections must be made with rosin core solder or mechanical connectors as specified. Terminations on all cable must be dressed properly with shrink tubing. All low voltage control level connections to terminal blocks are to be made with crimp on spade lugs. All crimp on connectors must be fastened with the proper tool as specified by the manufacturer. Improper crimping will be cause for rejection. All "drain" wires on microphone and line level terminations are to be properly dressed using transparent shrink tubing to avoid the possibility of shorting "whiskers".

3.4 LABELS

A. All wiring is to be numbered on both ends with “EZ Code” type markers. Wire numbers are to be secured with transparent shrink tubing. Wire numbers are to follow a logical sequence and are to be listed on the proper document. “Brady” type labels are acceptable.

3.5 DOCUMENTATION

A. Upon final completion of the system a documentation package is to be turned over to the Owner and include the following items:

1. System signal flow diagrams (for audio, video, and control) showing all components, interconnections, and connector types and wire numbers. As-built revisions are to be noted on the submittal drawings.
2. Manufacturer instruction manuals for all electronics.
3. Product specification sheets for all equipment without instruction manuals such as microphones, loudspeakers and lighting instruments.

ADDENDUM NO. 1

4. Copies of the proof of performance data. Provide one original (no photocopies) and one copy (photocopies are acceptable) of the total documentation package.
5. A single copy of the system signal flow diagram with wire numbers indicated is to be laminated and posted in the door of the sound equipment rack.
6. Special documentation is required as part of the Owner training and operation of the systems. This documentation is to consist of an instruction sheets that describe the operation of the system from the stage. Each instruction sheet is to be step by step "cookbook" with touchscreen panel screen shots with arrow indicators that describe step and function. A laminated poster version of this instruction sheet is to be mounted on the side of each equipment rack. The bullet points detailed on this sheet include:
   a. Turning on system power.
   b. Select desired source.
   c. Adjust volume levels
   d. Select lighting presets (where applicable)
   e. Recording stop/start functions (where applicable)
   f. VTC calling functions (where applicable)
   g. Other functions of the Owner control panel.

3.6 CLEAN UP

A. During construction periodically remove discarded containers and refuse from the job site. At the completion of the job the sound system components and equipment areas are to be left clean and neat and all refuse removed from the site.

3.7 SOUND SYSTEM TEST AND MEASUREMENT

A. The contractor is to conduct a performance verification test for the Owner. The contractor must complete the installation and verify that it is in working order and conforms to the following performance criteria. These performance standards are set forth as an indication of a properly installed and functioning sound system. It is implied through his action of submitting a bid that the contractor has reviewed these documents and is in agreement with the concept and execution of the design of the specified sound system. No financial adjustments will be allowed for discrepancies discovered after bid is accepted.
   1. In rooms where voice lift or voice reinforcement is required, there is a programmable DSP in the system. The contractor is expected to tune the system to eliminate any hot frequencies in the room that would cause premature feedback as well as blemish the sound quality of the microphones.
   2. Microphone line resistance: Less than 1.7 Ohms with short at input jack. Measured from mixer end of microphone cable. Measure with Ohm meter.
   3. Maximum amp output: 100% of rated power at less than 0.25% THD. Measure with distortion analyzer.
   4. Signal to noise ratio: Better than 80 dB or an absolute noise level less than 62 dBm for systems with +18 dBm maximum line operating level. Measured at amplifier input with RMS voltmeter with dB scale.
   5. Audio frequency response: +/- 1 dB 50 Hz to 15 kHz control equalizer set flat and room equalizers switched out – Microphone input to amplifier output. Measure with RTA.
   6. Polarity: All microphones and source equipment are to be wired so as to be in absolute polarity with the loudspeaker systems. Measure with polarity checker.
   7. Synchronize delay and fill systems to within 15 milliseconds of first arrival of primary loudspeaker system as measured on Smaart or TEF measurement systems.
   8. Acoustic coverage: Maximum +/- 3 dB SPL variance front to rear / side-to-side in audience area through the 4 kHz full octave band. Measure with octave band Sound Level Meter.
   9. Acoustic amplitude response: With the room equalizers switched in +/- 3 dB maximum deviation from the following curve averaged from three test positions in the audience area flat 60 Hz to 2 kHz, 10 dB at 50 Hz and 12 kHz. Measure with RTA.

10. Electroacoustic gain: No less than 15 dB from 500 Hz to 4 kHz with one microphone and 12-inch source to microphone distance. Gain is to be measured 50 feet from the source. Measure with Sound Level Meter.
11. Maximum sound level: Greater than 85 dB-C for large conference spaces when amplifier occasionally clips on program peaks. Measure with Sound Level Meter.
12. Acoustic noise floor: No audible hum, hiss, or R.F. interference shall be audible under normal room conditions in audience seating area and stage or platform areas.
13. All loudspeakers are to exhibit the same acoustic polarity. Measure with Polarity Checker (Galaxy Cricket).

3.8 VIDEO SYSTEM PROOF OF PERFORMANCE

A. Verify all devices and cables match information on final drawings
B. Test all inputs on video switcher / scaler.
C. Adjust Color Temperatures on projectors to accurately reproduce NTSC and RGBHV Data Color Bars.
D. Adjust projector images to match screen size, eliminating any overscan, underscan or keystone.
E. Adjust all switching functions to eliminate sync roll or glitches upon switching.
F. Test all video sources for full operation. Test all data sources up to maximum projector frequency.
G. Test audio output of switcher scaler. Verify that all input audio levels are equal. Verify maximum audio output not to exceed +4dB.
H. Verify there are no 60hz grounding interference aka “humbars” existing in displayed images.
I. Optimize projector contrast, sharpness and brightness to avoid blooming and achieve optimal black level.
J. Commissioning of Digital Media System by certified Digital Media Engineer.

3.9 LIGHTING SYSTEM COMMISSIONING

A. Commissioning by ETC Certified Specialist

END OF AUDIO VIDEO AND LIGHTING SYSTEMS FOR 27 41 16

APPENDIX 1 – ORCHESTRA SHELL SPECIFICATIONS

PART 1 GENERAL

Supply and coordinate orchestra shell tower equipment with Wenger Corporation, 555 Park Drive, Owatonna, MN 55060-4940, 505-455-4100. - Jeff Frost Jeff.Frost@wengercorp.com.

PART 2 EQUIPMENT

2.2 SECTION INCLUDES.

2.2.1 Theater and stage equipment including the following:
2.5Acoustical clouds.
2.6Acoustic tower, Legacy Select Acoustic Tower.

2.3 RELATED SECTIONS

2.3.1 Section 05 50 00 - Metal Fabrications.

2.3.2 Section 06 10 00 - Rough Carpentry.

2.3.3 Section 09 22 16.13 - Non-Structural Metal Stud Framing.

2.3.4 Division 16 - Electrical for power wiring.

2.4 REFERENCES

2.4.1 American Hardboard Association (AHA):
2.5AHA A135.4-95: Basic Hardboard.

2.4.2 American Plywood Association (APA).
2.5Performance Standards and Policies for Structural Use Panels.

2.4.3 American Society of Civil Engineers (ASCE):
2.5ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

2.4.4 Architectural Woodwork Institute (AWI):
2.5Quality Manual, 8th Edition.

2.4.5 ASTM International (ASTM):
2.5ASTM A36/A 36M - Standard Specification for Carbon Structural Steel.
2.6ASTM A500 -Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
2.7ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.
2.8ASTM A1011 - Standard Specification for Steel, Sheet and Strip, Hot Rolled, Carbon, Structural, High-Strength Low Alloy, High-Strength Low Alloy With Improved Formability, and Ultra High Strength.
2.9ASTM B85 - Standard Specification for Aluminum Alloy Die Castings.
2.10 ASTM B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
2.11 ASTM B221 - Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
2.12 ASTM B429 - Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
2.13 ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
2.14 ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2.15 ASTM E 413 - Classification for Rating Sound Transmission.

2.4.6 International Building Code (IBC).
2.5IBC 2018, Chapter 8.

2.4.7 National Association of Architectural Metal Manufacturers (NAAMM): Metal Finishes Manual for Architectural and Metal Products.

2.4.8 National Electrical Manufacturers Association (NEMA): NEMA LD 3-2000 - High Pressure Decorative Laminates.

2.4.9 U.S. Department of Commerce, National Institute of Standards and Technology: DOC PS 1: U.S. Product Standard for Construction and Industrial Plywood.

2.4.10 US Green Building Council (USGBC): Leadership in Energy and Environmental Design (LEED).

2.5 SUBMITTALS

2.5.1 Submit under provisions of Section 01 30 00 - Administrative Requirements.

2.5.2 Product Data: Manufacturer's data sheets on each product to be used, including:
- 2.5 Provide test results by certified independent testing laboratory indicating compliance with performance requirements.
- 2.6 Rated capacities, construction details, material descriptions, dimensions of individual components, profiles, and finishes.
- 2.7 Maintenance instructions and recommendations.
- 2.8 Acoustical testing data demonstrating minimal compliance with required acoustical performance criteria.
- 2.9 Photometric data for light fixtures, if applicable to the product.

2.5.3 LEED Submittals:
- 2.5 Manufacturer's certificate indicating that composite wood products and adhesives contain no added urea formaldehyde.
- 2.6 Manufacturer's certificate indicating percentages by weight of post-consumer and pre-consumer recycled content. Include statement indicating costs for each product having recycled content.
- 2.7 Credit EQ 4.4: Manufacturer's Signed Confirmation indicating that composite wood products and adhesives used in acoustical shells contain no urea formaldehyde.

2.5.4 Shop Drawings:
- 2.5 Submit component and project specific installation drawings, cut sheets, and schedules showing all information necessary to fully explain the design features, appearance, function, fabrication, installation, and use of system components in all phases of operation. Submit for approval before beginning any fabrication, installation, or erection.
- 2.6 Include fabrication and installation details. Distinguish between factory and field work.
- 2.7 Include plans, elevations, sections, attachments and work by other trades.
- 2.8 Include wiring diagrams when applicable.
- 2.9 Indicate seismic bracing and fastening requirements as applicable.

2.5.5 Product Schedule:
- 2.5 Use designations indicated on the Drawings.
- 2.6 Include room locations, dimensions, accessories, finishes, and project specific notes.

2.5.6 Verification Samples:
- 2.5 Exposed Finishes and Finish Materials: Not less than 4 by 4 inches (102 by 102 mm), for each type, color, pattern, surface and material selected.

2.5.7 Closeout Submittals:
- 2.5 Operation and Maintenance Data: For adjusting, repairing and replacing components and accessories.
- 2.6 Warranty: Submit manufacturer's warranty.
- 2.7 As-Built Drawings: For completed work.

2.6 QUALITY ASSURANCE

2.6.1 Source Limitations: Obtain all products from a single manufacturer through one source providing a comprehensive material and installation package:

2.6.2 Manufacturer Qualifications: Minimum 5 years' experience in design and manufacturing of similar products on projects of similar size, scope and complexity, and with the production capacity to meet the construction and installation schedule.

2.6.3 Installer Qualifications: ESTA-certified and experienced in installation of the work of this sec-

tion and acceptable to the manufacturer and in the regular employ of the manufacturer.

2.6.4 Electrical Components: Listed and labeled per NFPA 70, Article 100 by a testing agency acceptable to Authorities Having Jurisdiction (AHJ).

2.6.5 Regulatory Requirements: Where components are indicated to comply with accessibility requirements, comply with the U.S. Architectural and Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities".

2.7 DELIVERY, STORAGE, AND HANDLING

2.7.1 Deliver materials in manufacturer's original unopened containers with manufacturer's labels attached. Do not deliver material until spaces to receive them are clean, dry, and ready for their installation. Ship to jobsite only after roughing-in, painting and other finishing work has been completed, installation areas are ready to accept work.

2.7.2 Handle and install materials to avoid damage.

2.8 PROJECT CONDITIONS

2.8.1 Environmental Limitations: Do not deliver or install materials until spaces are enclosed and weather tight, wet work in spaces is complete and dry, HVAC system is operating and maintaining ambient temperature at occupancy levels during the remainder of the construction period.

2.8.2 Field Measurements: Verify field measurements as indicated on Shop Drawings. Where measurements are not possible, provide control dimensions and templates.
2.5 Coordinate installation and location of blocking and supports as requested.
2.6 Verify openings, clearances, storage requirements and other dimensions relevant to the installation and final application.
2.7 Where applicable, coordinate locations of electrical junction boxes.

2.8.3 Field Measurements: Verify field measurements as indicated on Shop Drawings. Where measurements are not possible, provide control dimensions and templates.
2.5 Coordinate locations of electrical junction boxes.

2.8.4 Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 3 - PRODUCTS

3.1 MANUFACTURERS

3.1.1 Requests for substitutions shall be considered in accordance with provisions of Section 01 60 00 - Product Requirements.
3.5 Manufacturers seeking approval shall submit the following:
A. Product data, including third-party certified acoustical data and proposed graphic/drawing layout for this project.
B. Project references: Minimum of 5 installations not less than 3 years old, of comparable size, scope and complexity of this project, complete with owner contact information.
C. Sample warranty.
3.6 Submit substitution request not less than required days prior to bid date.
3.7 Approval shall be indicated by issuance of written Addendum.
3.8 Approved manufacturers shall meet separate requirements of Submittals Article.

3.9 Manufacturers' products that are either listed as pre-approved in these Specifications or who have been granted approval as an alternate must still demonstrate all of the material performance and operational characteristics required by this Section.

3.2 ACOUSTICAL CLOUDS

3.2.1 Basis of Design: DIVA Acoustical Clouds as manufactured by Wenger Corporation.

3.2.2 Acoustical Panel Sound Transmission: Provide third party test results indicating acoustical shell system comprised of acoustical shell panels have the following sound transmission requirements:

3.5 Sound Transmission Class (STC): Minimum 21 per ASTM E 413.

3.2.3 Materials:

3.5 Aluminum Extruded Bars, Profiles, and Tubes: ASTM B 221 (ASTM B 221M), 6063T alloy.

3.6 Steel Tube: ASTM A 501, hot formed steel tubing.

3.7 Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B.

3.8 Veneer-Faced Panel Products (MDF core): Meets all CARB-2 requirements for formaldehyde emissions.

3.9 Hardboard: AHA A135.4, Class 1 Tempered - formaldehyde free.

3.10 High-Pressure Decorative Laminate: NEMA LD 3, Grade VGS.

A. HPDL with urea formaldehyde-free adhesive.

3.2.4 Acoustical Cloud Panels: Manufacturer's standard stressed-skin composite acoustical cloud panels, with STC meeting performance requirements, designed to mix and blend sound and reflect a maximum range of audible frequencies to audience.

3.5 Core: 1-1/2 inches thick (38 mm) honeycomb core material shall have an open geometric pattern with cell walls vertical to panel skins and defined by alternating straight and sine wave layers. Height of sine wave shall be 1/2 inch, wall thickness shall correspond to 60 lb kraft. Bonding of core material to panel faces shall be with permanently cured urethane adhesive. Foam core materials and contact adhesives shall not be permitted.

3.6 Back: 3/16 inch (4.8 mm) thick hardboard stressed skin, painted black.

3.7 Panel Edge Frame: Straight panel edges are reinforced with extruded aluminum edge frame.

3.8 Acclimate panel face and back materials in a temperature and humidity controlled environment for a minimum of 72 continuous hours so that they reach appropriate equilibrate condition prior to lamination to improve dimensional stability of finished laminated panels.

A. Documentation of specified process must be available for review.

3.2.5 Overhead Sound Reflecting Acoustical Cloud: Acoustical cloud panels suspended directly from overhead supports.

3.5 Cloud Panel Size and Configuration: As indicated.

3.6 Cloud Panel Face Finish:

A. Hardwood Plywood Veneer: Plain sliced, slip-matched and balance matched to maintain a uniform leaf width across the full width of the panel.

1. Veneer must be a minimum of 80+ or 85+ grade. Grade A veneer, or veneer of a lesser grade, is not acceptable.
2. Sort veneer by grain density, grain structure, and color.
3. Clip around character marks to minimize pin knots, mineral, gum, sap, and color variation.
4. Individually clip and hand splice each veneer leaf with the grain cathedrals centered in the middle of each leaf. Veneer leaves with grain cathedrals

not centered shall be rejected as unacceptable for the Work of this Section.

3.2.6 Cloud Suspension: Shackle from each of four corners to overhead supports.

3.2.7 Miscellaneous Supports: Battens, channels, and other miscellaneous supports are part of the work of Division 05 Section "Metal Fabrications."

3.2.8 Acoustical Cloud Installation Accessories:
3.5 Shackles: Rated screw pin shackles.

3.2.9 Finishes:
3.5 Aluminum Framing: Painted.
3.6 Painted Finish for Acoustical Cloud Panel: Sherwin Williams Kem Aqua Paint.
3.7 Transparent Wood Finish for Acoustical Cloud Panel Face: Manufacturer's standard, comparable to AWI custom grade acrylic lacquer.

3.3 ACOUSTIC TOWER (LEGACY SELECT ACOUSTIC TOWER)

3.3.1 Basis of Design: Legacy Select Acoustic Tower as manufactured by Wenger Corporation; mobile acoustical towers.

3.3.2 Materials:
3.5 Aluminum Extruded Bars, Profiles, and Tubes: ASTM B 221 (ASTM B 221M), 6063T alloy.
3.6 Steel Tube: ASTM A 500, hot formed steel tubing
3.7 Hardboard: AHA A135.4, Class 1 Tempered - urea formaldehyde free.
3.8 High-Pressure Decorative Laminate: NEMA LD 3, Grade VGS.
A. HPDL with urea formaldehyde-free adhesive.

3.3.3 Acoustical Shell Panels: Manufacturer's standard stressed-skin composite acoustical shell panels, designed to mix and blend sound and reflect a maximum range of audible frequencies to both audience and performers.
3.5 Core: 3/4-inch (19-mm) thick honeycomb, resin-impregnated, bonded to frame and faces with permanent urethane adhesive. Contact cement adhesive does not meet the requirements of this specification.
3.6 Face, Painted Panel: 3/16-inch (5-mm) thick hardboard stressed skin, material and finish as indicated, with no exposed fasteners.
3.7 Back: 3/16-inch (5-mm) thick hardboard stressed skin, painted black.
3.8 Panel Edge Frame: Extruded aluminum edge angle, along straight edges.

3.3.4 Mobile Acoustical Towers: Free-standing, self-supporting, movable towers. Towers consist of acoustical shell panels with rigid steel frame in nesting configuration. Tower is equipped with removable bottom filler panel that stores on back of tower. Counterweighted tower base, painted black, with non-marring casters.
3.5 Size: 6 feet (1829 mm) wide.
3.6 Height: 11 feet 6 inches (3505 mm).
3.7 Panel Radius: 10 feet (3050 mm).
3.8 Fabrication: Construct panels utilizing nested configuration and folding top to enable nested storage and passage of panel through 34 by 80 inch (864 by 2032 mm) door opening. Equip top panels with compression gas springs to support raising and lowering of panel. Include standard tools required to raise and lower panels.
3.9 Panel Hinges: Self-lubricating ABS bushings and steel framework.

PART 4 - EXECUTION

ADDENDUM NO. 1

4.1 EXAMINATION

4.1.1 Examine installation areas and mounting surfaces with Installer present, for compliance with manufacturer's installation tolerances including required clearances, floor level, location of blocking and anchoring reinforcements, and other existing conditions that may affect installation or performance.

4.1.2 Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

4.1.3 Proceed with installation only after correction of unsatisfactory conditions.

4.2 PREPARATION

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

4.3 INSTALLATION - GENERAL

4.3.1 Install manufactured units in accordance with manufacturer's recommendations, approved submittals, and in proper relationship with adjacent construction.

4.3.2 Clean exposed surfaces. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

4.4 INSTALLATION OF ACOUSTIC ROOM COMPONENTS

4.4.1 Install housings utilizing manufacturer's supplied brackets and fasteners recommended for application. Adjust upper and lower limits individually after installation.

4.4.2 Test electrically operated units to verify that motorized acoustical banner controls, limit switches, and other operating components perform in accordance with manufacturer's written requirements.

4.5 INSTALLATION OF THEATER AND STAGE EQUIPMENT

4.5.1 Install manufactured units in location indicated to verify components are complete and operational. Adjust equipment until satisfactory results are achieved.

4.5.2 Acoustical Cloud Installation: Install auditorium acoustical cloud units plumb, level, and true, in accordance with manufacturer's recommendations and approved submittals. Suspend from overhead structure using specified installation accessories. Clean exposed surfaces of acoustical clouds. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

4.5.3 Acoustical Shell Installation:

4.5Acoustical Shell Towers:

A. Following assembly of all acoustical shell towers, use the transporter to place each acoustical shell tower in its proper playing position location on the stage, as indicated in coordination with Owner's personnel.
B. Verify that all shell tower components including access doors, door locks and telescoping wing-stays are complete and operational.
C. Strike shell tower units following approval of assembled acoustical shell and use air or wheeled transporter to store in shell tower stacking location(s) indicated.

ADDENDUM NO. 1

4.6 Acoustical Shell Ceiling Panels:

A. Suspend each row of acoustical ceiling panels from stage rigging using specified installation accessories, in accordance with manufacturer's recommendations and approved submittals.
B. Install acoustical shell ceiling panel units plumb, level, and true.
C. Verify setting of units in performance and storage positions.
D. Verify adjustability of units.
E. Install, connect, address, commission and test integral lighting.

4.5.4 Orchestra Shell Installation: Install orchestra shell components in accordance with manufacturer's written instructions.

4.5 Position all components accurately as indicated on Drawings and true, plumb, and level.

4.6 Note any deviations required to adjust for field obstructions and report to required persons to incorporate changes into as-built drawings.

4.7 Installation supervisor shall be a currently certified ETCP Rigger for Theatre.

4.8 Utilize only qualified riggers for installation, trim, and adjustment.

4.9 Clean and touch up all field welds and abraded paint finishes with matching materials.

4.6 INSTALLATION OF RIGGING SYSTEMS

4.6.1 Equipment shall be installed by fully trained superintendents and workmen. The Rigging Contractor shall employ Entertainment Technician Certification Program (ETCP) Certified theatre Riggers. Certified Riggers shall, at a minimum, be used as the project manager and site foreman and be responsible for the overall project including the layout, inspection, and on-site user training.

4.6.2 Equipment shall be installed per plans and specifications. Equipment shall be aligned, adjusted, and trimmed for the most efficient operation, the greatest safety and for the best visual appearance.

4.6.3 Standards: Installation practices shall be in accordance with OSHA Safety and Health Standards and all local codes. All welding shall be performed in full compliance with the latest edition of the Structural Welding Code (ANSI/AWS D1.1).

4.6.4 Alignment: Mule blocks, cable rollers and guides shall be installed, as required, to provide proper alignment, to maintain specified fleet angles, and to prevent contact with other surfaces.

4.6.5 Attachments: All equipment shall be securely attached to the building structure.

4.7 INSPECTION AND TESTING OF RIGGING SYSTEMS

4.7.1 Inspection: During the installation of equipment the Rigging Contractor shall arrange for access as necessary for inspection of equipment by the Owner's representatives.

4.7.2 System Pre-Testing By Rigging Contractor: On completion of installation the Rigging Contractor shall conduct a complete test of the system to ensure it is working properly and in conformance with this specification.

4.7.3 Completion Testing: Upon completing the installation, the Rigging Contractor shall notify the Owner or Owner's Representative, who shall schedule inspection and testing of the full rigging system. At the time of testing, the Rigging Contractor shall furnish sufficient workers to operate all equipment and to perform such adjustments and tests as may be required by the Owner's representative. All testing equipment and personnel shall be at the Rigging Contractor's expense. Any equipment, which fails to meet with approval, shall be repaired or replaced with suitable equipment and the inspection shall be re-scheduled under the same

conditions as previously specified. At the time of these inspections, no other work shall be performed in the auditorium and stage areas. All temporary bracing, scaffolding, etc. shall be removed to permit full operation of, and access to, all equipment. Final approval shall be withheld until all systems have been thoroughly tested and found to be in full working order and meets requirements herein.

