PROJECT MANUAL

CWA Project No. 2023-01

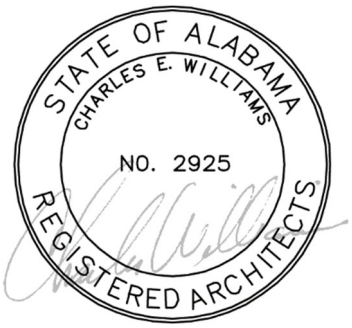
PROJECT NAME:
IRONDALE FIRE STATION #3

PROJECT ADDRESS

2101 JOHN ROGERS DRIVE
BIRMINGHAM, AL 35210

A PROJECT FOR THE CITY OF IRONDALE

DATE ISSUED: AUGUST 30, 2024



VOLUME 2 OF 2

SET NO. _____

Charles Williams
& Associates, Inc
ARCHITECTS

SECTION 21 11 16

FIRE HYDRANT SPECIFICATIONS

General

Fire hydrants shall comply in all respects with AWWA Standard C-502, latest revision. Fire hydrants shall be of the compression type, with the main valve opening against the pressure and closing with the pressure. The main valve opening shall be 5 ¼" in diameter. Fire Hydrant shall be of a dry barrel, dry top design. The nozzle section shall consist of two (2) hose nozzles and one (1) 5" STORZ coupling.

Rating

Fire hydrants shall be rated at 250 psi water working pressure, tested at 500 pounds hydrostatic for structural soundness in the following manner: 500-pound hydrostatic test supplied from the inlet side. First with the main valve closed for the testing of the valve seat: second, with the main valve open for testing of the drain valves and the hydrant barrel. Testing is to be completed in accordance with AWWA C-502 and ULFM requirements.

End Configuration

Hydrants shall be connected to the main by a 6" epoxy coated mechanical joint. Mechanical joint shoes shall be fitted with strapping lugs.

Design

The main valve seat of the hydrant shall be made of rubber and be supported by a one-piece bronze top plate/ drain valve mechanism. Drain valves shall be faced with rubber.

The bottom stem threads of the main valve rod shall be fitted with an epoxy coated, cast iron bottom plate, sealing lower rod threads from the water. Changes in size or shape of the waterway (hydrant nozzles) shall be accomplished by means of easy curves. Exclusive of the main valve opening, the net area of the waterway of the barrel and the foot piece at the smallest part shall not be less than 120% of that of the net opening of the main valve.

Hose and pumper nozzles shall be threaded and screwed into the nozzle section and then mechanically locked to prevent turning.

Hose and pumper caps shall be chained to the hydrant.

The hydrant shall be so designed that when it is in place, no excavation will be required to remove the main valve and movable parts of the drain valve. Further, the hydrant shall be of the type that can be extended without excavating. Hydrants shall be so

designed that, in the event of accident, or breaking of the hydrant above or near grade level; the main valve will remain closed. The main valve rod shall be made in two parts and fitted with breakable coupling at the ground line flange.

The ground line connection between nozzle section and the barrel shall incorporate the use of traffic flange. This connection shall be so designed that the nozzle section can be rotated in any increment of 360°. The ground line connection between the barrel and nozzle sections shall have a rubber "O" ring gasket to provide a seal.

The operating threads of the hydrant shall be so designed as to avoid the working of any iron or steel parts against either iron or steel. The operating stem and operating nut threads shall be square or acme type. The operating thread shall be lubricated at factory with food grade grease. Access shall be provided to field lubricate the operating mechanism. The operating thread shall be sealed from water at all times when the valve is either in the opened or closed position. The operating rod shall be bronze sheathed where it passes through the double "O" ring seal in the bonnet. The bonnet shall be weatherproof and utilize a weather shield integral with the external wrench operating nut.

The operating nut shall be made of bronze with a self-lubricating design. Hydrants shall be of the dry barrel type and hydrant shoe shall have two positive acting non-corrosive drain valves that shall drain the hydrant completely by opening when the main valve is closed, and close tightly in accordance with A WWA C-502 requirements when main valve is open.

The main valve assembly shall be seated in the hydrant with a bronze-to-bronze interface to facilitate removal of the main valve, should maintenance be required. The nozzle section shall consist of two-2 1/2" hose nozzles to the specified thread designation (NST) and one pumper nozzle 4 ½" in diameter to the specified thread designation (NST), or other combination of nozzle outlets, including independent hose gate valves, as specified.

Two O-ring seals shall be utilized where the main hydrant rod passes through the I piece bonnet. Hydrant standpipe shall be ductile iron and single piece for all bury depths.

All like parts of hydrants of the same size and model produced by the same manufacturer shall be inter-changeable.

Hydrant shall open by turning to the left. Direction of opening shall be permanently marked on hydrant bonnet.

Threads on hose and steamer nozzles shall be National Standard unless otherwise specified.

Size and shape of operating nuts cap nuts shall conform to National Standard unless otherwise specified.

Bury shall be (specify depth of bury) measuring depth from grade line to bottom of trench or connecting pipe.

Auxiliary shut-off (isolation) gate valves, always required, shall be of the same manufacture as the hydrant.

Coating

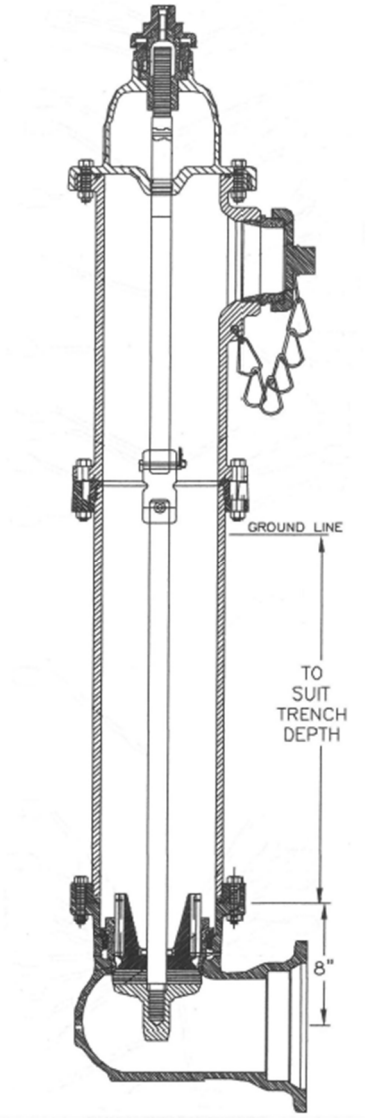
The inside of all hydrants shall be coated in accordance with AWWA standards except for bronze and threaded machined surfaces. Exterior on hydrant nozzle section shall be painted Safety Yellow or as otherwise specified. Hydrant shoes shall have an interior and exterior thermosetting epoxy coating of 5 to 6 mils meeting AWWAC550.

Markings

Hydrant shall be marked with the name of the manufacturer, size of valve opening, direction of opening and the year of manufacture all in accordance with the AWWA C-502. Country of origin shall be cast on all major hydrant castings.

Preferred Manufacturer and Hydrant

M&H Valve - model 129 Fire Hydrant with Integral STORZ



END OF SECTION 21 11 16

SECTION 220405

PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following plumbing identification materials and their installation:

1. Pipe markers.
2. Valve tags.
3. Valve schedules.
4. Equipment labels.
5. Warning signs and labels.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Valve numbering scheme.
C. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.03 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.04 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
B. Coordinate installation of identifying devices with location of access panels and doors.
C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME A13.1, unless otherwise indicated.

2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
4. Pipes with OD, Including Insulation, 6 Inches and Larger: Full-band pipe markers at least three times letter height and of length required for label.
5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pre-tensioned Pipe Markers: Pre-coiled semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Self-Adhesive Pipe Markers: Are not allowed

2.02 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Architect. Provide 5/32-inch hole for fastener.

1. Material: 3/32-inch thick laminated plastic with 2 black surfaces and white inner layer.
2. Valve-Tag Fasteners: Brass wire-link chain, beaded chain or S-hook.

2.03 VALVE SCHEDULES

A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
2. Frame: Extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.04 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Color Coding:

System	Background Color	Letters

Other equipment	Black	White

3. Temperatures up to 160 deg F.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Letter shall be a minimum of 1/2" high. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless-steel self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number.

2.05 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
B. Letter Color: White.
C. Background Color: Yellow.
D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
F. Minimum Letter Size: Minimum 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
G. Fasteners: Stainless-steel self-tapping screws.
H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
I. Label Content: Include caution and warning information as indicated elsewhere in the specifications and on the Drawings.

PART 3 - EXECUTION

3.01 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 22 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.02 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pre-tensioned pipe markers. Use size to ensure a tight fit.

2. Pipes with OD, Including Insulation, Less Than 6 Inches: Full Band pipe markers. Use color-coded, self-adhesive plastic tape, [**at least ¾ inch**] [**1-1/2 inches**] wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
3. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.
4. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.

B. Locate pipe markers and color bands where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and non-accessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. Label 2 psi gas piping at 6 foot intervals.

3.03 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:

1. Valve-Tag Size and Shape:

   a. Cold Water: **2 inches square**.
   b. Hot /HWR Water: **2 inches square**.
   c. Fire Protection: **2 inches square**.
   d. Gas: **1-1/2 inches round**.

2. Valve-Tag Color:

   a. Cold Water: **Natural**.

b. Hot Water: **Blue**.
c. Fire Protection: **Red**.
d. Gas: **Yellow.**

3. Letter Color:

a. Cold Water: White
b. Hot Water: **White**.
c. Fire Protection: **White**.
d. Gas: **White**.

3.04 VALVE-SCHEDULE INSTALLATION

A. Mount valve schedule on wall in accessible location in each major equipment room.

END OF SECTION 220405

22 04 10
GENERAL PROVISIONS

PART 1 - GENERAL

1.01 SCOPE:

A. Provisions of this Section apply to all Plumbing and Fire Protection work.
B. Include the provisions of General, Supplementary and Special Conditions and provisions of the Specifications shall apply to and form a part of this Section.
C. Provide all labor, materials, equipment, and services necessary for the completion of all work shown or specified, except work specifically specified to be done or furnished under other sections of the Specifications. Include performing all operations in connection with the complete installation in strict accordance with the specification and applicable drawings subject to the terms and conditions of the Contract, for the following system:

1. A system of sanitary waste and vent piping.
2. A system of domestic water piping.
3. A system of natural gas piping.
4. A system of fire protection piping.

D. Give required notices, file drawings obtain and pay for permits, deposits and fees necessary for the installation of the work. Obtain and pay for inspections required by laws, ordinances, rules, regulations or public authority having jurisdiction. Obtain and pay for certificates of such inspections, and file such certificates with Owner.
E. "Provide" means to furnish and install, complete and ready for operation.

1.02 DRAWINGS:

A. Drawings are diagrammatic and subject to requirements of Architectural Drawings. Drawings indicate generally the location of components and are not intended to show all fittings or all details of the work. Coordinate with Architectural, Structural, Electrical, HVAC and other Building Drawings.
B. Follow the Drawings closely, check dimensions with Architectural Drawings and field conditions. DO NOT scale Drawings for location of system components.
C. Make no changes without Architect's written permission. In case of doubt, obtain Architect's decision before proceeding with work. Failure to follow this instruction shall make the Contractor liable for damage to other work and responsible for removing and repairing defective or mis-located work.
D. Do not scale Drawings to locate sprinkler heads. Coordinate with lighting, ceiling grids, ceiling diffusers and/or reflected ceiling plans. Install Sprinkler Heads in center of ceiling tiles.

1.03 APPLICABLE CODES AND STANDARDS:

A. Comply with the current editions of the following Codes and Standards:

1. ANSI/ASHRAE 15 - Code for Building Services Piping.
2. NFPA 70 - National Electrical Code.
3. NFPA 101 – National Life Safety Code.
4. Other Standards as referenced in other Sections of Division 22.
5. Local Building Code (International Building Code if no local Building Code in effect).
6. Local Plumbing Code (International Plumbing Code if no local Plumbing Code is in effect).
7. Local gas code (International Gas Code if no local code is in effect).
8. NFPA 13 - Sprinkler System installation.
9. NFPA 24 – Installation of Private Fire Service Mains.
10. NFPA 110 - Emergency and standby power.
11. NFPA 72 - National Fire Alarm and Signaling Code.

1.04 QUALIFICATIONS OF SUBCONTRACTOR:

A. The Plumbing Contractor shall meet the following qualifications:

1. The Plumbing Contractor must be approved by the Architect.
2. The Plumbing Contractor shall have been in business as a Plumbing Contractor for at least three (3) years prior to Bid Date. He shall have a current Master's Plumber's Certificate and Gas Certificate of competency issued by the State of Alabama and the city and county in which work occurs.
3. The Plumbing Contractor shall have a satisfactory experience record with Plumbing installations of character and scope comparable with this project, and for at least three (3) years prior to the Bid Date and shall have had an established service department capable of providing service inspection or full maintenance contracts.

B. The Fire Protection Sub-Contractor shall meet the following qualifications:

1. The Fire Protection Contractor shall be approved by the Architect,
2. The Fire Protection Contractor shall have been in business as a Fire Protection Contractor for at least three (3) years prior to the Bid date and shall be licensed by the State, County and City in which the work will be performed.
3. The Fire Protection Contractor shall have a satisfactory experience record with Fire Protection installations of character and scope comparable with this project and shall have completed three (3) such installations in the past three (3) years.
4. The Fire Protection Contractor shall be a Registered Engineer in the State in which the work occurs or be a Nicet Level 3.
5. The Fire Protection Contractor shall be the employer of the NICET Level 3 Designer. The NICET Level 3 designer will oversee installation and provide in closeout documentation.

1.05 CONFLICTS AND INTERFERENCES:

A. If systems interfere or conflicts, the Architect shall decide which equipment to relocate regardless of which was first installed.

1.06 WORKMANSHIP:

A. Do all work in a neat and first-class manner. Remove and replace work not done in such manner as directed by the Architect.

1.07 COOPERATION:

A. Cooperate with all other crafts. Perform work in a timely manner. Do not delay the execution of other work.

1.08 VISITING SITE:

A. Visit site and become familiar with location and various conditions affecting work. No additional allowance will be granted because of lack of knowledge of such conditions.

PART 2 - PRODUCTS:

2.01 MATERIALS, SUBSTITUTIONS AND SUBMITTALS:

A. Unless otherwise noted, provide new, standard, first-grade materials throughout. Equipment and materials furnished shall be fabricated by manufacturers regularly engaged in their production and shall be the standard and current model for which replacement parts are available. Equipment shall be substantially the same equipment of a given manufacturer which has been in successful commercial use and operation for at least three (3) years.

B. Where materials or products are specified by manufacturer's name, brand, trade name, or catalog reference, such named materials or products shall be the basis of the Bid, without substitution, and shall be furnished under the Contract unless requests for substitutions are approved as noted below. Where two or more brands are named the choice of these shall be optional with the Contractor.

C. Substitutions will be considered only if written request for approval has been received by the Architect TEN (10) DAYS prior to the date established for receipt of Proposals. Each request shall include the name of the material or equipment for which substitution is proposed and a complete description of the proposed substitute including drawings, cuts, performance and test data, samples and any other information necessary for evaluation. A statement setting forth any changes in other materials, equipment or other Work that incorporation of the substitute may require shall be included. The burden of proof of the merit of the proposed substitute is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution is final.

D. If the Architect approves any proposed substitution prior to receipt of Proposals,

approval will be set forth in an Addendum. DO NOT rely upon approvals made in any other manner.

E. No substitutions will be considered after the Contract has been executed, except as described in the General Conditions.

F. Submittal data and shop drawings, shall be submitted at one time, partial submittals will not be considered. Within 30 days of execution of Contract and before ordering materials and equipment, submit to Architect and obtain his approval of a detailed list showing each item which is to be furnished by make, trade name, catalog number, or the like; together with manufacturer's specifications, certified prints, and other data sufficient for making comparisons with items specified. When approved, such schedule shall be of equal force with these specifications in that no variation there from shall be allowed except with Architect's written approval. Number of Shop Drawings and procedure shall be as directed by the Architect.

G. All pressure vessels shall be constructed and tested in accordance with applicable ASME Codes and shall bear ASME stamps. Certificates of inspection and approval shall be submitted to Architect.

H. Similar items of equipment shall be the product of the same Manufacturer.

I. See section, "ALTERNATES" in other sections of the Specifications and Bid accordingly.

2.02 SHOP DRAWINGS:

A. Before starting work, submit and obtain approval of the following:

1. Equipment piping.
2. Plumbing Equipment, Products and Fixtures.

B. Thirty (30) days before starting work, submit Fire Protection Shop Drawings bearing the Seals of the Owner's underwriters and all governmental agencies having jurisdiction. Shop Drawings will not be considered without these seals. Complete shop drawings are required to be submitted at one (1) time.

1. Piping routing showing sizes, dimensions, elevations, and head locations (coordinate with reflected ceiling plan). Provide minimum six (6) sets of blue line drawings.
2. Provide a sprinkler head layout on a reflected ceiling plan. Indicate on plan all lights, HVAC ceiling air devices, smoke detectors, exit lights and any other ceiling attachments. Adjust locations of heads after Architectural review.

2.03 RECORD DRAWINGS:

A. When work starts obtain from Architect two (2) complete sets of white prints of the Plumbing. All corrections, variations, and deviations, including those required by change orders, if any, must be recorded in colored ink or colored pencil at the end of each working day on these drawings. The marked prints shall be available at all times for the Architect's inspection.

B. Prior to examining the request for final payment or making any response thereto, the

Architect shall receive from the Contractor one (1) complete set of the white prints, marked as stated above, indicating the actual completed installation of the work included under this Contract.

C. The Architect will forward the marked white prints to the Consulting Engineers for review. They will then be returned by the Architect to the Contractor for use in preparing record drawings.

D. When work is completed Contractor shall purchase from the Architect (At Architects' printing cost) one (1) set of reproducible electronic files and prints of Plumbing Drawings for use in preparing record drawings. Contractor shall transfer the information from the marked white prints to the dwg record drawings, removing all superseded data in order to show the actual completed conditions.

1. Accurately show location, size and elevation of new exterior piping work and its relationship to any existing piping and utilities, obstructions, etc., contiguous to the area of work.
2. Block out areas modified by change-order and identify them by change-order number.

2.04 ELECTRICAL EQUIPMENT:

A. Provide electrical equipment compatible with the current shown on electrical drawings. Verify current characteristics before ordering equipment.

B. Should the Contractor with the Architect's/Engineer's approval make changes in electrical equipment from those shown on the Electrical Drawings, he shall be responsible for the coordination and cost of required changes.

C. Provide factory installed fuses in all equipment requiring fusing for branch circuit protection.

D. Verify electrical characteristics of all equipment and voltages available with Electrical Section prior to ordering any electrical equipment.

2.05 SLEEVES:

A. Refer to the Architectural Life Safety Drawings for wall ratings and close all openings to match rating of wall.

B. Submit details of all pipe penetrations thru rated walls indicating wall construction, penetrating material and method of closing penetration including materials and listing of detail.

C. All Penetrations thru walls are to be closed. If the wall is not rated, sheet rock joint compound may be used to close space around piping. For walls with ratings opening shall be closed with a U.L. Listed rating system compatible with wall rating. Insulation is to be continuous thru all openings.

D. For pipe through floors inside rated chases or through non-fire-rated walls: 20 gauge galvanized steel sleeve 1/2" larger than pipe or pipe covering. Pipe insulation to be continuous thru sleeve. Seal opening between sleeve and pipe or pipe covering

E. For uninsulated pipe through 2 hour fire rated walls, partitions or floors outside chases: Hilti FS605 with sleeve, U.L. Listing #WL1056.

F. For insulated pipe passing through fire rated partitions or walls or floors outside

chases: Hilti #FS611A with no sleeve, U.L. Listing #WL5029. Insulation: 1" thick fiberglass continuous thru wall.

G. For pipe passing thru concrete floor, concrete walls, and concrete block walls:

1. Uninsulated Schedule 40 steel and copper: Hilti #FS605 with sleeve, U.L. #CAT1155.
2. Insulated Schedule 40 steel and copper: Hilti #FS611A, U.L. #CAT5045.

H. For 4" and smaller acid waste or PVC pipe passing thru 3 hour concrete floor, wall or concrete block wall - Hilti #FS611A with collar, UL System #CAJ095.
I. For 2" and smaller acid waste or Schedule 40 PVC pipe penetrating a 1H12 concrete floor or wall - Hilti #FS611A sealant, UL #CAT2062 or UL #CAJ2066.
J. Under this Section, the Contractor shall be responsible for closing and making fire safe all openings exposed during construction (both new and existing) in the floor and deck above. Closing of opening shall be compatible with rating and shall not compromise the rating of the wall or floor being sealed.
K. Set sleeves before concrete is poured or masonry is erected. In existing construction, grout sleeves firmly in place.
L. In Mechanical Rooms extend sleeves 1-1/2" above finish floor and waterproof.
M. Where exposed pipes pass through walls and partitions in finished or exposed spaces, provide chrome plated F & C plates or escutcheons. Seal wall penetration and case work penetration with silicone prior to installing escutcheon.
N. All wall floor penetrations shall be closed in a neat manner. The method used to the close penetrations shall be compatible with the rating of the wall and shall in no way compromise the integrity of the partition or floor.

2.06 ACCESS DOORS:

A. Provide access doors for valves, and other items requiring maintenance located above hard ceilings or behind partitions or walls. Doors in fire rated walls and ceilings: UL labeled with fire rating equal to fire rating of wall or ceiling. Provide door styles, sizes and colors as specified under the Architectural section.
B. Mark lay-in ceilings with paper brads at valve locations and maintenance access points. Bend ends of brads over above ceiling tile.

PART 3 - EXECUTION:

3.01 PROTECTION OF EQUIPMENT:

A. During construction all fixtures and equipment shall be protected from damage caused by weather, masonry, plaster, paint and job accidents.
B. When installation is complete, clean equipment and make ready for painting. Adjust all flush valves.

3.02 INSTALLATION OF FIXTURES AND EQUIPMENT:

A. Install fixtures and equipment to provide normal service access to all components.

B. Provide sufficient space for removing components, install fixtures and equipment to provide such clearance.
C. Install fixtures and equipment in accordance with manufacturer's instructions. If manufacture's instructions conflict with contract documents, obtain Architect's decision before proceeding.
D. All fixtures and equipment shall be firmly fastened in place:

1. All wall hung fixtures shall be installed on a floor mounted fixture support with anchoring bolts in all holes of each leg. Bolts shall be sized as per manufacturer's recommendation.

3.03 CUTTING AND PATCHING:

A. Set sleeves and inserts and lay-out and form openings in walls, beams, girders and structural floors in this Section.
B. Cut, patch and repair as required to accomplish work and finish to match adjacent work. Architect's approval required before cutting any part where strength or appearance of finished work is involved.
C. Cutting, patching and repairing of walls, floors, etc., where noted in paragraph "A" above, have been located or sized incorrectly are included in this Section.

3.04 INCIDENTAL WORK:

A. All power wiring is included in Electrical Section.
B. Permanent drain and relief connections for **Plumbing Equipment** to nearest floor drain or to grade are included in this Section whether shown or not.
C. Items obviously omitted from drawings and/or specifications shall be called to attention of the Architect prior to submitting Bid, after award of Contract any changes or rearrangements necessary to complete Contract shall be at no additional cost to Owner.

3.05 FLASHING:

A. Vent Pipe and Roof Drain Flashing: Specified in "Architectural Roofing Section".
B. Coordinate all roofing penetrations with Roofing Section.

3.06 EXCAVATION AND BACKFILLING:

A. Include all excavation and backfilling required to bring the work to line and grade shown, including excavation of rock and all other materials which may be encountered.
B. Excavate trenches wide enough for proper installation of work. Grade trench bottoms evenly. Provide bell holes as necessary to insure uniform bearing for pipes. Excavate minimum 6" below pipe. Refill cuts below required pipe grade with sand or compacted gravel. Support pipe continuously along its entire length. Do not use piers to support piping.
C. Backfill after inspection by Architect and authorities having jurisdiction. Backfill

compacted areas with "Engineered Fill", sand or fine gravel in accordance with requirements of "Sitework". Backfill paved areas with sand or fine gravel compacted to meet requirements of Paving Section. Backfill shall be free of rock, wood, steel, brick, etc. Do not disturb pipe. Restore or repair pavements and the like after backfilling, to meet the requirements of the authority having jurisdiction.

3.07 PAINTING:

A. Refinish equipment damaged during construction to new condition.
B. Paint all non-potable water pipe and insulation with two (2) coats of bright yellow paint in compliance with the Local Plumbing Code and these specifications. Paint piping prior to installing insulation. Paint type to be equal to Paint Specified in Painting Section of the Specifications.
C. Other painting is specified in "PAINTING SECTION, Finishes Division".

3.08 PIPE IDENTIFICATIONS:

A. Identify all piping exposed to view or accessible through removable ceilings or access panels with plastic snap-on pipe line markers. Color code markers in accordance with ANSI A13.1. Show pipe contents and direction of flow. Markers on lines 8" OD and smaller shall be taped in place; on lines over 8" OD secure with spring clips.
B. Submit samples of all nameplates, tags, chains and etc., for approval.
C. Protect all factory identification tags, nameplates, model and serial numbers, stenciling, etc., during construction and replace if damaged.
D. Label Spacing and Extent:

    1. On straight run of pipes; Above suspended ceilings space labels approximately 10 feet on center; elsewhere, 20 feet on center.
    2. Wherever a pipe enters or leaves a room or building.
    3. At change of direction.
    4. At main valves and control valves (not equipment valves).
    5. On risers, just above and below floors.

3.09 VALVE TAGS:

A. 2" X 3" laminated plastic with 1/2" numbers engraved at top, leaving space for further engraving by others. Secure tags with chains to valve yoke or stem, not handles.
B. Valve tags colors:

    1. Plumbing: Red tags with white numbers.

C. Valve tag locations: At all valves on mains, risers and branches.
D. Valve tag numbers: Starting with Number 1, number tags in sequence from the lowest point to the highest point in the building. In existing building extend existing sequences.

E. Starting with Number 1, number valve tags on this floor extending existing sequence. If there are no valve tags on existing valve, provide tags for all existing valves and new valves beginning floor sequence with Number 1.

3.10 VALVE CHARTS:

A. In all mechanical rooms, provide charts showing number and locations of all valves, type of service, etc. Frame with aluminum, under glass.
B. In existing buildings include existing valves in the charts of new valves.

3.11 WARRANTY AND INSTRUCTIONS:

A. See General Conditions - One-Year Warranty.
B. Contractor shall and hereby does warrant all materials, workmanship and equipment furnished and installed by him to be free from defects for a period of one (1) year after date of substantial completion of the Contract. Should any defects in materials, workmanship, or equipment be made know to Contractor within the one (1) year warranty period, Contractor shall replace such materials, workmanship, or equipment without charge.
C. After completion of the work, Contractor shall operate the equipment which he installs for a period of ten (10) working days, as a test of satisfactory operating conditions. During this time, Contractor shall instruct the Owner's operating personnel in the correct operation of the equipment. Furnish necessary oral and written operating instructions to the Owner's representative.
D. Provide three (3) sets of manufacturer's operating and maintenance manuals and parts lists including nearest manufacturer's sales and service representative by name, address and phone for all equipment and materials furnished. Provide a maintenance schedule listing routine maintenance operations and suggested frequency there of. Include all warranty dates on equipment and guarantees. Include names, address and phone of any subcontractor and work performed. Bind above items in loose leaf three (3) ring binders with tab for each class of equipment.
E. During the period of tests, adjust all controls, regulators, etc., to comply with these Specifications.
F. Make available to the Owner, without additional cost, service and adjustment of the equipment for the guarantee period.

3.12 PROJECT CLOSE-OUT DOCUMENTS:

A. Prior to the issuance of a certificate for final payment, submit to Architect and obtain his approval of the following:

1. Record drawings – Plumbing & Fire Protection (reproducible). Electronic drawings dwg format and pdf format.
2. Equipment and Fixture Submittal Data: List of manufacturers representative including name,
address and telephone number that supplied requirement (3).
3. Equipment operating and maintenance manuals including: Spare parts

required (3).

4. Maintenance schedule (3).
5. Equipment warranty dates and guarantees (3).
6. List of Owner's Personnel who have received maintenance instructions.
7. Record of inspections indicating what system was tested, type of tests, date of tests and
   those parties witnessing tests.
8. Valve Tag Chart.
9. Current flow test.

END OF SECTION 22 0410

SECTION 22 04 20
TESTING, CLEANING AND ADJUSTING (TCA)

PART 1 - GENERAL

1.01 SCOPE

A. Provisions of this section apply to all Plumbing work.
B. Include Section 220410, "GENERAL PROVISIONS - PLUMBING AND FIRE PROTECTION", with this Section.
C. All tests shall be witnessed by the Architect in addition to authorities having jurisdiction. A minimum of 48 hour notice is required prior to performance of test.

PART 2 - PRODUCTS

2.01 NOT APPLICABLE

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

A. After system have been installed, Test, Balance and Adjust System for proper operation, flow rates, pressures and temperatures. Correct any noise and/or vibration conditions.
B. Perform all tests as required by local codes. Contractor shall furnish testing equipment. Keep a record of all tests indicating dates of tests, those persons witnessing tests and results of tests.
C. Provide with the Close-Out Documents a Testing Record.
D. If local Codes are more stringent, local Codes shall govern.

3.02 SANITARY WASTE SYSTEMS

A. Test piping by stopping lower outlets and filling with water to 10' hydrostatic head. Stop leaks and repeat test until watertight. All joints shall be exposed throughout test.
B. Provide "Ball Test" on all piping 3" and larger with ball 1/2" smaller than pipe diameter.
C. Provide visual inspection of all building drain piping below grade. Visual inspection shall be by means of a video camera routed through the drain system. Where the drain piping is connected to existing drain piping, the visual inspection shall include the existing drain piping from the point of connection, downstream to the point of connection to the public utility. A video tape and written report, noting any defects, on the findings of the visual inspection shall be provided to the owner with the close-out documents. The Plumbing Contractor shall provide personnel and equipment required for the visual inspection.

3.03 DOMESTIC WATER PIPING

A. On completion of roughing-in, cap all outlets, make connections with house supply line, and put under full water pressure. Test by applying additional pressure (by temporary pump or compressed air connection) to total hydrostatic pressure 1-1/2 times street pressure but not less than 150 psig for not less than 4 hours.
B. Immediately and completely stop all leaks and retest until system is watertight. After testing, leave general pressure on until ready to install fixture (except when necessary to drain to avoid freezing during construction). After completion of all tests, repairs and installation of fixtures, flush all domestic hot and cold water piping with water to remove all sediment scale and until water runs clear, then disinfect.
C. Disinfect piping with hypochlorite solution of chlorine or compressed chlorine gas applied through on approved chlorinator. Operate all valves and faucets several times to Ensure the chlorine reaches all parts of the system. Feed water and chlorination agent into the system at rates that will provide a residual chlorine content of not less than 50 ppm after a retention period of 6 hours and 10 ppm after a retention period of 24 hours. Upon completion of treatment, flush treated water from each system until the water supply is satisfactory to the public health authority having jurisdiction. Provide Architect a certificate of compliance from the local Health Department.
D. Clean air aerators, hose sprays, flush valves, etc. and adjust to proper flow rates.

3.04 NATURAL GAS PIPING TESTS

A. After all piping is roughed-in but before connection to main or to appliances or equipment, test piping for tightness as required by local gas company. In the absence of such requirements, apply in Architect's presence an air pressure test equal to 25 psig. Piping shall maintain pressure without drop for at least four (4) hours. Stop all leaks shown up by such test and repeat test until piping is air tight.

3.05 FIRE PROTECTION PIPING TEST

A. Test in accordance with NFPA Pamphlets 13 and 20. Architects, Owner's, Underwriters and local Fire Marshall shall witness test. Provide certificate of inspection to the Architect/Engineer including the name of those witnessing the test.
B. On completion of roughing-in and before connection to existing piping, cap all outlets, make connections with house supply line, and put under full water pressure. Test by applying additional pressure, by temporary pump or compressed air connection, to total hydrostatic pressure 1 1/2 times street pressure, but not less than 200 psig for a period of not less than four (4) hours. Immediately and completely stop all leaks. Retest when system is watertight.
C. After testing, leave general pressure on until ready to install sprinkler heads and fire department valves, etc. except when necessary to drain to avoid freezing during construction.

3.06 COMPLETION OF TEST

A. Upon completion of all testing, Contractor shall provide to the Architect copies of test results and include a listing of all personnel witness to the tests.

END OF SECTION 22 0420

SECTION 22 0450
MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SCOPE

A. Include Section 220410, "GENERAL PROVISIONS - PLUMBING", with this Section.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All pipe, fittings and valves shall be manufactured in the United States of America.
B. Pipe and fittings to be the same manufacturer.

2.02 SANITARY WASTE AND VENT PIPING, BELOW GRADE OR BELOW SLAB ON GRADE

A. PVC Pipe: Below Slab
   Pipe: Schedule 40, ASTM D2665 and ASTM D1785.
   Fittings: PVC with DWV pattern, ASTM D2665.
   Joints: ASTM D2855, solvent weld with ASTM F-656 purple primer and ASTM D2564 solvent cement.

2.03 SANITARY WASTE AND VENT PIPING, ABOVE SLAB ON GRADE

A. Waste and vent piping to be cast iron or PVC. Waste piping 2 inch and smaller from fixture to trap to be galvanized steel, DWV copper tube or cast iron.
   Cast iron piping in Bay Area. Transition vent piping 24" prior to penetration of roof. Provide cast iron vent penetrations.
B. PVC Pipe:
   Pipe: Schedule 40, ASTM D2665 and ASTM D1785.
   Fittings: PVC with DWV pattern, ASTM D2665.
   Joints: ASTM D2855, solvent weld with ASTM F-656 purple primer and ASTM D2564 solvent cement.
C. Cast Iron Pipe:
   Pipe: CISPI 301, hub less, service weight, bituminous coating.
   Fittings: Cast iron, bituminous coated.
   Joints: CISPI "heavy duty" neoprene gaskets and stainless-steel clamps and shield assemblies. Mission or Husky.
   May not be used below grade or slab on grade.
D. Copper DWV Tube:
   Pipe: ASTM B306, DWV.
   Fittings: ASME B16.23, cast bronze, or ASME B16.29, wrought copper.

Joints: 50-50, ASTM B32, solder, Grade 50B.

E. Steel Pipe:
   Pipe: ASTM A53, Schedule 40, galvanized.
   Cast Iron Fittings: ASME B16.4, drainage pattern threaded fittings.
   Malleable Iron Fittings: ASME B16.3, screwed type.
F. Connect to site sanitary 5'-0" outside building. Verify with Civil Site Drawings exact size, location and invert of site sewer prior to beginning work.

2.04 DOMESTIC WATER PIPING

A. Domestic Water Piping: Copper tube.
B. Copper Tube: ASTM C-88, copper water tube, Type "L" hard temper inside building, Type "K" outside building and below slab on grade. Fittings, cast brass or wrought copper water tube fittings, ANSI B-16.18 or B-16.22.
C. Joints on copper tube:
   a. Inside Building: Properly cleaned fluxed and soldered as recommended by manufacturer, using 95-5 solder and 100% lead free flux.
   b. Outside Building and below slab on grade: "Sil-Fos".
D. Provide temporary construction water at site as required.
E. Connect to water service 5'-0" from building, provided and installed under Civil Section. Verify exact location with Civil Drawings.
F. All water piping installed below slab on grade to be type "K" soft copper bent up on both ends with no joints below slab.

2.05 NATURAL GAS PIPING

A. All gas piping: Black steel. All gas piping below grade, mill-wrapped with fittings field-wrapped with PVC tape, same thickness as mill wrapping. Mill wrapping shall be X-TRU coat.
B. Black steel pipe, Schedule 40, ASTM A-53. Fittings on pipe 2" and smaller, black malleable iron screwed fittings, ASTM A-197. Fittings on pipe 2-1/2" and larger, welded, using butt welding fittings.
C. Joints on screwed pipe made up with Teflon tape applied to male threads only.
D. Joints on welded pipe made up with butt welding fittings. Mitering and notching for tees, etc., not permitted. Weldolets are permitted.
E. Unions 2" and smaller, black malleable iron screwed, unions 2-1/2" and larger flanged.
F. Arrange for tapping of utilities main, service from main to meter and installation as required by local utility. Pay all charges, fees, temporary deposits, etc.
G. All gas piping in the 2 psig system, labeled at the beginning, at all gas cocks, at ends and at 4' intervals with labels reading "2 psig". See piping identification for materials.
H. Install appliance type regulators as shown on drawings. Regulators shall have vent limiting device as required by local code and local utility or shall be vented to the exterior as approved by Architect.

I. Sleeved gas piping below slab shall be type "K" copper tubing, ASTM B88, with lead free soldered fittings.
J. All exposed exterior piping shall be painted with two coats of paint equal to "Tar-Guard" by Sherwin Williams. Coordinate colors with architect.

2.06 VALVES

A. Domestic Water Piping Valves

1. Ball Valves: All bronze, 150 psig WP, chrome plated bar stock ball, full port Teflon seats, stem packing seal and thrust washer, Watts B-6080 or B-6081, Apollo 20-100, Red White 5044F or 5094F, Kitz 56 or 57. Provide valve handle extension to (minimum 1") clear insulation.
2. Check valves 2" and smaller: All bronze, 125 psig WP, bronze disc, swing check, Stockham B-309, Crane 1342, Nibco S-413-B, Milwaukee 1509, Red White 237, Kitz 14.
3. Check valves 2-1/2" and larger: Iron body, bronze trim, switch check, 125 psig WP, Stockham G-931, Crane 373, Nibco F-918-B, Milwaukee F2974, Red White 435, Kitz 78.

B. Water pressure reducing valves: Watts, Wilkins, or Cash Acme, complete with inlet strainer, unions, inlet and outlet pressure gages and shut-off valve up stream of strainer.
C. Natural gas valves: Plug cocks 2-1/2" and larger, Rockwell 143; 2" and smaller, Rockwell 142, A.F.C. or Walworth, lubricated, 175 psi.
D. Gas pressure regulator:

1. System Regulator: Equal to Reliance Model 1893 with built-in under and over pressure shut off size and capacity as shown on drawings.
2. Appliance Regulator: Equal to Maxitrol 325-5 on 325-5M complete with vent limiting device. Valve shall be full line size and capacity as shown on Drawings.

2.07 PIPE HANGERS

A. General: Pipe hangers, Grinnell, PHD, Michigan Hanger, or Elcen. Grinnell figure numbers are given for reference. Provide copper clad hangers on bare copper lines.
B. Pipe hangers for lines 3" and smaller, adjustable wrought ring hangers, Grinnell Fig. 97 or wrought clevis hangers, Grinnell Fig. 260.
C. Pipe hangers for lines 4" and larger, adjustable wrought clevis hangers, Grinnell Fig. 260.
D. Parallel piping graded in same direction may be grouped on trapezes. Trapezes for line 4" and smaller, Unistrut P2000 channel, or equal, with rods sized as specified below for largest pipe on trapeze. Guide lines on (but not anchor to) trapezes using

Unistrut Series P1100 clamps. Trapezes shall not exceed 3' in length. Space lines to allow at least 3" clear between adjacent pipe or pipe covering and between pipes or pipe covering and rods. Space trapezes as specified for pipe hangers based upon smallest size of pipe on trapeze.

E. Provide riser clamps on pipe risers on each floor. Clamps in contact with copper or plastic pipe, plastic coated.
F. Beam Clamps: Grinnell Fig. 229.
G. Inserts for hangers in concrete structures: Underwriter's listed cast iron inserts. Grinnell Fig. 282.
H. For fasteners in existing concrete structures use drilled in expansion anchors with load rating at least 150% of pipe hanger rating (power driven anchors are not acceptable).
I. Size rods for pipe hangers not smaller than the following: 3/8" rods for pipe up to 2", 1/2" for 2-1/2" and 3" pipe, 5/8" rods for 4" and 5" pipe, 3/4" rods for 6" pipe, and 7/8" rods for 8" and 10" and 12" pipe, 1" rods for 14" and 16" pipe and 1-1/8" rods for 18" pipe.
J. Space pipe hangers at maximum: 5' intervals for cast iron pipe with additional hanger at each fittings. Pipe hanger spacing for screwed, solder joint and welded piping: 1/2", 6 ft.; 3/4" to 1-1/4", 8 ft.; 1-1/2" to 2-1/2", 10 ft.; 3", 12 ft.; 4" to 6", 14 ft.; 8" and over, 16 ft. Polypropylene and PVC plastic pipe 4 ft. horizontally maximum or as directed by manufacturer if closer, and 10 ft. vertically. Install additional hangers at change of direction and valve clusters.
K. Install pipe hangers on insulated pipe over pipe covering. Provide sheet metal saddle under hanger length to be 1-1/2 times the pipe diameter, minimum 12" long.
L. On sanitary and storm piping requiring insulation, hanger may be installed directly on pipe and insulation installed over hanger.

PART 3 - EXECUTION

3.01 PIPE INSTALLATION

A. All piping shall be securely anchored in place to the Building Structure.
B. Cut pipe square and ream full size after cutting. Clean pipe. Make threaded joints with Teflon tape. Do not spring pipe into place.
C. Provide welding material and labor in accordance with the welding procedures of the Heating, Piping, and Air Conditioning Contractor's National Association or other approved procedure conforming to the requirements of ANSI B-31.9 "Building Service Piping". Employ only welders fully qualified in the above specified procedure and currently certified by recognized testing authority. Use either electric arc or oxactylene welding. Provide full perimeter wells at both face end and collar end of each slip-on flange.
D. Install piping to allow for expansion. Make connections to all equipment to eliminate undue strains in piping and equipment. Furnish necessary fittings and bends to avoid spring of pipes during assembly.
E. Install chrome plated floor and ceiling plates on pipe passing through finished

surfaces in finished spaces.

F. Make pipe size reductions using reducing fittings. Bushings are prohibited.
G. Install 3/4" ball or gate valve drains with hose adapters at low points of water piping and at bases of all risers or where shown provide large drains.
H. Make connections to equipment using screwed unions in sizes 2" and smaller and flanged unions in sizes 2-1/2" and larger. Install unions in all piping connections to each piece of equipment.
I. Wherever ferrous pipes or tanks and copper tubing connect, provide dielectric insulation unions or couplings, equal to EPCO.
J. Run piping concealed, except where specifically shown or specified exposed. Plumb all vertical lines and run mains parallel to building walls unless specifically shown otherwise.
K. Lay underground pressure piping so top of pipe is at least 18" below finished grade. Provide deeper bury if required by local regulations. Support all underground piping solidly along body of pipe. Strongly suspend other piping from building construction.

L. Run no piping or tubing in direct contact with slag fill. Where necessary to pass through slag, protect piping with not less than two (2) wrappings of polyvinyl chloride tape or equivalent protection approved by Architect.
M. Install shock arrestors as manufactured by J. R. Smith, Josam, Zurn or Wade as required by the IPC Plumbing Code and where indicated on drawings. Size in accordance with manufacturer requirements.

3.02 INSTALLATION OF VALVES

A. Provide shut-off valves where shown and detailed on Drawings. Locate valves to isolate each item to facilitate maintenance and/or removal.
B. Locate valves in piping connections to water heaters, etc., so heads and tube bundles can be removed without disconnecting equipment or piping other than union or flange connections immediately adjacent to heat exchangers.
C. Provide sweat to screw adapters where required.
D. In Buildings with water pressure exceeding 80 psig, provide and install a water pressure reducing valve(s) immediately upon entering building or as shown on Drawings. The P.R.V. shall be line size and have an integral strainer or separate WYE strainer up stream of P.R.V. Provide a ball or gate valve immediately upstream of P.R.V. and strainer.

END OF SECTION 22 0450

SECTION 22 0451
GENERAL FIRE PROTECTION REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Division 1 – Section "ALTERNATES": Coordinate related Division 22 work and modify surrounding work to integrate the Work of each Alternate.

1.02 SUMMARY

A. Description of General Fire Protection Requirements. Applies to all Division 22, Section 220450's (Fire Protection).

1.03 DEFINITIONS

A. "Provide" means to furnish and install, complete and ready for operation.

1.04 REFERENCES

A. ASME: American Society for Mechanical Engineers.
B. ASTM: American Society of Testing and Materials.
C. AWWA: American Water Work Association.
D. FM: Factory Mutual.
E. NEMA: National Electrical Manufacturer's Association.
F. NFPA: National Fire Protection Association.
G. MSS: Manufacturer's Standardization Society of the Valve and Fitting Industry.
H. UL: Underwriters Laboratories, Inc.

1.05 REGULATORY REQUIREMENTS

A. Comply with current edition, unless otherwise noted, of the following codes and standards.

1. ANSI B31.9 - Building Services Piping.
2. ADA - Americans with Disabilities Act.
3. NFPA 13 – Installation of Sprinkler System.
4. NFPA 24 – Installation of Private Fire Service Mains.
5. NFPA 30 – Flammable and Combustible Liquids Code.
6. NFPA 31 – Installation of Oil-Burning Equipment.
7. NFPA 54 – National Fuel Gas Code.
8. NFPA 70 – National Electrical Code.
9. NFPA 101 - Life Safety Code.
10. IBC - International Building Code with Fire, Mechanical, Plumbing and Gas Codes; 2021 Edition.

B. Permits, Licenses, Inspections and Fees.

1. Obtain and pay for all permits, licenses, inspections and fees, and comply with all rules, laws and ordinances pertaining to the Contractor's portion of the Work.
2. Obtain and pay for certificates of required inspections, and file certificates with Owner.

1.06 PRODUCT REQUIREMENTS

A. Provide new standard, materials throughout.
B. Multiple items of similar equipment shall be the product of the same manufacturer.
C. Substitutions:

1. Comply with the provisions of Division 1, Section "Product Requirements" and the following:
2. When several manufacturers are named in the specifications, the corresponding products and models made by the specified manufacturers will be accepted and Contractor may base his bid on any one of those products. However, if the Contractor's bid is based on products other than the scheduled or specified **basis of design**, it shall be understood that there will be no extra cost involved whatsoever, and the effect on other trades has been included in the Contractor's proposal. Coordination with other trades for substituted equipment or use of products other than the named basis of design shall be the responsibility of the Contractor furnishing the equipment.
3. The basis of design manufacturer's equipment has been used to determine space requirements. Should another approved manufacturer's equipment be used in preparing proposals, Contractor shall be responsible for determining that said equipment will fit space allocated. Submission of shop drawings or product data on such equipment shall be considered as indicating that the Contractor has reviewed the space requirements and the submitted equipment will fit the space allocated with due consideration given to access required for maintenance and code purposes.
4. The basis of design manufacturer's equipment and scheduled Fire Protection equipment electrical requirements have been used to coordinate the electrical requirements of the plumbing equipment with the electrical systems serving that equipment.

    a. Contractor shall coordinate the electrical requirements of the equipment actually furnished on this project and provide the electrical systems required by that equipment at no additional cost to the Owner.
    b. Equipment of higher or lower electrical characteristics may be

furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified at no additional cost to the Owner.

c. Prior to approval of submittals of Fire Protection equipment with electrical requirements that are greater or lower than those shown on the Drawings, Contractor shall submit letter verifying that required changes to the electrical system, serving the specific piece of equipment in question, have been coordinated with the electrical contractor. Letter to be included with the associated equipment submittal, addressed to the Architect with a copy to the electrical engineer.

5. Each bidder may submit to the Architect a list of any substitutes which he proposes to use in lieu of the equipment or material named in the specifications with a request for the approval of proposed substitutes. To be considered, such requests must be delivered to the office of the Architect not later than 10 days prior to bid due date. The submittal shall include the following:

   a. Specific equipment or material proposed for substitution giving manufacturer, catalog and model number.
   b. All performance and dimensional data necessary for comparison of the proposed substitute with the equipment or material specified.
   c. A statement setting forth any changes in other materials, equipment or other Work that incorporation of the substitute may require.

6. The burden of proof of the merit of the proposed substitute is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution is final.

1.07 SUBMITTALS

A. Submit under provisions of Division 1, Section "Submittal Procedures" and the following:

B. Product Data: Submit to the Architect and obtain his approval of a complete list of materials and equipment which are to be provided under the 220450 Sections of Division 22.

   1. List shall be complete with manufacturer's names, catalog number, dimensions, specifications, rating data and options utilized. Capacities shall be in the terms specified.
   2. Call attention to deviations from specified items as to operation and physical dimensions.

3. Performance curves for pumps shall be included.
4. Final equipment orders shall not be placed until submittals have been returned marked "No Exceptions Noted" or "Make Corrections Noted".
5. Bind all equipment submittals and provide index tab for each type of equipment. Submit all at one time. Reserve two sets for project close-out documents.

C. Shop Drawings: Before starting work, submit and obtain approval from Architect of detailed drawings of the following, fully dimensioned and drawn to 1/8" to 1'-0" scale. Submit six (6) prints of each drawing. Engineer will return five (5) of the prints with comments noted. Failure to submit shop drawings will make the Contractor responsible for changes required to facilitate installation.

1. Fire Protection Systems. See Division 22, Section "Fire Protection System."
2. For multi-story buildings, submit detailed floor penetration sleeve layout drawings. See Division 22, Section "Plumbing Basic Materials and Methods," Article "Informational Submittals."