4.5 Manual counterweight rigging shall be tested in accordance with ANSI E1.4 "Entertainment Technology Manual Counterweight Rigging Systems".

4.6 Powered rigging shall be tested. Each hoist shall be operated over five full continuous cycles at 1.25 times its full working load at full speed and travel distance. The emergency stop function shall be tested at 100 percent WLL in both the ascending and descending directions.

A. Demonstrate that all over travel limit switches have been correctly set for the actual field conditions of the specific project.

B. If it applies to the project, demonstrate that all position encoders have been correctly set for the actual field conditions of the specific project.

4.7 Provide written recommendations to the Owner for necessary repairs or changes not included in the warranty. Provide a copy to the rigging equipment Manufacturer and in the Operations Manual.

4.7.4 The Owner or Owner's Representative shall witness and sign off on the inspection. A copy of the certificate shall be included in the permanent log turned over to the owner.

4.7.5 Upon completion of the work, the Rigging Contractor shall submit 3 copies of a comprehensive Operating and Maintenance Manual including as-built shop drawings, equipment descriptions, and parts lists. The Rigging Contractor shall provide a safety and instruction class with personnel designated by the owner to demonstrate and explain the operation and maintenance of the systems.

4.7.6 Signage with basic operating instructions and warnings shall be posted in the area where the equipment shall be operated. Signage shall be in conformance with ANSI-Z535.

4.8 RIGGING SYSTEMS, FOLLOW-UP INSPECTION

4.8.1 The Contractor shall return to site 12 months and 24 months after system turnover and provide the following services:

4.5 Inspection in accordance with ANSI E1.4-1 Entertainment Technology - Manual Counterweight Rigging Systems, ANSI E1.6-1 Entertainment Technology - Powered Hoist Systems, and ANSI E1.47 - Recommended Guidelines for Entertainment Rigging System Inspections.

4.6 Make all required adjustments.

4.7 Correct all warranty items and provide a written report to the Owner and Manufacturer.

4.8 Provide written recommendations to the Owner and Manufacturer for necessary repairs or changes not included in the warranty.

4.9 Conduct a rigging operation and safety class.

4.10 Subsequent to the 24 month inspection, provide a written proposal for the following year's inspection.

4.9 FIELD QUALITY CONTROL

4.9.1 Inspect installed work to verify compliance with requirements.

4.5 Verify that HVAC work and electrical work complies with manufacturer's submittals and written installation requirements.

4.6 Perform installation and startup checks as recommended by manufacturer.

4.7 Prepare inspection reports and submit to Architect.

ADDENDUM NO. 1

4.10 DEMONSTRATION

4.10.1 Train Owner's personnel to adjust, operate, and maintain equipment. Turn over keys, tools, and operation and maintenance instructions to Owner.

4.11 CLEANING AND PROTECTION

4.11.1 Repair or replace defective work as directed by Architect upon inspection.

4.11.2 Clean surfaces. Touch up marred finishes or replace damaged components that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by manufacturer.

4.11.3 Protect installed products from damage, abuse, dust, dirt, stain, or paint until completion of project. Do not permit use during construction.

END OF APPENDIX 1

SECTION 27 50 10 - INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

A. The scope of work shall consist of providing a complete, operable, local intrusion detection system with **IP connection** to the owner's monitoring company. Provide all labor, equipment, materials, programming, supervision and testing required to complete the work.

1.3 QUALITY ASSURANCE:

A. Acceptable Manufacturer's: This specification is based on a Bosch 7412G4 series system. Equals such as Honeywell Ademco Vista 32FBP and others will be considered on a prior approval basis only.

B. Submittals: Refer to Section 270120 for requirements.

C. Installer Qualification:
   a. Minimum of five years experience installing access control, surveillance and security systems and devices.
   b. After-sales support: The Contractor shall be a factory-authorized and trained dealer of the system and shall be factory-trained and certified to maintain/repair the system after system acceptance. Dealer shall be within a 100 Mile Radius of the facility.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION:

A. The Digital Alarm Communicator System (DACS) specified herein shall include a Digital Alarm Communicator Transmitter (DACT), built-in telephone line monitor, 500 event memory logger, real time clock, calendar, test timer, battery charging / voltage supervision circuitry, battery lead supervision, diagnostics displays, time / event based scheduling system, lightning / EMI protection circuits, and the associated optional modules and components for a complete system.

1. The DACS control panel shall be Bosch Security Systems, Inc.

B. Point Functionality and Expansion:
   1. Each point in the system shall be programmable to provide the following type of response in the system:
      a. Always on (24 hour response).

b. On when the system is Master Armed.
c. Only on when the system is Perimeter Armed.
d. Displays / Does Not Display at the ACC when the point is activated.
e. Provides / Does Not Provide entry warning tone.
f. Sounds / Does Not Sound audible alarm indication.
g. The Point is bypassable / not bypassable.
h. Alarm Verification with programmable verification time.
i. Relay activation by Point.
j. Provides / Does Not Provide "watch point" capability.
k. Provides Swinger Bypass.
l. Defers Bypass Report.
m. Can return to the system after being force armed and then restoring.
n. Can return to the system after being bypassed and then restoring.

2. The DACS shall be capable of supporting "group zoning." Group zoning refers to the combining of points into a separately identifiable and separately annunciated (programmable text) areas.
3. The DACS shall be capable of allowing variable point response times via programming. Point response times shall be programmable over a range of 300 milliseconds to 4.5 seconds.
4. The DACS shall have the capability to expand up to 75 separately identifiable points, of which 8 are on-board and 67 are off-board addressable points connected to multiplexed backbone trunks via wired modules and/or wireless receivers.
   a. The 8 on-board points shall be able to accommodate powered class B functionality using a powered loop interface module.
   b. Point Expansion Modules (Wired and Wireless) shall be able to be located remote to the main panel to a maximum distance of 1000 feet.
5. Capability to expand up to 40 separately-identifiable points of which 8 are on-board points and 32 are off-board addressable points connected to point expansion modules and/or wireless receivers.
6. Capability to expand up to 24 separately-identifiable points of which 8 are on-board points and 16 are off-board addressable points connected to point expansion modules and/or wireless receivers

C. Areas/Accounts:
1. The DACS shall support 8 independent areas.
2. The DACS shall be capable of linking multiple areas to a shared area which may be automatically controlled (hallway or lobby).
3. The DACS shall accommodate conditional area arming dependant on the state of other areas (master or associate). Any area can be configured for perimeter and interior arming, not requiring a separate area for this function.

D. Output Relay Expansion: The DACS shall provide the capability for output relay expansion using relay expansion modules. Independent control of relay functions by area shall be possible through programming assignments

E. Scheduling: The DACS shall support scheduling capabilities with the following characteristics:
1. Arm / Disarm specific area(s) based on open/close windows.
2. Bypass / Unbypass point(s).
3. Activate / Deactivate relay(s).
4. Send test reports.
5. Up to 4 programmable holiday schedules of 366 days each (includes leap year). Based on the holiday settings, different time windows for open/close and other system functions can be executed.

6. Automatic adjustment of system clock for daylight savings time.
7. Turn an Access Authority Level On / Off.
8. Hold a Door Open (unlocked and shunted).
9. Secure a Door Closed (locked, no valid cards will allow entry).
10. Return a Door to Normal Operation (locked, valid cards will allow entry).
11. Turn recording of Access Granted events On/ Off (and transmittal if routing is ON).
12. Turn recording of Access Denied events On/ Off (and transmittal if routing is ON).

F. Alarm Command Centers:

1. The DACS shall accommodate connection with up to 8 ACCs, each capable of displaying custom English text on liquid crystal or vacuum fluorescent (VF) displays.
2. The ACC's shall be capable of displaying point status, arm/disarm status, and carry out user command functions.
3. The ACC can be programmed to respond to the entry of any of the specifically authorized user passcodes.
4. The ACCs shall be able to be configured to control a specific area, or group of areas, or all areas in the system.
5. The ACCs shall be able to be temporarily re-addressed to view the status of a remote area.
6. The ACC's shall be able to provide different audible tones for Intrusion, Fire alarms, and system troubles

G. User Passcodes and Authority: Passcodes shall be programmable with authority levels to allow users to operate any or all areas

H. Communication: The DACS shall be capable of reporting system events and supervisory reports including alarm, trouble, missing modules, restorals, system status, AC failure, battery status to primary and secondary off-site DACR's.

I. Network Communication: The DACS shall be capable of network communications over a LAN, WAN, Intranet, or the Internet. The system shall include supervision of the network communication utilizing configurable periodic heartbeats to the Digital Alarm Communications Receiver (DACR). The DACR shall provide notification of the loss of communications from a networked system after a programmable timeframe since the last communication.

J. Event Log: The DACS shall maintain a log of events indicating time, day, month, year type of event, account number, area number, user ID, point text, user text and primary/secondary event route. The system shall allow the following characteristics:

K. Testing, Diagnostic, and Programming Facilities: The DACS shall be capable of sending (manually or automatically) test and status reports to remote DACRs.

L. Primary power: The Contractor shall provide a dedicated 120 VAC power circuit to the DACS system. This circuit shall be connected to the emergency power system. The 120 VAC is stepped down to power the DACS panel using a class two, plug-in transformer. This power circuit shall be properly rated to continuously power all points and functions indefinitely in full alarm condition.

M. Primary power supervision: When the primary power source fails, the system can be configured to report an "AC Fail" message to a commercial central station.

N. Secondary power (standby battery): The Contractor shall provide adequate battery power as defined by the relevant application criteria, (UL 864 and UL 985 for alarm installations or

NFPA 72 chapters for fire applications). Appropriate battery chargers shall be provided consistent with the battery back-up capacity. The most current accepted version of NFPA 72 and any applicable local codes or AHJ requirements must be met accordingly.

O. Wiring: The contractor shall provide cables consistent with the manufacturer's recommendations. Exposed wiring shall be installed in conduit.

2.2 ACCESSORIES:

A. SYSTEM HARDWARE DESCRIPTION:

1. DACS System: The DACS shall be provided, at minimum, with the following components and specialized services in the quantities and capacities required to achieve the level of operation specified for the number and types of devices indicated. Additional accessories shall be provided based on the quantities and features required for the application.

2. Annunciation Devices (Keypads):
D1255: Alarm Command Center (ACC) - Built-in multi-tone sounder. Displays status in custom English text on 16 character display. ACCs provide "command menu" user interface. ACC can be supervised. **[**Provide five; install four in the locations indicated and one spare.**]**

3. Motion Sensors:
a. Corridor Unit:
- Bosch DS720i Tri Tech 300 ft range.(Supply with a 8127U addressable Module)
- Bosch ISC-PDL1 Tritech 80 ft. range. (Supply with a 8127U addressable Module)

b. Room Unit: Bosch ISC-PDL1 Tritech Motion detector. (Supply with a 8127U addressable Module)

c. Gym and Multipurpose rooms: DS9730 PIR (up to 25ft Mounting height) (Supply with a 8127U addressable Module)

4. Magnetic Door Contacts: Bosch ISN-CTC75 (Supply with addressable module 8127U.

PART 3 – EXECUTION

3.1 GENERAL:

A. System wiring is not shown on the drawings. Provide all wiring required to place the system into operation.

B. Wiring shall be installed in accordance with Section 279010, Wiring Methods for Communications Systems. Exposed wiring shall be installed in conduit.

C. Where there are a number of power requiring devices, group in numbers so power required does not exceed 80% of manufacturer's power supply rating. Provide extra wiring, or extra power supplies required to fulfill that requirement. In addition, provide extra or larger size wiring to alleviate voltage drops which makes device operate beyond voltage limits for which it was designed.

3.2 SENSOR LOCATIONS:

A. The locations shown for detectors is schematic in nature, intended to designate spaces in which detectors are to be installed and the anticipated location of the detectors within the space. The actual locations shall be determined by the installer based on a field survey of each space.

B. Cables may be pulled into space before sensors are installed and coiled above ceiling. Leave sufficient slack so that sensor location can be adjusted, if required by the field survey. Wall outlet rough-in is not required in spaces with accessible, suspended ceilings, where sensor is located within 12" of ceiling. Under such conditions, cable shall be neatly trained down the wall and shall be supported. Provide a white plastic split-cover grommet at ceiling penetration.

C. Program the local system to operate as specified.

D. Program the ACC's as follows :

1. Kitchen : To activate/deactivate kitchen and cafeteria area sensors.
2. Cafeteria : To activate/deactivate cafeteria sensors.
3. Gym : To activate/deactivate gym sensors.
4. Main Entrance: To activate/deactivate administration area sensors and to activate/deactivate all sensors in the school.
5. Primary Staff Entry: To activate and deactivate the main and class room corridors.

3.3 TESTING, CUSTOMIZATION, CERTIFICATION AND TRAINING:

A. Preliminary Tests: Upon completion of the installation, test the local system and remote station for proper operation. Make all adjustments and corrections necessary. Retest until proper operation is achieved.

B. Customization: Schedule on-site meeting with Owner's designated representative and review system operation to:

1. Determine custom labels.
2. Determine access levels and assign passwords.
3. Review all adjustable features and determine setpoints.
4. Verify that ACC programming is consistent with intended use of facility and determine if changes are necessary.

C. This work is applicable to both the local system and central station. Allow a minimum of one 8-hour day for meeting with the Owner's designated representatives. Upon completion, customize system and document all settings. This work shall not commence until the system is 100% operational.

D. Final Test: After customizing system, perform walk-test of local system. Initiate an alarm condition on each device in the system. Initiate a trouble condition on at least one of each type device per area. The central station connection may be disabled during testing except to the extent necessary to verify that the central station is operating properly. Upon completion of tests, print alarm history log to verify tests and then clear the log.

E. Certification: Upon completion of final tests, provide written certification that the system has

been customized and is fully operation in accordance with the Owner's requirements.

F. Final Inspection (Architect/Owner): Review test results with Owner and Architect. Demonstrate system operation as directed.

END OF SECTION 27 50 10

SECTION 27 90 10 - WIRING METHODS FOR COMMUNICATIONS AND ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION:

A. The work required by this section of the specifications applies to all systems specified under Division 27 and the HVAC systems control cabling specified under Division 23.

B. Installation of outlet boxes, raceway systems, cable trays, backboards and sleeves is specified under Division 26. Intermediate cable supporting systems, for cables not installed in cable trays is specified in this Section of the work.

1.3 QUALITY ASSURANCE:

A. Submittals: Refer to Section 27 01 20.

PART 2 - PRODUCTS

2.1 CABLE CHARACTERISTICS:

A. Wire size, shielding and insulation requirements for cables shall be determined by the system manufacturer for each system based on specific system requirements, the National Electrical Code and EIA/TIA standards.

B. Cables installed outdoors or run below grade shall be suitable for use in wet locations.

C. All indoor cables shall be plenum-rated, type CMP. Cables penetrating floors shall be riser rated, type CMR in accordance with Article 800 of the NEC.

D. Cable ties shall be velcro and plenum-rated type.

E. Bridle rings shall be tiered-type, with a separate tier for each system cable, such as CableCat clips manufactured by Caddy. Provide wide-body saddles for each ring.

2.2 SURGE SUPPRESSION:

A. Provide surge protection for conductors in accordance with NEC Article 800, where conductors enter and exit buildings.

B. Provide surge protection for the 120V incoming power connections to all headend equipment.

PART 3 - EXECUTION

3.1 GENERAL:

A. Wiring methods shall comply with Articles 725, 760, 800 and 810 of the National Electrical Code for power-limited circuits, and EIA/TIA standards, as applicable.

B. Cable systems, or portions of cable systems, shall be installed in a conduit system under the following conditions:

1. When required by the National Electrical Code
2. When required by the system manufacturer
3. To prevent or eliminate interference from cables of one system to another or from outside sources to cable systems.
4. Wiring concealed in walls
5. Wiring run above inaccessible ceilings
6. Cables penetrating walls and floors.
7. Wiring run exposed on interior walls (i.e. unfinished spaces)
8. Wiring run in finished spaces with no ceiling unless otherwise noted on the drawings.
9. Wiring run below grade, both inside and outside of the building footprint.
10. (indoors in spaces or outdoors) and wiring run below grade shall be installed in raceways.
11. All fire alarm system cables.

C. Unless specifically noted, required by the National Electrical Code or system manufacturer, wiring above accessible ceilings is not required to be installed in conduits.

3.2 CABLE SYSTEM AND CONDUIT SYSTEM ROUTES:

A. Complete conduit system not required:

1. Horizontal cables shall be routed in the cable tray systems installed under Division 26, and bridle rings installed under this Division of the work. Cable tray routes have been predefined but may be adjusted to suit the master cabling plan, subject to the Architect's approval. The location of bridle rings shall be field determined based on this specification.
2. Vertical cable drops shall be installed in conduits installed under Division 26.
3. Cables passing through walls and floors shall be installed in conduit sleeves installed under Division 26. The sealing of all sleeves is also specified under Division 26.

B. Complete conduit system required:

1. Cables shall be installed in a complete conduit system installed under Division 26.

3.3 INTERMEDIATE SUPPORTS:

A. Cables not installed in cable trays shall be supported by bridle rings installed under this Division of the work. Provide a separate tier for cables of each system. The location of bridle rings shall be determined by the contractor based on the approved Master Cabling Plan, required by Section 27 01 20. is not shown. The Contractor shall develop the pathways based on these specifications.

B. Bridle rings shall be installed no more than 5 feet apart on straight runs and within 12" of all corners

C. Bridle rings shall be attached to the building structure. The installation of cables shall not inhibit the removal of accessible ceiling panels. This precludes using ceiling panels as a means of support. Do not support cables from conduit or piping systems.

D. Cables shall be run parallel or perpendicular to the building structure in all three planes. Cables shall be readily accessible.

E. Grouping and Securing: Group all cables of one system along entire length of run using cable ties installed every 2-1/2 feet. Secure cable groups to bridle rings/j-hooks using cable ties.

3.4 SEPARATION:

A. Maintain a minimum separation of 2" between cables of different systems. Make crossovers as recommended by each specific manufacturer.

B. Maintain clearance from sources of interference as outlined in EIA/TIA standards.

C. The use of common sleeves through walls and floor is acceptable as long as this installation does not degrade system operation.

END OF SECTION 27 90 10

SECTION 31 10 00 – SITE CLEARING

PART 1 - GENERAL

1.1 SCOPE:

Under this heading shall be included the furnishing of all labor, materials and equipment and performing of all operations necessary for clearing and grubbing all areas and disposal of all unsuitable material.

1.2 LIMITS:

Clearing and grubbing under this Contract shall be performed within the area necessary to perform the work as shown on the plans. Additional areas of clearing and grubbing outside the areas necessary to perform the work shall be approved by Owner prior to beginning.

PART 2 – PRODUCTS

N/A

PART 3 - EXECUTION

3.1 CLEARING:

Completely clear, remove, and satisfactorily dispose of all unsuitable materials resting on or protruding above the surface of existing ground. Clearing includes trees (unless designated for preservation), stumps, bushes, grass, rubbish, refuse, scrap iron, rubble and all other deleterious materials. Excavate for stumps if necessary.

3.2 GRUBBING:

Completely grub the entire designated area free of all roots, stumps, logs, rubbish and other deleterious materials to a depth of at least two feet below existing ground. If no further excavation is to be made within the limits of Work under this heading then the holes caused by the removal of stumps, trees and rocks shall be filled and compacted with suitable material and graded to conform with surrounding surface.

3.3 BENCHMARKS:

The Contractor shall maintain and protect all benchmarks, monuments, settlement monitoring devices and other reference points. Any reference point damaged or destroyed as a result of the Contractor's operations or negligence shall be repaired or replaced at no cost to the Owner.

3.4 DISPOSAL:

Disposal of all cleared and grubbed materials shall be made off the site and property of the Owner unless shown otherwise on the Plans.

3.5 MEASUREMENT AND PAYMENT:

Measurement and payment for work under this section shall be included in overall project lump sum amount unless otherwise specified in Section 01 22 00.

END OF SECTION 31 10 00.

SECTION 31 20 00 – EARTH MOVING

PART 1 - GENERAL

1.1 SCOPE:

Under this heading shall be included the following:

a) Excavation required for structures.
b) Sub-cut excavation as required or designated.
c) Excavation as required for roadways.
d) Shoring, sheeting, and bracing as required.
e) Wasting and disposal of excess or unsuitable materials.
f) Furnishing and placing borrow material.
g) Furnishing and placing granular foundation material.
h) Compaction of all materials.
i) Dewatering or un-watering as necessary to complete the excavations to the required depths and as necessary to maintain the excavation sufficiently dry so that all work can be accomplished.
j) Site grading as required, including excavation and backfill.
k) Preparation of sub-grades.
l) All other work specified herein.

Excavation and backfill for outside utility systems and other underground piping is specified in Section 31 23 00 of these Specifications.

1.2 GENERAL:

The Contractor shall accept the site in its existing condition and shall assume the risk of encountering whatever materials as may occur.

PART 2 – PRODUCTS

N/A

PART 3 - EXECUTION

3.1 SOILS:

The Contractor shall make his own determination of the soil structure and site conditions as it may affect the work. Any soil boring information provided is indicative of the soils encountered at the particular boring location. Any groundwater information provided is indicative of conditions prevailing on the date soil borings were made. Groundwater elevations vary seasonally.

3.2 DEWATERING AND PROTECTION AGAINST WATER:

The Contractor shall remove water from the site and shall lower the ground water level as necessary to complete the excavations to the required depths and as required to maintain the excavations

sufficiently dry so that all required work can be accomplished. The Contractor shall do such well construction, well pointing, sheeting, ditching, diking and pumping and shall construct necessary drains, channels, sumps and cofferdams to keep his excavations and new structures clear of ground water, storm water or sewage and to keep his construction areas dry during the progress of the work and until the finished work is accepted by the Owner, except as otherwise specified.

The Contractor shall be responsible for the effect of dewatering operations on adjacent property and for the effect on water supplies located in the vicinity of the project.

Adequate measures and protection shall be provided by the Contractor to protect his work from damage from uplift due to ground water, storm water, or flood water. Any damages which may result shall be the Contractor's responsibility.

The Contractor shall accept all responsibility for damage to the work of this Contract because of floods and water pressures and other water damages and shall accept all risks of floods and other events which may occur.

All water discharged by pumping operations shall be discharged so as not to interfere with work under this Contract or with existing structures and operations. Route of dewatering pipe shall be subject to the Design Professional's review. Discharge facilities and water quality shall comply with applicable regulations of State and Federal agencies.

Dewatering operations shall be uninterrupted and continuous during the course of the work so as not to endanger any construction in place or to present a hazard to workmen in and around the site. The Contractor shall take all measures necessary including, but not limited to, standby equipment and constant attendance to ensure that the dewatering system remains operational and effective throughout the period of time that it is required.

3.3 MATERIALS:

a) Earth Fill.

Earth fill, including pavement sub-grades, shall consist of all suitable materials from required excavations. Suitable materials for earth fill shall generally be composed of sands, clay-sand mixtures and silt-sand mixtures. Clay-sand and silt-sand mixtures shall be approved by the soil technician prior to being incorporated in fills. Clays, silts, and organic soils will be considered as unsuitable materials.

b) Excavated Materials.

All suitable materials from excavations shall be used in the permanent construction required under these Specifications. Suitable materials shall be excavated separately from materials to be wasted and the suitable materials shall be segregated by loads during the excavation operations and shall be placed in temporary stockpiles and later placed in the designated locations. Excavated materials, which, after drainage, are suitable for the embankment but which, when excavated are too wet for immediate compaction in the embankment, shall be placed temporarily in stockpiles until the moisture content is reduced sufficiently to permit them to be placed in the earth fills.

All temporary stockpiles shall be placed in such a manner that will least affect normal daily activities in the area.

c) Excess Materials.