1.08 COORDINATION DRAWINGS

A. General:

1. Within 60 days of Notice to Proceed provide Coordination Drawings for the following areas of the building:

   a. Auditorium (Include all Rigging)

2. Do not base Coordination Drawings on reproduction of Contract Documents or standard printed data.
3. Submitted Coordination Drawings are for information only and typically will not be returned to the Contractor. Architect will not take any action, but may define coordination conflicts or problems and inform the Contractor of such conflicts or problems.

B. Content:

1. Project specific information, drawn accurately to scale.
2. Show sequencing and spatial relationship of separate units of work that must function in a restricted manner to fit in the space provided, or function as indicated.
3. Indicate dimensions shown on Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

C. Format:

1. Coordination shop drawings shall be drawn to a scale of not smaller than ¼" = 1'-0".
2. Provide drawings on electronic media in AutoCad .dwg format.
3. Provide layering system separate from wall outline and unique to each discipline.
4. In addition to plan view, provide sections as required to clarify congested situations and verify vertical clearances.
5. Base drawings and building sections in .dwg format will be provided by Architect.

D. Fire Protection Shop Drawings: Fire Protection subcontractor shall add all fire protection equipment, piping, sprinkler heads and other elements to database.

1. Upon completion of Fire Protection shop drawings, transmit electronic database to Electrical subcontractor.

E. General Contractor's Final Coordination: General Contractor shall thoroughly review shop drawings, adding additional building elements where appropriate, and shall resolve conflicts, coordinating with the Architect, and the various subcontractors.

F. Submit Coordination Shop Drawings: Upon completion of final coordination, General Contractor shall approve coordination shop drawings and transmit 3 sets of hard copies and electronic files on CD's to Architect.

G. The Architect will not process fire protection shop drawings until such time as the coordination drawings have been sufficiently completed and conflicts resolved.

1.09 QUALITY ASSURANCE

A. Installer's Qualifications: Firm experienced in installation of systems similar in size and complexity to those required for this project, plus the following:

1. Acceptable to, or licensed by, manufacturer.
2. Not less than 3 years experience with systems.
3. Successfully completed not less than 5 comparable scale projects using systems similar to those for this project.
4. Professional Engineer licensed in the State in which the work occurs; or NICET Level 3 and licensed by the State Fire Marshall in the State in which the work occurs. NICET Level 3 designer must be an employee of the Fire Protection Contractor. NICET Level 3 designer must oversee installation of shop drawings.

1.**10** SUMMARY OF WORK

A. Scope: Provide all labor, materials, equipment and services necessary for the completion of all fire protection work shown or specified, except work specified to be done or furnished by others, complete and ready for operation.

1.11 DRAWING INTERPRETATION AND COORDINATION

A. Drawings are intended to show size, capacity, approximate location, direction and general relationship of one phase to another, but not exact detail or arrangement.
B. Do not scale drawings for location of system components. Check all measurements, location of pipe, ducts, and equipment with the detail architectural, structural, and electrical drawings and conditions existing in the field and lay out work so as to fit in with ceiling grids, lighting and other parts.
C. Make minor adjustments in the field as required to provide the optimum result to facilitate ease of service, efficient operation and best appearance.
D. Where doubt arises as to the meaning of the Drawings and Specifications, obtain the Architect's written decision before proceeding with parts affected; otherwise assume liability for damage to other work and for making necessary corrections to work in question.
E. Refer to Architectural Drawings for all dimensions and location of lights, ceiling diffusers and sprinkler heads.

1.12 PROJECT/SITE CONDITIONS

A. Visiting Site: Visit site and become familiar with location and various conditions affecting work. No additional allowance will be granted because of lack of knowledge of such conditions.
B. Determine sizes and locations, and inverts of existing and new utilities near site.
C. Cause as little interference or interruption of existing utilities and services as possible. Schedule work which will cause interference or interruption in advance with Owner, authorities having jurisdiction, and all affected trades.

1.13 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit under provisions of Division 1 Sections - "Closeout Procedures" and "Project Record Documents" and the following.
B. Record Drawings:

1. Keep accurate record of corrections, variations, and deviations, including those required by change orders to the Fire Protection drawings.
2. Accurately show location, size and elevation of new exterior work dimensioned from permanent structure.
3. Record changes daily on a set of prints kept at the job site.
4. Submit prints marked as noted above to Architect for review prior to request for final payment.
5. Marked prints will be returned to Contractor for use in preparing Record Drawings.
6. The Fire Protection Contractor shall use marked up drawing showing as-built conditions provided by Contractor to prepare Record Drawings. Asbuilt drawings shall be incorporated on electronic files.

C. Prior to the issuance of a certificate for final payment, submit to Architect and obtain his approval of the following:

1. Record drawings – fire protection piping/shop drawings, bond and electronic files in AutoCAD *.dwg & PDF format.
2. Equipment Submittal Data (2).
3. Equipment operating and maintenance manuals (2).
4. Equipment warranty dates and guarantees (2).
5. List of Owner's Personnel who have received operating and maintenance instructions.
6. Install valve charts and valve location plans in main mechanical room. (See Division 22, Section "Plumbing Identification.")
7. Submit factory start-up/field reports for:
   a. Pressure Reducing Valve

D. Contractor's Material and Test Certificate for above ground piping.
E. Contractor's Material and Test Certificate for underground piping.

END OF SECTION 22 0451

SECTION 22 0453
BASIC FIRE PROTECTION MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY

A. Description of common piping, equipment, materials and installation for Fire Protection systems.
B. This Section includes the following:

1. Piping materials and installation instructions common to most Fire Protection piping systems.
2. Sleeves.
3. Concrete.
4. Grout.
5. Escutcheons.
6. Access doors - Building.
7. Flashing
8. Workmanship.
9. Cutting and patching.
10. Excavation, trenching and backfilling.
11. Piping systems installation - Common Requirements.
12. Equipment installation - Common Requirements.
13. Painting and finishing.
14. Concrete bases.
15. Supports and anchorages.
16. Protection and cleaning of equipment and materials.

1.02 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.03 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Escutcheons.
3. Access doors - building.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: For multi-story buildings, submit detailed drawings of the floor penetration sleeve sizes and locations, including the following information:

1. Fully dimensioned off column lines with location respective to adjacent walls shown.
2. Sleeve size.
3. Pipe size.
4. Pipe service.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture. If pipes do not ship with end caps, cover ends of pipe stored on site with 6 mil plastic.
B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.06 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for Plumbing installations.
B. Coordinate installation of required supporting devices and set sleeves and inserts in poured-in-place concrete and other structural components as they are constructed.
C. Coordinate installation of building access doors for fire protection items requiring access that are concealed behind finished surfaces.
D. Electrical Characteristics for Fire Protection Equipment:

1. Coordinate electrical system installation to match requirements of equipment actually furnished on this project.

2. Include a letter with the respective equipment submittal from the electrical contractor and approved by electrical design consultant, detailing changes to the electrical system required to accommodate changes in the power distribution system to accommodate Fire Protection equipment that has different electrical

power requirements from that equipment used as basis of design, or power provisions, as shown on the electrical drawings.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

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

2.02 PIPE, TUBE AND FITTINGS

A. Refer to individual Division 22 Fire Protection Piping Sections for pipe, tube, and fitting materials and joining methods.
B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
C. All piping and fittings prior to PRV shall be rated for 250psi.

2.03 JOINING MATERIALS

A. Refer to individual Division 22 Fire Protection Piping Sections for special joining materials not listed below.
B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.

2.04 SLEEVES

A. Galvanized-Steel Sheet: 20 gauge minimum thickness; round tube closed with longitudinal joint.
B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
C. Firestopping Sealant: See Division 7 Sections "Through-Penetration Firestop Systems" and "Fire Resistive Joint Systems" for firestopping sealant requirements.
D. Stuffing Insulation: Glass fiber type, non-combustible.

2.05 CONCRETE

A. Nominal weight concrete (145 PCF) using Type I Portland Cement, 1-inch maximum size coarse aggregate to provide a minimum 28 day compressive strength of 3000 psi.

2.06 GROUT

A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.07 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

1. Finish: Polished chrome-plated.

2.08 ACCESS DOORS – BUILDING

A. Manufacturers:

1. Bilco.
2. Milcor.
3. Nystrom.

B. Construction:

1. Door: 14-gauge, cold rolled steel.
2. Frame: 16-gauge, cold rolled steel of configuration to suit material application.
3. Hinge: Concealed spring hinge.
4. Latch: Screwdriver cam latch.
5. Finish: Phosphate dipped and prime coated.
6. UL labeled when in fire-rated construction with rating to match construction.
7. Stainless steel (Type 304) shall be used in ceramic tile or glazed structural tile.

C. Size: 18 inch x 18 inch minimum, as indicated on drawings, or as required to allow inspection, service, and removal of concealed items.

2.09 FLASHING

A. Flexible Flashing: 47 mil thick sheet butyl compatible with roofing.
B. Lead Flashing: Waterproofing, 5 lb/SF sheet lead.
C. Pitch Cups: 20 gauge galvanized steel, minimum 8 inches deep, bases mitered and soldered and extending at least 4 inches horizontally.

PART 3 - EXECUTION

3.01 WORKMANSHIP

A. First class and in accordance with best practice. Work to be orderly, neat, workman-like in appearance and performed by skilled craftsman.
B. Poor or improper workmanship shall be removed and replaced as directed by the Architect without additional cost to the Owner or design professionals.

3.02 CUTTING AND PATCHING

A. Comply with the requirements of other Divisions for the cutting and patching required to accommodate the installation of Fire Protection work. Repair and finish to match surrounding.
B. Architect's approval required before cutting any part where strength, or appearance of finished work is involved.
C. Openings are to be laid out and built-in, set sleeves and inserts and furnish detailed layout drawings to other trades in advance of their work.
D. Core drill or saw cut openings in existing masonry construction.

3.03 EXCAVATION, TRENCHING AND BACKFILLING

A. Provide trenching, excavation, backfilling necessary for performance of work, including excavation of rock and all other materials which may be encountered.
B. Grade bottom of trenches evenly and excavate bell holes to insure uniform bearing for the full pipe length. Excavate minimum 6 inches below pipe. Refill cuts below grade with sand.
C. Backfill after inspection by Architect and authorities having jurisdiction. Backfill compacted areas (engineered fill) with sand or fine gravel in accordance with requirements in Division 2. Section "Earthwork" no less than 95% compactancy. Backfill paved areas with sand or fine gravel compacted to meet requirements of Paving Section. Backfill shall be free of rock, wood, steel, brick, etc. Do not disturb pipe.
D. Refer to Division 22, Fire Protection Piping Sections for specific bedding and backfill requirements.
E. Restore existing pavement, curbs, sidewalks, sodding, bushes, etc., matching surroundings.
F. Restore all pavement cuts to meet the requirements of the cuts of the local authority.

3.04 PIPING SYSTEMS INSTALLATION - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Fire Protection Piping Sections specifying piping systems.
B. Drawings, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas and stairwells.
D. Install piping indicated to be exposed and in service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
F. Install piping to permit valve servicing.
G. Install piping at indicated slopes.
H. Install piping free of sags and bends.
I. Install fittings for changes in direction and branch connections. No mitering or notching for fittings permitted.
J. Select system components with pressure rating equal to or greater than system operating pressure.
K. Install escutcheons where exposed piping penetrates walls, ceilings, and floors in finished spaces.

3.05 SLEEVES

A. Sleeves are not required for core-drilled holes.

1. In mechanical room floors and other potentially wet areas, provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

B. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length so that sleeve extends out ½ inch from both surfaces.

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas, or other potentially wet areas, 1-1/2 inches above finished floor level. Caulk space outside of sleeves water tight.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Use the following sleeve materials:

    a. Sleeves for Piping Through Concrete Beams, Concrete Walls, Footings, and Potentially Wet Floors: Steel pipe.
    b. Sleeves for Piping through Masonry Walls and Gypsum Board Partitions: Steel sheet sleeves 1/2 inch larger than pipe or pipe covering.

4. Where piping penetrates non-rated equipment room wall, floors or roofs outside of a shaft, close off space between pipe or duct and adjacent work with stuffing insulation and caulk air tight.
5. Above ground, non-rated, exterior wall penetrations: Seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth,

and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

6. Provide for continuous insulation wrapping thru sleeve.
7. Seal space around the outside of sleeves with grout at masonry walls and floors and dry wall mud at gypsum board partitions.

C. Fire-Rated Penetrations: Where pipes pass through fire-rated and fire-resistive floors, walls, and partitions, install appropriately rated sleeves and firestopping sealant. Firestopping materials and installation methods are specified in Division 7 Sections "Through Penetration Firestop Systems" and "Fire Resistive Joint Systems".

3.06 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Fire Protection Piping Sections specifying piping systems.
B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

D. Flanged Joints:

1. 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.
2. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.07 PIPE CLEANING

A. Keep pipe clean and free of dirt. Keep caps on ends of pipe when it is stored on site and reinstall caps on ends of installed piping at the end of each day.

3.08 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.

D. Install equipment in accordance with manufacturer's instructions. If manufacturer's instructions conflict with Contract Documents, obtain Architect's decision before proceeding.
E. Install equipment to allow right of way for piping installed at a required slope.
F. All equipment shall be firmly fastened in place:

1. Pad mounted equipment shall be secured to pads using poured in place anchor bolts or cinch anchors.
2. Vibration isolators shall be secured to floors or pads and equipment shall be bolted to the isolators.

3.09 PAINTING AND FINISHING

A. Except as specified below or noted on the Drawing, requirements for painting of Fire Protection systems, equipment, and components are specified in Division 9 Sections "Interior Painting" and "Exterior Painting."
B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

C. Painting of fire piping:

1. The following piping within boiler and chiller room shall be painted in its entirety under Division 9: Painting. Color codes are listed here for information only.

    a. Fire Protection Piping: Red Metaltex B47R3.

2. Should there be a conflict of colors in existing installations, contact the Architect.

3.10 CONCRETE BASES

A. Provide concrete foundations with nominal dimensions conforming to the following schedule for floor-mounted equipment:

Equipment	Foundation
Equipment and piping stands and supports	4" high pad
Equipment located in equipment rooms, not listed above	4" high pad or as indicated on the Drawings

B. Concrete bases shall be continuous and shall have beveled edges and smooth float finish. Concrete bases shall be reinforced with No. 3 bars a maximum of 12" on center each way, and held in place with dowel rods at each corner anchored in the slab. Dowel rods shall not penetrate through the slab.

C. Roughen and clean exposed slabs before pouring foundations. Apply bonding agent to surfaces in contact.
D. Concrete pads shall extend a minimum of 4" beyond the equipment footprint in all directions, including appurtenances, vibration isolators, base elbow supports, and motors.
E. Equipment attached directly to foundations or inertia bases; bases provided with grout holes; and bases consisting of a structural frame shall have voids filled with grout after attachment to foundation.
F. Fill voids between baseplates and foundations, and level equipment, with grout.

3.11 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section "Metal Fabrications" requirements.
B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing and fire protection materials and equipment.
C. Field Welding: Comply with AWS D1.1.

3.12 GROUTING

A. Mix and install grout for Fire Protection equipment base bearing surfaces, pump and other equipment base plates, and anchors.
B. Clean surfaces that will come into contact with grout.
C. Provide forms as required for placement of grout.
D. Avoid air entrapment during placement of grout.
E. Place grout, completely filling equipment bases.
F. Place grout on concrete bases and provide smooth bearing surface for equipment.
G. Place grout around anchors.
H. Cure placed grout.

3.13 ACCESS DOORS – BUILDING

A. Provide access doors in wall and inaccessible ceilings to allow access to service and maintain concealed Plumbing equipment, valves, etc.
B. Coordinate installation of access doors with Divisions responsible for Building System in which panels are being installed.

3.14 PROTECTION AND CLEANING OF EQUIPMENT, FIXTURES, AND MATERIALS

A. Equipment and materials shall be carefully handled, properly stored, and protected from weather, dust-producing procedures, or damage during construction.
B. At completion of all work, thoroughly clean exposed materials (pipe, etc.) and equipment and make ready for painting.

END SECTION 22 0453

SECTION 22 0455
FIRE PROTECTION SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pipe, Fittings, Valves for:

1. Service from the water main to the building.
2. Wet sprinkler system.

B. System design and installation. Base system design hydraulic calculations using the area/density method on the following criteria and in accordance with NFPA 13 latest edition.

1. Sprinkler Protection:

a. Offices, fire bays, classrooms, lobbies, waiting areas, educational areas, dining areas, and corridors: Light hazard, 0.10 gpm/sq. ft. over the hydraulically most remote 1500 sq. ft.
b. Kitchen, Mechanical Equipment Rooms, Transformer Rooms, Electrical Switchgear Rooms, Electric Closets, Elevator Shafts, Elevator Machine Rooms, Refrigeration Service Rooms, and storage between 100 and 250 sq. ft.: Ordinary Hazard, Group 1, 0.15 gpm/sq. ft. over the hydraulically most remote 1500 sq. ft.
c. Utility and Maintenance rooms, laundry, laboratory and storage rooms, storage rooms over 250 sq. ft., loading docks, energy centers areas: Ordinary Group 2, 0.20 gpm/sq. ft. over the hydraulically most remote 1500 sq. ft.
d. Provide sprinklers in accessible shafts per NFPA 13 latest edition.

2. Add water allowance of 250 gpm for inside and outside hose streams to the sprinkler requirements at the connection to the distribution main.
3. Hydraulic Calculations: The calculated demand including hose stream requirements shall fall no less than 10 percent below the available supply curve.
4. Comply with IBC (2009 Edition), NFPA 13 (2009 Edition), NFPA 30, Flammable and Combustible Liquid Code, NFPA 45, Standard on Fire Protection for Laboratory Using Chemicals, NFPA 54, National Fuel Gas Code, NFPA 58, Liquefied Petroleum Gas Code, NFPA 70, National Electric Code, NFPA 72, National Alarm and Signaling Code, and NFPA 101, Life Safety Code (2009 Edition).

1.02 RELATED SECTIONS

A. Section 220405 – Plumbing Identification.
B. Section 220451 – General Fire Protection Requirements.
C. Section 220453 – Basic Fire Protection Materials and Methods.

1.03 SYSTEM

A. A wet sprinkler system providing coverage for the entire building.
B. Fire service from approximately 5ft outside the building to inside the building.

1.04 SUBMITTALS FOR REVIEW

A. Submit under provisions of Division 1, Section "Submittal Procedures" and the following:
B. Product Data: Submit to the Architect and obtain his approval of a complete list of materials and equipment which are to be furnished under Division 22.

1. List shall be complete with manufacturer's names, catalog number, dimensions, specifications, rating data and options utilized. Capacities shall be in the terms specified.
2. Call attention to deviations from specified items as to operation and physical dimensions.
3. Performance curves for equipment such as pumps shall be included.
4. Final equipment orders shall not be placed until submittals have been returned marked "No Exceptions Noted" or "Make Corrections Noted".
5. Bind all equipment submittals and provide index tab for each type of equipment. Submit all at one time. Reserve two sets for project close-out documents.

C. Shop Drawings:

1. A reflected ceiling plan indicating locations of sprinkler heads, lights, HVAC devices, smoke detectors, exit lights and any additional items attached to ceiling. In lift out ceilings, sprinkler heads are to be centered in ceiling tiles. In hard ceilings, sprinkler heads to follow the general arrangement of the ceiling. After review by the Architect, revise layout as required.
2. Prepare a working pipe shop drawing based on hydraulic calculations. The piping shop drawing shall indicate routing and configuration of piping, size of pipe, piping support, elevation of piping and coordination of piping with ductwork. Shop drawings shall include low point drain downs.
3. Hydraulic calculations are to be prepared utilizing a current water flow test (maximum 90 days old). If current flow test is not available, obtain a current flow test and pay for all fees required.

4. If water flow information is not available due to new main extension or other construction which prohibits the availability of flow information at the start of construction, the contractor shall estimate probable flow information based on information available. Once permanent water is available at the site, the Contractor shall perform a flow test, incorporate the information into the calculation and make any modifications to the system as may be required.
5. When drawings and hydraulic calculations are submitted to the Engineer for review, they shall bear the seals of review and approval of the Architect, General Contractor, the Owners Insurance Underwriter, and the Nicet Level 3 Designer. The Nicet registered designer shall be an employee of the Fire Protection Installing Contractor and shall oversee installation of Project. Nicet registration seal shall be included on shop drawings.
6. Contractor to provide to the State reviewing Agency a set of shop drawings reviewed and approved by Engineer of Record as required by the State of Alabama.
7. The Contractor shall incorporate all comments for approval by local Fire Marshall's Office and any State of Alabama Reviewing Agency. Contractor shall provide signed, and approved set of plans to Engineer upon approval by state and local authorities.
8. Each system calculations, components and alarming to be on shop drawings.

1.05 SYSTEM INSTALLATION AND INSPECTION

A. Required Inspections:

1. All underground and above ground fire line piping must be inspected by owner's representative prior to being covered or concealed.

B. Fire Stopping:

1. All fire stopping of any and all fire rated assemblies must be inspected and approved by a State Inspector prior to the work being concealed.

C. Hydrostatic Testing Requirements:

1. The required hydrostatic testing of the underground and above ground fire line piping must be witnessed and approved by City Inspector prior to being covered or concealed.

D. Underground Fire Line Pipe Flush Test Requirements:

1. The required flush test of the underground fire line piping must be witnessed by an Owners representative prior to being connected to the above ground piping or riser.

E. Acceptance Inspections & Testing:

1. Allow fire protection and life safety systems installation and acceptance test must be inspected, test, witnessed and approved by an AHJ and Owner's representative.

F. Plans Review & Approval:

1. All fire protection and life safety system drawings and specifications must be reviewed by this office to ensure code compliance prior to start of any work.

1.06 REGULATORY REQUIREMENTS

A. Materials: Conform to UL and FM Global Requirements and Standards.
B. Sprinkler System: Conform to NFPA 13, State of Alabama Fire Marshall Requirements, Montgomery Fire Requirements and Alabama State Building Commission Requirements.
C. Private Service Mains: Conform to NFPA 24.
D. NFPA 25, Inspections, Testing and Maintenance of Water-Based Fire Protection Systems.
E. NFPA 72, Standard for the Installation, Maintenance and Use of Protective Signaling Systems.
F. NFPA 72E, Standard on Automatic Fire Detectors.
G. Applicable Building Codes.
H. Welding Materials and Procedures: Conform to ASME Code.
I. Valves: Bear UL, FM label or marking. Provide manufacturer's name and pressure rating marked on valve body.
J. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

1.07 EXTRA MATERIALS

A. Provide extra sprinklers under provisions of NFPA 13, State and Local requirements.
B. Provide suitable wrenches for each sprinkler type.
C. Provide metal storage cabinet in location designated. (Designate location).

PART 2 - PRODUCTS

2.01 PIPING BELOW GRADE AND BELOW SLAB ON GRADE

A. Ductile Iron: Cement lined ANSI A-21.50.
B. Joints on Ductile Iron: Standard mechanical joint ANSI A-21.11. Provide with retainer glands at all fittings and thrust blocks minimum 1 cubic yard of concrete at all changes of direction.

2.02 WET SPRINKLER SYSTEM

A. Wet System - Above Ground Piping:

1. Black Steel Pipe:

   a. All piping 1-1/2" and smaller, all piping larger than 1-1/2" with cut grooves on threaded and all welded piping, Schedule 40 black steel ASTM A53, ASTM A795, ASTM A135.
   b. Piping larger than 1-1/2" for roll grooving only, Schedule 10 ASTM A795, ASTM B36.10. Schedule 10 pipe may not be used for threading or cut grooving. Schedule 7 pipe will note be accepted.
   c. Cast iron threaded fittings ANSI B16.4 cast iron flanges and flanged fittings ANSI B16.1.
   d. Malleable iron threaded fittings, ANSI B16.3.
   e. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts and washers; galvanized for galvanized pipe.
   f. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement into pipe.
   g. Malleable Iron Fittings 175 lb. (250 lb.); ASME B16.3, threaded fittings.

   Black Steel Piping and fittings shall be domestic manufacturer. Bull Moose Tube, Victaulic, or Wheatland are approved manufacturers. Substitutions require prior approval.

   All piping and fittings prior to PRV shall be rated for 250psi.

2. Copper Tubing: ASTM B75; ASTM B88; Type K, hard drawn.

   a. Fittings: ASME B16.22, wrought copper and bronze, solder joint, pressure type.
   b. Joints: AWS A5.8 Classification BCuP-3 or BCuP-4 silver braze.

   Copper Piping and fittings shall be domestic manufacturer. Bull Moose Tube, ARGCO, Mueller, or Cerro are approved manufacturers. Substitutions require prior approval

B. Sprinklers:

1. Sprinklers to be UL approved glass bulb quick response type.
2. All sprinkler heads to be rated for 175°F, unless otherwise noted on drawings.
3. Suspended Ceiling (Lay-in and Gypsum):

a. Manufacturers:

1) Viking Model M.
2) Tyco, Reliable, Victaulic.

b. Type: Quick response concealed pendant type with painted cover plate.
c. Cover Plate: White. Unless indicated otherwise. Provide color chart to Architect for color selection.
d. Finish: Sprinkler Head – chrome plated.
e. Fusible Link: Glass bulb type temperature rated for specific area hazard.

4. Exposed Area Type:

a. Manufacturers:

1) Viking Model M.
2) Tyco, Reliable, Victaulic.

b. Type: Quick response upright type with guard.
c. Finish: Brass or chrome plated.
d. Fusible Link: Glass bulb type temperature rated for specific area hazard.
e. Guards: Finish to match sprinkler finish.

5. Sidewall Type:

a. Manufacturers:

1) Viking Model M.
2) Tyco, Reliable, Victaulic.

b. Type: Quick response recessed sidewall type.
c. Finish: Chrome plated.
d. Escutcheon Plate Finish: Chrome plated in color.
e. Fusible Link: Glass bulb type temperature rated for specific area hazard.

6. Dry Pendent Sprinklers (Cooler/Freezer and all areas subject to temperature below 40 deg F.):

a. Manufacturers:

1) Viking Model M.

2) Tyco, Reliable, Victaulic.

b. Type: Quick response recessed sidewall type with matching push on escutcheon plate.
c. Escutcheon Plate Finish: Chrome plated.
d. Fusible Link: Glass bulb type temperature rated for specific area hazard.

C. Pipe Hangers and Supports:

1. Conform to NFPA 13.
2. Hangers for Pipe Sizes ½ to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Plate Support: Carbon steel ring, adjustable, copper plated.
10. All hangers to be a maximum of 12 inches from the end of a branch line or an arm-over for drop.

Pipe hangers and supports shall be of one manufacturer. Grinnell, Anvil or Tolco are approved manufacturers. Substitutions require prior approval.

D. Gate Valves:

1. Up to and including 2 Inches:

a. Manufactures:

1) Nibco Model T-104-O.
2) Where Nibco is listed, Victaulic, Stockham, Watts, Tyco and Milwaukee are equal.

b. Bronze body, bronze trim 175 psi WP, UL Listed, rising stem, handwheel, solid wedge or disc, threaded ends.

2. Over 2 Inches:

a. Manufactures:

1) Nibco Model F-607-OTS.

2) Where Nibco is listed, Victaulic, Watts, Tyco and Milwaukee are equal.

b. Iron body, bronze trim 175 psi WP, UL Listed, rising stem pre-grooved for mounting tamper switch, handwheel, OS&Y, solid bronze or cast iron wedge, flanged or grooved ends.

E. Butterfly Valves:

1. Cast or Ductile Iron Body

a. Manufactures:

1) Nibco Model GD-4765-4/8.
2) Where Nibco is listed, Victaulic, Watts, Tyco and Milwaukee are equal.

2. Cast or ductile iron, chrome or nickel plated ductile iron or aluminum bronze disc, resilient replaceable EPDM seat, lug, or grooved ends, extended neck, handwheel and gear drive and integral indicating device, and internal tamper switch rated, UL / FM approved.

F. Check Valves:

1. Up to and including 2-1/2 inches to 6 inches:

a. Manufacturers:

1) Nibco Model G-917-W.
2) Where Nibco is listed, Victaulic, Watts, Tyco and Milwaukee are equal.

b. Iron body and swing disc, bronze seat, stainless steel spring, grooved ends, 175 psi WP.

G. Water Flow Switch:

1. System sensor WFD water flow detector. Poetter Reomer, Viking, and Tyco are acceptable manufacturers.

H. Supervisory Switches:

System sensor OSY2 Model tamper detector. Poetter Roemer, Viking, and Tyco are acceptable manufacturers.

I. Fire Department Siamese Connection:

1. Crocker Figure No. 6410-PC chrome plated exposed with clappers, caps and chains.
2. Location to be coordinate with Fire Chief and Architect.

Elkhart, Croker and Guardian Fire are acceptable manufacturers

J. Test and Drain Assembly:

1. Viking Model A-1 complete with sight glass and ½" orifice for test purpose. Pipe discharge to drain riser on to exterior and spill on splash block.

Tyco, Victaulic, and Reliable are acceptable manufacturers.

2.03 FIRE STOP SYSTEMS

A. All wall and floor penetrations are to be closed. Refer to the Arch. Life Safety Plans and close all openings with a U.L. listed assembly compatible with the rating of the wall or floor being penetrated.
B. Non-rated walls – sheet rock joint compound may be used to seal opening.
C. For piping passing through listed sheet rock walls or partitions:

1. Uninsulated pipe passing through 2 hour walls or partitions – minimum 5/8" depth of Hilti FS 605 filling annular space between wall and pipe on both sides of wall. U.L. Listing #WL1056.
2. Uninsulated pipe passing through 2 hour walls or partitions – minimum 1-1/4" depth of Hilti FS 601 filling annular space between pipe and wall on both sides of wall, U.L. Listing #WL1054.

D. For piping passing through concrete floors, concrete walls or concrete block walls.

1. Uninsulated Schedule 40 steel pipe; fill annular space between pipe and opening with Hilti #FS 605. U.L. Listing #CJ1184.

PART 3 - EXECUTION

3.01 PREPARATION

A. Install piping in accordance with NFPA 13 for sprinkler systems, NFPA 14 for standpipe and hose systems, and NFPA 24 for service mains.
B. Connect to site fire service installed under another section. Verify the site with civil drawings for the exact size and location of the service prior to beginning work.
C. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
D. Install piping to conserve building space, to not interfere with use of space and other work.

E. Group piping whenever practical at common elevations.
F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
G. Inserts:

1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers form reinforcement concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

H. Pipe Hanger and Supports:

1. Install in accordance with NFPA 13 and NFPA 14.
2. Hangers on branch lines to comply with NFPA 13, 9.2.3.
3. Hangers on mains to comply with NFPA 13, 9.2.4.
4. All hangers to be a maximum of 12 inches from the end of a branch line or an arm-over for a drop.
5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
6. Where several pipes can be installed in parallel and at same elevation, provide multiple trapeze hangers may be used.
7. Provide copper plated hangers and supports for copper piping.
8. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

I. Slope piping and arrange systems to drain at low points.
J. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coast of zinc rich primer to welding.
K. Do not penetrate building structural members unless indicated.
L. Provide sleeves when penetrating floors and wall. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.
M. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.
N. Die cut threaded joints with full cut standard taper pipe threads and connect with Teflon tape or Teflon pipe compound applied to male threads.
O. Install valves with stems upright or horizontal, not inverted.
P. Provide valves for shut-off or isolating service and where shown on plans.
Q. Provide drain valves at main shut-off valves, low points of piping and apparatus.

R. Install piping in attic directly on top of joists. Install plastic sheeting over top of pipe and secure joists. Insulation to be installed over pipe and plastic sheeting.
S. Exterior exposed equipment shall be chrome plated.
T. All fire department or maintenance connections shall be coordinated with the Fire Department.
U. The fire protection contractor is responsible for coordination and labelling of fire devices supplied under this specification.
V. Where pipes penetrate exterior or finished surfaces escutcheons shall be used. Escutcheons shall be chrome finished and single piece design.
W. All devices and equipment shall be labelled as required by NFPA 13 and 24.

END OF SECTION 22 0455

SECTION 22 0480
PLUMBING INSULATION

PART 1 - GENERAL

1.01 SCOPE

A. Include Section 220410 "GENERAL PROVISIONS - PLUMBING AND FIRE PROTECTION", with this Section.
B. Repair existing insulation at points of connection to existing work.
C. "Exposed" is defined as: Exposed to view when construction is complete. Items which are not "exposed" are "concealed".
D. Insulate all items subject to sweating or loss of heat.
E. All insulation shall be installed by licensed applicator and applied in accordance with the Manufacturer's Recommendations.

1.02 INSULATION REQUIREMENTS

A. Comply with NFPA 90A.
B. Pipe hanger saddles are specified in Section 220450 "MATERIALS AND METHODS - PLUMBING"
C. Use insulation and adhesives with Underwriter's Laboratories flame spread rating not over 25 without evidence of continued progressive combustion, and smoke developed rating not exceeding:

1. 50 for pipe covering located in air ducts, plenum or casing.
2. 150 for all other pipe, and equipment insulation.

PART 2 - PRODUCTS

2.01 FIBERGLASS PIPE COVERING

A. Snap-on glass fiber insulation minimum density 5#/cu. ft. maximum thermal conductivity at 75°F mean temperature 0.25 BTU/(hr) (sq. ft.) (°F/in.) with UL rated vinyl coated and embossed vapor barrier laminate of aluminum foil and kraft reinforced with glass fiber yarns (ASJ).
B. For all lines seal jacket with self sealing lap and staple with outward clinching staples 3" o.c. Butt adjoining sections of insulation tightly and seal with self-adhering butt joint strips.
C. Cover fittings to thickness of adjacent covering with factory pre-molded fitting covers. Cover flanged valve bodies with flanged unions. Do not cover screwed unions on hot lines. Finish fittings with a skim-coat of insulating cement and when cement is dry fitting shall be covered with glass fab and vinyl acrylic mastic. Finish fittings exposed in equipment rooms, boiler room, and in finished spaces with vinyl acrylic mastic over glass fab.

D. At Contractor's option, concealed tees may be insulated with field fabricated tee covers consisting of straight pipe covering on run of tee with notch at branch together with pipe covering on branch contoured to fit notch. Glass fab shall be applied around main, lapping contoured joint at branch by 1" minimum for the full circumference of joint. Cover entire fitting covering with vinyl- acrylic mastic over glass fab, 1/8" thick (dry) coat. Submit sample of fabricated tee covering to Architect for approval before work is begun.

2.2 ALUMINUM JACKET PIPING COVER:

A. 0.010" thick corrugated aluminum jacket with laminated polyethylene and draft paper adhered liner.
B. Securely rivet jacket in place and band with flat aluminum bands 18" o.c.
C. Finish fittings on aluminum jacketed lines with 1/8" thick (dry) coat of vinyl acrylic mastic reinforced with glass cloth.

2.3 MANUFACTURERS

A. Acceptable Manufactures for Fiberglass Insulation Materials:

1. Owens-Corning.
2. Certaniteed.
3. Knauf.
4. Manville Corporation

B. Acceptable Manufacturers for Foamed Plastic Closed Cell Elastometric Insulation Materials:

1. Armstrong AP.
2. Rubatex.

C. Acceptable Manufacturers for Adhesives, Mastics and Coatings:

1. Armstrong.
2. Benjamin Foster.
3. Childers.
4. Marathon.

D. Acceptable Manufacturers for Metal Jackets:

1. Childers.
2. Manville Metal-Loc.

2.4 SCHEDULES - PIPING

E. Plumbing Piping:

1. Domestic Cold Water Interior, Above Grade above ceiling:

    a. Glass Fiber Pipe Insulation

        1) All pipe sizes: 1 ½ inch thick.
        2) Pipes located in walls: 1 inch thick foamed plastic.

    b. Foamed Plastic Pipe Insulation

        1) All pipe sizes: 1-1/2 inch thick.
        2) Pipes located in walls: 1 inch thick foamed plastic.

2. Domestic Hot and Recirculating Water Interior, Above Grade above ceiling:
    a. Glass Fiber Pipe Insulation

        1) All pipe sizes: 1-1/2 inch thick.
        2) Pipe located in walls: 1 inch thick foam plastic.

    b. Foamed Plastic Pipe Insulation

        1) All pipe sizes: 1 1/2 inch thick.
        2) Pipes located in walls: 1 inch thick foamed plastic.

    Note: All exposed insulation in Bay Area shall be elastomer foamed plastic.

3. Floor Drain Bodies, Traps and Waste Piping Between Floor Drain and Waste Stack for Floor Drains Serving Refrigeration Equipment, Ice Machine and AC Units; Interior, Above Grade

    a. Foamed Plastic Pipe Insulation

        1) All pipe sizes: 1 inch thick.

2.5 INSTALLATION – EQUIPMENT INSULATION GENERAL

A. Install in accordance with NAIMA Insulation Standards.
B. Factory Insulated Equipment: Do not insulate.
C. Exposed Equipment: Locate insulation and cover seams in least visible locations.
D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires or bands.
E. Fill joints, cracks, seams and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
F. Insulated equipment containing fluids below ambient temperature: Insulate entire system.

G. Finish insulation at supports, protrusions, and interruptions.
H. Equipment in Mechanical Rooms or Finished Spaces: Finish with canvas jacket or as scheduled.
I. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
J. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.
K. Install in accordance with NAIMA National Insulation Standards.
L. Exposed Piping: Locate insulation and cover seams in least visible locations.
M. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
N. Fit pipe hangers over insulation.
O. Inserts and Shields

1. Application: Protect insulated piping at hangers and supports with insulation shield. On pipe sizes over 2 inches, provide insert.
2. Insulation Protection Shield: Galvanized steel formed in half circle to fit insulation. Length and gauge as follows:

    a. Up to NPS 4: 12 inches long and 22 gauge.
    b. NPS 6: 18 inches long and 22 gauge.
    c. NPS 8 through 12: 24 inches long and 18 gauge.
    d. NPS 14 and Large: 24 inches long and 16 gauge.

3. Insulation-Insert Material: Water repellent treated, ASTM C533, Type I calcium silicate; or ASTM C552, Type II cellular glass of same thickness and vapor barrier jacket specified for surrounding insulation. Insert shall be a minimum of 2 inches longer than the shield.
4. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
5. For Clevis Hangers: Insert shall cover lower 180 degrees of pipe.
6. Option: At Contractor's option, insert may be factory fabricated Thermal Hanger Shield (insulation insert encased in sheet metal shield) equal to Pipe Shield, Inc. "Insulated Pipe Supports."

P. Continue insulation through metal studs, walls, sleeves, pipe hangers, and other pipe penetrations. Finish firestopping at supports, protrusions, and interruptions. At fire separations, refer to Division 7 and Section 220410: Sleeves.
Q. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

PART 3 - EXECUTION

3.1 PLUMBING PIPING INSULATION

A. Bodies of floor drains serving refrigeration equipment, AC units and ice machines and traps and waste piping between such drains and waste stack: "Fiberglass Pipe Covering". 1" thick foamed plastic.

B. Cold water piping, interior, above grade: "Fiberglass Pipe Covering", 1" thick. Pipe insulation in partitions and chases may be 1/2" thick "Arma-cell" or approved equal. Exposed piping in bay to be foamed plastic with pvc jacket.

C. Hot and Hot Water Return water piping, interior, above grade: "Fiberglass Pipe Covering", 1-1/2" thickness. Pipe insulation in partitions and chases may be 1" thick "Arma-cell" or approved equal. Exposed piping in bay to be foamed plastic with pvc jacket.

D. Exposed P-Traps, stops and supplies on handicapped lavatories, and sinks. Equal to "PRO-WRAP" by McGuire.

E. Roof drain and overflow drain bodies and all storm piping above ceiling: "Fiberglass Pipe Covering", 1" thick foamed plastic.

F. Insulation with aluminum jacket: All exposed hot and cold water piping in Mechanical Rooms, Janitor's Closets and Water Heater Rooms.

END OF SECTION 22 0480

SECTION 22 0490
FIXTURES AND EQUIPMENT

PART 1-PRODUCTS

1.1 SCOPE

A. Include Section 220410, "GENERAL PROVISIONS - PLUMBING ", with this Section.
B. Pay particular attention to requirements in the General Provisions for substitution of products not named or listed as substitutions.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Furnish and install cleanouts where indicated on drawings and at all 90-degree bends, angle, upper terminals and not over 50 feet apart on straight runs. All cleanouts to have bronze countersunk tapered slotted plugs, except acid waste piping cleanouts, which shall be standard of piping system used. Flush-with-floor cleanout access covers shall have non-skid covers. All wall cleanout access covers shall have polished satin finish. All cleanouts shall be full size of pipe, piping larger than 6" shall have minimum 6" cleanout covers.
B. Exposed Cleanouts: Cast brass plug type, J.R. Smith #4470.
C. Wall type cleanout plug and access covers, J.R. Smith #4472. Cleanout plug must be within 1" of finish wall and must be tapped for access cover.
D. Install wall cleanouts on stacks at flush valve fixtures 12" above top of flush value, 12" above finish floor on sinks, lavatories and water coolers and 12" above grab bars at fixtures with grab bars. Locate cleanouts to clear baseboard at floor.
E. Floor type cleanout access covers: J.R. Smith #4248-NB. Plug must be within 3" of finished floor. Grout cleanout below access cover to seal watertight.
F. Outside Cleanouts: J.R. Smith #4258 cleanout access encased in a 18" X 18" X 6" deep concrete pad. See Detail on Drawings.

2.2 REDUCED PRESSURE ZONE BACKFLOW PREVENTER AND DOUBLE CHECK VALVE ASSEMBLIES

A. One (1) inch and larger: Equal to Watts #909 with gate valves and inlet strainer. Provide additional valve upstream of strainer. Clayton, Beeco, Febco, Conbraco, Wilkins or equal. Provide same size as piping.
B. One-half (1/2) inch and three-fourth (3/4) inch: Watts #9D, Wilkins #750, same size as pipe.
C. Pipe relief from backflow preventer full size to nearest floor drain. Provide factory made air gap for relief connection.
D. Double check valve assemblies: Watts, Clayton or Beeco.

2.3 PLUMBING FIXTURES AND EQUIPMENT

A. All "wetted" domestic potable fixtures, piping materials, valves shall meet the Federal Lead Free Guidelines. All materials shall be clearly marked and submitted with complete data during submittal review.
B. Unless otherwise specified, all fixtures complete as catalogued, commercial grade, white color, exposed metal trim chromium plated.
C. Fixtures and brass shall be securely anchored. Carriers shall be securely anchored to floor with lug bolts in all holes as recommended by the manufacturer.
D. Flush valve "YJ" supports shall be installed 1" below vacuum breaker on all water closet flush valves
and around vacuum breaker on urinals.
E. Seal all fixtures at wall and floor with white silicone sealant. Seal countertop fixtures with clear silicone sealant.
F. Mount all fixtures at standard mounting height unless otherwise noted.
G. Furnish sinks and lavatories with correct number of drilling required by the faucet and accessories. Cock hole covers are not acceptable.
H. All items complete as catalogued as shown on drawings:

2.4 FOOD SERVICE AND CULINARY ARTS EQUIPMENT

A. All equipment is furnished and set in place under the Food Service Section.
B. All sink waste outlets, strainers, lever wastes and tailpieces are furnished under Food Service Section.
C. All faucets are furnished under the Food Service Section.
D. Under this Section rough and connect in accordance with shop drawings accompanying the equipment.
E. Under this Section extend all wastes to floor sinks, using D.W.V. copper and securely anchored in the horizontal. Install flow control devices on sink wastes as shown and detailed on drawings.
F. Receive faucets, furnished under the Food Service Section set, rough, connect and furnish McGuire #165 supplies with stops.
G. Furnish faucets as specified for each individual piece of equipment.
H. Furnish McGuire #8912 P-Traps where sink, etc., is not piped to a floor sink.

2.5 SUBSTITUTE MANUFACTURERS

A. Where Kohler is listed above, Crane, Eljer, American Standard or Zurn may be substituted.
B. Where J.R. Smith is listed above, Josam, Zurn or Wade may be substituted.
C. Where Elkay water coolers are mentioned above, Halsey Taylor, or Oasis may be substituted, only if water ways are constructed of totally lead free materials.
D. Where McGuire is listed above for traps, outlets and stops, EBC, Kohler, Crane, Eljer or American Standard may be substituted.
E. Where Symmons is listed above, Chicago Faucet or Powers, Zurn may substituted.

F. Where Chicago Faucet is listed, T&S Brass may be substituted.
G. Where Elkay sink (s) are listed above, Just may be substituted.
H. Where Church is listed above, Bemis, Beneke or Centoco may be substituted.
I. Where Lochinvar tank type water heaters are listed, A.O. Smith or Rheem may be substituted.
J. Where Stern Williams is listed above, Fiat may be substituted.
K. Where Sloan is listed, Toto and Zurn may be substituted.
L. Where Symmons is listed above for shower control valves, Speakman, Leonard, Powers, T&S or Zurn may be substituted.
M. Where Armstrong is listed above, the equal of B & G, Taco, Grundfos or Thrush may be substituted.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment shall be installed in accordance with manufacturer's recommendation.
B. See details for mounting instruction and accessories.
C. Install electric water heaters so elements can be removed without disconnecting and/or removing heater.
D. Cleanouts on water closet stacks shall be installed minimum 12" above top of the flush valve on standard water closets, minimum 12" above top of grab bar on handicapped water closets and minimum 12" above tope of tanks on non-handicapped tank type water closets. On urinal locate cleanouts minimum 12" above top of flush valve on handicapped urinals and 12" above finish floor on standard units. On lavatories and sinks - 12" above finish floor and all other fixtures 12" above floor or above top of fixture.
F. Stops and supplies are to be installed with chrome plated brass nipples penetrating wall with deep escutcheon at wall. Compression type stops are not acceptable.
G. All floor mounted fixtures supports are to be securely attached to the floor using anchors in all mounting hole of size as recommended by manufacturer.
H. Provide wood backing in wall at all flush valve brackets and faucet supports and anchor brackets and supports to wood backing with anchors of sufficient length to penetrate backing.
I. Handicapped flush valve shall be installed with the pull handle on the open side or side opposite the adjacent wall.

END OF SECTION 22 0490

Section 23 05 00

GENERAL PROVISIONS - HVAC

PART 1 - GENERAL

1.01 SCOPE:

A. HVAC means Heating, Ventilation and Air Conditioning.

B. Provisions of this Section apply to all HVAC and Building Management and Control System (BMCS) work.

C. Include the provisions of General, Supplementary and Special Conditions and provisions of the Specifications shall apply to and form a part of this Section.

D. Provide all labor, materials, equipment, and services necessary for the completion of all HVAC work shown or specified, except work specifically specified to be done or furnished under other sections of the Specifications. Include performing all operations in connection with the complete HVAC installation in strict accordance with the specification and applicable drawings subject to the terms and conditions of the Contract.

E. Give required notices, file drawings, obtain and pay for permits, deposits and fees necessary for the installation of the HVAC work. Obtain and pay for inspections required by laws, ordinances, rules, regulations or public authority having jurisdiction. Obtain and pay for certificates of such inspections, and file such certificates with Owner.

F. "Provide" means to furnish and install, complete and ready for operation.

G. All equipment shall be U.L. or E.T.L. Listed as an assembly.

1.02 DRAWINGS:

A. HVAC Drawings are diagrammatic and subject to requirements of Architectural Drawings. HVAC Drawings indicate generally the location of components and are not intended to show all fittings or all details of the work. Coordinate with Architectural, Structural, Electrical, Plumbing and other Building Drawings.

B. Follow the Drawings closely, check dimensions with Architectural Drawings and field conditions. DO NOT scale HVAC Drawings for location of system components.

C. Make no changes without Architect's written permission. In case of doubt, obtain Architect's decision before proceeding with work. Failure to follow this instruction shall make the Contractor liable for damage to other work and responsible for removing and repairing defective or mislocated work.

D. Do not scale Drawings to locate ceiling diffusers. Coordinate with lighting, ceiling grids and/or reflected ceiling plans.

1.03 APPLICABLE CODES AND STANDARDS:

A. Comply with the current editions of the following Codes and Standards:

1. ANSI/ASHRAE 15 - Code for Building Services Piping.
2. ANSI B9.1 - Safety Code for Mechanical Refrigeration.
3. NFPA 54 - National Fuel Gas Code.
4. NFPA 70 - National Electrical Code.
5. NFPA 90A - Air Conditioning and Ventilating Systems.
6. NFPA 91 Blower and Exhaust Systems.
7. NFPA 96 Commercial Cooking Equipment, Vapor Removal.
8. NFPA 101 - Life Safety Code.
9. Other Standard as referenced in other Sections of Divisions 15.
10. Local Building Code (International Building Code if no local Building Code in effect).
11. Local Plumbing Code (International Plumbing Code if no local Plumbing Code in effect).
12. Local Gas Code (International Gas Code if no local Gas Code in effect).
13. Local Mechanical Code (International Mechanical Code if no local Code in effect).

1.04 QUALIFICATIONS OF SUBCONTRACTOR:

A. The HVAC Contractor shall meet the following qualifications:

1. The HVAC Contractor must be approved by the Architect.
2. The HVAC Contractor shall have a satisfactory experience record with HVAC installations of character and scope comparable with this project and have completed five projects of the same cost (or more) as the cost of this project, and for at least three (3) years prior to the Bid Date shall have had an established service department capable of providing service inspection or full maintenance contracts.
3. Contractor must have bonding capacity for project of this size and must bond the project.