All excess material from required excavations shall be removed from the site unless written authorization is given by the Design Professional to stockpile the material on the site.

3.4 EXCAVATION:

Excavation shall include the loosening, loading, removing, transporting, stockpiling and disposing of all materials, wet or dry, necessary to be removed to construct all structures included in this Contract to the lines and grades, and at the locations, shown on the Contract Drawings. Excavation for outside piping, storm sewers and utilities systems are included in other Sections of these Specifications.

Excavation for structures shall conform to the depth and dimensions necessary for the proper installation of all structures detailed on the Contract Drawings. Unless shown on the Drawings excavation shall not be carried below the elevations shown on the Drawings. Where bottoms of excavations are slightly unstable and the Drawings do not require a stabilized granular backfill and the Design Professional does not direct additional excavation and replacement, the Contractor may provide a gravel course, but such work will be considered as for the Contractor's convenience and will not be considered as extra work.

Where any unauthorized excavation is made below the elevation indicated on the Contract Drawings, the excavation shall be restored to the proper elevation with compacted, well graded granular backfill. Such backfill shall be compacted as specified in the Article entitled "Compaction".

Excavation for pipes under and adjacent to structures shall be made after the installation of the granular backfill. Excavations shall be made to the required depths, grades, alignment, and trench widths required for the installation of the pipe. Temporary sheeting and bracing shall be used as required to confine the trench size and width. Trench size and width shall conform to the requirements in Section 31 23 00.

Excavation shall be made for roadways and other site work to the required depths, grades, and alignment.

Excavations, where conditions require, shall be properly shored, sheeted and braced by the Contractor to maintain excavation in a condition to permit the safe and efficient installation of all items of Contract work. Upon completion of the various Contract items, all temporary forms, shores, and bracing shall be removed. While being withdrawn, all voids left by the sheeting and bracing shall be carefully filled with sand and compacted.

3.5 TOPSOIL CONSERVATION:

Over areas requiring excavation and/or fill, there may be limited amounts of existing topsoil, suitable for future use. The Contractor shall strip all such topsoil and shall stockpile it for future use under this Contract. Except for topsoil material available from the excavation, topsoil shall be obtained from off-site borrow.

3.6 UNSUITABLE MATERIAL:

Where material encountered is unsuitable for subgrade construction of roads, buildings and walks, such material shall be excavated to the required depth of compaction (generally two feet below pavement base course), disposed of off the site and property of the Owner and replaced with suitable material. Unsuitable materials are those classified as MH, CH, OH, OL, and Peat in accordance with the Unified Soil Classification System. Excess water in material will not be a basis for establishing unsuitable material regardless of gradation. The Design Professional shall be notified immediately upon encountering of unsuitable material.

3.7 BORROW:

It is anticipated that suitable offsite borrow material will be required for required fill and backfill material. However, it is the Contractor's responsibility to determine if offsite borrow is required.

3.8 BACKFILLING:

All excavation shall be backfilled to the lines and grades shown on the Contract Drawings. Backfill adjacent to structures shall not be placed until forms, form lumber and all debris from construction has been entirely removed from around the work. No backfilling shall be done in unsuitable weather or over ground that is frozen or too wet.

Backfill shall not be placed against structures until the concrete has cured at least 7 days. Backfill, in general, shall be placed in horizontal layers not in excess of 12 inches in thickness, except in the cases of embankment construction around structures and under roadway and piping locations, where backfill shall be placed in 6 inch layers, with each layer thoroughly compacted as specified hereinafter , prior to the addition of the succeeding layer.

Fill immediately adjacent to walls shall be hand tamped and special care shall be taken to prevent any wedging action or eccentric loading against the walls.

Fill material shall be suitable material taken from the excavation. All sticks, debris, organic matter, frozen material, stones or cobbles over 6 inches in maximum dimension, and other deleterious material shall be removed from the backfill material prior to its use.

3.9 COMPACTION:

a) General.

Compaction of earth fill and all pavement subgrades shall be performed to the percentages of maximum standard or modified dry densities and to the depths as shown on the drawing or as follows:

1. Subgrades Under Paved Areas and Structures.

95 Percent Modified (ASTM Test D1557) 24 inches

2. Pedestrian Traffic Subgrades.

95 Percent Modified (ASTM Test D1557) 12 Inches

3. Unpaved Areas To Be Grassed Or Sodded.

95 Percent Modified (ASTM Test D1557) Full Depth.

b) Moisture Content.

All compactions shall be performed at material moisture contents within 3 percentage points, plus or minus of optimum. Compaction and proof rolling equipment shall be as outlined in Section 32 10 00 or as may be required for the type of fill being compacted.

3.10 TESTING:

a) General.

The Design Professional will select a qualified independent testing laboratory for the purpose of identifying soils, checking densities, and classifying soils materials during construction.

Payment for the testing will be by the Design Professional through the Owner.

The Design Professional shall include the cost of one compaction test per 100 cubic yards, 300 linear feet of curb, 200 linear feet of subgrade along pavement centerline and 1,500 square yards of base and one "proctor" test for each type of fill material to determine if the proper compaction has been attained.

b) Moisture-Density Tests.

Testing shall be in accordance with ASTM Method D1557. A test shall be performed on each type of material used in the work regardless of source. Tests will be accompanied by particle-size analyses of the soils tested (ASTM Methods D421 and D422). Changes in color, gradation, plasticity, or source of fill material will require the performance of additional tests. Copies of all test results shall be furnished to the Design Professional.

c) Field Density Tests.

Tests shall be made in accordance with ASTM Method D1556. If any compaction test reveals that fill or backfill is not compacted as specified, the Contractor shall scarify and recompact as required to achieve the specified density. Additional compaction tests shall be made to verify proper compaction. These additional tests, required due to failure of the original test, shall be paid for by the Contractor and not be reimbursed by the Owner.

d) Submittals.

The soils technicians will submit formal reports of all compaction tests and retests to the Contractor, Owner and Design Professional as soon as possible upon completion of the required tests.

This report information is to include but not be limited to the following:

1. Date of the test and date submitted.
2. Location of test.
3. Wet weight, moisture content and dry weight of field sample.
4. Description of soil.
5. Maximum dry density and moisture content of the lab sample which best matches the field sample in color, texture, grain size and maximum dry density.
6. Ratio of field dry density to maximum lab dry density expressed as a percentage.
7. Comments concerning the field density passing or failing the specified compaction.
8. Comments about recompaction if required.

e) Compaction Results.

The soils technician is to advise the Design Professional and Contractor immediately of any compaction tests failing to meet the specified minimum requirements. No additional lift is to be placed on a lift with any portion failing.

3.11 GRADING:

Upon completion of other construction operations, the entire site, within the limits shown on the Drawings, shall be brought to the finished grades shown. All surfaces shall be sloped to the grades indicated and which will provide proper drainage. All surfaces shall be raked smooth and shall be free of all vegetable matter, debris and stones larger than 2-1/2 inches. Allow for thickness of required topsoil, sod, and/or landscaping cover where shown.

3.12 MEASUREMENT AND PAYMENT:

Measurement and payment for work under this section shall be included in overall project lump sum amount unless otherwise specified in Section 01 22 00.

END OF SECTION 31 20 00.

SECTION 31 23 00 - EXCAVATION AND FILL

PART 1 - GENERAL

1.1 SCOPE:

Under this heading shall be included the excavation, trenching and backfilling required for all applicable underground utility systems. Utility systems include sanitary sewers, water piping force mains, underground electrical service, and communications conduit.

1.2 GENERAL:

Underground piping and utility systems which are to be installed in trenches whose lowest point of excavation is below the existing ground level, and are unaffected by an excavation for structures, may be installed at any time during the course of the work. Piping and systems to be installed in or over fill, backfill or new embankments shall not be installed until all earthwork has been completed to rough grade, nor until settlement of the fill or embankment has taken place.

Braced and sheeted trenches and open trenches shall comply with all state laws and regulations, and local ordinances relating to safety, life, health, and property. Also, this shall conform to the Occupational Safety and Health Standards for Excavations, Final Rule (29 CFR Part 1926) as printed in the October 31, 1989 issue of the Federal Register.

The sides and bottoms of the trenches shall be protected against any instability which may interfere with the proper laying of the pipe and as necessary for the safety of the workmen and others and as may be necessary to protect adjacent structures. Refer to safety requirements of the General Conditions and Special Conditions. Protective systems for trenches shall be utilized by the Contractor and shall conform with Section 1926.652, 29 CFR Part 1926, Final Rule.

PART 2 – PRODUCTS

N/A

PART 3 - EXECUTION

3.1 LOCATION AND PROTECTION OF UTILITIES AND STRUCTURES:

It shall be the responsibility of the Contractor to acquaint himself with the location of all utilities and structures both present and proposed, also all existing surface structures which may be affected by work under the Contract. The location of any underground structures furnished, shown on the Plans or given on the site are based upon the available records but are not guaranteed to be complete or correct, and are given only to assist the Contractor in making a determination of the existence of underground structures.

Overhead utilities, poles, etc., shall be protected against damage by the Contractor, and if damaged by the Contractor, shall be replaced by him. The Contractor shall notify those who maintain utilities sufficiently in advance of the proposed construction so that they may locate, uncover, and disclose such work. If the progress of construction necessitates the removal or relocation of poles, overhead utilities and obstructions, the Contractor shall make all arrangements and assume all costs of the work involved.

The Contractor shall provide for the continuance of the flow of any sewers, drains, water pipes, and water courses, and the like. Where such facilities, water courses, or electric overhead wires or conduits are interfered with by the work of the Contractor, the interruption shall be a minimum and shall be scheduled in advance with the Design Professional and the utility owner.

The Contractor shall restore all facilities interfered with to their original condition or acceptable equivalent. The cost of such restoration or damage caused directly by his work shall be paid for by the Contractor and shall be included in the bid price according to Owner's bid schedule.

3.2 EXCAVATION AND TRENCHING:

a) Excavation.

Excavate all materials encountered. See Article 3.7 for payment for removal of unsuitable materials.

b) Caution in Excavation.

The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures in the trench zone may be determined before being damaged. He shall be held responsible for the repair or replacement of such structures when broken or otherwise damaged because of his operations.

c) Subsurface Explorations.

The Contractor shall make explorations and excavations at no additional charge to the Owner to determine the location of existing underground structures.

d) Depth of Trench.

Utilities and other piping shall be laid in open trenches as shown and specified. Trenches shall be excavated to the designated lines and grades, beginning at the outlet end and progressing toward the upper end in each case. Trenches for pipe shall be shaped to the lower 1/3 of the pipe and provide uniform and continuous bearing. Bell holes shall be dug to allow ample room for working fully around each joint.

e) Width of Trench.

Trenches shall be of minimum width to provide ample working space for making joints and tamping backfill. Width on each side of barrel of pipe shall be not less than 8 inches or more than 12 inches. Sides of trenches shall be closely vertical to top of pipe and shall be sheet piled and braced where soil is of unstable nature. Above the top of the pipe, trenches may be sloped. The width of the trench above this level may be wider for sheeting and bracing and the performance of the work.

f) Alignment and Grade.

Trenches shall be excavated on the alignments shown on the Plans, and to the depth and grade necessary to accommodate the pipes at the elevations shown. Where elevations of the invert or centerline of a pipe are shown at the ends of a pipe, the pipe shall be installed at a continuous grade between the two elevations.

g) Over Excavation.

Excavation in excess of the depth required for proper shaping shall be corrected by bringing to grade the invert of the ditch with compacted coarse, granular material at no additional expense to the Owner. Bell holes shall be excavated to relieve bells of all load, but small enough to ensure that support is provided throughout the length of the pipe barrel.

Excavation in excess of the depths required for manholes and other structures shall be corrected by placing a sub-foundation of 1,500 psi concrete, at no additional expense to the Owner.

If trenches are excavated to widths in excess of those specified, or if the trench walls collapse, the pipe shall be laid in accordance with the next better class of bedding at the expense of the Contractor.

3.3 TRENCHES:

Trenches shall be maintained in a safe condition to prevent hazardous conditions to persons working in or around the trench.

Braced and sheeted trenches and open trenches shall comply with all State and Federal Laws and Regulations, and local ordinances relating to safety, life, health, and property.

The top portion of the trench may be excavated with sloping or vertical sides to any width which will not cause damage to adjoining structures, roadways, utilities, etc. The bottom of the trenches shall be graded to provide uniform bearing and support each section of the pipe on undisturbed soil at every point along its entire length, except for the portions of the pipe sections excavated for bell holes and for the sealing of pipe joints. Bell holes and depressions for joints shall be dug after the trench bottom has been graded and in order that the pipe rests upon the trench bottom for its full length and shall be only of such length, depth and width for making the particular type of joints. The bottom of the trench shall be rounded so that at least the bottom one-third of the pipe shall rest on undisturbed earth for the full length of the barrel as jointing operations will permit. This part of the excavation shall be done manually only a few feet in advance of the pipe laying by workmen skilled in this type of work.

The sides of all trenches and excavation for structures shall be held by stay bracing, or by skeleton or solid sheeting and bracing according to conditions encountered, to protect the excavation, adjoining property and for the safety of personnel. Bracing and shoring may be removed when the level of the backfilling has reached the elevation to protect the pipe work and adjacent property. When sheeting or shoring above this level cannot be safely removed, it may be left in place. Timber left in place shall be cut off at least 2 feet below the surface. No sheeting below the level of the top of the pipe may be removed.

3.4 DEWATERING AND PROTECTION AGAINST WATER:

The Contractor shall remove water from the site and shall lower the ground water level as necessary to complete the excavations to the required depths and so that all required work can be accomplished under dry conditions. The Contractor shall do such well construction, well pointing, sheeting, ditching, and pumping, and shall construct necessary drains, channels and sumps to keep his excavations and new structures clear of ground water, storm water or sewage and to keep his construction areas dry during the progress of the Work.

Adequate measures and protection shall be provided by the Contractor to protect his work from damage from uplift due to ground water, storm water, or flood water. Any damages which may result shall be the Contractor's responsibility.

The Contractor shall accept all responsibility for damage to the work of this Contract because of floods and water pressures and other water damages and shall accept all risks of floods and other events which may occur.

All water discharged by pumping operations shall be discharged so as not to interfere with work under this Contract or with existing structures and operations. Water from dewatering operations shall be conveyed to the existing drainage features, using piping and pumping facilities provided by the Contractor.
Route of dewatering pipe shall be subject to the Design Professional's review. Discharge facilities and water quality shall comply with applicable regulations of State and Federal agencies.

Dewatering operations shall be uninterrupted and continuous during the course of the work so as not to endanger any construction in place or to present a hazard to workmen in and around the site. The Contractor shall take all measures necessary including, but not limited to, standby equipment and constant attendance to ensure that the dewatering system remains operational and effective throughout the period of time that it is required.

No water shall be allowed to run over any uncompleted portions of the work. No units of the work shall be constructed under water. The cost of dewatering shall be included in the price bid for the item of work for which it is required.

3.5 PILING EXCAVATED MATERIALS:

All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing roadways.

3.6 LIMIT TO LENGTH OF OPEN TRENCH:

The routine of operation shall be so organized to keep the length of open trench to a practicable minimum. No trenches shall be allowed to remain open over night or during periods with no construction activity. Additionally, open trenches shall be properly secured and protected during times of construction activities.

3.7 REMOVAL OF UNSUITABLE MATERIAL:

Should overdepth excavation be necessary to remove unsuitable material and to replace with satisfactory material, the Contractor will be paid for this work for removal and replacement of unsuitable material, based on the following requirements:

a) Unsuitable materials for filling and backfilling are those classified as MH, CH, OL, OH and PT in accordance with the Unified Soil Classification System. Excavated soils that are too wet to compact shall not be classified unsuitable due to high moisture content alone.

b) When the trench is excavated to the plan depth or as required by these specifications, and soft or other material not suitable for bedding purposes is encountered in the trench, the Contractor shall immediately notify the Design Professional for inspection and measurement of the unsuitable material to be removed. The contractor will not receive additional pay for the normal volume of bedding aggregate that is used while installing any piping as per plans and details. This volume shall be subtracted from the volume of unsuitable materials, removed and replaced with suitable material.

c) No overdepth excavation or backfilling of the overdepth excavated trench shall start until proper measurements of the trench have been taken by the Design Professional for the determination of the quantity in cubic yards of unsuitable material excavated. Backfill material and backfilling shall conform to the requirements specified in Article 3.10 below.

d) No payment will be made for any overdepth excavation of soft unstable material due to the failure of the Contractor to provide adequate means to keep the trench dry.

e) No payment will be made for any overdepth excavation of the unsuitable material and replacement not inspected and measured by the Design Professional prior to excavation.

3.8 BEDDING OF CONCRETE, DUCTILE IRON OR STEEL PIPE:

Pipe shall be laid on foundations prepared in accordance with ASTM C12 as modified herein, and in accordance with the various classes of bedding required by the trench width and trench depth for the size of pipe to be laid. Bedding shall be included in the appropriate unit price bid for concrete, ductile iron, or steel pipe.

a) Class "A" Bedding.

Class "A" Bedding shall be achieved by either of the following two construction methods:

1. Concrete Cradle.

The pipe shall be bedded in a monolithic cradle of plain or reinforced concrete having a minimum thickness under the pipe barrel of one-fourth the inside diameter of the pipe but in no case less than 4 inches and extending up the sides to a height of at least one-fourth of the pipe outside diameter. The cradle shall have a width equal to the full width of the trench as excavated. The pipe shall be laid to line and grade on concrete blocking after which the concrete shall be placed to the limits described. Concrete shall be 3,000 psi concrete.

2. Concrete Arch.

The pipe shall be bedded in crushed stone or rounded gravel bedding material having a minimum thickness under the pipe barrel of one-fourth the outside diameter of the pipe but in no case less than 4 inches and shall extend up the sides of the pipe to the horizontal centerline. The top half of the pipe shall be covered with a monolithic plain or reinforced concrete arch having a thickness of one-fourth the inside diameter of the pipe but in no case less than 4 inches at the crown of the pipe. The arch shall have a width equal to the full width of the trench as excavated.

b) Class "B" Bedding.

Class "B" Bedding shall be achieved by either of two construction methods:

1. The bottom of the trench excavation shall be shaped to conform to a cylindrical surface with a radius at least 2 inches greater than the radius of the outside of pipe with a width sufficient to allow 6/10 of the width of the pipe barrel to be bedded in fine granular fill placed in the shaped excavation. Carefully compacted backfill shall be placed at the sides of the pipe to a thickness of at least 12 inches above the top of the pipe.

2. The pipe may be bedded in compacted crushed stone, placed on a flat trench bottom. The crushed stone bedding shall have a minimum thickness of 1/4 the outside pipe diameter and shall extend halfway up the pipe barrel at the sides. The remainder of the side fills and a minimum depth of 12 inches over the top of the pipe shall be filled with carefully compacted material.

c) Class "C" Bedding.

Class "C" Bedding shall be achieved by either of two construction methods:

1. The pipe shall be bedded in an earth foundation formed in the trench bottom by a shaped excavation which will fit the pipe barrel with reasonable closeness for a width of at least 50 percent of the outside pipe diameter. The side fills and area over the pipe to a minimum of 12 inches above the top of the pipe and shall be filled with compacted fill.

2. The pipe shall be bedded in compacted granular material placed on a flat trench bottom. The granular bedding shall have a minimum thickness of 4 inches under the barrel and shall extend 1/6 of the outside diameter up the pipe barrel at the sides. The remainder of the side fills and area to a minimum depth of 12 inches over the top of the pipe shall be filled with compacted backfill. Class "C" Bedding shall be used except where the use of Class "A" or Class "B" bedding is shown on the Plans.

d) Class "D" Bedding.

Class "D" Bedding is achieved by shaping bell holes only on a flat trench and no care is taken to secure compaction at the sides and immediately over the pipe. This type

bedding is not permitted.

e) Bell Holes.

Bell holes shall be provided in all classes of bedding to relieve pipe bells of all load, but small enough to ensure that support is provided throughout the length of the pipe barrel.

f) Coarse Granular Bedding.

Coarse Granular Bedding material shall consist of crushed stone or pea gravel, clean and graded, 95 to 100 percent of which shall pass a ¾ inch sieve with 95 to 100 percent retained on a No. 4 sieve. Bedding material shall be placed on a flat bottom trench and thoroughly compacted by tamping or slicing with a flat blade shovel. Compacted bedding material shall be extended up the sides of the pipe to the heights shown for the various classes of bedding.

g) Overwidth Excavation.

If trenches are excavated to widths in excess of those specified below, or if trench walls collapse, pipe shall be laid in accordance with the requirements for at least the next better class of bedding at the expense of the Contractor.

h) Borrow Backfill.

Borrow backfill will be required if there is not sufficient suitable material available from other parts of the work to backfill the trenches. Borrow backfill from approved borrow pits shall be used. Only those soils in the borrow pits that meet the specified requirements for suitable material shall be used.

i) Trench Widths.

Trench widths at the top of the pipe and depths for clay, concrete and metal pipes using the various bedding classes, shall not exceed those shown below:

Ductile Iron, Concrete, or Steel Pipe

Maximum Pipe Size	Maximum Trench Width	Maximum Trench Depth Class D Bedding	Maximum Trench Depth Class C Bedding	Maximum Trench Depth Class B Bedding	Maximum Trench Depth Class A Bedding
6”	2’-6”	0	14’	20’	30’
8”	2’-6”	0	14’	20’	30’
10”	2’-6”	0	14’	22’	30’
12”	2’-8”	0	14’	22’	30’
15”	3’-0”	0	14’	22’	30’
21”	3’-6”	0	14’	22’	30’
24”	4’-0”	0	14’	22’	30’

3.9 BEDDING OF PVC PIPE AND FRP PIPE:

a) Pipe shall be bedded true to line and grade with uniform and continuous support from a firm base in accordance with ASTM D2321 as modified herein. Blocking shall not be used to bring the pipe to grade. Bedding material shall be included in the unit price for plastic and FRP pipes.

b) Embedment materials listed here include a number of processed materials plus the soil types defined by the USCS Soil Classification Systems in ASTM D2487. These materials are grouped into categories according to their suitability for this application:

1. Class I.

   Angular 6 to 40 mm (1/4 to 1-1/2 inches), graded stone including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

2. Class II.

   Coarse sands and gravels with maximum particle size of 40 mm (1-1/2 inches), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW and SP are included in this class.

3. Class III.

   Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil types GM, GC, SM and SC are included in this class.

4. Class IV.

   Silt, silty clays and clays including inorganic clays and silts of medium to high plasticity and liquid limits. Soil types MH, ML, CH and CL are included in this class. These materials are not to be used for bedding, haunching or initial backfill.

5. Class V.

   This class includes the organic soils OL, OH and PT as well as soils containing frozen earth, debris, rocks larger than 40 mm (1-1/2 inches) in diameter, and other foreign materials. These materials shall not be used for bedding, haunching and initial backfill.

c) Compaction of foundation, bedding, haunching and initial backfill shall extend to the trench wall.

d) Embedment material in the area around the pipe shall be installed with care. Care shall be used to ensure that sufficient material has been worked under the haunch

of the pipe to provide adequate side support. Precautions must be taken to prevent movement of the pipe during placing of the material through the pipe haunch. Place initial backfill material in three stages: First, to the center line of the pipe; second, to the top of the pipe; and third, to a point 12 inches above the top of the pipe. Compact each stage of haunching and initial backfill by hand or mechanical tamping to a minimum of 90 percent Standard Proctor Density. Where unstable trench walls exist because of migratory materials such as waterbearing silts or fine sands, care shall be taken to prevent the loss of side support through the migratory action.

e) Avoid contact between the pipe and compaction equipment. Compaction of haunching, initial backfill and backfill material shall be done in such a way so that compaction equipment will not have a damaging effect on the pipe.

f) Trench depths, using the various bedding classes, shall not exceed those shown below:

MAXIMUM TRENCH DEPTH

Pipe Size	Class IV Bedding	Class III Bedding	Class I or Class II Bedding
All Sizes	Not To Be Used	16’	30’

- *Density (Standard Proctor) of 90 percent minimum in pipe zone.*

g) ASTM D2321 "Underground Installation of Flexible Thermoplastic Sewer Pipe" shall be used in conjunction with the above.