1.05 CONFLICTS AND INTERFERENCES:

A. If systems interfere or conflict, the Architect shall decide which equipment to relocate regardless of which was first installed.

1.06 WORKMANSHIP:

A. Do all work in a neat and first-class manner. Remove and replace work not done in such manner as directed by the Architect.

1.07 COOPERATION:

A. Cooperate with all other crafts. Perform work in a timely manner. Do not delay the execution of other work.

1.08 VISITING SITE:

A. Visit site and become familiar with location and various conditions affecting work. No additional allowance will be granted because of lack of knowledge of such conditions.

1.09 SCHEDULED WORK HOURS AND FACILITY OCCUPANCY:

A. Schedule all connections to existing systems and shutdowns with the Architect/Owner.

PART 2 - PRODUCTS

2.01 MATERIALS, SUBSTITUTIONS AND SUBMITTALS:

A. Unless otherwise noted, provide new, standard, first-grade materials throughout. Equipment and materials furnished shall be fabricated by manufacturer regularly engaged in their production and shall be the standard and current model for which replacement parts are available. HVAC equipment shall be substantially the same equipment of a given manufacturer which has been in successful commercial use and operation for at least three (3) years.

B. Where materials or products are specified by manufacturer's name, brand, trade name, or catalog reference, such named materials or products shall be the basis of the Bid, without substitution, and shall be furnished under the Contract unless requests for substitutions are approved as noted below. Where two or more brands are named the choice of these shall be optional with the Contractor.

C. Substitutions will be considered only if written request for approval has been received by the Architect ten (10) days prior to the date established for receipt of Proposals. Each request shall include the name of the material or equipment for which substitution is proposed, specification section/paragraph number and a complete description of the proposed substitute including drawings, cuts, performance and test data, samples and any other information necessary for evaluation. A statement setting forth any changes in other materials, equipment or other Work that incorporation of the substitute may require shall be included. The burden of proof of the merit of the proposed substitute is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution is final.

D. If the Architect approves any proposed substitution prior to receipt of Proposals, approval will be set forth in an Addendum. Do not rely upon approvals made in any other manner. Prior approval to be secured for "equal" or "approved equal" manufacturer.

E. No substitutions will be considered after the Contract has been executed, except as described in the General Conditions.

F. Submittal data and shop drawings, except controls, shall be submitted at one time, partial submittals will not be considered. Provide submittal in three (3) ring binders with tab sheets for each major item of equipment. Before ordering materials and equipment, submit to Architect and obtain his approval of a detailed list showing each item which is to be furnished by make, trade name, catalog number, or the like; together with manufacturer's specifications, certified prints, and other data sufficient for making comparisons with items specified. When approved, such schedule shall be of equal force with
these specifications in that no variation there from shall be allowed except with Architect's written approval. Number of Shop Drawings and procedure shall be as directed by the Architect.

G. Architect and / or Engineer's approval of submittal data does not relieve the contractor of his responsibility to comply with the contract documents.

H. It is the responsibility of the Mechanical contractor to coordinate all Electrical requirements of the submitted equipment with the Electrical contractor. Any increase in cost due to a variance between the contract documents and the submitted equipment shall be the responsibility of the Mechanical Contractor.

I. All pressure vessels shall be constructed and tested in accordance with applicable ASME Codes and shall bear ASME stamps. Certificates of inspection and approval shall be submitted to Architect.

J. Similar items of equipment shall be the product of the same Manufacturer.

K. See section, "ALTERNATES" in other section of the Specifications and Bid accordingly.

2.02 SHOP DRAWINGS:

A. Before starting work, submit and obtain approval of detailed drawings of the following, fully dimensioned (including elevations of ductwork and piping) and drawn not less than 1/4"= 1'-0" scale. Submit one (1) set of bond prints or (1) set of PDFs.

1. Ductwork (do not scale diffuser locations, coordinate with ceiling grids and lighting layout). See Section 23 5860 "DUCT ACCESSORIES".
2. Plenum casings.

3. Complete mechanical equipment and fan room plans showing location of equipment, conduit stubs for motors, floor drains, and equipment pads and foundations.
4. Equipment piping.

B. Submit complete control and power wiring diagrams for approval before installing controls. See Section 23 5900 "CONTROLS".

2.03 RECORD DRAWINGS:

A. When work starts, obtain white prints of the HVAC Drawings. All corrections, variations, and deviations, including those required by change orders, if any, must be recorded in colored ink or colored pencil at the end of each working day on these drawings. The marked prints shall be available at all times for the Architect's inspection.

B. Prior to examining the request for final payment or making any response thereto, the Architect shall receive from the Contractor one (1) complete set of the white prints, marked as stated above, indicating the actual completed installation of the work included under this Contract.

C. The Architect will forward the marked white prints to the Consulting Engineers for review. They will then be returned by the Architect to the Contractor for use in preparing record drawings.

D. When work is completed Contractor shall purchase from the Architect (At Architects' printing cost) one (1) set of mylar reproducible prints of HVAC Drawings for use in preparing record drawings. Contractor shall transfer the information from the marked white prints to the mylar record drawings, removing all superseded data in order to show the actual completed conditions.

1. Accurately shown location, size and elevation of new exterior piping work and its relationship to any existing piping and utilities, obstructions, etc., contiguous to the area of work.
2. Block out areas modified by change-order and identify them by change-order number.

E. Ductwork and Control Drawings may be a set of shop drawings, up-dated to show actual conditions at completion of work.

F. HVAC piping drawings may be prepared as noted in paragraph "D" above, or HVAC piping may be added to the ductwork shop drawings as noted in paragraph "E" above.

2.04 MOTORS, STARTERS AND ELECTRICAL EQUIPMENT:

A. Provide electrical equipment compatible with the current shown on electrical drawings. Verify current characteristics before ordering equipment.

B. Should the Contractor with the Architect's approval make changes in electrical equipment from those shown on the Electrical Drawings, he shall be responsible for the coordination and cost of required changes.

C. Provide factory installed fuses in all equipment requiring fusing for branch circuit protection.

D. Motors:

1. 1750 RPM open drip-proof construction unless otherwise shown or specified. Integral horsepower three phase motors shall be of premium energy-efficient design with apparent efficiency (power factor X efficiency) not less than ASHRAE 90.1.
2. Unless shown otherwise motors less than 1/2 HP shall be single phase, motors 1/2 HP and larger shall be three phase.
3. Allis-Chalmer, General Electric, Goulds, Louis Allis, and Westinghouse.

E. Do not run motors until correct overload elements are installed in starters. Trading overload elements for elements of correct size for motors actually furnished shall be included in this Section.

F. Starters shall be equipped with melting alloy terminal overload protection, in a 3 phase. Starters, unless indicated otherwise, shall be across-the-line type with overload and low voltage protection. Starting equipment shall comply with local utility company requirements.

G. Starters to be Square "D", Allen-Bradley, Cutler-Hammer or approved equal.

H. For single phase motors provide manual starters equal to Square "D" Class 2510. When installed in equipment rooms provide surface mounted enclosure, and when installed in finished walls outside equipment rooms provide flush mounted enclosure, key operated.

I. Key operated manual starters with Flush enclosures, equal to Square "D" Class 2510.

J. Provide magnetic line voltage starters with NEMA I enclosures and melting alloy overload elements.

K. Provide non-fused combination magnetic line voltage starters with NEMA I enclosures and melting alloy overload protection.

L. Provide H-O-A switches, fused control circuit transformers, auxiliary contacts, etc., as shown on control diagrams or required by control sequences and/or arrange for these items to be furnished with the starters or motor control centers specified in Electrical Work.

M. All starters shall be by the same manufacturer.

N. Provide thermal overload with equipment for motors 1/2 HP and less at 120/1/60.

2.05 SLEEVES:

A. For pipe through floors inside rated chases or through non-fire-rated walls: 20 gauge galvanized steel, 1/2" larger than pipe or covering.

B. For uninsulated pipe through fire rated walls or partitions or floors outside chases: Pipe Shields, Inc., Model WFB or approved equal at walls, Model DFB at floors.

C. For insulated pipe passing through fire rated partitions or walls or floors outside chases: Pipe Shields, Inc., Model WFB-CS for hot lines, VFB-CS-CW for cold lines. Insulation: Calcium silicate for hot lines and foamglass for cold lines, thickness specified for adjacent pipe covering.

D. For pipe through concrete beams: Schedule 40 black steel pipe, 1/2" larger than pipe or covering. Pipe covering passing through sleeve: calcium silicate in a 24 gauge galvanized steel shield similar to Pipe Shields, Inc. thermal hanger shield. Caulk space between bare pipe insulation jacket and beam with fire retardant rope at both ends of the sleeve and seal with 3M Brand fire barrier caulk CD 25 or Putty 303, thickness and application in strict accord with manufacturer's recommendations, minimum thickness 1".

E. At Contractor's option, instead of the factory fabricated sleeves specified above for pipe passing through floors and fire rated walls and partitions substitute 20 gauge galvanized steel sleeve 1/2" larger in diameter than pipe or pipe covering and seal one end of sleeve (both ends if both ends are exposed) with 3M Branch Fire Barrier Caulk CP25 or Putty 303, thickness and application in strict accord with manufacturer's recommendations, minimum thickness 1". Where pipe is insulated, insulation shall be continuous thru sleeve, calcium silicate for hot lines and foamglass for cold lines. In exposed areas, after product has dried it shall be sanded smooth for painting under painting section.

F. Set sleeves before concrete is poured or masonry is erected. In existing construction, grout sleeves firmly in place.

G. Sleeves for ducts: See Fire Dampers (See Section 23 5860 "DUCT ACCESSORIES").

H. Extend sleeves 1-1/2" above finish floor and waterproof.

I. Where exposed ducts pass through walls and partitions, provide 4" wide 20 gauge galvanized steel closure plates except at grilles and registers. Fit closure plates snugly to duct and secure to wall. Grout around ducts and sound absorbers at equipment room walls.

J. Where exposed pipes pass through walls and partitions in finished spaces, provide chrome plated F & C plates or escutcheons.

2.06 ACCESS DOORS:

A. Doors in non-fire rated walls and ceilings: 17-gauge steel with hinges and screwdriver latches, Bilco, Milcor, Miami-Carey, or equal. Doors in fire rated walls and ceilings: UL labeled with fire rating equal to fire rating of wall or ceiling. Provide door styles compatible with adjoining surfaces as selected by Architect. Size doors to permit removal of equipment and/or maintenance, minimum size 18" X 18".

B. Mark lay-in ceilings with paper brads at maintenance access points. Bend ends of brads over above ceiling tile.

PART 3 - EXECUTION:

3.01 PROTECTION OF ROTATING PARTS:

A. Equip exposed belt drives with belt guards with holes for measuring speeds of driven shafts.

B. Provide exposed couplings with coupling guards.

C. Equip propeller fans with guards.

D. Equip inlets and outlets of open centrifugal fans with 1-1/2" #10 Diamond mesh galvanized steel screens.

E. All motors or other equipment exposed to weather shall be provided with weatherproof covers.

3.02 PROTECTION OF EQUIPMENT:

A. During construction, protect mechanical equipment from damage or deterioration.

B. When installation is complete, clean equipment and make ready for painting.

C. During construction all ductwork, piping, and equipment shall be stored in a clean/dry location. Any ductwork or piping stored outside that is not protected shall be removed from the job site. Installed ductwork and piping shall have open ends covered at the end of each work day to prevent dust, dirt, and water from entering the ductwork and piping.

3.03 INSTALLATION OF EQUIPMENT:

A. Install equipment to provide normal service access to all components.

B. Provide sufficient space for removing components, install equipment to provide such clearance.

C. Install equipment in accordance with manufacturer's instructions. If manufacturer's instructions conflict with contract documents, obtain Architect's decision before proceeding.

D. All equipment shall be firmly fastened in place:

1. Roof curbs shall be secured to deck and structure and curb mounted items shall be secured to curbs.
2. Pad mounted equipment shall be secured to pads using poured in place anchor bolts or cinch anchors.
3. Vibration isolators shall be secured to floors, pads or structure and equipment shall be bolted to the isolators.

3.04 EQUIPMENT SUPPORTS:

A. Provide supports for ductwork, piping and equipment. Hot dip galvanize after fabrication all grillage, supports, etc., located outdoors.

B. Set all floor-mounted equipment, other than condensate pumps, on concrete pads or rails (as indicated of height shown, but not less than 4" high). Coordinate pad height with condensate drain trap requirements. Chamfer rails and pads 1". Where shown, provide reinforced floating pads mounted on vibration isolators. Form, reinforce and pour any pads and rails required but not shown on Structural and Architectural Drawings.

3.05 CUTTING AND PATCHING:

A. Set sleeves and inserts and lay-out and form openings in walls, beams, girders and structural floors in this Section.

B. Cut, patch and repair as required to accomplish HVAC Work and finish to match adjacent work. Architect's approval required before cutting any part where strength or appearance of finished work is involved.

3.06 INCIDENTAL WORK:

A. Provide all motors incidental to the Mechanical Systems. Wiring of motors, switches and starters is included in "ELECTRICAL SECTIONS".

B. Do all control wiring required for Mechanical work.

C. Provide motor starters as specified above.

D. Submit refrigerant piping diagrams as prepared by the HVAC Contractor and/or refrigeration equipment manufacturer for approval.

E. Final water connections to services are included in this Section.

F. Permanent drain connections for AC units, etc., and auto air vents to nearest floor drain are included in this Section.

G. Door louvers are not included in this Section.

H. Items obviously omitted from drawings and/or specifications shall be called to attention of the Architect prior to submitting Bid, after award of Contract any changes or rearrangements necessary to complete Contract shall be at no additional cost to Owner.

I. All return air and exhaust air grilles shall be covered with filter media if they are started and operated during construction.

3.07 FLASHING:

A. General: Furnish all fans curbs, pitch cups, metal base flashing and counter flashing required for HVAC Work. Installation of above items is specified in "ROOFING SECTION" with coordination by HVAC Contractor.

B. Fan curbs for power roof ventilators are specified with the fans.

C. Pitch Cups: 20 gauge galvanized steel, at least 8" deep, bases mitered and soldered and extending at least 4" horizontally.

D. Metal Base Flashing: Galvanized steel for ferrous items, and stainless steel for stainless steel duct and aluminum for aluminum duct. Minimum thickness 22 gauge (0.034") galvanized steel, 20 gauge (0.038") stainless steel, 0.032" aluminum. Bases mitered and soldered extending out at least 4" horizontally and 8" vertically.

E. Metal Counter Flashing: Of material and gauges specified for base flashing, lapping base flashing at least 3".

3.08 HVAC INSTALLATION OF AND CONNECTIONS TO ITEMS FURNISHED BY OTHERS OR SPECIFIED IN OTHER SECTIONS:

A. Kitchen Hood: Provide exhaust and make-up air

B. Clothes Dryers: Provide Vents.

C. Duct Mounted Smoke Detectors: Install in duct.

D. Domestic Water Heaters: Provide gas flues and combustion air vents.

3.09 PAINTING:

A. Refinish equipment damaged during construction to new condition.

B. Paint un-insulated duct surfaces visible through grilles and registers flat black.

C. Other painting is specified in "PAINTING SECTION, Finishes Division".

3.10 EQUIPMENT IDENTIFICATIONS:

A. Provide 2" X 3" or larger laminated plastic nameplates with 1/2" numbers and letters in colors specified below. Screw tags to equipment in obvious locations. Engrave equipment designation and numbers as shown on plans and drawings on upper half of tags, leaving lower half of tag for future engraving by Owner.

B. Provide similar nameplates for motor starters furnished under this section.

C. Secure nameplates with acorn head screws.

D. Colors:

1. Equipment connected to utility power only - black letters on white nameplates.
2. Equipment connected to emergency power - red letters on white nameplates.

E. In existing building replace all existing nameplates which do not comply with above colors.

3.11 ACCESS DOORS:

A. Provide access doors for valves, fire dampers, dampers, controls, air vents, and other items located above non-lift-out ceilings or behind partitions or walls.

3.12 WARRANTY AND INSTRUCTIONS:

A. See General Conditions - One-Year Warranty.

B. Contractor shall and hereby does warrant all materials, workmanship and equipment furnished and installed by him to be free from defects for a period of one (1) year after date of substantial completion of the Contract. Should any defects in materials, workmanship, or equipment be made known to Contractor within the one (1) year warranty period, Contractor shall replace such materials, workmanship, or equipment without charge.

C. All centrifugal, reciprocating, screw or scroll type refrigeration compressors shall bear five (5) year non-pro-rated parts warranty.

D. All gas fired air furnaces shall bear ten (10) year prorated heat exchanger warranties.

E. After completion of the work, Contractor shall operate the equipment which he installs for a period of ten (10) working days, as a test of satisfactory operating conditions. During this time, Contractor shall instruct the Owner's operating personnel in the correct operation of the equipment. Furnish necessary oral and written operating instructions to the Owner's representative.

F. Provide five (5) sets of manufacturer's operating and maintenance manuals and parts lists including nearest manufacturer's sales and service representative by name, address and phone for all equipment and materials furnished. Provide a maintenance schedule listing routine maintenance operations and suggested frequency. Include all warranty dates on equipment and guarantees. Include names, address and phone of any subcontractor and work performed. Bind above items in loose leaf three (3) ring binders with tab for each class of equipment.

G. During the period of tests, adjust all controls, regulators, etc., to comply with these Specifications.

H. Supply initial charges of refrigerant, refrigeration lubricating oil; and anti-freeze necessary for the correct operation of the equipment. Maintain these charges during the guarantee period, with no additional cost to the Owner, unless loss of charge is the fault of the Owner.

I. Make available to the Owner, without additional cost, service and adjustment of the equipment for the guarantee period.

1. Service shall include:
    a. On call nuisance issues.
    b. Replenishing refrigerant and antifreeze if loss occurs due to system failure.
2. Service shall not include:
    a. Routine maintenance of the equipment unless specified in specific equipment specification section(s).

3.13 PROJECT CLOSE-OUT DOCUMENTS:

A. Prior to the issuance of a certificate for final payment, submit to Architect and obtain his approval of the following:

1. Record drawings - sheet metal work (2 hard copies, PDFs, and CAD files).
2. Record drawings - piping (reproducible).
3. Record drawings - control systems (reproducible).
4. Control manufacturer's letter of certification (3).

5. Air balance report (3).
6. Equipment Submittal Data (3).
7. Equipment operating and maintenance manuals (3).
8. Maintenance schedule (3).
9. Equipment warranty dates and guarantees (3).
10. List of Owner's Personnel who have received maintenance instructions.

END OF SECTION 23 05 00

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Section 23 05 13

MATERIALS AND METHODS - HVAC

PART 1 - GENERAL

1.01 SCOPE:

A. Include Section 23 5010, "GENERAL PROVISIONS - HVAC", with this Section.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. All pipe, fittings and valves shall be manufactured in the United States of America.

2.02 HVAC DRAIN PIPING:

A. Type "L" hard copper with wrought copper sweat fittings or Schedule 40 PVC, at Contractor's option.

B. Provide drain traps for AC Unit drain pans. Size traps as required to drain under operating conditions.

2.03 REFRIGERATION PIPING:

A. ACR hard drawn copper tubing with wrought copper sweat fittings. Joints: Silfossed with continuous flow of dry nitrogen through lines.

B. Size suction and discharge lines so as to insure oil return at minimum loading.

C. Small lines 5/8" OD and smaller may be soft copper with flare fittings, provided that all joints are exposed for visual inspection.

D. Refrigerant piping shall be sized and installed as recommended by the equipment manufacturer. Provide lift traps or double suction risers as required for oil return.

2.04 PIPE HANGERS:

A. General: Pipe hangers, Grinnell, PHD, Michigan Hanger, or Elcen. Grinnell figure numbers are given for reference. Provide copper clad or plastic coated hangers on bare copper lines. Provide stainless steel or plastic coated hangers in Pool areas subject to chlorine atmosphere.

B. Pipe hangers for lines 3" and smaller (other than steam and condensate lines), adjustable wrought ring hangers, Grinnell Fig. 97 or wrought clevis hangers, Grinnell Fig. 260.

C. Beam Clamps: Grinnell Fig. 229.

D. Inserts for hangers in concrete structures: Underwriter's listed cast iron inserts. Grinnell Fig. 282.

E. Size rods for pipe hangers not smaller than the following: 3/8" rods for pipe up to 2", 1/2" for 2-1/2" and 3" pipe, 5/8" rods for 4" and 5" pipe, 3/4" rods for 6" pipe, and 7/8" rods for 8" and

10" and 12" pipe, 1" rods for 14" and 16" pipe and 1-1/8" rods for 18" pipe.

F. Space pipe hangers at maximum: 5' intervals for cast iron pipe. Pipe hanger spacing for screwed, solder joint and welded piping: 1/2", 6 ft.; 3/4" to 1-1/4", 8 ft.; 1-1/2" to 2-1/2", 10 ft.; 3", 12 ft.; 4", 14 ft.; 5", 12 ft. 6", 10 ft., 8" and over, 6 ft. Polypropylene and PVC plastic pipe 4 ft. horizontally maximum or as directed by manufacturer if closer, and 10 ft. vertically. Install additional hangers at change of direction and valve clusters.

G. Space pipe hangers for PVC pipe at maximum: 1/2" - 4" pipe, 4 ft. Install additional hangers at change of direction and valve clusters.

H. Install pipe hangers on insulated pipe (other than steam and condensate lines) over pipe covering. Provide factory fabricated insulated pipe shields equal to Pipe Shields, Inc. "Thermal Hanger Shields" at hangers. Provide shield insulation of waterproofed calcium silicate for hot water piping and foamglass for chilled water piping, same thickness as adjacent pipe covering. At Contractor's option, pipe shields may be field fabricated using waterproof calcium silicate or foam glass insulation with ASJ and 20 gauge galvanized steel protector. Shield length: 1.5 times nominal pipe size but not less than 4".

2.05 VIBRATION ISOLATION:

A. General: Mount all piping and rotating equipment using vibration isolators as specified below. Amber Booth, Korfund, Mason Industries, Peabody, Vibration Eliminator Co., or VMC. Mason Industries part numbers are given for reference. Minimum 95% isolation efficiency.

B. Isolators for Suspended Equipment: Combination steel spring and rubber in shear isolators, #30N. Static deflections: As required to provide 95% isolation efficiency or 1" static deflection, whichever is greater. Provide isolators for all suspended rotating equipment.

C. Mount air handling unit sections in contact with concrete pad on single layer of ribbed neoprene on top of housekeeping pads as shown. Neoprene vibration pad shall cover the entire surface of the unit in contact with the concrete pad.

D. Provide snubbing isolators, similar to those specified above for pipe hangers for flexible connections at fans.

PART 3 - EXECUTION

3.01 PIPE INSTALLATION:

A. Cut pipe square and ream full size after cutting. Clean pipe. Make threaded joints with Teflon tape. Do not spring pipe into place.

B. Provide welding material and labor in accordance with the welding procedures of the Heating, Piping, and Air Conditioning Contractors' National Association or other approved procedure conforming to the requirements of ANSI B31.9 "Building Service Piping". Employ only welders fully qualified in the above specified procedure and currently certified by recognized testing authority. Use either electric arc or oxactylene welding. Provide full perimeter wells at both face end and collar end of each slip on flange.

C. Install piping to allow for expansion. Make connections to all equipment to eliminate undue strains in piping and equipment. Furnish necessary fittings and bends to avoid spring of pipes

during assembly.

D. Pitch air conditioning unit drain lines down in direction of flow 1" in 20'.

E. Install chrome plated floor and ceiling plates on pipe passing through finished surfaces in finished spaces.

F. Make horizontal water and steam supply line size reductions using eccentric reducers with tops flat in water lines and bottoms flat in steam lines.

G. Install 3/4" ball or gate valve drains with hose adapters at low points of water piping and at bases of all risers or where shown provide large drains.

H. Make connections to equipment using screwed unions in sizes 2" and smaller and flanged unions in sizes 2 1/2" and larger. Install unions in all piping connections to each piece of equipment. Provide rubber grommets at pipe penetrations to equipment casings.

I. Wherever ferrous pipes or tanks and copper tubing connect, provide dielectric insulation unions or couplings, equal to EPCO.

J. Near heating and air conditioning equipment requiring water valved and capped water outlets of sizes shown, for connection to equipment, including reduced pressure principal backflow preventers shall be provided. Make final connections under HVAC work. Note that all piping and insulation downstream of backflow preventer must be painted yellow.

K. Run piping concealed, except where specifically shown or specified exposed. Plumb all vertical lines and run mains parallel to building walls unless specifically shown otherwise. All piping shall be ran as high as practical and not on the floor unless otherwise indicated.

3.02 INSTALLATION OF VALVES:

A. Provide shut off valves in supply and return to each item of equipment. Locate valves to isolate each item to facilitate maintenance and/or removal.

B. Provide check valve in discharge line adjacent to each pump.

C. Locate valves in piping connections to boilers, heat exchangers, water heaters, refrigeration machine, etc., so heads and tube bundles can be removed without disconnecting equipment or piping other than union or flange connections immediately adjacent to heat exchangers.

D. Provide seat to screw adapters where required.

3.03 REFRIGERATION SYSTEM:

A. Split Systems: When system is complete, but before the pipe covering has been installed, test components with dry nitrogen and make tight at equipment manufacturer's recommended test pressures. Then evacuate the system to 26" Hg. vacuum which the system shall hold for 24 hours. After passing the above tests, charge and leak test under operating conditions using electronic leak detector.

B. Split and Packaged Systems: Check operation of refrigeration cycle and report head pressure, suction pressure and oil pressure.

END OF SECTION 23 0513

Section 23 05 52

PIPING SPECIALTIES - HVAC

PART 1 - GENERAL

1.01 SCOPE:

A. Provisions of this section apply to all HVAC work.

PART 2 – PRODUCTS

2.01 SPECIALTIES - REFRIGERANT:

A. Install molded desiccant core filter dryer in each liquid line. Provide throw away dryers for lines 1/2" and smaller. Provide replaceable core dryers for lines 5/8" and larger. Dryers shall be Sporlan "Catchall".

B. Install moisture indicating sight glass in each liquid line.

C. Service valves: Wing cap valves, Henry, or approved equal.

D. Expansion valves: Thermostatic valves with external equalizers, Sporlan, or approved equal.

E. Install solenoid valve in each liquid and hot gas bypass line. Hot gas solenoid valve shall be equipped with a high temperature coil.

F. Install suction line accumulators in all outdoor heat pumps and condensing units where refrigerant lines exceed 85'in length, or where recommended by manufacturer.

G. Refrigerant circuit access ports located outdoors shall be fitted with locking-type, tamper-resistant caps. Provide owner with any tools necessary to un-lock the caps.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Specialties shall be installed in accordance with manufacturer's recommendations.

B. See Details for mounting instructions and accessories.

END OF SECTION 23 0552

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Section 23 05 93

TESTING, BALANCING, AND ADJUSTING (TBA)

PART 1 - GENERAL

1.01 SCOPE:

A. Provisions of this section apply to all HVAC work.

B. All tests shall be witnessed by the Architect in addition to authorities having jurisdiction. A minimum of 48 hour notice is required prior to performance of test.

C. Provide complete report to Engineer for approval TEN (10) working days prior to Engineer's final site visit.

1.02 QUALIFICATIONS:

A. All TBA work shall be performed by an independent Test and Balance Agency specializing in Testing, Balancing and Adjusting of HVAC Systems.

B. All TBA work shall be under supervision of a qualified registered professional engineer regularly engaged in the TBA Agency.

C. TBA Agency shall be an AABC or NEEB Member and/or shall obtain written approval from the Architect prior to Bidding.

1.03 APPROVAL:

A. Application for approval of TBA agency shall be submitted prior to Bid.

B. Submittal information regarding the TBA agency to include:

1. List of at least five (5) projects successfully completed of similar size and scope.

2. Copy of reporting forms to be used for this projected indicating scope of TBA work.

3. Name of registered engineering in charge with resume of qualifications. List of personnel that will perform TBA work on project and qualifications.

4. List of instruments to be used with dates of latest calibrations.

5. List of memberships in AABC, NEBB or other similar organizations.

PART 2 - PRODUCTS

2.01 INSTRUMENTS:

A. All instruments used for the TBA work shall be calibrated within six (6) months and checked for accuracy prior to start of work.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS:

A. After HVAC system has been installed, Test, Balance and Adjust System for proper operation, air distribution, flow rates, temperatures and humidities. Correct any noise and/or vibration conditions.

B. Include a "Deficiency List" with the TBA air and water balance report. Deficiency list shall include TBA items that are not in accordance with Contract Documents.

C. Perform all tests as required by local codes. Contractor shall furnish testing equipment.

D. If local Codes are more stringent, local Codes shall govern.

3.02 AIR SYSTEM:

A. When system has been completed, remove all trash and dirt, set grille bars and diffuser patters for required throws and adjust and balance air duct systems so air quantities at outlets are as directed and distribution from each supply outlet is free from drafts and excessive noise, and uniform over the face of each outlet. Do all testing and balancing with filters blanked to provide pressure drops midway between clean condition and manufacturer's recommended change-out condition. Balance air quantities to within ± 10% of indicated air quantities.

B. Make adjustments so dampers and volume adjusters close to air outlets will have the least pressure drop consistent with volume requirements. Obtain additional pressure drop required for balancing of shorter runs by adjusting dampers at branch duct take-offs. Adjustable fan drives shall be used for making final adjustments of total air quantities. Change sheaves on drives larger than 15 HP. Provide additional sheaves as required.

C. Direct reading velocity meters may be used for comparative adjustment of individual outlets, but measure air quantities in ducts having velocities of 1000 feet per minute or more with pitot tubes. Cap pitot tube openings in low pressure ducts with plastic plugs. Cap pitot tube openings in medium and high pressure ducts and kitchen and laboratory exhaust ducts with Duro-Dyne test ports.

D. Permanently mark settings of dampers and other volume adjusting devices so they can be restored if disturbed.

E. When air balancing has been completed, submit to Architect an air balance log, including design and actual air quantities, pressures, etc., in each branch duct and at each grille, register, and outlet. Individual outlet air rates are required for boots on boot-box systems.

F. Include for each system the following information:

1. Fan rpm, motor amps, motor nameplate amps, and amp rating of starter heater.

2. Total air quantity supplied by each system and/or fan.

3. Total outside air quantity supplied by each system.

4. Provide velocity pressure across each duct mounted smoke detector and list manufacturer's required velocity pressure range.

5. Air flow at all grilles.

6. Static pressure profile thru each air handler.

3.03 COILS:

A. Provide the following:

1. Entering and leaving air temperatures.

2. Outside air temperature at time of test.

3. Air pressure drop.

3.04 START-UP AND SERVICE:

A. At the beginning of the first heating session, adjust and balance operating phases and repeat at the beginning of the first cooling session or vice-versa, as the case may be, all without charge.

B. The Contractor and Factory Representative of the boilers, chillers, AC units and major HVAC equipment shall place very item of such equipment into satisfactory operation with all automatic and safety devices. Further, all adjustment service required shall be performed during the warranty period. Adjustment services does not include lubricating fans or motors and does not include changing filters or adjusting belts.

C. In addition, submit equipment manufacturers' start-up reports for items listed above. See "Projected Close-Out".

END OF SECTION 23 0593

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Section 23 51 80

INSULATION-HVAC

PART 1 - GENERAL

1.01 SCOPE:

A. Include Section 23 5010 "GENERAL PROVISIONS - HVAC", with this Section.

B. Repair existing insulation at points of connection to existing work.

C. "Exposed" is defined as: Exposed to view when construction is complete. Items which are not "exposed" are "concealed".

D. "Attic" is defined as any ceiling space that is below the roof line and above the bottom chord of the roof truss.

E. Insulate all items subject to sweating or loss of heat.

F. All insulation shall be installed by licensed applicator and applied in accordance with the Manufacturer's Recommendations.

1.02 INSULATION REQUIREMENTS:

A. Comply with NFPA 90A.

B. Pipe hanger shields are specified in Section 23 5050 "MATERIALS AND METHODS - HVAC".

C. Use insulation and adhesives with Underwriter's Laboratories flame spread rating not over 25 without evidence of continued progressive combustion, and smoke developed rating not exceeding 50 for all other pipe, duct and equipment insulation.

PART 2 - PRODUCTS

2.01 FOAM PLASTIC PIPE COVERING:

A. Fire retardant foamed plastic pipe covering, maximum K factory at 75degF mean temperature not exceeding 0.27 BTU/(hr) (sq. ft.) (degF/in). Armstrong "Armaflex II", or approved equal.

B. Pipe covering may be seamless insulation slipped over piping before erection or may be slit longitudinally and installed over erected piping.

C. Make fitting covers from segments of pipe covering.

D. Cement all joints and seams in accordance with manufacturer's instruction using Armstrong 520 adhesive.

E. Fit pipe hangers over insulation (See PIPE HANGERS). Use hanger shields as specified under pipe hangers.

2.02 ALUMINUM JACKET PIPING COVER:

A. 0.010" thick corrugated aluminum jacket with laminated polyethylene and draft paper adhered liner.

B. Securely rivet jacket in place and band with flat aluminum bands 18" o.c.

C. Finish fittings on aluminum jacketed lines with 1/8" thick (dry) coat of vinyl acrylic mastic reinforced with glass cloth.

2.03 DUCT INSULATION, INTERNAL:

A. Glass fiber acoustical/thermal insulation complying with NFPA 90A and UL 181 and having an erosion resistant anti-microbial membrane equal to Johns Manville, Linacoustic RC on the air side. Edge coating shall be factory applied to the edges of the liner core. Shop fabrication cuts and field cuts or tears shall be coated with Superseal Duct Butter. NRC (1" thick) not less than 0.70, minimum density 3 lb/cu. ft., and maximum friction correction factor at 2000 fpm average velocity 1.15 (per TIMA test method AHS-1S2-76U), minimum R=4.2.

2.04 DUCT INSULATION, EXTERNAL FOR CONCEALED:

A. Formaldehyde free flexible glass fiber insulation with foil-scrim-craft (FSK) facing equal to Johnson Manville Micro-Lite XG. Flame spread classification, 25 or less, smoke developed rating not exceeding 50. Minimum density, 3/4 lb./cu. ft., 3" thickness, installed R=8.3 minimum.

2.05 DUCT INSULATION, EXTERNAL FOR EXPOSED INDOOR DUCTS:

A. Fire retardant foamed plastic insulation, Armstrong "Armaflex", or approved equal.

B. 6 lb/cu. ft. fiberglass board with FSK facing and thermal conductivity not exceeding 0.22 BTU/(hr) (sq. ft.) (EF/in.) at 75EF mean temperature.

2.06 DUCT INSULATION, EXTERNAL FOR EXPOSED OUTDOOR DUCTS:

A. 6 lb/cu. ft. fiberglass board with FSK facing and thermal conductivity not exceeding 0.22 BTU/(hr) (sq. ft.) (□F/in.) at 75□F mean temperature. Finish with glass cloth embedded in vinyl acrylic mastic.

PART 3 - EXECUTION

3.01 HVAC PIPING INSULATION:

A. Refrigerant Suction Lines and Hot Gas Bypass Lines: "Foam Plastic Pipe Covering", 3/4" thick. Jacket piping located outdoors or exposed to view with aluminum jacket.

B. AC Unit Drain Lines: "Foam Plastic Covering", 3/4" thick. Jacket piping exposed to view with aluminum jacket.

3.02 AIR TERMINAL DEVICES:

A. Ceiling Mounted Supply Diffusers: 3" thick duct insulation on back of diffuser, type: "external for concealed". Alternatively, contractor may use 2" thick Armaflex insulation on backside of ceiling diffusers.

B. Fire Dampers for Internally Lined Ducts and Externally Insulated Ducts: 3" thick duct insulation on all sides, "external for concealed".

3.03 DUCT INSULATION, EXTERNAL, FOR CONCEALED DUCTS:

A. Adhere insulation to duct surface with approved adhesive applied in strips above 6" wide on approximately 12" centers. Flare door staples may be used for securing the insulation until the adhesive sets. Lap jacket and vapor seal all joints and seams with suitable mastic.

B. On rectangular and flat oval ducts 30" wide and wider, additionally support insulation with weld pins and speed clips 18" on centers. Seal weld pins with mastic and FSK tape.

C. Thickness and Extent:

1. Supply ductwork not specified to be lined: 2.3" thick.

2. Return / exhaust ductwork not specified to be lined: 2.3" thick.

3. Outside air ductwork not specified to be lined: 2.33" thick.

4. Supply, return, exhaust and outside air duct located in attic: 3" thick.

NOTE: Conical and straight spin-ins on both lined and unlined ducts shall be insulated. Insulation

shall be slit at damper rods, at spin-ins and sealed vapor tight.

3.04 DUCT INSULATION, EXTERNAL, FOR EXPOSED DUCTS:

A. Insulate exposed supply, return, and outside air ductwork and plenums located in mechanical rooms (from finished floor to 10'-0" above finished floor) with 2" thick 6 #/cu. ft., R=8.7 fiberglass board with FSK jacket. Secure board with weld pins and speed clips 12" on centers. Seal clip indentations with mastic. Seal all joints and seams with mastic.

B. Cover all angles, seams and joint reinforcing with insulation and seal vapor tight.

3.05 DUCT INSULATION, EXTERNAL, FOR OUTSIDE DUCTS:

A. Insulate all exposed, outdoor ducts with 2" thick 6 #/cu. ft. fiberglass board with FSK jacket in addition to the insulation specified above. Secure board with weld pins and speed clips 12" on centers. Seal clip indentations with mastic. Seal all joints and seams with mastic. Finish with aluminum jacket, 26 gauge, slope top of duct insulation so rain will not stand on duct.

B. Cover all angles, seams and joint reinforcing with insulation and seal vapor tight.

3.06 INSULATION WETTED DURING CONSTRUCTION:

A. Contractor shall replace any and all insulation wetted during construction at his own expense.

END OF SECTION 23 5180

Section 23 52 10

AIR PURIFICATION SYSTEMS -HVAC

PART 1 - GENERAL

1.01 SCOPE:

A. This section describes the design, performance and installation of an air purification system intended for use as part of another manufacturer's air handling unit or mounted on the duct as shown on the plans, details and equipment schedules.

1.02 REFERENCED CODES & STANDARDS:

A. The following codes and standards are referenced through out. 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 IBC 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 required as of December 21, 2007

1.03 RELATED WORK:

1. Testing, Adjusting and Balancing
2. Facility Access and Protection
3. Ductwork
4. Filters
5. Water and Refrigerant Piping
6. Electrical Wiring
7. Control Wiring

1.04 QUALITY ASSURANCE:

A. Basis of design is Top Product Innovations. Global Plasma Solutions and Phenomenal Aire shall be considered equal subject to meeting all specifications herein.

B. The Air Purification System shall be a product of an established manufacturer within the USA.

C. A qualified representative from the manufacturer shall be available to inspect the installation of the air purification system to ensure installation in accordance with manufacturer's recommendation.

D. 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.

E. Projects designed using ASHRAE Standard 62, IAQ Procedure shall require the manufacturer to provide Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1-2013 to validate acceptable indoor air quality at the quantity of outside air scheduled with the technology submitted.

F. The Air Purification System 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.

G. 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.

1.05 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for ion generators including:

1. Schedule of plasma generators indicating unit designation, number of each type required for each unit/application.

2. Data sheet for each type of plasma generator, and accessory furnished; indicating construction, sizes, and mounting details.

3. Performance data for each type of plasma device furnished.

4. Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1-2013 to validate acceptable indoor air quality at the quantity of outside air scheduled (when projects are designed with outside air reduction).

5. Product drawings detailing all physical, electrical and control requirements.

6. Copy of UL 867 independent ozone test.

B. Operating & Maintenance Data: Submit O&M data and recommended spare parts lists.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver in factory fabricated shipping containers. Identify on outside of container type of product and location to be installed. Avoid crushing or bending.

B. Store in original cartons and protect from weather and construction work traffic.

C. Store indoors and in accordance with the manufacturers' recommendation for storage.

1.07 WARRANTY:

A. Equipment shall be warranted by the manufacturer against defects in material and workmanship for a period of twenty-four months after shipment, whichever occurs first. Labor to replace equipment under warranty shall be provided by the owner or installing contractor.

PART 2 - PRODUCTS

2.01 GENERAL:

A. The air purification system(s) shall be of the size, type, arrangement and capacity indicated and required by the unit furnished and shall be of the manufacturer specified.

B. Basis of Design: Top Product Innovations Type C unit

C. All other Suppliers of comparable products requesting prior approval shall:

1. Submit for prior approval in accordance with the requirements of Section 15010.

2. In addition, manufacturers submitting for prior approval for Bi-Polar Ionization must as part of the prior approval request provide their ASHRAE 62.1-2013 calculations that prove conformance to the ASHRAE Standard with the reduction of outside air to the scheduled values. A letter on the manufacturer's letterhead requesting prior approval must accompany the request for prior approval stating their calculations are ASHRAE compliant. A third party validation study performed on a previous installation of the same application shall also be included.

3. Submit independent test data from ETL or UL showing ozone levels produced during the UL 867 ozone chamber test. Manufacturers without this test data shall not be acceptable.

2.02 BI-POLAR IONIZATION DESIGN & PERFORMANCE CRITERIA"

A. Each piece of air handling equipment, so designated on the plans, details, equipment schedules and/or specifications shall contain a Plasma Generator with Bi-polar Ionization output as described here within.

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. Capable of reducing static space charges.

4. Increasing the interior ion levels, both positive and negative, to a minimum of 800 ions/cm³ measured 5 feet from the floor.

C. The bi-polar ionization system shall operate in a manner such that equal amounts of positive and negative ions are produced. Uni-polar ion devices shall not be acceptable.

1. 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 air purification system.

2. Velocity Profile: The air purification device shall not have maximum velocity profile.

D. Humidity: Plasma Generators shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0 - 100%, condensing, shall not cause damage, deterioration or dangerous conditions within the air purification system. Air purification system shall be capable of wash down duty.

E. Equipment Requirements:

1. Electrode Specifications (Bi-polar Ionization):

a. Each Plasma Generator with Bi-polar Ionization output shall include the required number of electrodes and power generators sized to the air handling equipment capacity. Unit shall be capable of treating 6,000 CFM (C6.0) or 10,000 CFM (C10.0). 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.

b. 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.

c. Electrode pair shall provide a minimum of 140 million ions per cubic centimeter (C6.0) or 200 million ions per cubic centimeter (C10.0), both positive and negative ions in equal quantities. Devices providing less than the rated ion densities shall not be acceptable.

F. Air Handler Mounted Units:

1. Where so indicated on the plans and/or schedules Plasma Generator(s) shall be supplied and installed. The mechanical contractor shall mount the Plasma Generator and wire it to the AHU control power (24VAC) as instructed by the Air Purification Manufacturer's instructions or line voltage subject to power available. Each unit shall be designed with an integral illuminated 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 AHU is required to interface to the BAS or the optional DDC controller. Dry contacts proving power has been applied in lieu of the ion output is actually operating, are not acceptable.

G. Plenum/Duct Mounted Units: Where so indicated on the plans and/or schedules, Plasma Generators(s) shall be supplied and installed. The generator shall be installed through the duct wall and into the air stream with the external power head in a convenient location for visual indication of power, removal and servicing, by the mechanical contractor. 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 duct is required to interface to the BAS or the optional DDC controller.

H. Ionization Requirements:

1. Plasma Generators with Bi-polar ionization output shall be capable of controlling gas phase contaminants and shall be provided for all equipment listed above.

a. The Bi-polar ionization system shall consist of Bi-Polar Plasma Generator and power supply. The Bi-polar system shall be installed where indicated on the plans or

specified to be installed and powered by 24VAC.

b. Ionization Output: The ionization output shall be controlled such that an equal number of positive and negative ions are produced. Imbalanced levels shall not be acceptable.

c. Ionization output from each electrode shall be a minimum of 140 million ions/cc (C6.0) and 200 million ions/cc (C10.0) when tested at 1" from the ionization generator.

d. 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

Manufacturers not providing the equivalent space kill rates shall not be acceptable. All manufactures requesting prior approval shall provide to the engineer independent test data from a NELEC accredited independent lab confirming kill rates and time meeting the minimum requirements stated in section 2.2 B, points 6A, 6B and 6C. Products tested only on Petri dishes to prove kill rates shall not be acceptable.

2. Ozone Generation:
The operation of the electrodes or Bi-polar ionization units shall conform to UL 867-2007 with respect to ozone generation. There shall be no ozone generation during any operating condition, with or without airflow.

I. Electrical Requirements:

1. Wiring, conduit and junction boxes shall be installed within housing plenums in accordance with NEC NFPA 70. The contractor shall coordinate electrical requirements with air purification manufacturer during submittals.

J. Control Requirements:

1. All Plasma Generators shall have internal short circuit protection, overload protection, and automatic fault reset.

2. Integral airflow sensing shall modulate the Plasma output as the air flow varies or stops. A mechanical air flow 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 Plasma device within the air handling unit specified or as shown or the plans. The contractor shall follow all manufacturer IOM instructions during installation.

4. All Plasma devices shall have a means to interface with the BAS system. Dry contacts shall be provided to prove there are ions being produced. Systems providing indication that power is applied to the Plasma device, but not directly sensing the power at the ion output, shall not be acceptable.

5. Plasma systems that use multiple modules with ion output alarm wires wired to the same terminal such that all ion modules must fail to show an alarm status shall not be acceptable.

PART 3 - EXECUTION

3.01 GENERAL:

A. The Contractor shall be responsible for maintaining all air systems until the owner accepts the building (Owner Acceptance).

3.02 ASSEMBLY & ERECTION: PLASMA GENERATOR WITH BI-POLAR IONIZATION:

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.

3.03 TESTING:

A. Provide the manufacturers recommended electrical tests.

3.04 COMMISSIONING & 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 5210

Section 23 57 60

HEAT PUMP UNITS

PART 1 - GENERAL

1.01 SCOPE:

A. Provisions of this Section shall apply to all HVAC work.

PART 2 - PRODUCTS

2.01 Heat Pump - (MINI-Split)

A. The Heat Pump system shall be a Trane, Daikin, Carrier or approved equal split system with Variable Speed Inverter Compressor technology. The system shall consist of a ceiling-suspended indoor section with wired, wall mounted controller and a horizontal discharge, single phase outdoor unit.

B. Quality Assurance

1. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.

2. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

3. The units shall be rated in accordance with Air-conditioning Refrigeration Institute's (ARI) Standard 210 and bear the ARI Certification label.

4. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

5. A dry air holding charge shall be provided in the indoor section.

6. The outdoor unit shall be pre-charged with R-410a refrigerant.

7. System efficiency shall meet or exceed 13.0 SEER.

C. Delivery, Storage and Handling

1. Unit shall be stored and handled according to the manufacturer's recommendations.

2. The wireless controller shall be shipped inside the carton with the indoor unit and able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.

D. Warranty

1. The units shall have a manufacturer's parts and defects warranty for a period one (1) year from date of installation. The compressor shall have a warranty of 6 years from date of installation. If, during this period, any part should fail to function

properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty does not include labor.

2. Manufacturer shall have over 25 years of continuous experience in the U.S. market.

E. Performance

1. Each system shall perform in accordance to the ratings shown in the table below. Cooling performance shall be based on 80°F DB, 67°F WB (26.7°C DB, 19.4°C WB) for the indoor unit and 95°F DB, 75°F WB (35°C DB, 29.3°C WB) for the outdoor unit. Heating performance shall be based on 70°F DB, 60°F WB (21.1°C DB, 15.6°C WB) for the indoor unit and 47°F DB, 15°F WB (8.3°C DB, 6.1°C WB) for the outdoor unit.

F. Indoor Unit

1. The indoor unit shall be factory assembled, wired and tested. Contained within the unit shall be all factory wiring and internal piping, control circuit board and fan motor. The unit in conjunction with the wired, wall mounted controller shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be purged with dry nitrogen before shipment from the factory.

2. Unit Cabinet

The casing shall be ABS plastic and have a Munsell 0.70Y 8.59/0.97 finish. Cabinet shall be designed for suspension mounting and horizontal operation. The rear cabinet panel shall have provisions for a field installed filtered outside air intake connection.

3. Fan

The evaporator fan shall have three high performance, double inlet, forward curve sirocco fans driven by a single motor. The fans shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. The indoor fan shall consist of four (4) speeds: Low, M1, M2, and Hi.

4. Vane

There shall be a motorized horizontal vane to automatically direct air flow in a horizontal and downward direction for uniform air distribution. The horizontal vane shall provide a choice of five (5) vertical airflow patterns selected by remote control: 100% horizontal flow, 80% horizontal flow (plus 20% downward airflow), 60% horizontal airflow (plus 40% downward airflow), 40% horizontal airflow (plus 60% downward airflow), and swing. The horizontal vane shall significantly decrease downward air resistance for lower noise levels, and shall close the outlet port when operation is stopped. There shall also be a set of vertical vanes to provide horizontal swing airflow movement selected by remote control.

5. Filter

Return air shall be filtered by means of an easily removable washable filter.