3.10 BACKFILLING:

Backfilling consists of placing suitable materials removed during the excavation into the excavated areas, placing embedment materials and compacting the same to a density equal to or greater than what exists before excavation or as specified herein.

Under backfilling operations is also included removal of excess materials and debris from the site, leveling all depressions caused by operation of equipment and maintaining the backfilled areas until accepted by the Owner.

All backfill material shall be free of stones, concrete, and clay lumps larger than 1/3 cubic foot. Roots, stumps, and rubbish which will decompose will not be permitted in the backfill. Backfill material shall have its moisture content corrected, as may be necessary before being placed in the trench to bring the moisture content to approximately "optimum" for good compaction. Any rock, stone, concrete, clay lumps larger than 1/3 cubic foot in volume, rubbish and debris shall be removed from the site and disposed of by the Contractor in a lawful manner.

Backfilling operations in this work are referred to herein as Backfilling at the Pipe Zone, Type "A" and Type "B".

Backfilling in the excavated areas below parts of proposed structures shall be referred to hereinafter as Type "A" Backfilling.

Where trenches cross or extend under structures or into present roadways, future roadways or parking areas as shown on the Plans, the backfilling shall be referred to hereinafter as Type " A " Backfilling.

Backfilling in all other areas shall be referred to hereinafter as Type "B" Backfilling.

a) Backfilling at the Pipe Zone.

Throughout the entire construction, backfilling at the pipe zone shall include bedding and shall be as follows: Backfill material shall be placed below, around each side, and over the top of the pipe, in approximately horizontal layers to a height of 12 inches over the top of the pipe. Layers shall be of such thickness to facilitate the required compaction. This backfill shall be well compacted by using mechanical tamping equipment in such manner as not to damage the pipe, pipe joints or shift the pipe alignment. Workmen shall not be permitted to walk over the pipe until at least 12 inches of compacted fill has been placed over the pipe. The Contractor shall not use water to obtain compaction except for adding water to the backfill material before placing in the trench to bring the moisture content to approximately "optimum" for good compaction.

b) Type "A" Backfilling.

Type "A" backfilling consists of placing sand and gravel or other suitable materials excavated from the trench in the trench in 6 inch thick layers from a point 12 inches above the top of the pipe and mechanically tamping or compacting by rolling until the backfill density after compaction is equal to 95 percent of the maximum density obtainable at optimum moisture content as determined by the Modified Proctor Test (ASTM D1557). No water shall be used to secure compaction except for adding water to the backfill material before placing in the trench to bring moisture content to approximately "optimum" for good compaction. Each 6-inch-thick layer shall be mechanically tamped before additional backfill material is placed in the excavated area.

c) Type "B" Backfilling.

Type "B" Backfilling consists of placing sand and gravel or other suitable material excavated from the trench in the trench in 12-inch-thick compacted layers from a point 12 inches above the top of the pipe. Each 12-inch-thick layer shall be compacted before additional backfill material is placed in the excavation. Only mechanical tamping, use of roller or small tractor will be allowed. The density of the backfilled material after compaction shall be equal to 95 percent of the maximum density obtainable at optimum moisture content as determined by the Modified Proctor Test (ASTM D1557). Except in the upper 12 inches, water shall be added to backfill material only before being placed in the trench in order to bring the moisture content to approximately "optimum" for good compaction.

3.11 PROTECTION OF WATER SUPPLY PIPES:

a) Horizontal Separation.

Sewers and force mains shall be laid at least 10 feet horizontally from any existing or proposed water main. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10 foot separation, such deviation may allow installation of the sewer or force main closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on the side of the sewer or force main and at an elevation so the bottom of the water main is at least 18 inches above the top of the sewer or force main.

b) Crossings.

Sewers and force mains crossing water mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer or force main. This shall be the case where the water main is either above or below the sewer or force main. The crossing shall be arranged so that the sewer or force main joints will be equidistant and as far as possible from the water main joints. Where a water main crosses under a sewer or force main, adequate structural support shall be provided for the sewer or force main to prevent damage to the water main.

c) Special Conditions.

When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the sewer or force main shall be designed and constructed equal to water pipe and shall be pressure tested to assure water tightness prior to backfilling.

3.12 UTILITY CONSTRUCTION IN OTHER EXCAVATION:

Where utilities are required to be constructed in areas also requiring excavation and backfill for other work, coordinate the work so that the parts come together properly and the construction of the various parts can be done without damage to other parts. Place bedding which will form bearing for pipes, using suitable material and shaping to the lower 1/3 of the pipe to provide uniform and continuous bearing. Compaction of backfill material which will form bearing shall be equal to that specified hereinbefore under Type "A" Backfilling. After the pipe or other utility is placed, backfilling shall proceed as specified hereinbefore following the requirements specified under "Backfilling at the Pipe Zone," "Type 'A' Backfilling", and "Type 'B' Backfilling" as applicable.

3.13 TESTING:

a) General.

The Owner shall select a qualified independent testing laboratory for the purpose of identifying soils, checking densities, and classifying soils materials during construction. The contractor shall coordinate testing with OWNER Project Manager. Copies of all test results shall be furnished to the Design Professional.

b) Moisture-Density Tests.

Testing shall be in accordance with ASTM Methods D698 and D1557. A test shall be performed on each type of material used in the work regardless of source. Tests will be accompanied by particle-size analyses of the soils tested (ASTM Methods D421 and D422). Changes in color, gradation, plasticity, or source of fill material

will require the performance of additional tests. Copies of all test results shall be furnished to the Design Professional.

c) Field Density Tests.

Tests shall be made in accordance with ASTM Method D1556. Tests shall be made in accordance with the following minimum schedule or as required by the soils technician or as may be directed by the Design Professional:

- One test for each lift of backfill for each 200 feet of trench or fraction thereof, and one test for each trench excavation under a roadway.

d) Submittals.

The soils technicians will submit formal reports of all compaction tests and retests. The reports are to be furnished to the Owner and the Design Professional as soon as possible upon completion of the required tests.
This report information is to include but not be limited to the following:

1. Date of the test and date submitted.
2. Location of test.
3. Wet weight, moisture content and dry weight of field sample.
4. Description of soil.
5. Maximum dry density and moisture content of the lab sample which best matches the field sample in color, texture, grain size and maximum dry density.
6. Ratio of field dry density to maximum lab dry density expressed as a percentage.
7. Comments concerning the field density passing or failing the specified compaction.
8. Comments about re-compaction if required.

e) Compaction Results.

If any compaction test reveals that fill or backfill is not compacted as specified, the Contractor shall scarify and recompact as required to achieve the specified density. Additional compaction tests shall be made to verify proper compaction. These additional tests required due to failure of the original test shall be paid for by the Contractor without reimbursement by the Owner.

The soils technician is to advise the Design Professional and the Contractor's Superintendent immediately of any compaction tests failing to meet the specified minimum requirements. No additional lift is to be placed on a lift with any portion failing.

3.14 CONSTRUCTION ALONG HIGHWAYS, STREETS AND ROADWAYS:

a) Excavation, Trenching and Backfilling Operations.

Excavation, trenching and backfilling along highways, streets and roadways shall be in accordance with the applicable regulations of the State Highway Department with reference to construction operations, safety, traffic control, road maintenance and repair.

b) Protection of Traffic.

Provide suitable signs, barricades, and lights for protection of traffic, in locations where traffic may be endangered by construction operations. All signs removed by reason of construction shall be replaced as soon as condition which necessitated such removal has been cleared. No highway, street or roadway shall be closed without first obtaining permission from the proper authorities.

c) Construction Operations.

The Contractor shall construct all work along highways, streets and roadways using the following sequence of construction operations, so as to least interfere with traffic:

1. Stripping.

Where the pipeline is laid along road shoulders, sod, topsoil and other material suitable for shoulder restoration shall be stripped and stockpiled for replacement.

2. Trenching, Laying and Backfilling.

Excavate trenches, install pipeline, and backfill. The trench shall not be opened any further ahead of pipe laying operations than is necessary for proper laying operations. Trenches shall be progressively backfilled and consolidated and excess material removed immediately.

3. Shaping.

Immediately after completing backfilling operation, re-shape any damage to cut and fill slopes, side ditch lines, and shall replace topsoil, sod and any other materials removed from shoulders.

d) Excavated Material.

Excavated material shall not be placed along highways, streets, and roadways in such manner as to obstruct traffic. Roadways and pavement will be maintained free of earth material and debris.

e) Drainage Structures.

All side ditches, culverts, cross drains, and other drainage structures shall be kept clear of excavated material and be free to drain at all times.

f) Maintaining Highways, Streets, Roadways and Driveways.

The Contractor shall furnish a power broom which shall be available for use at all times for maintaining highways, streets and roadways. All such streets, highways and roadways shall be maintained in suitable condition until completion and final acceptance of the work.

Repair all driveways that are cut or damaged. Maintain them in suitable condition until completion and final acceptance of the work.

3.15 REMOVING AND RESETTING FENCES

Where existing fences must be removed temporarily to permit construction, the Contractor shall remove such fences. As construction progresses, reset the fences in their original location and to their original condition. All costs of removing and resetting fences and such temporary works as may be required shall be included in the Contractors bid.

3.16 PROTECTING TREES, SHRUBBERY AND LAWNS:

Trees and shrubbery along trench lines shall not be disturbed unless absolutely necessary. Trees and shrubbery necessary to be removed shall be properly heeled-in and re-planted. Heeling-in and re-planting shall be done under the direction of an experienced nurseryman. Where utility trenches cross established lawns, sod shall be cut, removed, stacked, and maintained in suitable condition until replaced. Topsoil underlying lawn areas shall likewise be removed and kept separate from general excavated materials. Removal and replacement of sod shall be done under the direction of an experienced nurseryman.

3.17 REMOVE AND REPLACE PAVEMENT:

Pavement and base course which must be removed for constructing sewers, manholes, force mains, water lines, and all other appurtenances in streets shall be replaced as per City of Savannah specifications.

a) The top 18 inches of subgrade material immediately under the paving base and also road shoulder shall be carefully removed and kept separate from the rest of the excavated material. This material shall be placed in the top 18 inches of the backfill. Further compaction shall be accomplished by leaving the backfilled trench open to traffic while maintaining the surface with crushed stone or gravel. Settlement in trenches shall be refilled with crushed stone or gravel, and such maintenance shall continue until replacement of pavement.

b) Where utility lines are constructed on unpaved streets, roads, or easements, the top 18 inches of soil shall be stripped and windowed separate from the excavation from trenches. After the line has been installed and the backfill completed within 18 inches of the original grade, the salvaged surfacing shall be replaced. This work shall be considered as general clean up along with the removal of surplus excavated materials from the site and the restoring of the surface outside trench limits to its original condition, the cost of which shall be included in the price bid for the utility line.

3.18 WALKS, DRIVES, CONCRETE CURB AND GUTTER:

Walks and drives removed or damaged during the course of construction shall be replaced with Class "A" Concrete at the same thickness as removed. They will be cut to a neat edge with a masonry saw

after backfilling and compacting trench in 6-inch layers to a density not less than 95 percent at ± 2 percent of optimum moisture content as determined by the Modified Proctor Test.

Concrete curb and gutter sections removed or damaged during the course of construction shall be replaced in full sections with concrete having a compressive strength of at least 3,000 psi.

3.19 MEASUREMENT AND PAYMENT:

Measurement and payment for work under this section shall be included in overall project lump sum amount unless otherwise specified in Section 01 22 00.

END OF SECTION 31 23 00.

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SECTION 31 25 00 - EROSION & SEDIMENT CONTROLS

PART 1 - GENERAL

1.1 WORK INCLUDED

a) Installation of soil erosion control devices.

b) Maintenance of soil erosion devices during construction.

c) Removal of temporary soil erosion control devices after stabilization of disturbed areas or final site stabilization.

d) Temporary grassing, dust control, matting/blanketing, and other applicable BMP's as specified on plans and as Contractor deems necessary during course of construction.

1.2 QUALITY CONTROL

a) After installing the soil erosion control devices as called for on the Construction Plans, the CONTRACTOR shall assure himself that all reasonable measures possible have been taken to prevent the siltation of nearby water courses.

b) The erosion and sediment control shall conform with the rules and regulations of the Georgia Erosion and Sedimentation Act of 1975, as amended, and the "Manual for Erosion and Sediment Control in Georgia" and all applicable local regulations.

PART 2 - PRODUCTS

2.1 SILT FENCE AND INLET PROTECTION

a) Posts

Silt fence posts shall be 2" x 4" pressure treated pine, or steel post, a minimum of four (4') feet long and spaced a maximum of six (6') feet apart.

b) Woven Wire Fence

Wire fence reinforcement shall be a minimum of 14-gauge 4" x 4" hogwire.

c) Filter Fabric

Use a synthetic filter fabric or a pervious sheet of polypropylene, nylon, polyester, or polyethylene yarn, which is certified by the manufacturer or supplies as conforming to the requirements shown in the Table below.

Synthetic filter fabric should contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six (6) months of expected usable construction life at a temperature of 0 to 120ºF.

Physical Property	Requirements
Filtering Efficiency	85% (min)
Tensile Strength at 20% (max) Elongation	Standard Strength-30 lb/lin in (min) Extra Strength-50 lb/lin in (min)
Slurry Flow Rate	0.3 gal/sq ft/min (min)

2.2 RIP-RAP

a) Stone

Stone for rip-rap shall be durable, dense, specifically selected and graded, quarried stone. The d_{50} size shall be 6, 9, or 12 inches as called for on the plans. The stone shall be Type 1/ Type 3 in accordance with Georgia DOT specifications.

b) Gravel

Gravel for filter blanket shall be ASTM No. 57.

c) Filter Fabric

Filter fabric for filter blanket shall be a non-woven geotextile suitable for filtration and separation. The fabric weight shall be a minimum of 6.0 ounces per square yard.

2.3 TEMPORARY GRASSING

a) Temporary seed

Temporary seed shall be annual ryegrass, brown top millet, and common bermuda at the planting rates specified herein.

b) Mulch

Mulch for temporary grassing shall consist of grain straw or other acceptable material and shall have been approved by the Design Professional before being used. All mulch shall be reasonably free from mature seedbearing stalks, roots, or bulblets of Johnson Grass, Nutgrass, Sandbur, Wild Garlic, Wild Onion, Bermuda Grass, Crotalaria, and Witchweed, and free from an excessive amount of noxious weeds at the time of use of the mulch, and also there shall be compliance with all applicable State and Federal domestic plant quarantines. Straw mulch that is matted or lumpy shall be loosened and separated before being used.

Material for holding mulch in place shall be an approved binding material. No asphalt tacking material will be allowed.

2.4 EXCELSIOR LINED DITCH OR SLOPE PROTECTION

a) Excelsior Matting

Excelsior matting shall be an erosion control blanket consisting of an excelsior mat with a synthetic netting similar and equal to Curlex as manufactured by American Excelsior

Company. Matting to be used on slopes and drainage ways shall be approved for use by Design Professional prior to its purchase and installation.

2.5 CHECK DAM

a) Stone

Stone shall be graded 2 - 10-inch stone.

b) Filter Fabric

Filter Fabric shall be a non-woven geotextile suitable for filtration and separation. The fabric shall be a minimum of 6.0 ounces per square yard.

c) Haybale

Haybales shall consist of grain straw and be free of deleterious material and noxious weeds. Haybales shall be tightly bound with bailing string or an equivalent means of retaining compaction.

2.6 CONSTRUCTION EXIT

a) Stone shall be a well graded 1.5" - 3.5".

b) Fabric

The fabric for underlayment shall be a woven geotextile suitable for road base stabilization, soil separation, and reinforcement. The fabric shall be Amoco Style 2006, Nicolon Mifafi 600X or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

Construct temporary and permanent erosion control measures as shown on the plans, as required by site conditions, regulatory agency or Design Professional. All permanent erosion control work shall be incorporated into the project at the earliest practicable time. Temporary erosion control measures shall be coordinated with permanent erosion control measures and all other work on the project to assure economical, effective, and continuous erosion control throughout the construction and post construction period and to minimize siltation of rivers, streams, lakes, reservoirs, other water impoundments, ground surfaces, or other property. If active construction ceases for more than 30 days, all disturbed areas shall be seeded and mulched using the temporary seed type and planting rates specified herein

The CONTRACTOR shall be liable for all damages to public or private property and fines as may be placed on the project by the local regulatory agencies due to soil erosion from the project site. Clear only those areas required to install the soil erosion control devices, request an inspection by the local agency having jurisdiction (or appropriate authority).

All erosion control devices shall be inspected by the CONTRACTOR after each rainfall. Any required repairs shall be made immediately. Sediment deposits shall be removed when deposits reach

approximately one-half of the capacity of the erosion control device, and approximately one-third of the capacity of the temporary sediment basin.

3.2 SILT FENCE

a) Silt fence shall be installed in accordance with the details in the plans.

b) Should the filter fabric deteriorate or become ineffective prior to the end of the construction as determined by the Design Professional, the fabric shall be replaced immediately at no additional cost to the Owner.

3.3 RIP-RAP

a) Prepare subgrade to the required lines and grades as shown or indicated on the contract drawings. Place any fill required in the subgrade to a density equal to that of the surrounding area. Place filter fabric on the finished subgrade.

b) Place rip-rap by mechanical methods, augmented by hand placing where necessary to prevent damage to permanent works, provided that when the rip-rap is completed it forms a properly graded, dense, neat layer of stone. The completed rip-rap shall have a thickness as shown on the plans.

3.4 TEMPORARY GRASSING

Temporary grassing procedures will be implemented only under the direction of the Design Professional, a cease of construction in excess of 30 days, or as required by the soil erosion inspector.

Seeding for temporary grassing shall be applied to all shoulders, side ditches, cut slopes, fill slopes, and any other area disturbed by the CONTRACTOR and not designated for pavement or structures. Temporary seeding shall occur immediately following final site stabilization. Any unseeded area which erodes shall be repaired to the satisfaction of the Design Professional at no additional cost to the Owner. Temporary seeding shall be applied at the following rates:

Temporary Seeding	LBS / Acre	Depth of Cover	Date of Planting
Annual Ryegrass	40	¼" - ½"	Sept. – Feb.
Brown Top Millet	40	¼" - ½"	April – August
Common Bermuda	10	¼" - ½"	March - June

Areas not receiving permanent cover that will be exposed for more than three (3) months shall receive temporary grassing. Temporary grassing shall consist of rye grass. Other cereal grass (i.e., millet or bermuda) may also be used. Other grassing methods which have proved effective by the operator may be substituted for these, however require approval from the Design Professional prior to implementation.

3.5 INLET PROTECTION

Inlets shall be protected as specified on the plans.

3.6 CHECK DAM

Place the stone to the lines and dimensions shown in the plans on a filter fabric foundation or place haybales accordingly as shown on plans.

3.7 CONSTRUCTION EXIT

The construction exit shall be constructed in accordance with the detail in the construction drawings and located as shown on plans.

3.8 REMOVAL OF TEMPORARY EROSION DEVICES

The CONTRACTOR shall remove all sedimentation and erosion control devices upon the approval of permanent seeding and stabilization by the agency having jurisdiction of the area and the Design Professional. All sediment deposits remaining in place after the erosion control devices are removed shall be dressed to conform with the existing grade, prepared, and seeded. The cost of removal and cleanup shall be included in the lump sum bid price amount.

3.9 CLEAN OUT PERMANENT EROSION CONTROL DEVICES (including storm pipes & structures)

The Contractor shall clean out permanent sediment and erosion control devices upon approval of permanent seeding and stabilization by the agency having jurisdiction of the area and the Design Professional. The devices shall be cleaned out to the original condition. The cost of cleanup shall be included in the lump sum bid price amount. Coordinate clean out with Owner Project Manager.

3.10 MEASUREMENT AND PAYMENT

Measurement and payment for work under this section shall be included in overall project lump sum amount unless otherwise specified in Section 01 22 00.

END OF SECTION 31 25 00.

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SECTION 31 31 16 - TERMITE CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. **Soil treatment with termiticide.**
2. **Wood treatment.**
3. **Bait-station system.**
4. **Metal mesh barrier system.**

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. **Include the EPA-Registered Label for termiticide products.**

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each type of termite control product.

C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:

1. **Date and time of application.**
2. **Moisture content of soil before application.**
3. **Termiticide brand name and manufacturer.**
4. **Quantity of undiluted termiticide used.**
5. **Dilutions, methods, volumes used, and rates of application.**
6. **Areas of application.**
7. **Water source for application.**

D. Sample Warranties: For special warranties.

1.4 QUALITY ASSURANCE

Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located.
1. **Installer shall be licensed as a Pest Control Operator (PCO).**

B. Regulatory Requirements: Formulate and apply termiticides according to the EPA-Registered Label.

C. Standards for Application: Current edition of Georgia Department of Agriculture regulations.

D. FIELD CONDITIONS

E. Soil Treatment:

1. **Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.**
2. **Related Work: Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.**
3. **Apply borate treatment after framing, sheathing, and exterior weather protection is completed but before electrical and mechanical systems are installed.**

1.5 WARRANTY

A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work consisting of applied soil termiticide treatment will prevent infestation of subterranean termites, including Formosan termites (Coptotermes formosanus). If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. **Warranty Period: Five years from date of Substantial Completion.**

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain termite control products from single source from single manufacturer.

2.2 SOIL TREATMENT

A. Termiticide: EPA-Registered termiticide acceptable to authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Prepare work areas according to the requirements of authorities having jurisdiction and according to manufacturer's written instructions before beginning application and installation of termite control treatment(s). Remove extraneous sources of wood cellulose and other edible materials, such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

1. Fit filling hose connected to water source at the site with a backflow preventer, according to requirements of authorities having jurisdiction.

3.3 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termiticide solution to a uniform consistency. Distribute treatment uniformly. Apply treatment at the product's EPA-Registered Label volume and rate for maximum specified concentration of termiticide to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction.

1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
2. Foundations: Soil adjacent to and along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing.
3. Masonry: Treat voids.
4. Penetrations: At expansion joints, control joints, and areas where slabs and below-grade walls will be penetrated.

B. Post warning signs in areas of application.

C. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.4 PROTECTION

A. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

B. Protect termiticide solution dispersed in treated soils and fills from being diluted by exposure to water spillage or weather until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

3.5 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Material Completion, maintenance service shall include 12 months' full maintenance by skilled employees of termite-control-treatment Installer. Include maintenance as required for proper performance according to the product's EPA-Registered Label and manufacturer's written instructions. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

B. Continuing Maintenance Proposal: Provide from termite-control-treatment Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1. Include annual inspection for termite activity and effectiveness of termite treatment according to manufacturer's written instructions.

END OF SECTION 31 31 16

SECTION 32 10 00 – BASES, BALLASTS, & PAVING

PART 1 - GENERAL

1.1 SCOPE:

Under this heading shall be included the furnishing and installation of base course and pavement as shown including subgrade preparation, base course, and pavement.

1.2 GENERAL:

Subgrade preparation shall include leveling, proof-rolling and compacting of the subgrade as required. Installation of the base course shall include the placing and compacting of the material with appropriate equipment. Pavement shall be placed as shown on the plans with the necessary equipment and shall include any prime coats or tack coats required. All work shall be in conformity with the lines, grades and typical cross-sections shown on the Plans. The Contractor must have all equipment and workers on the job site necessary to perform a given operation when it is initiated.

PART 2 – PRODUCTS

N/A

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION:

The subgrade shall be brought to the line and grade necessary to accommodate the base and pavement at the required finished grades. All subgrade shall be proof-rolled as specified before base course is placed on the subgrade.

3.2 BASE COURSE:

a) Preparation of Base.