6. Coil

The evaporator coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. The multi-angled heat exchanger shall have a modified fin shape that reduces air resistance for a smoother, quieter airflow. All tube joints shall be brazed with PhosCopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil.

7. Electrical

The electrical power of the unit shall be 208 volts or 230 volts, 1 phase, 60 hertz. The system shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts. The power to the indoor unit shall have an option of being supplied from the outdoor unit, using Mitsubishi Electric A-Control system or separate power source for indoor and outdoor units.

8. Control

a. The control system shall consist of two (2) microprocessors, one on each indoor and outdoor unit, interconnected by a single non-polar two-wire cable. Field wiring shall run directly from the indoor unit to the wall mounted controller with no splices.

b. For A-Control, a three (3) conductor 14 ga. AWG wire with ground shall provide power feed and bi-directional control transmission between the outdoor and indoor units.

c. Where separate power is supplied to the indoor and outdoor units, a two (2) 20 ga. AWG wire shall be run between the units to provide forbid-directional control communication..

d. The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller panel.

e. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from the wired controller, providing emergency operation and controlling the outdoor unit.

f. The indoor unit shall be connected to a wall mounted wired controller to perform input functions necessary to operate the system. The wired controller shall have a large multi-language DOT liquid crystal display (LCD) presenting contents in eight (8) different languages, including English, French, Chinese, German, Japanese, Spanish, Russian, and Italian.

g. There shall be a built-in weekly timer with up to eight pattern settings per day. The controller shall consist of an On/Off button, Increase/Decrease Set Temperature buttons, a Cool/Dry/Fan mode selector, a Timer Menu button, a Timer On/Off button, Set Time buttons, a Fan Speed selector, a Vane Position selector, a Louver Swing button, a Ventilation button, a Test Run button, and a Check Mode button. The controller shall have a built-in temperature sensor. Temperature shall be displayed in either Fahrenheit (°F) or Celsius (°C). Temperature changes shall be by increments of 1°F (1°C) with a range of 67°F to 87°F (19°C to 30°C).

h. The wired controller shall display operating conditions such as set temperature, room temperature, pipe temperatures (i.e. liquid, discharge, indoor and outdoor), compressor operating conditions (including running current, frequency, input voltage, On/Off status and operating time), LEV opening pulses, sub cooling and discharge super heat.

i. Normal operation of the wired controller shall provide individual system control in which one wired controller and one indoor unit are installed in the same room. The controller shall have the capability of controlling up to a maximum of sixteen systems at a maximum developed control cable distance of 1,500 feet (500 meters).

j. The control voltage from the wired controller to the indoor unit shall be 12 volts, DC. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Up to two wired controllers shall be able to be used to control one unit.

k. Control system shall control the continued operation of the air sweep louvers, as well as provide On/Off and mode switching. The controller shall have the capability to provide sequential starting with up to fifty seconds delay.

G. Outdoor Unit

1. The outdoor unit shall be compatible with the three different types of indoor units (PKA - wall mounted, PCA - ceiling suspending, and PLA - four way ceiling cassette). The connected indoor unit must be of the same capacity as the outdoor unit.

2. Models PUY-A24NHA and PUY-A36NHA shall have the option to connect to two indoor units, within the same confined space, to improve air distribution (total capacity shall be equivalent to outdoor unit).

3. The outdoor unit shall be equipped with a control board that interfaces with the indoor unit to perform all necessary operation functions.

4. The outdoor unit shall be capable of operating at 0°F (-18°C) ambient temperature without additional low ambient controls (optional wind baffle may be required).

5. The outdoor unit shall be able to operate with a maximum height difference of 100 feet (30 meters) between indoor and outdoor units.

6. System shall have a maximum refrigerant tubing length of 165 feet (50 meters) between indoor and outdoor units without the need for line size changes, traps or additional oil.

7. Models PUZ-A24NHA, PUZ-A30NHA and PUZ-A36NHA shall be pre-charged for a maximum of 70 feet (20 meters) of refrigerant tubing. Model PUZ-A42NHA shall be pre-charged for a maximum of 100 feet (30 meters) of refrigerant tubing. The outdoor unit shall be completely factory assembled, piped, and wired. Each unit must be test run at the factory.

8. Cabinet

The casing shall be constructed from galvanized steel plate, coated with a finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection and have a munsell 3Y 7.8/1.1 finish. The fan grille shall be of ABS plastic.

9. Fan

Models PUZ-A24NHA, PUZ-A30NHA, and PUZ-A36NHA shall be furnished with an AC fan motor. Model PUZ-A42NHA shall have two (2) DC fan motors. The fan motor shall be of aerodynamic design for quiet operation, and the fan motor bearings shall be permanently lubricated. The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent contact with moving parts.

10. Coil

The L shaped condenser coil shall be of copper tubing with flat aluminum fins to reduce debris build up. The coil shall be protected with an integral metal guard. Refrigerant flow from the condenser shall be controlled by means of linear expansion valve (LEV) metering orifice. The LEV shall be control by a microprocessor controlled step motor.

11. Compressor

The compressor for models PUY-A24NHA, PUY-A30NHA and PUY-A36NHA shall be a DC rotary compressor with Variable Compressor Speed Inverter Technology. The compressor for model PUY-A42NHA shall be a scroll compressor with variable speed technology. The compressor shall be driven by inverter circuit to control compressor speed. The compressor speed shall dynamically vary to match the room load for significantly increasing the efficiency of the system which results in vast energy savings. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be intermittently applied to the compressor motor to maintain enough heat. The outdoor unit shall have an accumulator and high pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.

12. Electrical

The electrical power of the unit shall be 208volts or 230 volts, 1 phase, 60 hertz. The unit shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts. The outdoor unit shall be controlled by the microprocessor located in the indoor unit. The control signal between the indoor unit and the outdoor unit shall be pulse signal 24 volts DC. The unit shall have Pulse Amplitude Modulation circuit to utilize 98% of input power supply.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Split System shall be installed in accordance with manufacturer's recommendations.

B. See details for mounting instructions and accessories.

END OF SECTION

Section 23 57 61

CONDENSING UNITS

PART 1 - GENERAL

1.01 SCOPE:

A. Provisions of this Section shall apply to all HVAC work.

PART 2 - PRODUCTS

2.01 CONDENSING UNITS:

A. Include one (or more) reciprocating compressor(s), condenser and condenser fan, all enclosed in a single casing. Provide separate refrigerant circuit for each compressor.

B. Casing: Aluminum or galvanized steel designed for outdoor installation. Galvanized steel casings shall be furnished with enamel over bonderizing. Equip casings with access panels, condenser inlet guards and fan outlet guards. Provide padlock connections for power and control access panels.

C. Compressors: Scroll type.

D. Condenser: Aluminum fins securely bonded to seamless copper tubes. Condenser Fans: Direct driven propeller fans, resiliently mounted, with weather protected fan motors.

E. Provide (liquid receiver if condenser coil will not contain entire system charge where 80% full at 100°F.) suction and discharge service valves and liquid stop valve.

F. Controls: Factory wired and located in a readily accessible location. Provide (2 step) line voltage contactor and both temperature and current sensitive overload devices for compressor motor, cycle timer to limit compressor starts to 5 or 6 minute intervals, oil pressure switch, high and low pressure switches and crankcase heater. Provide low-ambient-start devices and flooding or variable air volume head pressure controls for stable starting and operation in ambient temperature of 10°F. Fan cycling head pressure controls are not acceptable.

G. Provide five (5) years non-prorated compressor parts warranty.

H. Manufactured by Trane, Carrier, Daikin or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Split System shall be installed in accordance with manufacturer's recommendations.

B. See details for mounting instructions and accessories.

END OF SECTION 23 5760

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Section 23 5763

ENERGY RECOVERY UNITS – HVAC

PART 1 - GENERAL:

1.01 SCOPE:

A. Provisions of this section apply to all HVAC work.

PART 2 - PRODUCTS:

2.01 ENERGY RECOVERY UNITS (DX COOLING / ELECTRICAL HEAT):

2.02 ACCEPTABLE MANUFACTURERS:

A. The contractor shall furnish and install outdoor air unit(s) as shown and scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

B. APPROVED MANUFACTURERS

1. Trane, Daikin, Carrier or approved equal.

2.03 SPLIT SYSTEM ENERGY RECOVERY:

A. Horizontal air handling units: Factory fabricated units having capacity shown. Units consisting in general of a mixing box section, filter sections, cooling coil section, fan section, access sections, diffuser section, energy recovery wheel section, discharge plenum section, drip pan and drain sections, all the product of a single manufacturer. Provide fan sections, mixing box section, filter sections, diffuser section, and coil sections of the same frame size. Units shall have by-pass damper for unoccupied dehumidification cycle. Units shall have single side access.

B. Casing: Not lighter than 18 gauge galvanized steel, all sections of casing insulated with 2 1/2" thick 3 lb./cu. ft. coated fiberglass insulation. Double wall construction with non perforated 26 gauge galvanized steel liner on air side. Entire unit to be double wall construction.

C. Drain Pans: Double construction with insulation between pans and 16 gauge type 304 stainless steel inner pan. Drain pan shall slope to drain.

D. Evaporator coils shall be constructed of copper tubes mechanically bonded to

a configured aluminum plate fin. For units greater than 30 nominal tons cooling, the hot gas reheat coils must be aluminum fin, mechanically bonded to copper tubing. For units 30 tons or less, hot gas reheat coil shall have a series of flat tubes containing a series of multiple, parallel flow microchannels layered between the refrigerant manifolds. Coil construction shall consist of aluminum alloys for fins, tubes, and manifolds in combination with a corrosion-resistant coating.

Coils shall be leak tested at the factory to ensure pressure integrity. The evaporator coil, reheat coil and condenser coil shall be leak tested to 500 psig and pressure tested to 500 psig.

Evaporator coil shall have six interlaced rows for superior sensible and latent cooling.

Reheat coil shall be fully integrated into the supply air and fan system and capable of delivering design supply air temperature.

To prevent re-evaporation of condensate from evaporator coil, the evaporator coil face and the hot gas reheat coil face shall be separated a minimum of six inches.

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E. Provide spacer sections for installing control bulbs between heating and cooling coils.

F. Provide hinged and latched access doors in casings at fan sections, filter sections, plenum sections and upstream and downstream from cooling coils. Access doors on positive pressure side of casing shall be air tight under 6" WG static pressure. Construct doors with 2" insulation between two (2) sheet 24 gauge galvanized steel. Set doors in frames arranged so that doors will be flush with exterior of casing. Equip each door with at least two (2) hinges and two (2) sets of double acting latches. Latches shall be made from non ferrous metal, with a lever handle on the outside and a lever handle on the inside of the casing. Lever handle on the outside of the casing shall cam over a door pull with a stop. Latches shall be Vent Fabrics #310 Ventlok latch, or equal. Doors shall be reinforced to prevent wracking and warping. Provide 3" butt hinges and weld to doors and to door frames.

G. Air filters: See Equipment Schedule and "AIR FILTERS". Provide side access filter sections, complying with the requirements under "AIR FILTERS".

H. Fans: Forward curved, airfoil, centrifugal fans, or plug fans, statically and dynamically balanced to a peak vibration velocity of 0.157 inch/second, with corrosion resistant coating. Bearings shall be self aligning grease lubricated ball bearings. Grease fittings shall be extended to accessible locations after units are installed. Fan and fan motor shall be mounted on spring isolated base

inside unit and snubbing isolators shall be provided for discharge flexible connections. Isolators shall comply with the requirements for "VIBRATION ISOLATORS". Fan motor shall be mounted on an adjustable base and shall be equipped with V belt drive sized for 150% motor nameplate rating, adjustable pitch motor pulley for motors 25 H.P. and smaller.

i. Heating components shall include electric resistance heaters.

1. All sheet metal parts in air stream shall be aluminized or galvanized steel. Heaters shall be listed in the Underwriter's Laboratories, Inc., Electrical Appliance and Utilization Equipment list or ETL Listed.

2. Heaters shall have ceramic supported nichrome wire elements, control box and 1/2" insulation between casings and control box. Provide spaces at terminal end of heater so that internal duct insulation will not cause hot sports. Provide NEMA I control boxes when boxes are located inside unit casing and weather type control boxes when boxes are located outdoors. Connections between control box and duct shall be air tight under 1" W.G. static pressure.

3. Control box shall contain three (3) phase heaters. Contactors shall be factory Wired to terminal strips.

4. Heaters shall have factory wired automatic high limit control bulb and in addition, a supplementary independent thermal device shall be provided to disconnect all power circuits in case automatic high limit fails.

J. Energy Recovery Wheel

A. The rotating wheel heat exchanger shall be composed of a rotating cylinder in an insulated cassette frame complete with seals, drive motor and drive belt.

B. The total energy wheel shall be coated with silica gel desiccant permanently bonded by a patented and proprietary process without the use of binders or adhesives, which may degrade desiccant performance

C. The substrate shall be a lightweight polymer and will not degrade nor require additional coatings for applications in marine or coastal environments. Coated segments should be washable with detergent or alkaline coil cleaner and water. Desiccant will not dissolve nor deliquesce in the presence of water or high humidity.

D. As the wheel rotates between the ventilation and exhaust air stream it picks should pick up sensible and latent heat energy and release it under the colder air stream. The driving force behind the exchange is the difference in temperature between the opposing air streams which is also called the thermal gradient.

E. A face and bypass damper shall be provided in parallel with the media for economizer and frost control.

K. POWER EXHAUST/RETURN SECTION

A. Provide, a factory supplied field installed power exhaust assembly that shall be designed to ventilate return air to atmosphere.

B. Fan wheel shall be airfoil configuration welded aluminum. Other fan construction not acceptable.

C. Direct drive motor, VFD control and plenum fan shall comply with section 204. Fan mount to be fixed.

D. Exhaust to ventilate through automatic louver located on side of unit cabinet.

L. Pressure test the assembled unit at the factory or in the field. Test pressure shall be five (5) inches W.G. positive on the fan discharge and five (5) inches W.G. negative on the fan suction side. Allowable total leakage shall be 1% of the fan scheduled air flow. Panel deflection shall be limited to 1/200th of the span. Provide certified factory test results or field test results to the engineer for record.

M. Trane, Daikin, Carrier, or approved equal.

3.00 EXECUTION:

3.01 INSTALLATION:

A. Units shall be installed in accordance with manufacturer's recommendations.

B. See Details for mounting instructions and accessories.

C. Manufacturer shall provide field start-up of all units.

END OF SECTION

Section 23 57 66

VARIABLE REFRIGERANT FLOW SYSTEM

PART 1 - GENERAL

1.01 SCOPE:

A. Provisions of this Section shall apply to all HVAC work.

1.02 SYSTEM DESCRIPTION:

A. The variable capacity, heat recovery air conditioning system shall be a electric CITY MULTI VRFZ or approved equal (Variable Refrigerant flow Zoning) system, a VRV system, Trane, Daikin, Carrier or approved equal. All VRF systems shall be capable of simultaneous cooling and heating.

B The VRF system shall consist of an outdoor unit, Branch Circuit controller, multiple indoor units, and Direct Digital controls. Each indoor unit or group of indoor units shall be capable of operating in any mode independently of other indoor units or groups. System shall be capable of changing mode (cooling to heating, heating to cooling) with no interruption to system operation. Each indoor unit or group of indoor units shall be independently controlled.

1.03 QUALITY ASSURANCE:

A. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.

B. All wiring shall be in accordance with the National Electrical code (N.E.C.).

C. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standard applying to environmental protection set by the International standard Organization (ISO).

D A full charge of R-410A for the condensing unit only shall be provided in the condensing unit.

E Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by VRF HVAC system manufacturer.

1. Each employee shall be certified by manufacturer for proper installation of systems, including, but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation.
2. Installer certification shall be valid and current for duration of Project.
3. Retain copies of Installer certificates on-site and provide copies in submittal.
4. Each person assigned to Project shall have demonstrated past experience with products being installed for period within three consecutive years before time of bid.

1.04 DELIVERY, STORAGE AND HANDLING:

1.05 SUBMITTALS:

A. Product Data: For each type of product.

a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for indoor and outdoor units.
b. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
c. Include operating performance at design conditions.
d. Include description of system controllers, dimensions, features, control interfaces and connections, power requirements, and connections.
e. Include description of control software features.
f. Include fully dimensioned piping shop drawings (see below) during submittal process in order to accurately determine refrigerant requirements.
g. Include total refrigerant required and a comprehensive breakdown of refrigerant required by each system installed.
h. Include refrigerant type and data sheets showing compliance with requirements indicated above.

B. Shop Drawings: For VRF HVAC systems.

a. Include plans, elevations, sections, and details.
b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
c. Include diagrams and details of refrigerant piping and tubing showing installation requirements for manufacturer-furnished divided flow fittings.
d. Include diagrams for power, signal, and control wiring.

C. Unit shall be stored and handled according to the manufacturer's recommendation.

PART 2 - PRODUCTS

2.01 R2-SERIES OUTDOOR UNIT:

A. General:

The R2-Series PURY outdoor unit shall be used specifically with CITY MULTI VRFZ components. The PURY outdoor units shall be equipped with multiple circuit boards that interface to the M-NET controls system and shall perform all functions necessary for operation. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.

1. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of outdoor rated capacity.

2. Outdoor unit shall have a sound rating no higher than 60 dB(A).

3. Both refrigerant lines from the outdoor unit to the BC (Branch Circuit) Controller (Single or Main) shall be insulated.

4. There shall be no more than 3 branch circuit controllers connected to any one

outdoor unit.

5. The outdoor unit shall have an accumulator with refrigerant levels sensors and controls.

6. The outdoor unit shall have a high pressure safety switch, over-current protection and DC bus protection.

7. The outdoor unit shall have the ability to operate with a maximum height difference of 164 feet and have total refrigerant tubing length of 984-1312 feet. The greatest length is not to exceed 492 feet between outdoor unit and the indoor units without the need for line size changes or traps.

8. The outdoor unit shall be capable of operating in heating mode down to -4°F ambient temperature without additional low ambient controls.

9. The outdoor unit shall not cease operation in any mode based solely on outdoor ambient temperature.

10. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.

B. Unit Cabinet:

1. The casing(s) shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel.

C. Fan:

1. The PURY-P125/PURY-P126 TGMV outdoor unit shall be furnished with one direct drive, variable speed propeller type fan.

2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.

3. All fan motors shall be mounted for quiet operation.

4. All fans shall be provided with a raised guard to prevent contact with moving parts.

5. The outdoor unit shall have vertical discharge airflow.

D. Refrigerant

1. R410A refrigerant shall be required for PURY-P-TGMU-A outdoor unit systems.

E. Coil:

1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.

2. The coil fins shall have a factory applied corrosion resistant blue-fin finish.

3. The coil shall be protected with an integral metal guard.

4. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.

5. The outdoor coil shall include 4 circuits with two position valves for each circuit, except for the last stage.

F. Compressor:

1. The PURY-P126/PURY-P126 TGMV outdoor units shall be equipped with one inverter driven scroll hermetic compressor.

2. A crankcase heater(s) shall be factory mounted on the compressor(s).

3. The outdoor unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable down to 16% of rated capacity.

4. The compressor will be equipped with an internal thermal overload.

5. The compressor shall be mounted to avoid the transmission of vibration.

G. Electrical:

1. The outdoor unit electrical power shall be 208/230 volts, 3-phase, 60 hertz.

2. The outdoor unit shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz), 207-253V (230V/60Hz).

3. The outdoor unit shall be controlled by integral microprocessors.

4. The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.02 Branch CIRCUIT (BC) controllers FOR R2-SERIES SYSTEMS

A. General:

The BC (Branch Circuit) Controllers shall be specifically used with R410A R2-Series systems. These units shall be equipped with a circuit board that interfaces to the M-NET controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish. The BC Controller shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of rated capacity.

B. BC Unit Cabinet:

1. The casing shall be fabricated of galvanized steel.

2. Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.

3. The unit shall house two tube-in-tube heat exchangers.

C. Refrigerant

1. R410A refrigerant shall be required for CMB-P-NU-G/GA/GB BC controllers in conjunction with PURY-P-TGMU-A outdoor unit systems.

D. Refrigerant valves:

1. The unit shall be furnished with multiple branch circuits which can individually accommodate up to 54,000 BTUH and up to three indoor units. Branches may be twinned to allow more than 54,000 BTUH.

2. Each branch shall have multiple two-position valves to control refrigerant flow.

3. Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.

4. Linear electronic expansion valves shall be used to control the variable refrigerant flow.

E. Integral Drain Pan:

An integral condensate pan and drain shall be provided.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.

2. The unit shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253V (230V/60Hz).

3. The BC Controller shall be controlled by integral microprocessors.

4. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.03 PLFY-PNBMU-E (4-WAY CEILING-RECESSED CASSETTE WITH GRILLE) INDOOR UNIT:**

A. General:

1. The PLFY shall be a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

B. Unit Cabinet:

1. The cabinet shall be space-saving ceiling-recessed cassette.

2. The cabinet panel shall have provisions for a field installed filtered outside air intake.

3. Branch ducting shall be allowed from cabinet.

4. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.

5. The grille vane angles shall be individually adjustable from the wired remote controller to customize the airflow pattern for the conditioned space.

C. Fan:

1. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.

2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.

3. The indoor fan shall consist of five (5) speed settings, Low, Mid1, Mid2, High and Auto.

4. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.

5. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.

6. The indoor unit shall have switches that can be set to provide optimum airflow based on ceiling height and number of outlets used.

7. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.

8. The vanes shall have an Auto-Wave selectable option in the heating mode that shall randomly cycle the vanes up and down to evenly heat the space.

9. If specified, the grille shall have an optional i-see sensor that will measure room temperature variations and adjust the airflow accordingly to evenly condition the space.

D. Filter:

1. Return air shall be filtered by means of a long-life washable filter.

E. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.

2. The tubing shall have inner grooves for high efficiency heat exchange.

3. All tube joints shall be brazed with phos-copper or silver alloy.

4. The coils shall be pressure tested at the factory.

5. A condensate pan and drain shall be provided under the coil.

6. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 33 inches above the condensate pan.

7. Both refrigerant lines to the PLFY indoor units shall be insulated.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.

2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

2.04. CONTROLS:

A. All Variable Refrigerant Flow equipment shall use controls provided by Mitsubishi Electric to perform functions necessary to operate the system and shall be an expansion to the existing VRF control system. In addition, all controls for VRF equipment shall be provided with required network interface for integration into building automation system.

2.05 SYSTEM REFRIGERANT PIPING

A. Refrigerant Piping:

1. Copper Tube: ASTM B280, Type ACR.
2. Wrought-Copper Fittings: ASME B16.22.
3. Brazing Filler Metals: AWS A5.8/A5.8M.

B. Refrigerant Tubing Kits:

1. Furnished by VRF HVAC system manufacturer.
2. Factory-rolled and -bundled, soft-copper tubing with tubing termination fittings at each end.
3. Standard one-piece length for connecting to indoor units.
4. Pre-insulated with flexible elastomeric insulation of thickness to comply with governing energy code and sufficient to eliminate condensation.
5. Factory Charge: nitrogen.

C. Divided-Flow Specialty Fittings: Where required by VRF HVAC system manufacturer for proper system operation, VRF HVAC system manufacturer shall furnish specialty fittings with identification and instructions for proper installation by Installer.

D. Refrigerant Isolation Ball Valves:

1. Description: Uni-body full port design, rated for maximum system temperature and pressure, and factory tested under pressure to ensure tight shutoff. Designed for valve operation without removing seal cap.
2. Seals: Compatible with system refrigerant and oil. Seal service life of at least 20 years.
3. Valve Connections: Shall be sweat.

E. All refrigerant piping joints shall be brazed connections.

F. Pressure test (manufacturer's recommendations shall supersede the below

requirements if they are more stringent):

a. All VRF systems should be pressure tested to 600 PSIG and held for 24 hours. First, start the nitrogen pressure test at 150 PSIG and hold for 3 minutes. Then increase the pressure to 325 PSIG and hold for 5 minutes. If no leaks are present, further increase the pressure to 550 PSIG and hold for 24 hours.

G. Triple Evacuation (manufacturer's recommendations shall supersede the below requirements if they are more stringent):

a. A triple evacuation of all piping should be performed to eliminate moisture in the system:

i. Pull a vacuum to 4,000 microns and hold for 15 minutes. Introduce nitrogen into the system at 2-3 psi. Always break the vacuum with nitrogen.

ii. Pull a vacuum to 1,500 microns and hold for 20 minutes.

iii. Evacuate the system down to 500 microns and hold for 1 hour.

PART 3 – EXECUTION

3.01 WARRANTY:

A. The units shall be covered by an extended manufacturer's limited warranty for a period of ten (10) years from date of installation. Warranty shall cover parts and compressors and controls.
If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired by the manufacturer.
This warranty shall not include labor.