The surface of the base course will be inspected by the Design Professional for adequate compaction and surface tolerances specified in applicable base course or sub-base course. Any ruts or soft yielding spots that may appear in the base course, any areas having inadequate compaction, and any deviations of the surface from the requirements specified for the base course shall be corrected by loosening the affected areas, by removing unsatisfactory material and adding approved material where required and by reshaping and recompacting to line and grade and to the specified density requirements. Compaction of base material shall be done by conventional means using a 30,000 to 40,000-pound vibratory roller or other means of obtaining the required compaction.

The lines and grades shown on the Contract Drawings for each pavement category of the Contract shall be established and maintained by means of line and grade stakes placed at the site of the work by the Contractor.

b) Stabilized Aggregate Base Course.

The aggregate in the base course shall consist of a mixture of either crushed gravel, together with sand, sand-gravel, soil or other materials having similar characteristics combined as necessary to give a mixture conforming to the requirements, prescribed herein. The material and installation shall meet the requirements of Type 2, Section 310 of the Georgia Department of Transportation Standard Specifications.

Type 2		Section 310	
Sieve Designation	Percent By Weight Passing	Sieve Designation	Percent By Weight Passing
1 – ½"	100	2"	100
¾"	65 – 100	1 – ½"	97 – 100
½"	50 – 90	¾"	60 – 90
⅜"	45 – 70	No. 10	25 – 45
No. 4	35 – 55	No. 60	5 – 30
No. 30	17 – 38	No. 200	0 – 15
No. 200	6 – 15		
Liquid Limit	25 Max.		
Plasticity Index	6 Max.		

3.3 BITUMINOUS PRIME:

Bituminous prime shall be cutback asphalt RC-70 applied at the rate of 0.20 gallons per square yards. The material and application shall comply with the applicable portions of the Georgia Department of Transportation Standard Specifications and the material and application rate can be adjusted when the applicable section so recommends.

3.4 BITUMINOUS TACK COAT:

The bituminous tack coat shall be an asphaltic material which meets the requirements of Section 413 of the Georgia Department of Transportation Standard Specifications. Application rate shall be at the rate indicated in the appropriate section.

3.5 BITUMINOUS PAVEMENT:

The bituminous wearing surface shall be a plant mix conforming to the requirements of Section 400 of the Georgia Department of Transportation Standard Specifications. The job mix shall meet the requirements of Superpave Asphaltic Concrete Mixtures, Section 828 of the Georgia Department of Transportation Standard Specifications.

A job mix formula indicating the single definite percentage for each sieve fraction of aggregate and for asphalt shall be submitted prior to surfacing operations. The job mix formula shall also show the percent voids, the percent voids filled with asphalt, the unit weight per cubic foot of compacted mix, and other parameters as required by Section 828.

The general composition limits are extreme ranges of tolerances to govern mixtures made from any raw materials meeting the specifications. The submission of the job mix formula shall bind the Contractor to furnish paving mixture meeting the exact formula within allowable tolerances.

Compaction shall be done with an 8 to 10-ton steel-wheeled roller or other means approved by the Design Professional. Thickness shall not vary more than one-fourth inch and smoothness shall not exceed one-eighth inch for a ten-foot straight edge.

3.6 REMOVE AND REPLACE PAVEMENT:

Pavement and base course which must be removed for constructing sewers, manholes, force mains, water lines, and all other appurtenances in streets shall be replaced with the paving section shown on the drawings or match the existing pavement section. The pavement shall be removed to neat lines cut by a masonry saw. The top 18 inches of subgrade material immediately under the paving base and also road shoulder shall be carefully removed and kept separate from the rest of the excavated material. This material shall be placed in the top 18 inches of the backfill. Further compaction shall be accomplished by leaving the backfilled trench open to traffic while maintaining the surface with crushed stone or gravel. Settlement in trenches shall be refilled with crushed stone or gravel, and such maintenance shall continue until replacement of pavement.

3.7 TESTING:

The following tests will be made in accordance with the current edition of the Georgia Department of Transportation Standard Specifications.

At least one density determination shall be made for each 3,000 square yards of base. Asphalt extraction and aggregate gradation on the asphaltic concrete plant mix: one for each 500 tons of material delivered to the job site.

3.8 PROOF-ROLLING:

Proof-rolling will be done with a loaded tandem dump truck (15 yards heaped) or as specified in the Georgia Department of Transportation Standard Specifications. Test rolling will be done parallel to the centerline at speeds between 2 and 5 miles per hour.

3.9 PAINTED LINES FOR PARKING AND TRAFFIC AREAS:

Painted lines shall be 4 inches wide and be located as shown on the Plans. Paint and all work shall be accordance with Section 652 of the Georgia Department of Transportation Standard Specifications. Glass beads are not required. The paint manufacturer shall submit a statement which certifies that the paint meets the Department of Transportation specifications. Color shall be same as that of removed striping.

3.10 MEASUREMENT AND PAYMENT:

Measurement and payment for work under this section shall be included in overall project lump sum amount unless otherwise specified in Section 01 22 00.

END OF SECTION 32 10 00

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SECTION 32 13 13 – CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 SCOPE:

Under this heading shall be included the construction of concrete pavements.

1.2 STANDARD SPECIFICATIONS:

All work under this Section shall be performed in accordance with the current edition of the Georgia Department of Transportation "Standard Specifications for Construction of Roads and Bridges," hereinafter referred to as the Standard Specifications, unless specifically changed by the Drawings or the requirements of this Section of the Project Specifications.

PART 2 - PRODUCTS

2.1 MATERIALS:

a) Aggregate.

Coarse aggregate shall be crushed stone and shall conform to the requirements of Section 800 of the Standard Specifications and shall meet the requirements of Class A, Group 1 with respect to wear resistance. Fine aggregate shall conform to Section 80I of the Standard Specifications.

b) Cement.

Cement shall conform to the requirements of ASTM O-150, Type I.

c) Water.

Water used in mixing and curing shall be of potable quality.

d) Joint Sealer.

Sealer for joints shall meet the requirements of Section 833 of the Standard Specifications.

e) Joint Filler.

Preformed joint filler shall meet the requirements of Section 833.01 of the Standard Specifications and shall be furnished in a single piece for the full width and depth of the required joint.

f) Dowels and Tie Bars.

Reinforcement for concrete pavements shall meet the requirements of Sections 853.01 and 853.08 of the Standard Specifications.

g) Admixtures.

The Contractor shall submit certificates indicating that the material to be furnished meets all of the requirements indicated below. In addition, the Design Professional may require the Contractor to submit complete test data from an approved laboratory showing that the material to be furnished meets all of the requirements of the cited specifications. Subsequent tests may be made of samples taken or proposed for use in the work to determine whether the admixture is uniform in quality with that approved.

1) Air-Entraining Admixtures.

Air-entraining admixtures shall meet the requirements of ASTM C260 and shall be added to the mixer in the amount necessary to produce the specified air content. The air-entrainment agent and the water reducer admixture, if used together, shall be compatible.

2) Water-Reducing Admixtures.

Water-reducing, set-controlling admixtures shall meet the requirements of ASTM C494, Type A, water-reducing or Type D, water-reducing and retarding. Water-reducing admixtures shall be added at the mixer separately from air-entraining admixtures in accordance with the manufacturer's printed instructions.

h) Forms.

Forms for use in pavement construction shall be of metal construction, free of dents, bends, and warps, and shall be cleaned and oiled prior to each use. Forms shall extend to the full height of the required pavement section and shall be sealed at joints as required to prevent grout loss and to insure a continuous smooth surface on the finished pavement.

i) Curing Agents.

Materials for curing shall conform to the requirements of Section 832 of the Standard Specifications.

PART 3 - EXECUTION

3.1 EQUIPMENT:

Equipment shall meet the requirements of Section 430.03 of the Standard Specifications and the additional requirements as specified herein.

3.2 CONSTRUCTION:

Concrete pavement construction shall be in accordance with Section 430 of the Standard Specifications except as modified herein.

3.3 PROPORTIONS:

Concrete mixes shall be designed to have the proportions of materials to provide a 2B day minimum flexural strength of 600 psi, an entrained air content of 4.0 to 5.5 percent, a maximum slump of 2.5

inches and a maximum water-cement ratio (lbs./lb.) of 0.53, as required for Class No. 1 in a accordance with section 430.05 of the Standard Specifications. The Contractor shall submit mix designs which have been verified by laboratory testing and which meet the requirements for strength, air content, water-cement ratio and slump as given above in accordance with Section 430.05 of the Standard Specifications. Variations from approved mix designs, for whatever purpose, will be permitted only upon written request by the Contractor and accompanied by new mix designs and the results of verification tests. Water shall not be added to concrete at the site of the work for any reason.

3.4 JOINTS:

a) Joint Pattern.

The Contractor shall determine the joint pattern which best serves his equipment and operation. Joint spacing shall be within the limits shown on the Drawings except that the ratio of longitudinal to transverse spacing shall not exceed 1.25 and the maximum panel size will be 12-1/2 feet by 15 feet for concrete up to 8 inches thick. This ratio may be exceeded only at those intermediate joints at structure penetrations of the pavement. At such penetrations, an intermediate joint shall be constructed in the transverse direction which has an axis bisecting the penetration center. The Contractor shall submit for approval a jointing plan which includes, but is not limited to, the direction of paving and joint spacing dimensions, the type of joint as designated on the Drawings, the locations and intermediate joint locations at pavement penetrations and the sequence of paving operations. The plan shall be submitted to the Design Professional at such time as required by the Standard Specifications for submittal of mix designs. Slight adjustment in location of drainage inlets will be permitted for the purpose of obtaining efficient joint patterns.

b) Sawed Joints.

The Contractor shall maintain the necessary personnel and equipment on the site at all times to ensure that joints are sawed at the appropriate time. Failure to saw joints at the appropriate stage of concrete set which results in uncontrolled cracking will be cause for the rejection of damaged pavement and such pavement shall be removed and replaced at no additional cost to the Owner.

c) Joint Filler.

Elastomeric joint filler shall only be placed on clean surfaces. All joint filler material yielded outside the joint and all over runs shall be removed.

3.5 FINISHING:

The surface shall have a broom finish in accordance with Section 430 of the Standard Specifications.

3.6 CURING:

a) Requirements.

Curing shall be in accordance with Section 430 of the Standard Specifications except that for hot weather concreting, the use of burlap cover maintained in a wet condition for 7 days shall be required.

b) Control.

The Contractor shall maintain the necessary personnel and equipment on the site at all times to ensure that curing is initiated at the proper stage of concrete set. Uncontrolled cracking resulting from improper or untimely curing will be cause for rejection of the work and the removal and replacement of pavement at no additional cost to the Owner.

3.7 ACCEPTANCE LIMITS:

a) Thickness.

Acceptance limits and payment adjustments for pavement thickness shall be in accordance with Section 430 of the Standard Specifications.

b) Properties.

Acceptance limits for properties other than thickness shall be in accordance with the Standard Specifications except as follows:

	SPECIFIED PROPERTY VALUE	LOWER ACCEPTANCE LIMIT	UPPER ACCEPTANCE LIMIT
Flexural Strength, psi	600	600	NONE
Slump, Inches	2		2
Water Cement Ratio, lbs./lb.	0.53		0.53
Entrained Air, Percent	5.5	4.5	6.0

The flexural strength of the concrete shall meet the following requirements: (1) the average of any 4 consecutive strength tests, tested at the end of 28 days, shall have an average flexural strength equal to or greater than the specified flexural strength; (2) not more than 20 percent of the beams tested at the end of 28 days shall have a flexural strength less than the specified strength. Specimens which are obviously defective shall not be considered in the determination of the strength. When the test specimens fail to conform to the requirements for strength, changes in the concrete mix shall be made to increase the strength to meet these requirements.

Materials not conforming to these limits will not be accepted in the work.

3.8 TESTING:

a) General.

All testing for quality assurance will be performed by a laboratory retained by Contractor.

b) Strength.

Flexure testing shall be performed in accordance with AASHTO: T 126 and T 97. Each set for field control shall consist of 3 beam specimens obtained during concrete placement operations and 6 cylinders from the same load of material. Cylinders shall be tested in accordance with ASTM 0496. Where adequate correlation is obtained, the Design Professional may allow use of cylinders in place of beam testing.

c) Frequency.

The following table presents the minimum testing intervals for all concrete testing.

The intervals may be increased during the work at the direction of the Design Professional.

TEST	FREQUENCY
Flexure	One set per 800 square yards
Slump	One per each 3 delivery vehicles
Entrained Air	One per each 3 delivery vehicles
Density	One per each 5 delivery vehicles

3.9 CRACK CONTROL:

The Contractor shall have total responsibility for the prevent ion of uncontrolled cracking of pavements from any cause. Cracks in pavements shall be repaired by removal and replacement of concrete pavement at no cost to the Owner. Cracks that occur within 2 feet of a joint for their total length shall be repaired by removal and replacement of concrete pavement between the crack and the adjacent joint. Other cracks shall be repaired by total removal and replacement of all pavement within the panel formed by adjacent joints. Subgrade repair made necessary by corrective operations shall be performed at no cost to the Owner. In the event that uncontrolled cracking occurs in two or more adjacent panels oriented in the direction of paving, the Contractor shall cease all placement of concrete and shall determine the cause. Upon determination of the cause, the Contractor shall submit to the Design Professional such modifications to operations and/or materials as may be required to prevent additional cracking.

3.10 USE:

The pavement shall be released to the Owner for use in completed condition at the end of the contract period. Such completion time shall include 28 days for curing. Use by the Owner will not constitute final acceptance for payment.

3.11 MEASUREMENT AND PAYMENT:

Measurement and payment for work under this section shall be included in overall project lump sum amount unless otherwise specified in Section 012200.

END OF SECTION 32 13 13

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SECTION 32 14 00 – UNIT PAVERS

1. SCOPE:

Under this heading shall be included the following:

a) Ungrouted mortarless brick pavers.
b) Edge restraints for brick pavers.

Compacted subgrade under brick pavers is specified in Section 31 20 00 of these Specifications (unless noted otherwise).

2. GENERAL:

Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

Product data for the following products:

1. Brick pavers.

Samples for initial selection purposes in form of actual brick or sections of brick showing full range of colors, textures, and patterns available for each type of brick paver indicated.

Samples for verification purposes in full-size brick of each type of brick paver indicated, in sets for each color, texture, and pattern specified, showing full range of variations expected in these characteristics.

3. DELIVERY, STORAGE, AND HANDLING:

Protect brick pavers and aggregate during storage and construction against wetting by rain, snow, or ground water and against soilage or contamination from earth and other materials.

4. PRODUCTS:

a) Manufacturers.

Subject to compliance with requirements, provide products by the following:

1. Brick Paver (traffic and pedestrian rated):

Pine Hall Brick

b) Colors and Textures.

Provide materials and products that result in colors and textures of exposed brick paver surfaces and joints complying with the following requirements:

1. See plans for requirements.

c) Brick Pavers.

Brick Pavers: Brick interlocking paving bricks, ASTM C 1272-F.

d) Edge Restraints.

1. Concrete for Job-Built Edge Restraints: Per Concrete Edger Strip detail on the plans.

2. Sand for Leveling Course: Fine aggregate complying with ASTM C 33.

3. Sand for Joints: ASTM C 144 except use aggregate graded with 100 percent passing the No. 8 sieve and 95 percent, the No. 16 sieve.

e) Ungrouted Mortarless Setting Materials for Brick Pavers.

1. Sand for Leveling Course: Fine, sharp, nonplastic aggregate complying with ASTM C 33.

2. Sand for Joints: ASTM C 144 except use aggregate graded with 100 percent passing the No. 8 sieve and 95 percent, the No. 16 sieve.

5. EXECUTION:

a) Examination.

Examine surfaces indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of brick pavers. Do not proceed with installation until unsatisfactory conditions have been corrected.

b) Preparation.

Proof roll prepared subgrade surface to check for unstable areas and areas requiring additional compaction. Do not proceed with installation of brick pavers until deficient subgrades have been corrected and are ready to receive subbase for brick pavers.

c) General Installation.

Do not use brick pavers with chips, cracks, voids, discolorations, and other defects that might be visible or cause staining in finished work.

Cut brick pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut brick pavers to provide pattern indicated and to fit adjoining work neatly. Use full brick without cutting where possible. Hammer cutting is not acceptable.

1. For brick pavers, a mortar-driven masonry saw or block splitter may be used.

2. Joint Pattern: As indicated below:

   a. Per Brick Paver detail(s) on the plans.

3. Handtight Joints: Where brick pavers are indicated without spaced joints, set brick pavers with hand-tight joints.

6. UNGROUTED MORTARLESS BRICK PAVER APPLICATIONS:

a) Compact soil subgrade uniformly to at least 95 percent of ASTM D 1557 laboratory density.

b) Place graded aggregate for subbase and base over compacted subgrade. Provide compacted thickness of base and subbase indicated. Compact subbase and base to at least 100 percent of ASTM D 1557 maximum laboratory density.

c) Place graded aggregate for base over compacted subgrade. Provide compacted thickness of base indicated. Compact base to at least 100 percent of ASTM D 1557 maximum laboratory density.

d) Place sand for leveling course and screed to a thickness of 1 inch to 1-1/4 inch, taking care that moisture content remains constant and the density is loose and constant until brick pavers are set and compacted.

e) Set brick pavers with a minimum joint width of 1/16 inch and a maximum of 3/16 inch, being careful not to disturb leveling base. If pavers have spacer bars, then place pavers hand tight against spacer bars. Use string lines to keep straight lines. Select brick from 4 or more cubes to blend color and texture variations. Fill gaps between brick that exceed 3/16 inch with pieces cut to fit from full-size brick pavers.

   1. When installation is performed with mechanical equipment, use only brick pavers with spacer bars on sides of each brick.

f) Vibrate brick pavers into leveling course with a low amplitude plate vibrator capable of a 3,500- to 5,000-pound compaction force. Perform at least 3 passes across paving with vibrator. Vibrate under the following conditions:

   1. After edge pavers are installed and there is a completed surface or before surface is exposed to rain.

   2. Before ending each day's work, fully compact installed brick pavers within 3 feet of the laying face. Cover the open layers with nonstaining plastic sheets overlapped 4 feet on each side of laying face to protect it from rain.

g) Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Brush and vibrate sand until joints are completely filled, then remove surplus sand.

h) Do not allow traffic on installed brick pavers until sand has been vibrated into joints.

i) Repeat joint filling process 30 days later.

7. REPAIR, POINTING, CLEANING, AND PROTECTION:

   a) Remove and replace brick pavers that are loose, chipped, broken, stained, or otherwise damaged or if brick do not match adjoining brick as intended. Provide new brick to match adjoining brick and install in same manner as original bricks, with same joint treatment to eliminate evidence of replacement.

   b) Provide final protection and maintain conditions in a manner acceptable to Installer, which ensures brick paver work being without damage or deterioration at time of Substantial Completion.

8. MEASUREMENT AND PAYMENT:

   Measurement and payment for work under this section shall be included in overall project lump sum amount unless otherwise specified in Section 01 22 00.

END OF SECTION 32 14 00.

SECTION 32 16 00 - CURB AND GUTTER (AND CONCRETE SIDEWALKS)

PART 1 - GENERAL

1.1 SCOPE:

Under this heading shall be included the construction of all concrete sidewalks, curb and gutter.

PART 2 - PRODUCTS

2.1 CONCRETE:

Concrete shall be composed of cement, admixtures, fine aggregate, coarse aggregate, and water proportioned and mixed to produce a plastic workable mix in accordance with the requirements of American Concrete Institute (ACI) Manual of Concrete Practice-1980 (MCP), and shall be suitable for the specific conditions of placement. Concrete shall be Class "A" and shall have 28-day compressive strength of not less than 4,000 psi, and contain not less than 540 pounds of cement per cubic yard of concrete. The maximum size of coarse, hard aggregate shall be ¾-inch.

All concrete shall be ready mixed concrete in accordance with ASTM C94. All reinforcement shall comply with ASTM A615.

PART 3 - EXECUTION

3.1 PREPARATION:

Before placing concrete, all debris and water shall be removed from the places to be occupied by the concrete. Wood forms shall be thoroughly wetted or oiled, and the reinforcement cleaned of coatings. Formwork and the placement of reinforcement, pipes, anchors, and other inserts shall be inspected by the Design Professional before any concrete is deposited.

3.2 PLACING:

The placing and depositing of all concrete shall be done in accordance with requirements of the ACI. Concrete shall be rapidly handled from mixer to forms and deposited as nearly as possible in its final position to avoid segregation due to rehandling or flowing. Concrete shall not be allowed to drop freely more than 4 feet. For greater drop a tremie or other means must be used. Concrete shall be spaced and worked by hand and vibrated to assure close contact with all surfaces of forms and reinforcement and leveled off at proper grade to receive finish. No concrete that has partially hardened or been contaminated by foreign material shall be deposited in the work. Concrete shall never be deposited upon soft mud or dry porous earth.

3.3 VIBRATION:

Concrete shall be placed with the aid of manual vibration. The intensity of vibration shall be sufficient to cause flow or settlement of the concrete into place, but shall not be long enough to cause segregation of the mix. To secure even and dense surfaces, vibration shall be supplemented by hand spading in the corners and angles of forms and along form surfaces while the concrete is plastic under the vibratory action. Caution must be exercised to prevent any injury to the inside face of the forms or any movement of the reinforcement.

3.4 CONSTRUCTION JOINTS, CONTROL JOINTS AND EXPANSION JOINTS:

Joints shall be formed and located as indicated on the Plans, or as recommended by applicable requirements of MCP. Final locations are subject to Design Professional's review.

The rate and method of placing concrete and the arrangement of construction joint bulkheads shall be such that the concrete between construction joints shall be placed in a continuous operation. Whenever it is necessary to stop work, such stops shall be located and temporary bulkheads erected. Before concreting is resumed, the surfaces of previously placed concrete shall be roughened, cleaned, wetted, and slushed with grout immediately before additional concrete is placed. Grout shall be one part Portland Cement and two parts sand.

Expansion joints shall be provided in walks, and curb and gutter where shown and at walls, intersecting walks and buildings. Expansion joints in walks and curb and gutter shall be made with 1/2 inch thick premolded, non-extruding expansion joint filler, "Flexcell," or "Meadows" or equal, extending through the full thickness of the concrete except the upper 1/4 inch at 50 foot intervals. When sidewalk is adjacent to curb the expansion joints shall coincide. These shall be set accurately in place to straight lines and concreted in. Control joints in sidewalks shall be spaced at intervals equal to the width of the sidewalk and in curb and gutter at 10-foot intervals. Edges of grooves, expansion joints and edges of walks and curb and gutter shall be rounded to a 1/4-inch radius with suitable grooving and edging tools.

3.5 FINISHING:

Walks and curb and gutter shall be finished as specified for troweled concrete except that final finishing shall be with wood floats, as directed by Owner and to match adjacent existing sidewalks, to produce non-slippery finish at right angles to the length unless otherwise directed. Completed work shall be finished true to line and grade and when tested with a 10-foot straightedge shall not show a variation of more than 1/4 inch from a straight line.

3.6 PROTECTION AND CURING:

Protect concrete against frost, freezing temperatures, rapid drying and heavy rain after placing during this period, concrete shall be maintained above 70 degrees F. for at least 3 days or above 50 degrees F. for at least 5 days.

Walks and other exterior concrete shall be cured by covering first with sprayed-on curing compound applied immediately after finishing and then also completely covered with an impermeable fiber filled paper for a period of not less than 12 hours.

Membrane curing compound shall comply with ASTM C309 for Type I and paper shall comply with ASTM C171.

Exterior concrete work constructed during hot weather shall be protected, in addition to the curing specified above, with Spencer Kellogg Anti-Spalling Compound, or Carter-Waters "Dek-Seal," or equal, applied as soon as conditions will permit after curing and when the concrete is clean and dry. The mixture shall be applied uniformly in 2 applications, in accordance with the manufacturer' s recommendations. The second application shall not be made until after the first coat has been completely absorbed by the concrete.

3.7 REMOVAL OF FORMS:

Care shall be taken in the removal of the forms not to damage the surface of the concrete. Immediately after the forms are removed, all damaged or imperfect work shall be patched in a neat and workmanlike manner, or if badly damaged or imperfect, the work shall be rebuilt. Leave shoring in place until concrete member will support its own weight safely plus any loads that may be placed upon it.

Freshly stripped surfaces shall not be pointed up or touched in any manner before having been inspected by the Design Professional.

3.8 PATCHING AND FINISHING CONCRETE FORMED SURFACES:

Immediately after removing forms, all concrete surfaces shall be inspected, and any honeycomb, voids, stone pockets, and tie holes shall be patched before the concrete is thoroughly dry. Defective areas shall be chipped away to a depth of not less than 1 inch with the edges perpendicular to the surface. The area to be patched and a space of at least 6 inches wide entirely surrounding it shall be wetted to prevent absorption of water from the patching mortar. The patch shall be finished in such a manner as to match the adjoining surface.

Immediately upon removing forms from finished concrete surfaces, they shall be cleaned of all cement fins and any air pockets shall be carefully filled with cement mortar worked in to ensure a bond with the concrete and finished off to match the surrounding surface.

All vertical exterior surfaces exposed in the finished work shall be finished to a smooth rubbed finish having a uniform appearance.

3.9 TESTING:

a) General.
All testing for quality assurance will be performed by a laboratory retained by Owner.

b) Strength.
Flexure testing shall be performed in accordance with AASHTO: T 126 and T 97. Each set for field control shall consist of 3 beam specimens obtained during concrete placement operations and 6 cylinders from the same load of material. Cylinders shall be tested in accordance with ASTM 0496. Where adequate correlation is obtained, the Design Professional may allow use of cylinders in place of beam testing.

c) Frequency.
The following table presents the minimum testing intervals for all concrete testing.

The intervals may be increased during the work at the direction of the Design Professional.

TEST	FREQUENCY
Flexure	One set per 800 square yards
Slump	One per each 3 delivery vehicles
Entrained Air	One per each 3 delivery vehicles
Density	One per each 5 delivery vehicles

3.10 MEASUREMENT AND PAYMENT:

Measurement and payment for work under this section shall be included in overall project lump sum amount unless otherwise specified in Section 01 22 00.

END OF SECTION 32 16 00.

SECTION 32 91 15 - SOIL PREPARATION (PERFORMANCE SPECIFICATION)

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes planting soils specified according to performance requirements of the mixes.

B. Related Requirements:

1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.

1.2 DEFINITIONS

A. CEC: Cation exchange capacity.

B. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

C. Imported Soil: Soil that is transported to Project site for use.

D. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

E. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

F. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

G. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.

H. SSSA: Soil Science Society of America.

I. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

J. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

K. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

L. USCC: U.S. Composting Council.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at project site at a time designated by project landscape architect or City of Savannah Landscape Architect.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each bulk-supplied material in sealed containers labeled with content, source, and date obtained; providing an accurate representation of composition, color, and texture.

C. Soil Test: Test to be provided for existing on-site soil in area where sod is to be placed and where shrubs and trees are to be planted. Three samples minimum.

D. Performance Soil Tests per section 3.4 of this specification section.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed such as the University of Georgia Cooperative Extension:
Soil, Plant, and Water Analysis Laboratory (SPW)
2400 College Station Road
Athens, Georgia 30602-9105
phone: 706-542-5350
fax: 706-369-5734

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED ACCORDING TO PERFORMANCE REQUIREMENTS

A. Existing, on-site surface soil, with the duff layer, if any, retained and stockpiled on-site; modified to produce viable planting soil. Using preconstruction soil analyses and materials specified in other articles of this Section, amend existing, on-site surface soil to become planting soil complying with the following requirements:

1. 45% sand, 40% silt 10% clay and 5% organic material with a pH of 6 to 7.

2. Manufactured soil shall not contain the following:

a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 5 percent by dry weight of the soil.

c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches (50 mm) in any dimension.

3. Percentage of Organic Matter: Minimum 5 percent by volume.

B. Imported, naturally formed soil from on or off-site sources and consisting of sandy loam soil according to USDA textures; and modified to produce viable planting soil. Amend imported soil with materials specified in other articles of this Section to become planting soil complying with the following requirements:

1. 45% sand, 40% silt 10% clay and 5% organic material with a pH of 6 to 7.

2. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches (100 mm) deep, not from bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass.

3. Additional Properties of Imported Soil before Amending: Minimum of 5 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration. Clean soil to be of the following:

a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.
c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches (50 mm) in any dimension.

C. Manufactured soil consisting of manufacturer's basic sandy loam according to USDA textures blended in a manufacturing facility with sand, stabilized organic soil amendments, and other materials as specified in other articles of this Section to produce viable planting soil.

1. Basic Properties: 45% sand, 40% silt 10% clay and 5% organic material with a pH of 6-7.

2. Manufactured soil shall not contain the following:

a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 5 percent by dry weight of the manufactured soil.

c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches (50 mm) in any dimension.

3. Percentage of Organic Matter: Minimum 5 percent by volume.

2.2 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through a No. 40 (0.425-mm) sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 (0.30-mm) sieve.

E. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

2.3 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance,".

B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, a pH of 3.4 to 4.8, and a soluble-salt content measured by electrical conductivity of maximum 5.

C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, a pH of 6 to 7.5, a soluble-salt content measured by electrical conductivity of maximum 5 dS/m, having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.

D. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

A. Superphosphate: Commercial, phosphate mixture, soluble.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium.

C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium.

PART 3 - EXECUTION

3.1 GENERAL

A. Place planting soil and fertilizers according to requirements in other Specification Sections.

B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

3.2 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth 6 inches (150 mm). Remove stones larger than 1-1/2 inches (38 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

C. Mixing: Spread unamended soil to depth required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is muddy, or excessively wet.

1. Amendments: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.

    a. Mix lime and sulfur as required with dry soil before mixing fertilizer.
    b. Mix fertilizer with planting soil no more than seven days before planting.

D. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.3 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

A. Application: Apply compost component of planting-soil mix to surface of in-place planting soil. Do not apply materials or till if existing soil or subgrade is muddy, or excessively wet.

B. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests:
   1. Performance Testing: For each amended planting-soil type, demonstrating compliance with specified performance requirements. Perform testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

C. Soil will be considered defective if it does not pass tests.

D. Prepare test reports.

E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.5 PROTECTION AND CLEANING

A. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

   1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 32 91 15

SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sodding.

1.2 DEFINITIONS

A. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

B. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329115 "Soil Preparation (Performance Specification)".

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.

   1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
   2. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

      a. Landscape Industry Certified Technician - Exterior.
      b. Landscape Industry Certified Lawncare Manager.
      c. Landscape Industry Certified Lawncare Technician.

   3. Pesticide Applicator: State licensed, commercial.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation"

sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

A. Turfgrass Species: Species to be selected to match existing sod species on site, and specific conditions where sod is to be established. Two species will be considered if sod is required for both shade and sun conditions. Species selection to be submitted to project landscape architect for approval prior to purchase or delivery.

2.2 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m)] of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

2.3 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

PART 3 - EXECUTION

3.1 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329115 "Soil Preparation (Performance Specification)". Minimum 3" of topsoil to be provided beneath sodded areas.

B. Reduce elevation of planting soil to allow for soil thickness of sod.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.2 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across slopes exceeding 1:3.
2. Anchor sod on slopes exceeding 1:3 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.

3.3 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

B. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings.

3.4 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).

2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

END OF SECTION 329200

SECTION 32 9300 - PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plants.

1.2 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.

C. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and fertilizers to produce a soil mixturefor plant growth. See Section 329115 "Soil Preparation (Performance Specification)" for drawing designations for planting soils.

D. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at project site at a time designated by project Landscape Architect.

1.4 ACTION SUBMITTALS

A. Product Data:
1. Plant photo submittal with nursery supplier for all plant species will be provided to the Landscape Architect for approval prior to purchase or delivery. Measuring stick or scalable object shall be in photo for all plant material 7 gallon size and larger.

B. Samples of mulch.

C. Irrigation Plan showing (at a minimum) manufacturer, size and location of meter, timer, lines, heads, bubblers and drip irrigation.

1.5 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Final Irrigation Plan record drawing showing any field-changes and deviations from previously submitted irrigation plan.

B. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Shall include any irrigation equipment manuals and recommendations for irrigation maintenance.

1.7 QUALITY ASSURANCE

A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

1. Pesticide Applicator: State licensed, commercial.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver bare-root stock plants within 24 hours of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.

B. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

C. Handle planting stock by root ball.

D. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1.9 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
b. Structural failures including plantings falling or blowing over.

2. Warranty Periods: From date of planting completion.

a. Trees, Shrubs, Vines, and Ornamental Grasses: 24 months.
b. Ground Covers, Perennials, and Other Plants: 24 months.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

B. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

2.2 FERTILIZERS

A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
1. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.3 MULCHES

A. Organic Mulch: Pine bark nuggets or Pine Straw

2.4 PESTICIDES

A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329115 "Soil Preparation (Performance Specification).”

B. Placing Planting Soil: Blend planting soil in place.

C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.2 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.

1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately three times as wide as ball diameter.
3. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
4. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.

B. Backfill Soil: Subsoil and topsoil removed from excavations may be used as backfill soil if it has been modified per Section 329115 "Soil Preparation (Performance Specification).”

3.3 TREE, SHRUB, AND ORNAMENTAL GRASS PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Set each plant plumb and in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.

1. Backfill: Planting soil per Section 329115"Soil Preparation (Performance Specification)."
2. Balled and Burlapped Stock: After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Container-Grown Stock: Carefully remove root ball from container without damaging root ball or plant.
4. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
5. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.

    a. Bare-Root Stock: Place tablets beside soil-covered roots; do not place tablets touching the roots.
    b. Quantity: Three per plant.

6. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.4 TREE AND SHRUB PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

C. Do not apply pruning paint to wounds.

3.5 GROUND COVER PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.

B. Use planting soil per Section 329115"Soil Preparation (Performance Specification)" for backfill.

C. Dig holes large enough to allow spreading of roots.

D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.6 PLANTING AREA MULCHING

A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 6 inches (150 mm) and secure seams with galvanized pins.

B. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees and Treelike Shrubs: Apply organic mulch ring of 3-inch (50-mm) average thickness, with radius as shown on plans around trunks or stems. Do not place mulch within 3 inches (75 mm) of trunks or stems.
2. Organic Mulch in Planting Areas: Apply 2-inch (50-mm) average thickness of organic mulch over whole surface of planting area and finish level with adjacent finish grades. Do not place mulch within 3 inches (75 mm) of trunks or stems.

3.7 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

D. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

E. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

F. At time of Substantial Completion, verify that irrigation system is in good working order and replace improperly functioning devices.

3.8 MAINTENANCE SERVICE

A. Maintenance Service: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period for Trees and Shrubs: 12 months from date of Substantial Completion.
2. Maintenance Period for Ground Cover and Other Plants: 12 months from date of Substantial Completion.

END OF SECTION 329300

SECTION 33 10 00 – WATER UTILITIES

PART 1 - GENERAL

1.1 SCOPE:

Under this heading shall be included installation of the water distribution system as shown and as specified herein.

The Contractor shall comply with all local codes and regulations of local utilities. He shall coordinate work necessary for the completion of utilities with local utility companies and cooperate with the companies as required.

1.2 EXCAVATION AND BACKFILL:

Excavation and backfill shall be as specified in Section 31 23 00, Excavation and Fill, except that the pipe zone shall be terminated at 2 inches above the pipe until after testing. A minimum cover over the top of the pipe of 2-1/2 feet from the proposed paving subgrade, shoulder or finished grade shall be provided.

All water piping shall be backfilled with select backfill (granular sandy material with no more than 30% passing No. 200 sieve) material for the entire excavation and shall be compacted in accordance with Specification Section 31 23 00. The select backfill shall be free of all roots, debris, and deleterious materials.

PART 2 - PRODUCTS

2.1 MATERIALS:

Except where specifically noted on the Plans, the following types of NSF approved pipe shall be used (all materials shall meet Owners Specifications):

a) Metal Pipe.

1) Ductile Iron Pipe.

Ductile iron pipe shall be manufactured in accordance with ANSI A21.51. Ductile iron pipe shall be of the thickness according to ANSI A21.50 for Laying Condition 2, and shall be Class 50 minimum.

2) Fittings.

Fittings shall conform to ANSI A21.10 and shall be push-on-type unless otherwise shown.

3) Joints.

Joints shall conform to ANSI A21.11, push-on-type unless otherwise shown.

4) Lining.

Lining for ductile iron pipe and fittings shall be a cement mortar lining meeting the ANSI A21.4 for standard thickness lining. After cement lining, the interior of the pipe shall be given a coat of approved bituminous material in accordance with ANSI A21.4.

5) Exterior Coating.

Exterior coating shall be an approved bituminous coating one mil thick unless otherwise shown and/or specified.

b) PVC Pipe.

PVC pipe shall be Underwriters' Laboratories approved and listed. PVC pipe used for water mains maintained by Owner shall be blue in color only. It shall meet or exceed AWWA C900 with the following supplemental specifications:

1) Pressure Pipe.

Pipe 4 inches and greater shall be Class 150 with Dimension Ratio 18 or lower (thicker). Pipe less than 4 inches shall be Class 200 with Dimension Ratio 21 or lower conforming to ASTM D2241.

2) Routine Hydrostatic Proof Test Requirements.

Each piece of pipe shall be tested at 4 times rated pressure class.

3) Outside Diameter.

Pipe shall have cast iron pipe outside diameter.

4) Joints.

Pipe shall have elastomeric-gasket integral bell end. Bell section shall have a thickened wall. Gasket groove wall thickness shall meet or exceed the thickness of the pipe barrel.

5) Fittings.

Ductile iron or cast iron, if used, push-on-type conforming to ANSI A21.10 unless otherwise shown.

6) Affidavit of Compliance.

The manufacturer shall furnish an affidavit that all materials delivered comply with the requirements of this standard and supplemental specifications.

7) Couplings and Fittings.

Couplings and fittings shall be furnished by the pipe manufacturer and shall accommodate the pipe for which they are to be used.

They shall have the same minimum pressure rating as the pipe. Coupling method

shall allow for expansion or contraction of each pipe section to be taken up at each end of the pipe. Couplings shall permit 5-degree deflection (2-1/2 degrees on each side) of the pipe without any evidence of infiltration, exfiltration, or breaking.

c) Galvanized Pipe.

Pipe shall be screw joint, conforming to F.S. WW-P-406, Schedule 40.

d) Gate Valves.

Gate valves shall be as shown on the Plans and shall conform to the following specifications:

1) Gate Valves (3 Inches and Larger).

Gate valves 3 inches and larger shall conform to AWWA C500 and shall be double disc, parallel seat type with non-rising stem.

Unless otherwise indicated or specified, gate valves shall be designed for a working pressure of not less than 150 psi.

Valves shall take full test pressure on either face. Valves shall be from not more than two manufacturers and similar sizes shall be identical and parts interchangeable. They shall be constructed with bolted bonnets provided with stuffing boxes having bolted followers. The stuffing boxes shall be easily accessible and shall be packed ready for use.

Iron body valves 3 inches and larger shall have fittings of Grade I Bronze, except peened or rolled-in gate rings, which shall be Grade 11 Bronze.

Rubbing surfaces and surfaces in contact during the seating operations, including wedge, wedge seats, thrust ring seats, top and bottom stem guide bearing surfaces, packing gland surfaces and contact seats provided for packing under pressure, shall be all bronze bushed or bronze faced.

Stems for valves 3 inches and larger shall be cast, forged or rolled bronze conforming to AWWA C500. Cast stems shall be of Grade IV Bronze. Bronze for forged and rolled stems shall be Grade III.

Gate valves for liquid service shall be designed for 150 psi working pressure and shall be similar in design, construction and materials to American-Darling No. 52 or 55, Mueller Company No. A-2480-20 or A-2380-6, Dresser Style 67, or equal.

Unless shown or specified otherwise, manually operated valves shall be equipped with a mechanism which will allow the valve to be opened or closed with a force of not more than 40 pounds applied to the nut, crank or handwheel.

All valves shall open by turning handwheels, tee wrenches or other operators in a counterclockwise direction.

2) Resilient-Seated Gate Valves (3 Inches & Larger).

Resilient-seated gate valves 3 inches and larger shall conform to AWWA C509 with non-rising stem.

Unless otherwise indicated or specified, gate valves shall be designed for a working pressure of not less than 150 psig.

Valves shall take full pressure on either face. Valves shall be from one manufacturer and similar sizes shall be identical and parts interchangeable. They shall be constructed with bolted bonnets provided with two O-ring stem seals which can be replaced with the valve under pressure in the full-open position.

Valves shall be constructed of materials conforming to AWWA C509. All internal and external surfaces shall be coated with epoxy to a minimum thickness of 8 mils.

Valve seats shall be coated with a rubber material conforming to AWWA C509 so that there shall be no rubber to metal contact when the valve is in the fully closed position.

Valves shall be hydrostatically tested in accordance with AWWA C509.

Valves shall be American, Waterous or equal and shall be furnished with standard handwheels, chain wheels or nuts as shown on the Plans and/or as specified.

3) Gate Valves (2-1/2 Inches & Smaller.)

Gate valves 2-1/2 inches and smaller shall be designed for a working pressure of not less than 125 psi. They shall be bronze, rising stem, double disc, parallel seat, screwed bonnet type. Valves shall be similar in design, construction, and materials to Crane No. 440, or Nibco No. T-111-2 or equal, with appropriate end connections.

e) Hydrants.

Hydrants shall conform to AWWA C502. Main Valve opening size shall be 4-1/2 inches minimum and inside barrel diameter shall be 7 inches minimum with 3 feet minimum bury. Hose connections shall be two 2-1/2 inches and one 4-1/2 inches. Nipple caps shall be chained to the barrel. Hydrant shall be DRY TOP type protecting operating threads from coming in contact with water. Operating threads will be grease lubricated through easily accessible Alemite fitting in top of operating nut. Direction of opening shall be counter-clockwise and be cast on the head of the hydrant. Hose nipples shall be bronze or non-corrosive metal and threads shall be National Standard.

Hydrants shall be traffic type utilizing stem breaking coupling and breakaway traffic flange. (Breakable bolts or nuts are not acceptable.)

Hydrants shall be painted with 1 coat of red lead paint and 2 finish coats of approved paint of fire hydrant yellow color or as otherwise directed.

Hydrants shall be the type and model (or approved equivalent) as required by Owner specifications.

f) Tapping Sleeves and Valves.

Tapping sleeves and valves shall be used for making branch connections to an existing watermain. Tapping sleeves shall be provided at the locations indicated on the Plans and shall be mechanical joint type, Mueller No. H-615, Clow F-5205 or equal. Tapping valves shall be mechanical joint type gate valves, Mueller No. 667, Clow F-5093 or approved equal, and shall conform to the requirements of this Section.

g) Water Service (Domestic & Irrigation) Pipe Material.

Pipe conforming to the following specifications will be required with no exception unless approved in writing:

	To Be Marked
Polyethylene	
Nominal Size	X
ASTM D2737	X
SDR 9	X
HDPE 4710	X
Working Pressure - 250 psi	X
Water Service Tubing	X
National Sanitation Foundation (NSF)	X
Preferable Pipe Color - Blue Stripe	

Unmarked pipe, without information noted above, will not be accepted. Brass or bronze compression type fittings shall be used. Flared connections will not be permitted. Continuous metallic tape over the pipe will be required. No gooseneck will be allotted nor will solvent weld joints be allowed. Corporation and curb stops will be required on all laterals.

h) Corporation Stops.

At each tapped point a connection to the pipe shall be made by installing a corporation stop. Corporation stops shall be Mueller H15008 Ground Key Corporation Stop, or approved equal, as required for the type of pipe being tapped.

i) Curb Stops.

Curb stop shall be 1 inch size or as shown on the Plans and shall be Mueller Company H-15317, H-10203, or approved equal.

j) Post Indicator Valve (PIV).

Each post indicator valve shall consist of a resilient seated gate valve which meets these specifications and an indicator post which meets National Fire Protection Association Code, NFPA 13. The gate valve and post indicator shall be compatible. Post indicator shall be painted with one coat of red lead paint and two coats of fire approved red paint suitable for exterior finish.

k) Post Indicator Valve Control Supervisory Switch (PIVCSS).

PIVCSS shall be installed on each valve as designated on the drawings and/or as specified herein. Switches shall be mounted so as not to interfere with the normal operation of the valve and shall be adjusted to operate within two revolutions of the valve control or when the valve flag has moved no more than one-fifth of the distance from its normal position. The mechanism shall be contained in a weatherproof die cast metal housing, which shall provide a side entrance for ½″ conduit and incorporate a ½″ NPT nipple for attachment to the valve body. A grounding provision is provided. The switch assembly shall include two switches each with a rated capacity of 10 Amp @ 125/250V AC and 2.5 Amp @ 24V DC. The cover shall contain tamper-resistant screws for which a security wrench will be provided with each switch. PIVCSS shall be Underwriters Laboratories listed for indoor or outdoor use. PIVCSS shall meet applicable NFPA requirements.

PART 3 - EXECUTION

3.1 INSTALLATION.

a) General.

Pipe, fittings, valves, hydrants, and other accessories shall, unless otherwise directed, be unloaded at the point of delivery, hauled to and distributed at the site of the project by the Contractor. They shall at all times be handled with care to avoid damage. In loading and unloading, they shall be lifted by hoists or slid or rolled on skidways in such a manner as to avoid shock. Under no circumstances shall they be dropped. Pipe handled on skidways must not be skidded or rolled against pipe already on the ground. In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Coated pipe shall be handled in such a manner that a minimum of damage to the coating will result. Damaged coating shall be repaired. Pipe shall be placed on the site of work parallel with the trench alignment and with bell ends facing the direction in which the work will proceed unless otherwise directed. The interior of all pipe, fittings, and other accessories shall be kept free from dirt and foreign matter at all times. Valves and hydrants shall be drained and stored in a manner that will protect them from damage by freezing before installation.

Cutting pipe for inserting fittings, or closure pieces, shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise directed, pipe shall be laid with the bell ends facing the direction of laying. For lines on an appreciable slope, bells shall face upgrade. Wherever necessary to deflect the pipe from straight line, whether in the vertical or horizontal plane to avoid obstructions, the degree of deflection shall not exceed 2-1/2 degrees. No pipe shall be laid in water or when the trench condition or the weather is unsuitable for such work. Installation shall be in accordance with manufacturer's instructions.

All pipe and fittings shall be carefully lowered into the trench piece by piece by means of derrick, ropes or other suitable tools or equipment in such a manner as to prevent damage to the pipe. Under no circumstances shall pipe or accessories be dropped into the trench. Before lowering and while suspended, ductile iron pipe shall be inspected for defects and rung with a light hammer to detect cracks. Any defective, damaged, or unsound pipe shall be rejected. All foreign matter or dirt shall be removed from the inside of the pipe before it is lowered into its position in the trench and it shall be kept clean by approved means during and after laying. Care shall be taken to prevent dirt from entering the joint space. At all times

when pipe laying is not in progress, the open ends of the pipe shall be closed by approved means and no trench water shall be permitted to enter the pipe.

b) Ductile Iron Pipe.

Proper implements, tools and facilities shall be provided and used by the Contractor for the safe and convenient prosecution of the work.

c) PVC.

Pipe shall be installed in accordance with ASTM D2321. Excavation, bedding and backfill shall be as specified in Section 31 23 00. Bedding shall be Class I, II or III.

d) Hydrants.

Hydrants shall be set at such elevations that the connecting pipe will have the same depth of cover as the distribution mains. The connecting pipe shall be ductile iron pipe. The hydrants shall be set on a base of concrete not less than 6 inches thick and 18 inches square. The back of the hydrant opposite the pipe connection, shall be firmly wedged by a poured-in-place concrete thrust block against the vertical face of the trench to prevent the hydrant from blowing off the line. The base of the hydrant shall be wrapped or oiled to prevent bond between thrust blocks and hydrants. Hydrants and valves shall have the interior cleaned of all foreign matter before installation. Not less than 1 cubic foot of broken stone shall be placed around the base of the hydrant.

Contractor shall place a bag over the hydrant to indicate its not being in service until after the water main is put into service.

e) Water Service Connections.

Service lines shall be connected to 4 inch and larger mains with corporation stops. Connections to mains smaller than 4 inches shall be made with a rigid connection. Plugged tees or crosses for future connections shall be installed where shown on the Plans. Minimum cover of 24 inches shall be provided until a short transition to 12 inches depth at the water meter.

Water service laterals shall be installed to the property line of all lots along streets and rights-of-way in which watermain is constructed or to a distance of 5 feet from the building line for apartments, condominiums, or other uses besides subdivision lots unless shown otherwise.

f) Galvanized Steel and Pipe Fittings.

Threads shall be cleanly cut with sharp tools and the jointing procedure shall conform with the best practice. Before jointing, all scale shall be removed from pipe by some suitable means. After cutting, all pipe shall be screwed together with an application of graphite and engine oil, teflon tape, or other sealing compound applied to all threads and once a joint has been screwed on it shall not be backed off unless the threads are recleaned and new compound or teflon tape applied. Unions shall be installed at every connection to the supply line.

g) Thrust Blocking.

All plugs, caps, bends 11-1/4 degrees or greater and tees shall be provided with thrust blocking in accordance with the Thrust Blocking or Restraint Schedule attached to this Section or as shown on the Plans. Thrust blocking shall bear directly against the undisturbed trench wall, and shall be made with concrete having a compressive strength of at least 2,500 psi. Thrust blocking should be so arranged that it will not interfere with reworking joints should such work become necessary. If the area for thrust blocking is over excavated beyond the dimensions required by the Schedule, additional concrete shall be provided to extend the thrust blocking to undisturbed earth at no additional cost to the Owner.

h) Hydrostatic Tests.

All piping and attached appurtenances subjected to system working pressure shall be hydrostatically tested at 200 psi or 50 psi in excess of system working pressure, whichever is greater.

The Contractor shall provide all necessary equipment and shall perform all work required in connection with the tests. Each section shall be tested. The Design Professional shall witness and certify that the pressure test meets testing requirements. Each section shall be slowly filled with water, care being taken to expel all air from the pipes. If necessary, the pipe shall be tapped at high points to vent the air. The required pressure as measured at the point of lowest elevation shall be applied for not less than 2 hours and all pipe, fittings, valves, hydrants, and joints shall be carefully examined for defects. All defective joints shall be repaired or replaced.

After completion and testing of the water distribution system provide the Owner with the Contractor's material and Test Certificates required by the National Fire Protection Association Standard 24, a copy of which is included in this specification.

i) Connection to Existing Water System.

The Contractor shall furnish necessary materials and perform all excavation, dewatering, shoring, backfilling, etc., necessary to make the connection of a new main to the existing watermain. The Contractor shall notify the Design Professional and Owner, a minimum of 48 hours in advance of construction. The Contractor shall be responsible for coordinating his construction with the Owner Project Manager.

j) Damage to Water System.

Damage to any part of the water system by the Contractor, or subcontractors, that is repaired by Water Department forces shall be charged to the Contractor on the basis of time and material, plus 30 percent for overhead and administration.

k) Protection of Water Supply Systems.

See Section 312300, Paragraph 13 for protection of Water Supply Systems.

3.2 LEAKAGE TEST:

A leakage test shall be conducted after the pressure test has been satisfactorily completed. The duration of the leakage test shall be 2 hours and during the test the main or section of main under test

shall be subjected to a pressure of 150 psi based on the lowest point in the line or section under test, and connected to the elevation of the test gauge. Leakage is defined as the quantity of water to be supplied into the newly laid pipe or any valved section thereof, necessary to maintain the specified leakage test pressure after the air has been expelled and the pipe has been filled with water at the test pressure. No pipe installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula below:

$$L = \frac{S \times D \times (P)^{1/2}}{133{,}200}$$

L = allowable leakage in gallons per hour
S = the length of pipe tested in linear feet.
D = the nominal diameter of the pipe in inches
P = the average test pressure during the leakage test
in pounds per square inch gauge.

- Should any test of pipe laid disclose leakage greater than the above specified, the Contractor shall at his own expense locate and repair the defective joints until leakage is within the specified allowance.

The description and results of all tests shall be recorded on the following National Fire Protection Association (NFPA) form “Contractor’s Material and Test Certificate for Underground Piping”. Said certification shall be completed in its entirety and the original submitted to the Design Professional.

Contractor's Material and Test Certificate for Underground Piping

PROCEDURE

Upon completion of work, inspection and tests shall be made by the contractor's representative and witnessed by an owner's representative. All defects shall be corrected and system left in service before contractor's personnel finally leave the job.

A certificate shall be filled out and signed by both representatives. Copies shall be prepared for approving authorities, owners, and contractor. It is understood the owner's representative's signature in no way prejudices any claim against contractor for faulty material, poor workmanship, or failure to comply with approving authority's requirements or local ordinances.

Property name		Date	
Property address			
Plans	Accepted by approving authorities (names)		
	Address		
	Installation conforms to accepted plans	❑ Yes	❑ No
	Equipment used is approved If no, state deviations	❑ Yes	❑ No
Instructions	Has person in charge of fire equipment been instructed as to location of control valves and care and maintenance of this new equipment? If no, explain	❑ Yes	❑ No
	Have copies of appropriate instructions and care and maintenance charts been left on premises? If no, explain	❑ Yes	❑ No
Location	Supplies buildings		
Underground pipes and joints	Pipe types and class	Type joint	
	Pipe conforms to _____ standard Fittings conform to _____ standard If no, explain	❑ Yes ❑ Yes	❑ No ❑ No
	Joints needing anchorage clamped, strapped, or blocked in accordance with _____ standard If no, explain	❑ Yes	❑ No
Test description	Flushing: Flow the required rate until water is clear as indicated by no collection of foreign material in burlap bags at outlets such as hydrants and blow-offs. Flush at one of the flow rates as specified in 10.10.2.1.3. Hydrostatic: All piping and attached appurtenances subjected to system working pressure shall be hydrostatically tested at 200 psi (13.8 bar) or 50 psi (3.5 bar) in excess of the system working pressure, whichever is greater, and shall maintain that pressure ±5 psi (0.35 bar) for 2 hours. Hydrostatic Testing Allowance: Where additional water is added to the system to maintain the test pressures required by 10.10.2.2.1, the amount of water shall be measured and shall not exceed the limits of the following equation (for metric equation, see 10.10.2.2.6): $L = \frac{SDP}{148{,}000}$ L = testing allowance (makeup water), in gallons per hour S = length of pipe tested, in feet D = nominal diameter of the pipe, in inches P = average test pressure during the hydrostatic test, in pounds per square inch (gauge)		
Flushing tests	New underground piping flushed according to _____ standard by (company) If no, explain	❑ Yes	❑ No
	How flushing flow was obtained ❑ Public water ❑ Tank or reservoir ❑ Fire pump	Through what type opening ❑ Hydrant butt ❑ Open pipe	
	Lead-ins flushed according to _____ standard by (company) If no, explain	❑ Yes	❑ No
	How flushing flow was obtained ❑ Public water ❑ Tank or reservoir ❑ Fire pump	Through what type opening ❑ Y connection to flange and spigot ❑ Open pipe	

Hydrostatic test	All new underground piping hydrostatically tested at _____ psi for _____ hours		Joints covered ❑ Yes ❑ No
Leakage test	Total amount of leakage measured gallons _____ hours		
	Allowable leakage _____ gallons _____ hours		
Forward flow test of backflow preventer	Foward flow test performed in accordance with 10.10.2.5.2:		❑ Yes ❑ No
Hydrants	Number installed	Type and make	All operate satisfactorily ❑ Yes ❑ No
Control valves	Water control valves left wide open If no, state reason		❑ Yes ❑ No
	Hose threads of fire department connections and hydrants interchangeable with those of fire department answering alarm		❑ Yes ❑ No
Remarks	Date left in service		
Signatures	Name of installing contractor		
	Tests witnessed by		
	For property owner (signed)	Title	Date
	For installing contractor (signed)	Title	Date

Additional explanation and notes

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3.3 CLEANING AND DISINFECTION OF NEW MAINS:

All water mains must be cleaned, disinfected and the water passing through them must show by laboratory tests safe results before the system can be placed in service. Disinfection of all water lines shall be in accordance with AWWA C651. Approved methods for the accomplishment of these are as follows:

Clean the interior of all pipe by brushing, swabbing, or washing out all debris before laying. Stop up all branches and other openings with wooden plugs or heads until either capped or connected.

Install sufficient number of hydrants to give representative sampling on the newly installed lines. The hydrants should be at least 18 inches higher than main and must discharge toward the ground.

Flush the new pipelines until the water runs clear at the end of all mains and laterals. This should be done after the pressure test and before disinfection. Each valved section of the newly laid pipe should be flushed separately with potable water.

Disinfect the pipelines with chlorine. The preferable point of application of the chlorinating agent is at the beginning of the pipeline extension, or any valved section of it, and through a corporation cock inserted in the horizontal axis of the newly laid pipe. Water from the existing distribution system should be controlled to flow very slowly into the newly laid pipe during the application of the chlorine. Partially open all hydrants or valves on the newly laid line under treatment to prevent the building up of water pressure. Continue treatment until the water flowing from the hydrants at the far end of the main contains sufficient residual chlorine to develop a deep red color (50 parts per million) when orthotolidine reagent is added to a sample of water. Stop the flow of water and chlorine by closing all openings. The chlorine residual after 24 hours shall be not less than 25 parts per million.

Allow the treated water to remain in the pipeline for at least 24 hours following which period the main must be thoroughly flushed until all the heavily chlorinated water has been removed.

Test water samples with orthotolidine reagent to make sure all chlorine has been flushed out or until the concentration of chlorine in the newly laid lines is no higher than that of a sample taken on the supply line.

Chlorine products for disinfecting water pipes are available in several forms as follows:

a) Liquid chlorine is available in 100 and 150 pound steel cylinders.

b) High test calcium hypochlorite is a powder and is available in 4 pound tins and 100 pound drums. The chlorine content is approximately 65 percent (comparable to commercial products known as "Perchloron", "H.T.H.", "Maxochlor", etc.).

c) Chlorinated lime is a powder and is available in 12 ounce cans and 110 pound drums. The chlorine content varies from 24 percent to 33 percent. Chlorinated lime is also known as chloride of lime and as bleaching powder.
Liquid chlorine may be applied to watermains by means of a solution feed chlorinating device or the gas may be fed directly from the cylinder provided it is equipped with proper devices for regulating the rate of flow and the effective diffusion of gas within the pipe. The former method is preferable to the direct feed method.

High test calcium hypochlorite or chlorinated lime must be prepared as a water mixture for introduction into the watermains. Either powder should first be made into a paste and then thinned to about one percent chlorine solution. This requires the following proportions of powder to water:

Product	Pounds of Powderof Water	Gallons
High Test Calcium Hypochlorite 65%	1	7.50
Calcium Hypochlorite 15 %	1	1.50
Chlorinated Lime 24 %	1	2.50
Chlorinated Lime	1	3.50

Prepare a 1 percent chlorine solution in a wooden or plastic barrel and permit solids to settle. Apply the clear supernatant solution to the main through a rubber hose either by gravity, siphonage, injection, or by pumping.

The application of small amounts of dry hypochlorite or chlorinated lime to each length of pipe as it is laid will not be permitted.

After the new lines have been properly cleaned, sterilized, and flushed the Contractor shall send samples of the water to a state approved independent laboratory. Two samples shall be taken 24 hours apart from locations selected by the Design Professional.

The Design Professional will arrange for the regulatory agency inspection. Lines will not be placed in operation until agency approval and Design Professional directs Contractor to do so.

A hydrant flow test will be performed after the lines are placed in service as directed by the Design Professional. Results of the test will be reported in writing to the Design Professional.

3.4 IDENTIFICATION:

Mylar detectable tape shall be installed 6 inches below the top of the trench of the watemains where non-metallic pipe is used. The tape shall be 2 inches wide, of blue color and have imprinted on the tape "Caution - Water Line Below." The tape shall be a printed foil warning tape encased in mylar and shall be easily detected by electronic pipe locators. The tape shall be laid the entire length of the trench.

3.5 SHOP DRAWINGS:

Shop drawings shall be submitted on each manufactured item supplied under this Section along with other information as specified herein.

3.6 MEASUREMENT AND PAYMENT:

Measurement and payment for work under this section shall be included in overall project lump sum amount unless otherwise specified in Section 01 22 00.

END OF SECTION 33 10 00.

SECTION 33 33 00 - LOW PRESSURE UTILITY SEWERAGE

PART 1 - GENERAL

1.1 SCOPE:

Under this heading shall be included the complete construction of sewers.

1.2 LOCATION AND GRADE:

The line and grade of the sewer and the position of all manholes and other appurtenances will be according to the Plans. The grade line as given on the profile or mentioned in these Specifications means the invert or bottom of the inside of the pipe, and the price for trenching shall include the trench for the depth below this line necessary to lay the sewer to this grade, but measurements for payment will be made only to the grade line.

All necessary lines and grades will be laid out by the Contractor from the control lines and benchmarks furnished by the Design Professional. The Contractor shall provide such field men as the Design Professional may request and such planks, stakes, spikes, nails and other fastenings as may be required for giving same.

The Contractor shall furnish the Design Professional with the original and one copy of the construction cut sheets.

1.3 ROADWAY AND OTHER CROSSINGS:

At such crossings, and other points as may be required, the trenches shall be bridged in an open and secure manner, so as to prevent any serious interruption of travel upon the roadway and sidewalks, and also to afford necessary access to the premises.

The material used, and the mode of constructing said bridges, and the approaches thereto, shall be submitted to the Design Professional for review. The cost of all such work must be included in the lump sum bid price amount.

1.4 PROTECTION OF OTHER UTILITIES AND STRUCTURES:

a) Damage to Existing Utility Lines.

Any damage done to existing utility lines, services, poles and structures of every nature shall be repaired or replaced by the Contractor at his own expense. The approximate positions of certain known underground lines are shown on the Plans for information. Existing small lines may not be shown. The Contractor shall locate these and other possible unknown utility lines and shall excavate and expose all existing underground lines in advance of trenching operations.

Removing and relaying of such lines and appurtenances which constitute an obstruction to the completed lines and grade of the new work will be made at the expense of the Owner, unless otherwise shown on Plans to be altered by the Contractor.

At locations where the sewer is to be constructed in roadways, the Contractor shall take all

precautions, and comply with all requirements, as may be necessary to protect the improvements, including installation and maintenance of lights and barricades for protection of traffic.

b) Protection of Water Supply Systems.

See Section 33 10 00 for protection of water supply pipes.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS:

Unless otherwise specified or shown on the Plans, the following types of pipe shall be used:

a) Clay Sewer Pipe

Clay Sewer Pipe shall be non-perforated, extra strength, vitrified type, furnished in lengths of not less than 4 feet and shall satisfy the requirements of ASTM C700. Pipe shall be of first quality, have smooth exterior and interior surfaces, be free from cracks, flaws, blisters, and other imperfections, and be true to theoretical form throughout each length. Pipe shall be subject to inspection by the Design Professional. Pipe which does not satisfy the requirements of this Section shall be so marked by the Design Professional, and the Contractor shall remove it from the job site upon notice being given of its rejection.

The manufacturer of the pipe shall submit evidence of having consistently produced pipe of the specified quality, and having satisfactory performance results in service over a period of not fewer than 5 years, unless otherwise specified.

Pipe shall be tested in accordance with the requirements of the Special Conditions and shall be stamped with the testing laboratory's special stamp. Crushing and absorption tests will be required for all sizes of pipe used in the work.

Joints shall meet the requirements of ASTM C425.

Fittings shall conform to the same specifications applicable to sewer pipe except all wyes or tees up and including 8 inches shall be monolithically formed and have joints conforming to ASTM C425. At the time of shipment, the manufacturer shall submit 3 copies of written certification and test results to the Design Professional that the pipe was manufactured and tested in accordance with the above specifications.

b) PVC Sewer Pipe (Solid Wall).

1. General.

Pipe shall be made of PVC Plastic having a Cell Classification of 12454-B or 12454-C or 13364-B (with a minimum tensile modulus of 500,000 psi) as defined in ASTM D1784. Pipe shall be available in standard laying lengths of 12-1/2 feet.

Fittings shall be made of PVC Plastic having a Cell Classification of 12454-B, 12454-C, or 13343-C as defined in ASTM D1784.

Pipe and fittings shall meet the requirements of ASTM D3034 for pipe 15" and

smaller, latest revision (SDR 26). Pipe 18" and larger shall conform to ASTM F679. Pipe and fittings shall be homogeneous throughout and free from cracks, holes, foreign inclusions, or other injurious defects. The pipe shall be as uniform as commercially practicable in color, opacity, density and other physical properties. Pipe shall be subject to inspection by the Design Professional. Pipe which does not meet the requirements of this Section shall be so marked by the Design Professional and the Contractor shall remove it from the job site upon notice being received of its rejection.

Pipe and fittings shall utilize rubber gasketed joints. The assembly of joints shall be in accordance with the pipe manufacturer's recommendations.

2. Certification.

Each length of pipe shall be marked with the following information: Manufacturer, Size, PVC Cell Classification, Type PSM, SDR, PVC Gravity Sewer Pipe, ASTM D3034 (pipe 15" and smaller), ASTM F679 (pipe 18" and larger), and Code Number.

The manufacturer of the pipe shall submit evidence of having consistently produced pipe of the specified quality, and having satisfactory performance results in service over a period of not fewer than 5 years, unless otherwise specified.

At the time of shipment, the manufacturer shall submit 3 copies of written certification and test results to the Design Professional that the pipe was manufactured
and tested in accordance with the above specifications.

c) PVC Sewer Pipe (Profile Wall)

PVC seamless ribbed pipe shall meet the requirements of ASTM F794 or F949. The pipe shall be homogeneous, and have a smooth interior with a solid cross-sectional rib exterior. Exterior ribs shall be open profile and perpendicular to the axis of the pipe. The pipe stiffness at 5% deflection shall be a minimum of 46 psi when tested in accordance with ASTM D2412.

d) Ductile Iron Pipe.

1) Ductile Iron Pipe.

Ductile iron pipe shall be manufactured in accordance with ANSI/AWWA C151/A21.51, latest revision. Ductile iron pipe shall be of the thickness according to ANSI/AWWA C150/A21.50, latest revision, for Laying Condition 2, and shall be Class 50 minimum.

2) Joints.

Joints shall conform to ANSI/AWWA C111/A21.11, push-on-type as described in latest revision, unless otherwise shown.

3) Fittings.

Fittings shall conform to ANSI/AWWA C11-/A21.10, latest revision, and shall be mechanical-joint type unless otherwise shown.

4) Lining.

Lining for the interior of ductile iron pipe and fittings shall be 40 mils nominal dry film thickness of ceramic epoxy, conforming to ASTM E-96-66, ASTM B-117, ASTM 6-95, ASTM D-714-87, latest revision. Ceramic epoxy shall be Protecto 401, or equal. Lining application, inspection, certification, handling and surface preparation of the area to receive the protective coating shall be in accordance with the manufacturer's specifications and requirements.

5) Exterior Coating.

Exterior coating shall be a petroleum asphaltic coating one mil thick in accordance with ANSI/AWWA C110/A21.10, latest revision, unless otherwise shown and/or specified.

PART 3 - EXECUTION

3.1 EXCAVATION, TRENCHING AND BACKFILL FOR UTILITY SYSTEMS:

Shall be as specified in Section 312300, "Excavation and Fill."

All sanitary sewer piping and structures shall be bedded with a minimum of 6 inches of #57 stone for the full width of the trench for piping and a minimum of 12 inches beyond the structure base unless otherwise detailed on the plans.

All piping shall be backfilled with select backfill (granular sandy material with no more than 30% passing No. 200 sieve) material for the entire excavation and shall be compacted in accordance with Specification Section 312300. The select backfill shall be free of all roots, debris, and deleterious materials.

3.2 LAYING PRE-FABRICATED JOINT PIPE:

All sewer pipe shall be laid upgrade; spigots shall point downgrade. The pipe shall be laid in the trench so that after the sewer is completed, the interior surface shall conform on the bottom accurately to the grades and alignment fixed or given by the Design Professional.

No joints shall be made where surfaces of pipe and bell to be joined have been soiled by earth in handling, until such soiled surfaces are thoroughly cleaned by brushing and wiping so that all traces of the earth are removed. The interior of the pipe shall be carefully made free from all dirt and superfluous material of every description as the work proceeds.

All pipe shall be carefully examined for cracks and other defects; no pipe shall be laid which is found defective. If pipe is found to be defective after being laid, it shall be removed and replaced with sound pipe, at no additional expense to the Owner.

The surfaces of pipe to be joined, as well as the gaskets, shall be cleaned and lubricated with a vegetable soap or other lubricating agents recommended by the pipe manufacturer. Lubricating agent shall not be injurious and detrimental to the gaskets. Gaskets shall be checked for proper position

prior to installation of the succeeding length of pipe.

No pipe shall be laid on blocking of any kind except at manholes and other structures where temporary blocking may facilitate installation of the pipe. After installation of the pipe, blocking shall be carefully removed and all voids left by the blocking shall be filled with selected material and tamped.

When the work of pipe laying is suspended, for the night and at other times, the end of the sewer shall be closed with a tight cover. The Contractor will be held responsible for keeping the sewer free from obstructions.

3.3 LAYING CLAY OR DUCTILE IRON PIPE:

No pipe shall be laid which is known to be defective. The pipe shall be thoroughly cleaned before being laid and shall be kept clean until accepted in the completed work.

Pipe shall be laid to conform accurately to the lines and grades shown on the drawings.

When pipe is laid in trenches, care shall be taken to give the pipe a solid bearing throughout its entire length, and in refilling the trenches the earth filled into the bottom of the trench under and up to a cover of 1 foot over the top of the pipe, shall be of selected material and shall be carefully tamped with proper tools for the purpose. Refer to Section 33 10 00.

3.4 LAYING PVC PIPE:

No pipe shall be laid which is known to be defective. All pipe shall be thoroughly cleaned before being laid and shall be kept clean until accepted in the completed work.

Pipe shall be laid to conform accurately to the lines and grades shown on the drawings.

PVC sewer pipe shall be installed in accordance with ASTM D2321 and Section 31 23 00. Bedding shall be Class I, II or III.

3.5 MANHOLES:

a) General.

Manholes shall be constructed as such points as designated on the plans. In all cases the channel shall be smooth and properly rounded. Special care shall be exercised in laying the channel and adjacent pipes to grade. The connection of the sewer with the wall and channel of the manholes shall be tight and smooth. Pipe connections shall be made to manholes using water stops, standard O-ring joints, special manhole couplings, or shall be made in accordance with the manufacturer's recommendations. The Contractor's proposed method of connection, showing materials selected and specials required, shall be submitted to the Design Professional prior to installation.

The top of manholes outside of roads, streets and highways shall be built to grades 3 inches above ground surface, unless otherwise shown. Manholes in roads, streets, and highways, shall be built to grades shown on the plans.

When directed by the Design Professional, the manhole shall be placed on 3,000 psi concrete or 12 inches #57 stone footing to ensure adequate bearing.

b) Precast Concrete Manholes

Precast Concrete manholes shall be constructed of reinforced Class "A" Concrete. Walls shall be not thinner than 5 inches, or 1/12 of the inside diameter, whichever is greater. Precast manholes shall meet all requirement of ASTM C478, "Specification for Precast Reinforced Concrete Manhole Sections."

Rings shall be custom made with openings to meet the necessary pipe alignment conditions and invert elevations. Shop drawings shall be submitted consisting of manufacturer's standard details of various sections, before placing order for manholes. Joints and gaskets shall conform to the applicable provisions of ASTM C443, "Joints for Circular Concrete Sewer and Culvert Pipe using Rubber Gasket" or Ram-Nek Premoulded Plastic Joint Sealer. Bell and spigot surfaces shall be smooth, accurately formed, and provide a loose, sliding fit, with a clearance between the bell and spigot of not more than 1/6 inch. Precast manholes shall be bedded on not less than 6 inches of compacted crushed stone as the Contractor's expense. The crushed stone shall extend not less than 6 inches outside the walls of the manhole and under the entire length of pipe within the excavation for the manhole.

c) Drop Manholes.

Drop manholes shall be precast conforming to ASTM C478 and shall be built at the locations and in conformance with the details shown where the difference in invert elevations between incoming pipe and manhole invert is more than 2 feet. The drop pipe shall be the same size as the influent sewer. Payment for drop manholes will be made at the unit prices for the various depths stated in the Proposal, and shall include all necessary pipe, pipe fittings, concrete encasement of drop pipe, extension of manhole base slab and compacted crushed stone under sewer spanning the manhole excavation.

d) Manhole Steps:

Manhole steps shall be cast into the manhole riser and cone sections by the manufacturer. Steps shall be 12 inches wide, 5 inch projection, arranged in a single row 16 inches on center. Steps shall be of a tough copolymer polypropylene that encapsulates a ½ inch, Grade 60, steel reinforcing rod.

e) Manhole Castings.

Manholes shall be provided with a cast iron frame and solid cover with concealed pickhole. The frame and cover shall weigh not less than 400 pounds and shall be of Class 30 cast iron, free from injurious flaws and defects, conforming to ASTM A48. The frame and cover shall be sandblasted prior to the application of a coal pitch tar finish. Bearing surfaces of the frame and cover shall be machined to fit and shall be non-rocking.

Provide covers with the inscription "SEWER" cast into the cover in lettering at least 2 inches high. The manufacturer's name, if it appears on the cover, shall be confined to the periphery.

Manhole covers and frames shall be Neenah R-1642, Clow F-3210, or equal, unless otherwise indicated on the Plans.

f) Stub-Outs.

Stub-outs from manholes shall be laid to the proper grade and alignment, plugged with a suitable pipe stopper and made watertight.

g) Pipe Connectors.

ASTM C923, KOR-N-SEAL or equal; connection to existing sanitary sewer manhole shall be with “Link Seal” meeting specifications of White Deer Township Sewer Authority.

3.6 ADAPTORS:

Prefabricated flexible couplings or adaptors shall be used for connecting pipe of dissimilar materials.

3.7 CONCRETE:

Refer to Division 03.

3.8 CONCRETE ENCASEMENT OF PIPE:

Where called for on the Plans sewer pipe shall be completely encased with concrete. The trench shall first be excavated not less than 6 inches below the bell of the pipe and the pipe laid to the line and grade on concrete blocking. Concrete shall then be placed to the full width of the trench, but in no case less than 6 inches above the top of the pipe bell. No backfill material shall be placed in the trench for a period of at least 24 hours after the concrete encasement has been placed.

3.9 SERVICE CONNECTIONS:

Service connections shall be provided at locations shown on the Plans. The connection shall be made as shown on the Drawings, or shall be a pipe stubbed out from a septic tank, and shall extend to a distance as shown on the plans at an elevation at least 2 feet below the finished floor elevation of the building being served or deeper if necessary to provide service to a building or to the property line as shown on the Plans.

Service pipe shall be extra strength cast iron soil pipe, ABS solid wall pipe conforming to ASTM D2751, SDR 26 or PVC Sewer Pipe conforming to ASTM D3034 SDR 26. Mylar detectable tape shall be installed where ABS or PVC pipe is used.

A 2" x 4" 30-inch long pressure treated flag stake painted red shall be located at the end of each sewer lateral.

3.10 PROTECTION OF EXISTING SANITARY SEWER SYSTEMS:

During the construction of new Sanitary Sewer Systems, the existing sanitary sewer shall be protected at the point of connection with use of a pneumatic or mechanical plug. This isolation shall remain in place until the new system is fully accepted. Provisions must be in place to prevent sediment and excess water from entering the Township’s existing Sanitary Sewer System. The isolation of the new system must be performed at the Contractor’s expense. Any breach of this isolation shall be resolved by the Contractor to meet Township’s expectations and standards. The Contractor may also be liable and responsible for remediation costs due to this breach.

3.11 CLEANING:

Prior to mandrel tests, televising, and before acceptance of the gravity sewer systems, all sewer lines shall be cleaned to the satisfaction of the Engineer. Where any obstruction occurs, the Contractor will be required to clean the sewers by flushing and by means of rod and swabs or other instruments. Cleaning of new sewers is to be completed without impacting the existing sewer system; debris/foreign material from the new line (i.e. dirt, sand, and trash) shall not be discharged into the existing system.

3.12 TESTING AND INSPECTION

A. Leakage Testing: Mains and Laterals

All new gravity sewers and laterals shall be pressure tested within 30 days following final backfill in accordance with the Time-Pressure Drop Method specified in ASTM F1417 - Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air, latest revision. The procedure is summarized as follows:

1. Isolate the section of the sewer line to be tested using inflatable plugs or stoppers.

2. Cap all laterals and stubs using glued caps. All caps and plugs shall be securely braced to prevent blow-out.

3. One of the plugs or caps shall have an inlet tap or other provision for connecting a hose to a portable air control source.

4. Connect the air hose to the inlet tap and portable air control source. The air source equipment shall include necessary valves and pressure gages to pressurize an oil free air source at a controlled rate into the test section.

5. Add air slowly to the test section until the pressure inside the pipe reaches four (4) psi greater than the average backpressure of any groundwater submerging the pipe. *(NOTE: All test pressures are measured as gage pressure, which is any pressure greater than atmospheric pressure. Since water produces a pressure of 0.43 psi per foot of depth, air test pressures must be increased to offset the depth of groundwater over the sewer line. If the groundwater is two (2) feet or more above the top of the pipe at the upstream end, or if the required test pressure exceeds nine (9) psi, this test should not be used)*.

6. Disconnect the air supply and allow a minimum of two (2) minutes for pressure stabilization.

7. Measure the pressure drop over the following time period, depending on the diameter of the sewer pipe being tested *(based on a maximum test section length of 400 feet between manholes)*:

8 inch: 6 minutes
10 inch: 8 minutes
12 inch: 12 minutes
15 inch: 18 minutes
18 inch: 26 minutes

8. Acceptable pressure drop over time period: Not more than 0.5 psi.

The testing shall be performed by the Contractor, and a representative of the Owner shall be present to observe the test. The Contractor shall be responsible for all costs associated with

performing the leakage testing, locating leaks, repairing leaks, and conducting additional leakage testing as necessary until the system passes the pressure test. No gravity sewers or laterals will be accepted by the Owner without a passing pressure test.

B. Deflection of Mains

It is the responsibility of the Contractor to assure that backfill is sufficient to limit deflection for all PVC pipe, eight (8) inch diameter and larger, to no more than 5% of the internal diameter of the pipe which shall be tested by a mandrel permitting no greater than maximum 5% deflection. All pipe shall be tested no sooner than 30 days after installation. All pipes not passing the 5% deflection limitation test shall be repaired or removed and replaced.

The mandrel shall be pulled through the pipe (SDR-26) with the following diameter:

Nominal Pipe Size (Inches)	Average inside Diameter (Inches)	Mandrel Size (Inches) Diameter Diameter (Inches)
8	7.754	7.37
10	9.692	9.20
12	11.538	10.96

C. Deflection of Laterals

It is the responsibility of the Contractor to assure that installation and backfill is sufficient to limit obstructions and deflections in the laterals. Laterals shall be tested by dropping a tennis ball in the upstream end of the pipe. The tennis ball must show up at the next downstream manhole. If not, the lateral must be repaired or removed and replaced. The tennis ball may be followed by water to help with its travel to the next downstream manhole.

D. Televising

After the completion of successful mandrel tests and cleaning, all newly constructed sewer lines must be televised by the Contractor prior to acceptance as follows:

a) Equipment:

a.1) Television inspection equipment shall have an accurate footage counter that will display on the monitor and record the camera distance from the centerline of the starting manhole.

a.2) The camera shall be of the remotely operated pan and tilt type. The rotating camera and light head configuration shall have the capability of panning 360 degrees with pan and tilt capability of providing a full view of the pipe to ensure complete inspection of the mainline pipe and service laterals.

a.3) The camera, television monitor, and other components shall be color. To ensure peak picture quality throughout all conditions encountered, the color camera shall be equipped with the necessary circuitry to allow for the remote adjustment of the optical focus iris from the power control unit at the viewing station. A variable intensity control of the camera lights shall also be located at the viewing station.

a.4) Lighting and camera quality shall be suitable to allow a clear, in-focus picture for the entire inside periphery of pipelines extending at least ten (10) feet in front of the

camera. In High Density Polyethylene (HDPE) or ductile iron poly-lined pipe, lighting should be sufficient enough to provide a clear view at least two (2) feet in front of the camera. The replay of the recorded video information shall be free of electrical interference and shall provide a clear stable image.

a.5) Camera quality shall be suitable to provide a full 360 degree view of the pipe during the inspection.

a.6) The travel speed of the camera shall be variable but uniform and shall not exceed 30 feet per minute. Any means of propelling the camera through the sewer line which would produce non-uniform or jerky movement of the camera, will not be acceptable.

a.7) The television system shall be capable of performing line segment inspection in increments of 400 feet with one setup.

a.8) Service laterals shall be inspected utilizing a CCTV inspection push camera system, capable of inspecting up to a minimum of 100 feet of pipe.

b) Procedure:

b.1) Prior to performing CCTV inspection activities, the Contractor shall thoroughly clean the sewer line(s) and service laterals designated to be televised.

b.2) Just prior to performing the video inspection procedure, water must be introduced into the nearest upstream manhole until observed at the nearest downstream manhole. This will ensure that any pipe segments with bellies are easily identified during CCTV inspection.

b.3) All fog shall be evacuated from the pipeline and the pipeline kept clear of any fog during the CCTV inspection process.

b.4) Main Line Inspection:

i) Perform the inspection on all mainline sections from manhole to manhole.
ii) Should access to a particular sewer segment be difficult, and where adjacent segments require television inspection, the CCTV Contractor may be allowed to complete the inspection of multiple sewer line segments with one setup. When multiple sewer line segments are inspected utilizing one setup, the CCTV Contractor shall zero the footage counter at each subsequent sewer manhole to establish a uniform starting point for each line segment televised.
iii) The interior of the pipe shall be carefully inspected to determine the location and extent of all deficiencies. Pipe conditions that result in a question of proper installation procedures shall be noted so that these conditions can be reviewed and, if necessary, corrected before actual acceptance of the sewer system.
iv) At all service connections, the camera shall be stopped and the pan and tilt features shall be used to obtain a clear picture. At each service lateral, the camera shall be panned to view up each lateral or point of connection. Make note of any deficiencies through the use of Data Collection Software.
v) Prior to the beginning of each CCTV inspection, manhole identification numbers as indicated on the record drawings, will be displayed in the title and shall become a part of the video record.

vi) As directed by the Owner and/or Engineer of Record or his designee, the camera shall be stopped to view and analyze conditions that appear unusual or uncommon. The CCTV inspection technician shall, at all times, be able to move the camera through the lines in either direction without the loss of quality in the video presentation.

b.5) Service Lateral Inspection:

i) Perform the inspection of all service laterals from the building line cleanout to all mainline and manhole connections.
ii) Prior to beginning each CCTV inspection, the starting location shall be indicated on the record drawings, will be displayed in the title and shall become a part of the video record.

c) Deliverables:

c.1) Contractor shall record inspection in a format suitable to the Engineer of Record and the video shall be recorded in an extra-high quality CD/DVD format. The title block shall include the following information.

i) Date
ii) Television operator's identification (Name, ID number, etc.)
iii) Sewer segment number. Segment numbers shall be assigned by the Engineer.
iv) Upstream manhole number.
v) Downstream manhole number.
vi) Size of sewer pipe.
vii) Pipe material and lining method.
viii) Direction of movement of camera and direction of normal flow.
ix) Location of service connections indicated by clock position and with counter distance in feet from beginning manhole's centerline.
x) Location (start and end counter distances in feet from the beginning manhole's centerline) and description of obstructions, structural defects, longitudinal and/or circumferential cracking, joints including open and/or offset joints, ovality, leakage or evidence thereof, break in connections, protruding connections, mineral deposits, roots, previous repairs, deposits on pipe walls, sags, and other abnormalities with respect to the sewer's condition with counter distance in feet from the beginning manhole's centerline.
xi) CCTV Contractor's log shall contain the same information.

c.2) CD/DVD shall visually display, at a minimum, CCTV Contractor's name, project name, date of inspection, pipe segment number, manhole numbers or lateral numbers. The distance between manholes shall be verified by measuring tape. If the counter distance and the taping distance differ by more than 2 feet per 100 feet, the run shall be re-televised by CCTV Contractor.

c.3) CD/DVD shall be maintained and delivered in a hard case, which shall display the project name, project number, date of inspection, manhole segment number(s) inspected, and camera operator's identification. No segment shall be split between two disks. A disk may have multiple segments, so long as an entire section is on one disk. Original disks of all sections will be submitted to the Owner as a part of the closeout submittals along with the respective television inspection field logs to be reviewed for completeness and soundness of construction.

d) Acceptance:

d.1) CCTV Contractor shall present inspection video and inspection logs on CD/DVD disk. A continuous image in complete conformance with these specifications with a full view of the internal pipe surface is required. CCTV Contractor shall re-clean and televise any segment for which the video does not present a clear image of the internal pipe surface at all times, and/or is accompanied by an incomplete inspection log.

d.2) Any of, but not limited to, the following observations shall be considered defects:

i) Any bellies in a joint of pipe
ii) Pipe out of roundness
iii) Joint separations
iv) Offset joints
v) Chips in pipe ends
vi) Cracked or damaged pipe or evidence of the presence of an external object bearing upon the pipe (rocks, roots, etc.)
vii) Infiltration
viii) Roots
ix) Debris or other foreign objects in of pipe
x) Other obvious deficiencies when compared to approved plans, permits, and/or minimum standards

d.3) The Owner and Engineer of Record will require corrections prior to acceptance of the project. The Contractor shall submit a plan for said corrections for review and approval by the Engineer of Record prior to correcting the deficiencies.

d.4) The Contractor shall be notified in writing of any deficiencies revealed by the television inspection that will require repair. The Contractor shall excavate and make the necessary repairs. Upon completion of repairs, the line segment(s) shall be re-inspected at the Contractor's expense. CCTV video shall be submitted to the Owner and Engineer of Record for review upon completion of repairs.

E. Compaction

Laboratory tests of the soil shall be made in accordance with ASTM D-698. In-place density tests shall be made in accordance with ASTM D-1556 or D-2922. Results of the tests shall be furnished to the Engineer by the testing laboratory. The minimum number of tests required shall be: 1. Backfill over sewer in traffic areas: 1 per 100 linear feet or less for each four (4) feet of depth or portion thereof. 2. Backfill over sewer in non-traffic areas: 1 per 200 linear feet or less for each six (6) feet of depth or portion thereof.

3.13 CLOSING PIPE

When the work or pipe laying is suspended, either for the night or at other times, the end of the gravity sewer or force main pipe must be closed with a water tight cover. The Contractor will be held

responsible for keeping the gravity sewer or force main free from obstruction. Plugs shall remain in pipe ends until all water is removed from the trench.

3.14 SHOP DRAWINGS:

Shop drawings shall be submitted on each manufactured item supplied under this Section along with other information as specified herein.

3.15 MEASUREMENT AND PAYMENT:

Measurement and payment for work under this section shall be included in overall project lump sum amount unless otherwise specified in Section 01 22 00.

END OF SECTION 33 33 00.

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SECTION 33 40 00 - STORM DRAINAGE UTILITIES

PART 1 – GENERAL

1.1 SCOPE:

Under this heading shall be included all operations in connection with the installation of the storm drainage system.

1.2 EXCAVATION AND BACKFILL:

Excavation and backfilling shall be as specified in Section 31 23 00, Excavation and Fill.

1.3 DELIVERY, STORAGE, AND HANDLING OF MATERIALS:

a) Delivery and Storage.

Materials delivered to site shall be inspected for damage, unloaded, and stored with the minimum of handling. Do not store materials directly on the ground. Inside of pipes and fittings shall be kept free of dirt and debris.

b) Handling.

Materials shall be handled in such a manner as to insure delivery to the trench in sound undamaged condition. Pipe shall be carried to the trench, not dragged. Gasket materials and plastic materials that are not to be installed immediately shall not be stored in the direct sunlight.

PART 2 - PRODUCTS

2.1 DRAINAGE STRUCTURES:

Drainage structures shall be of the following types, constructed of the materials specified for each type and in accordance with the indicated details.

a) Manholes and Inlets.

Construction shall be of reinforced concrete, plain concrete, brick, precast reinforced concrete or precast concrete segmental blocks, complete with frames and covers or gratings. Precast concrete manholes and inlets shall be designed for the required depth and to sustain the required wheel loads and/or surface pressures. When manholes and inlets are to be constructed of prefabricated materials, shop drawings shall be submitted for approval before ordering the material.

b) Connection to Existing Inlets and/or Manholes.

Pipe connections to existing inlets and/or manholes shall be in such a manner that the finished work will conform as nearly as practicable to the applicable requirements specified for new inlets and/or manholes, including all necessary concrete work, cutting and shaping.

2.2 MATERIALS FOR DRAINAGE STRUCTURES:

a) Mortar.

Mortar for connections to other drainage structures, and brick or block construction shall conform to ASTM C270, Type M, except the maximum placement time shall be one hour.

Hydrated lime may be added to the mixture of sand and cement in a quantity equal to 25 percent of the volume of cement used. Hydrated lime shall conform to F.S. SS-L-351, Type M, or ASTM C141, Type A.

The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but in no case shall exceed 2.65 liters of water per sack of cement. Water shall be clean and free of harmful acids, alkalis, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water.

b) Concrete.

Refer to Division 03.

c) Precast Reinforced Concrete Manholes.

Manholes shall conform to ASTM C478 or AASHTO M199. Joints between precast concrete risers and tops shall be full-bedded in cement mortar and shall be smoothed to a uniform surface on both exterior and interior of the structure or joints may be made with flexible rubber-type gaskets.

d) Precast Concrete Segmental Blocks.

Blocks shall conform to ASTM C139, not more than 8 inches thick, not less than 8 inches long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

e) Bricks.

Bricks shall conform to ASTM C62, Grade SW; ASTM C55, Grade S-I or S-II; or ASTM C32, Grade MS. Mortar for jointing and plastering shall consist of one part portland cement and two parts fine sand. Lime may be added to the mortar in a quantity not more than 25 percent of the volume of cement. The joints shall be filled completely and shall be smooth and free from surplus mortar on the inside of the structure. Brick structures shall be plastered with 3/4 inch of mortar over the entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course. For round structures, brick shall be laid radially with every sixth course a stretcher course.

f) Frame and Cover or Gratings.

Fabrication shall be from one or more of the material operations presented in F.S. RR-F-621, except the malleable cast iron option shall conform to ASTM A220, Grade 40010. Weight, shape, size and waterway openings for grates and curb inlets shall be as indicated on the plans. Frames and covers for curb inlets and for areas not subject to vehicular traffic or storage may be malleable iron if so indicated. Malleable iron frames and covers shall conform to ASTM A220 and shall be of the weight, shape and size indicated. Frames and grates shall

be A.D.A. and bicycle compatible where noted on the plans and in pedestrian traffic areas.

PART 3 - EXECUTION

3.1 BEDDING:

See Section 312300 "Excavation and Fill", for additional requirements.

All storm piping and structures shall be bedded with a minimum of 6 inches of #57 stone for the full width of the trench for piping and a minimum of 12 inches beyond the structure base.

3.2 PLACING PIPE:

Each pipe shall be carefully examined before being laid, and defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe be laid in water, and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Pipe shall be moved horizontally into place by use of a winch or other suitable means. A backhoe bucket or other means which could damage the pipe shall not be used. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. All pipe in place shall be inspected before backfilling, and those damaged during placement shall be removed and replaced at no additional cost to the Owner. No additional compensation will be given to the Contractor for the required diversion of drainage and/or dewatering of trenches.

3.3 BACKFILLING:

Backfilling shall be done in accordance with Section 312300, "Excavation and Fill."

All storm piping shall be backfilled with select backfill (granular sandy material with no more than 30% passing No. 200 sieve) material for the entire excavation and shall be compacted in accordance with Specification Section 312300. The select backfill shall be free of all roots, debris, and deleterious materials.

3.4 STONE RIPRAP:

a) Materials.

The stone used for stone slope protection shall be sound, rough, dense and resistant to the action of air and water and satisfactory to the Design Professional. The stone shall have a density of not less than 150 pounds per cubic foot. Neither the breadth nor the thickness of any piece of stone shall be less than one-third of its length. The stone will be subject to inspection on delivery and if found to be improper gradation or quality, it will be rejected. The stone shall consist of quarry run sizes, graded as specified below:

STONE SLOPE PROTECTION

SIZE OF STONE	PERCENT OF TOTAL WEIGHT SMALLER THAN THE GIVEN SIZE	
		Class I
100 lb.		100
60 lb.		80
25 lb.		50
2 lb.	Not to Exceed	10

b) Placement.

The slope protection shall be placed in such a manner as to produce a reasonable well-graded mass of material with the minimum practicable percentage of voids, and shall be constructed within the limits and to the lines, grades, and sections shown on the Plans. A tolerance of plus 6 inches or minus 3 inches from the limits shown on the Plans will be allowed in the finished surface on the slope protection except that the extreme of this tolerance shall not be continuous over an area greater than 100 square feet. Materials shall be placed in horizontal layers starting on the riverward edge of the section and worked up the slope. Dumping down the slope will not be permitted. Materials shall not be dropped from a height greater than 3 feet. Any damage to the slope due to the fault of the Contractor shall be repaired at no expense to the Owner.

3.5 SUBGRADE DRAINS:

Subgrade drains will be provided from storm drain inlets. Subgrade drains shall be installed at or above the spring line of the storm pipe where possible, but in no case shall be less than 8 inches above the invert of the storm pipe and no less than 24 inches below finished grade or top of pavement elevation at the inlet. The subgrade drain will consist of a trench containing a 6 inch perforated HDPE sock drain and will be bedded with 3" of #57 stone and then backfilled with #57 sone from the bedding to the bottom of the proposed base course under paved areas or to within 4 inches below finished grade in grassed areas. The drain will extend 10 feet in two directions from the inlet and will be extended beyond that point when directed by the Design Professional. The drains will be constructed on a uniform slope toward the inlet. Cost for the first 10 feet in each direction will be included in the cost of the inlet with additional length paid at the unit price submitted with the underground utility Sub-Contractor's bid.

3.6 SHOP DRAWINGS:

Shop drawings shall be submitted on each manufactured item supplied under this Section along with other information as specified.

3.7 TESTING:

i) Each section between inlets/manholes will be lamped by the Design Professional.
ii) Contractor shall furnish suitable assistants to help Design Professional.
iii) A minimum of 95 percent of a true circle will be required in the lamp test to indicate a properly constructed pipeline.
iv) Contractor shall repair any sections not passing lamp test.

3.8 MEASUREMENT AND PAYMENT:

Measurement and payment for work under this section shall be included in overall project lump sum amount unless otherwise specified in Section 01 22 00.

END OF SECTION 33 40 00.