B. Manufacturer shall have a minimum of twenty-five years of HVAC experience in the U.S. market.

C. The CITY MULTI VRFZ system shall be installed by a Mitsubishi authorized CITY MULTI Diamond Dealer with extensive CITY MULTI install and service training. The mandatory contractor service and install training should be performed by the manufacturer.

D. Provide factory programming and setup.

3.02 INSTALLATION:

A. Provide factory programming, setup and startup. Prior to startup, a factory representative shall visit site and inspect all piping connections. In addition, as-built piping shop drawings with as-built individual line lengths shall be provided to manufacturer a minimum of 15 days prior to startup.

B. Heat pumps shall be installed in accordance with manufacturer's recommendations.

C. See details for mounting instructions and accessories.

3.03 INSTALLATION OF REFRIGERANT PIPING

A. Refrigerant Tubing Kits:

a. Unroll and straighten tubing to suit installation. Deviations in straightness of exposed tubing shall be unnoticeable to observer.
b. Support tubing using hangers and supports indicated at intervals not to exceed 5 ft. Minimum rod size, 1/4 inch.
c. Prepare tubing ends and make mating connections to provide a pressure tight and leak-free installation.

B. Install refrigerant piping in accordance with ASHRAE 15 and governing codes.

C. Select system components with pressure rating equal to or greater than system operating pressure.

D. Install piping as short and direct as possible, with a minimum number of joints and fittings.

E. Arrange piping to allow inspection and service of equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

F. Install refrigerant piping and tubing in protective conduit where installed belowground.

G. Install refrigerant piping and tubing in rigid or flexible conduit in locations where exposed to mechanical damage.

H. Unless otherwise required by VRF HVAC system manufacturer, slope refrigerant piping and tubing as follows:

a. Install horizontal hot-gas discharge piping and tubing with a uniform slope downward away from compressor.
b. Install horizontal suction lines with a uniform slope downward to compressor.
c. Install traps to entrain oil in vertical runs.
d. Liquid lines may be installed level.

I. When brazing, remove or protect components that could be damaged by heat.

J. Before installation, clean piping, tubing, and fittings to cleanliness level required by VRF HVAC system manufacturer.

K. Joint Construction:

a. Ream ends of tubes and remove burrs.
b. Remove scale, slag, dirt, and debris from inside and outside of tube and fittings before assembly.
c. Construct joints in accordance with AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
    i. Use Type BCuP (copper-phosphorus) alloy for joining copper fittings with copper tubing.
    ii. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze.

END OF SECTION

Section 23 57 68

UNITARY HEATING AND COOLING-HVAC

PART 1 - GENERAL

1.01 SCOPE

A. Provisions of this Section shall apply to all HVAC work.

PART 2 - PRODUCTS

2.01 RADIANT TUBE HEATERS (VENTED & UNVENTED):

A. Gas fired infra-red space heaters shall be furnished and installed in accordance with National and Local Codes as shown.

B. Heaters will be equipped with a direct 100% Globar hot surface ignition control system.

C. Power supply to each heater will be 120 Volts AC 60 Hz. Heater control will include dual vacuum differential switches to provide a complete shut down in event of combustion air and/or flue blockage.

D. The heater will be of a positive pressure. Heater will be equipped with a prepurge mode. The heater will be equipped with indicator lights to indicate pressure on and gas valve open.

E. The material used for the combustion chamber and heat exchanger shall be 16 gauge 4" O.D. aluminized steel. The reflector shall be of bright buffered aluminum.

F. The fan motor shall be protected by a thermal overload switch and shall have ball bearings.

G. Unit shall be design certified by the American Gas Association (A.G.A.) and (C.G.A.). The supplier shall provide a manufacturer's written warranty covering the heater's radiant tube element assembly for a period of five (5) years and all components utilized in the heater's control assembly for a period of one (1) year.

H. Heater shall be designed for vented and unvented application.

I. Provide chains, supports and clamps.

J. Heater shall be Reznor, Modine or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Units shall be installed in accordance with manufacturer's recommendations.

B. See details for mounting instructions and accessories.

END OF SECTION 23 5768

Section 23 58 20

FANS - HVAC

PART 1 - GENERAL

1.01 SCOPE:

A. Provisions of this Section shall apply to all HVAC work.

PART 2 - PRODUCTS

2.01 FANS, CENTRIFUGAL - GENERAL

A. Fan Rating: Certified in accordance with AMCA Standard 210 for capacity and sound. Provide fans of class required for service based on static pressures 20% greater than those scheduled. All fans are to be rated for continuous duty.

B. Provide forward curved blade, radial blade, backward curved blade or air foil blade fans statically and dynamically balanced with L (10) 80,000 hour rated self-aligning, grease lubricated ball or roller bearings rigidly supported by bearing stands.

C. For all fans furnish adjustable motor bases or rails.

D. Size V-belt drives for 50% overload, and provide adjustable pitch motor pulleys for drives of 15 BHP and smaller.

E. For all fans outside casings provide belt and drive guards.

F. Provide scroll access doors with quick-operating latches for all exhaust fans.

G. Equip all fans with flanged outlets and casing drains.

H. Sound power levels shall not exceed those shown.

I. Size fan motors to provide at least 5% drive loss, with motor service factors not exceeding 1.0. Provide high efficiency motors as specified under "MOTORS".

J. Where scheduled provide variable inlet vanes with rods extended for connection to control operators.

K. Where scheduled provide corrosion resistant coating consisting of two (2) coats of chlorinated rubber base paint on all parts in airstream.

L. Where shown on electrical drawings provide two (2) speed separate winding motors (1800/900 rpm).

M. Where shown on electrical drawings provide motors suitable for two (2) step

increment starting.

N. Vibration isolators: See "MATERIALS AND METHODS" Section 23 5050.

O. All roof and wall mounted fans are to be factory painted, color by Architect.

P. Fans shall be manufactured by Loren Cook, Greenheck, Penn Barry or approved equal.

2.02 FANS, CENTRIFUGAL IN-LINE

A. AMCA approved air and sound rated direct (or) belt driven fans (as scheduled) complete with V-belt drive sized for 50% overload, self aligning grease lubricated ball bearings, adjustable pitch motor pulleys, adjustable motor bases and statically and dynamically balanced backward curved blade wheels, all enclosed in a galvanized steel housing with inlet bell and outlet duct collars. (Fan wheel and motor assembly shall be hinged for access.)

B. Fans shall be manufactured by Greenheck type SQ, Acme, Cook, Peerless, or approved equal.

2.03 FANS, PROPELLER

A. AMCA rated fans, belt or direct driven as scheduled. Equip belt driven fans with V-belt drives sized for 50% overload, adjustable pitch motor pulleys and adjustable motor bases.

B. Equip each fan with belt and wheel guards and a mounting panel not lighter than 16 gauge.

C. Provide gravity or motor operated shutters where indicated in equipment schedule. Equip motor operated shutters with spring return motors with oil-immersed gear trains.

D. Where indicated on plans provide fans equipped with panels reversed for supply operation.

E. Where shown provide penthouses constructed of not lighter than 18 gauge galvanized steel and 18 gauge galvanized steel prefabricated curbs. Equip penthouses with access doors and internal insulation not lighter than 1" X 3 lb/cu. ft.

F. Fans shall be manufactured by Cook, Coolair, Greenheck, Acme, Powerline or approved equal.

2.04 FANS, CENTRIFUGAL CEILING EXHAUST

A. AMCA rated direct drive centrifugal fans for ceiling mounting, complete with

removable ceiling grille, disconnect, fan mounted solid state speed control, flexible duct connection, integral backdraft damper and discharge outlet. Maximum noise level: _____ sones.

B. Fans shall be manufactured by Greenheck, Acme, Cook, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Fans shall be installed in accordance with manufacturer's recommendations.

B. See details for mounting instructions and accessories.

END OF SECTION 23 5820

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Section 23 58 40

DUCTWORK - HVAC

PART 1 - GENERAL

1.01 SCOPE:

A. Include Section 23 5010, "GENERAL PROVISIONS - HVAC", with this section.

B. Provisions of this Section shall apply to all HVAC work.

1.02 SHOP DRAWINGS:

A. Ductwork shop drawings shall include details of duct constructions: seams, joints, gauges, reinforcing and hanger details for each pressure class and size range together with details of turning vanes, branch connections, dampers and access doors and elevations of all ductwork.

PART 2 - PRODUCTS

2.01 DUCTWORK - GENERAL:

A. Unless otherwise shown or specified construct ducts of galvanized steel sheet metal using gauges and recommended details as contained in the current edition of the SMACNA HVAC Duct Construction Standards. Ductwork shall include supply air, exhaust air, return air, and outdoor air ducts, together with all necessary fittings, splitters, dampers, quadrants, flexible connections, sleeves, hangers, support, braces, etc. Hang and install ducts in a neat and workmanlike manner from structural members (not roof deck) with adequate bracing and cross breaking to prevent breathing, rattling, and vibration.

B. No flexible ductwork on return, exhaust or outside air.

C. Install Duro-Dyne locking quadrants and Duro-Dyne end bearings on all spitters and manual volume dampers located above accessible ceiling and Young #1 regulator, C.P., and Duro-Dyne end bearings elsewhere.

D. ***DUCT SIZES SHOWN ARE CLEAR INSIDE DIMENSIONS. INCREASE SHEETMETAL SIZE AS REQUIRED TO ALLOW FOR LINER THICKNESS.***

E. Duct Turns: Wherever possible, duct turns shall have a centerline radius equal to 1.5 times the duct width in the plane of the turn. Vane other duct turns to provide a dynamic loss co-efficient ("C") not greater than 0.2. No reducing ells or tees to be used.

F. Duct Sealing: Seal duct seams and joints as noted below. Seal entire circumference of all branch duct connections, tapping collars and spin-ins. Seal ducts using mastic sealant equal to United Duct Sealer.

1. Class "A" Seal: Seal all joints and seams and leak test as specified.

2. Class "B" Seal: Seal entire circumference of all transverse joints, seal all longitudinal joints.

3. Class "C" Seal: Seal entire circumference of all transverse joints.

4. Class "D" Seal: Seal corner of transverse joints.

2.02 DUCTWORK - LOW PRESSURE:

A. Ductwork: Low Pressure, Pressure and Seal Class shall include: All supply, return, exhaust and outside air duct, 2" pressure class "B" seal.

B. Construct ducts in accordance with SMACNA Duct Construction Standards for pressure and seal classes noted.

2.03 DUCTWORK LOCATED OUTDOORS:

A. Construct ducts served by exhaust fans as specified for respective exhaust ducts, above. Seal all seams weather tight using glass cloth tape and carbolastic or United Duct Sealer.

2.04 FLEXIBLE DUCTS:

A. Flexible duct connectors: A two (2) element spiral construction composed of galvanized steel supporting spiral and coated woven textile fabric with metal or mineral base, UL listed as Class I Air Duct and Connector (UL 181) minimum R=6.0.

B. Flexible connectors shall not exceed 5 feet in length.

C. Make connections between flexible ducts and other equipment using galvanized steel draw bands with plated screws and buckles and United Duct seal for high and medium pressure ducts and nylon draw bands for low pressure ducts.

D. Factory insulate cold flexible ducts using insulation equivalent to that specified for cold ducts.

E. Flexible ducts: Thermoflex M-KC, Wiremold 57K, Technaflex 57K, or Flexmaster Type 4M. Submit sample for approval of any other manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Ductwork shall be installed in accordance with manufacturer's recommendations.

B. All ductwork shall be ran as high as practical and not on the floor unless otherwise

indicated.

C. See details for mounting instructions and accessories.

END OF SECTION 23 5840

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Section 23 58 50

SPECIAL DUCTWORK SYSTEM

PART 1 - GENERAL

1.01 SCOPE:

A. Include Section 15010, "GENERAL PROVISIONS" with this section.

B. Provisions of this Section shall apply to all HVAC work.

2.00 PRODUCTS:

2.01 DUCTWORK - KITCHEN EXHAUST:

A. Make final duct connections to kitchen hoods and dishwashers under this Section. Hoods and dishwashers will be installed under other Section.

B. Kitchen exhaust ducts located below kitchen ceiling shall be 18 gauge type 316 stainless steel with all seams and joints welded.

C. Kitchen exhaust ducts other than those located below kitchen ceilings: 16 gauge steel with all longitudinal and transverse seams continuously welded.

D. Reinforce ducts as specified for low pressure ducts, above.

E. Install access doors 20 feet on centers in sides of kitchen exhaust ducts.

F. Install trapped drain at foot of exhaust riser and extend 1" copper drain line to nearest floor drain or outdoors.

3.00 EXECUTION:

3.01 INSTALLATION:

A. Ductwork shall be installed in accordance with SMACNA Standards.

B. Ductwork shall be installed in accordance with manufacturer's recommendations.

C. See details for mounting instructions and accessories.

END OF SECTION 15850

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Section 23 58 60

DUCT ACCESSORIES - HVAC

PART 1 - GENERAL

1.01 SCOPE:

A. Provisions of this Section shall apply to all HVAC work.

PART 2 - PRODUCTS

2.01 SHEET METAL SPECIALTIES:

A. Make rectangular take-offs in low pressure supply, return and exhaust ducts using 45 degrees entry tap (SMACNA Duct Construction Standards Figure #2-8) with manual damper with end bearings and locking quadrant in branch. End bearings and quadrants shall have air tight duct connections and shaft seals: Ruskin, Duro-Dyne, or approved equal.

B. Manual balancing dampers: Comply with SMACNA Duct Construction Standards, Figure 2-14 and 2-15. Equip all dampers with locking quadrants and end bearings. End bearings and quadrants shall have air tight duct connections and shaft seal, Ruskin, Duro-Dyne, or approved equal.

C. When damper quadrants are located other than above lay-in ceilings.

1. Provide all necessary accessories for remote control of balancing dampers without requiring access doors. Substitute Young #1 regulators and an additional end bearing or Ventlock #688 regulators and an additional end bearing for the quadrant (regulators shall be chrome plated), or, Architect/Engineer option.

2. Provide access door for access to the quadrant (See sub-section 2.05 "ACCESS DOORS", hereinafter).

D. Provide "Stand-Offs" (hat sections) for damper quadrants, controls, etc., on externally insulated ducts.

E. Branch duct connections for connecting round low pressure branches to rectangular low pressure trunks: Conical take-off spin-in fittings with integral dampers with end bearings, stand-off and beaded collars. Seal Class of components penetrating duct shall be consistent with duct pressure class. Spin-in shall be Flexmaster - CBD. Submit sample for approval of other manufacturers for prior approval.

2.02 FIRE DAMPERS:

A. Install UL labeled 1-1/2 hour fire dampers wherever sheet metal ducts pass through chase walls, floors, outside fire chases, and elsewhere as shown or required by local Code. Install dampers per SMACNA "Fire Damper Guide" and UL 555.

1. Fire dampers shall be Type "B" "Venation Blind" dampers. Unless otherwise shown folded blades shall not obstruct duct. Dampers in floors shall be spring loaded.

2. Provide factory fabricated steel integral *wall/floor* sleeve 3" longer than wall thickness for each fire damper and install sleeve using bolts and angles as detailed in Figure #1 of SMACNA "Fire Damper Guide".

3. Provide rectangular, round and/or flat-oval collars. See Drawings for sizes and locations.

4. For aluminum ductwork provide stainless steel fire dampers.

2.03 AUTOMATIC DAMPERS:

A. Factory fabricated dampers with extruded aluminum blades and frame with full gasket stops for blades ends. Equip blades with air tight plastic or butyl rubber seals and bronze or nylon bearings. Ruskin Model CD50.

B. Automatic dampers located near fan outlets or in ducts having maximum velocities exceeding 1500 FPM shall have extruded aluminum air-foil blades and all linkages shall be located outside of airstream. Such dampers shall have leakage rates not exceeding 1% maximum design flow at 4" WG pressure differential.

2.04 SMOKE DETECTORS:

A. Smoke detectors shall be ionization detectors which detect product of combustion. Furnish, wire, and install smoke detectors under this Section. Provide smoke detectors compatible with fire alarm system specified under Electrical Work and equip them with contacts for connection to Fire Alarm System. (See sub-section 15901 "CONTROLS", hereinafter). Provide remote visual/audio indicator mounted on the ceiling near the detector.

B. Smoke detectors will be furnished and wired under Electrical Work but shall be installed in ducts under this Section.

C. Locate smoke detectors so that indicating lights are visible and so that they will not be affected by moisture from coils or humidifiers.

D. Install access door in duct at each smoke detector. (See sub-section 2.5 "ACCESS DOORS", hereinafter).

2.05 ACCESS DOORS:

A. Access doors in plenum casings are specified under "DUCTWORK - PLENUM CASINGS".

B. Access doors in low pressure ducts: Galvanized steel frame with gasket permanently secured to duct with a removable gasket access port held in place with screw driver

or thumb operated latches. Door in insulated ducts: Double thickness with insulation. Doors in non-insulated ducts: A single thickness. Weld door frames to kitchen exhaust ducts. Size doors to permit removal of equipment or maintenance. Minimum size 12" X 12".

C. Kitchen hood exhaust duct access doors:16 gage black iron with high temperature ceramic fiber rope gasket for services up to 2000°F. Provide thumb screw access. Equal to Ruskin ADR-KE & ADF-KE.

D. Mark access points in lift-out ceilings with brass paper brads. Bend points of brads over top of ceiling.

2.06 FLEXIBLE DUCT CONNECTIONS:

A. Install Neoprene coated glass cloth flexible connections at all duct connections to all fans and AC Units.

B. Install flexible connections in all ducts at building expansion joints.

2.07 ELECTRICAL GROUNDING:

A. Ground all fans. Install braided copper jumpers around all flexible connections, taking care that jumpers do not bind flexes.

2.08 INTAKE AND RELIEF HOOD:

A. Gravity roof ventilators shall be constructed of heavy gauge aluminum as specified.

B. Hoods shall be constructed of precision formed, arched panels with interlocking seams.

C. Bases shall be constructed so that the curb cap in 8" larger than the throat size. Provide 12" bases.

D. Hood support members shall be constructed of galvanized steel and fastened so that the hood can be either removed completely from the base or hinged open.

E. Birdscreens constructed of 1/2" galvanized steel mesh shall be mounted horizontally across the intake/discharge area of the hood.

F. Intake units with throat widths through 42" shall ship assembled when throat lengths do not exceed 84". Relief units with throat widths through 48" shall ship assembled when throat lengths do not exceed 96".

G. Units shall be factory painted to match roof.

H. Gravity hoods shall be Fabra Hood Model FHI for intake or Model FHR for relief (as specified) as manufactured by Greenheck, Cook or equal.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Duct shall be installed in accordance with SMACNA Standards. Equipment shall be installed in accordance with manufacturer's recommendations. See details for mounting instructions and accessories.

END OF SECTION 23 5860

Section 23 58 70

OUTLETS

PART 1 – GENERAL

1.01 SCOPE:

A. Include section 23 5010 "GENERAL PROVISIONS" with this section.

B. Provisions of this Section shall apply to all HVAC work.

PART 2 – PRODUCTS

2.01 GRILLES, REGISTERS AND DIFFUSERS:

A. General: Air devices may be Titus, Price, Nailor, or approved equal. Where fire dampers are required at grilles, provide steel grilles, not aluminum.

B. Grilles, Registers, and Diffusers Finishes:
1. All diffusers located in lay-in ceilings: off-white enamel finish.
2. All wall mounted grilles and registers: primer finish. (grilles and registers to be field painted by others.)
3. All grilles and registers mounted on exposed ductwork: primer finish. (grilles and registers to be field painted by others.)
4. All floor grilles: satin anodized finish.
5. If there is a grille, register, or diffuser in a location other than what is described above, provide an off-white enamel finish.

B. Supply Registers (SR): Adjustable vertical deflection, adjustable horizontal deflection, removable core, opposed blade damper, all aluminum construction, and off-white baked enamel finish. Titus 350.

C. Wall Return Grilles (WRG): Horizontal bars fixed at about 30° angle, close spacing and plaster frames. All aluminum construction and off-white baked enamel finish. Titus 350.

D. Wall Return Register (WRR): same as WRG but with opposed blade damper.

E. Ceiling Return Grilles (R), Ceiling Exhaust Grilles (E) and Transfer Air Grilles (T): All aluminum, 1/2" X 1/2" X 1/2" cube core and plaster frames as needed. Off-white baked enamel finish. Provide 24 x 24 panel so grille will fit in 24 x 24 ceiling grid. Titus "50F".

F. Bar Return Grille (BRG): All steel, heavy duty, 16 gauge border, 14 gauge blades, 1/2" spacing, 38° deflection. Provide all frames. Titus "33R

G. Architectural Supply Diffuser (S): The diffuser shall have an 18 gauge aluminum face panel, which shall be a one piece assembly, removable by means of four positive locking posts. The back pan shall be one piece aluminum construction. finish shall be off-white. Option downblow clips shall be provided to restrict the discharge air in certain directions as indicated on drawings. Diffuser shall be Titus OMNI. Round diffusers equal to R-OMNI.

2.02 WEATHER LOUVERS:

A. Louvers shall be 6" thick extruded aluminum louvers with 12 gauge blades with drainable head frame, drainable blades, water stop, and with angled sill. 57% F.A. minimum. Equip with 1/2" mesh aluminum birdscreen on inside of louver. Finishes: Kynar. Submit color sample to Architect (20 year warranty on finish). Ruskin ELF6375DX, Louvers & Dampers, Greenheck, Airolite, or approved equal.

B. Storm Shelter Louvers:

1. The grilles must be furnished and include the following:

   a. FEMA 361 Standards for 200 + mph wind speed and large missile impact resistance.

2. Performance Requirements: Missile impact protective grille with a nominal 2 x 4 of not less than 15 lbs. in weight at a velocity of not less than 155 ft./sec. Grille must withstand impacts without visible damage and must prevent missiles from penetrating through.

3. Design Wind Load: Incorporate structural supports and mullions required to withstand design wind load of ±150 PSF.

4. Warranty: Provide written warranty to the owner that all products will be free of defective materials or workmanship for a period of one year from date of installation.

5. The grilles and related materials herein specified and indicated on the drawings shall be as manufactured by: Ruskin, HPG3848 Protective Impact Grille, or approved equal.

6. Grille Fabrication:

   a. Frame:

      1. Material: Hot rolled steel.
      2. Wall Thickness: .25 inch, nominal.
      3. Depth: 8 inches.

   b. Blades:

1. Style: Sightproof, horizontally mounted.
2. Material: Hot rolled steel.
3. Wall Thickness: .25 inch, nominal.
4. Centers: 2.125 inches, nominal.
5. Assembly: Factory assemble grille components.
8. Maximum assembly size: 80" wide x 60" tall or 60" wide x 80" tall.
9. Finishes:

    a. General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory. Protect finishes on exposed surfaces prior to shipment. Remove scratches and blemishes from exposed surfaces that will be visible after completing finishing process. Provide color as indicated or, if not otherwise indicated, as selected by architect.

    b. Fluorocarbon Coating:

        1. Grilles to be finished with an inhibitive thermo-cured primer, 0.2 mil minimum dry film thickness, and a thermo cured fluorocarbon coating containing "Kynar 500" resin, 1.0 mil minimum dry film thickness.

        2. All material shall be thoroughly cleaned and given a pre treatment before application of the Kynar/Hylar coating. The coating shall receive a bake cycle of 17 minutes at 450°F. All finishing procedures shall be one continuous operation in the plant of the manufacturer.

    c. Wind Drive Rain Resistant Louvers: Extruded aluminum, wind driven rain resistant, stationary louvers with horizontally mounted sight proof blades.

        1. References:

            A. AAMA 605.2 - High Performance

Organic Coatings on architectural Extrusions and Panels.

B. AMCA 500-L - Test Methods for Louvers.

C. AMCA 511 - Certified Ratings Program for Air Control Devices.

2. Submittals:

A. Product Data: Submit manufacturer's product data including performance data.

3. Shop Drawings: Submit shop drawings indicating materials, construction, dimensions, accessories, and installation details.

4. Delivery, Storage and Handling:

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

B. Storage: Store materials in a dry area indoors, protected from damage and in accordance with manufacturer's instructions.

C. Handling: Protect materials and finishes during handling and installation to prevent damage.

5. Manufacturer:

A. Ruskin. Louvers & Dampers, Greenheck, Airolite, or approved equal.

6. Extruded Aluminum Stationary Louvers:

A. Fabrication: Ruskin Model #EME520DD.

B. Frame:

1. Material: Extruded aluminum, Alloy 6063-T5.

2. Wall Thickness: 0.081 inch, nominal.

3. Depth: 5 inches.

C. Blades:

1. Style: Sightproof, double drainable, horizontally mounted.

2. Material: Extruded aluminum, Alloy 6063-T5.

3. Wall Thickness: 0.081 inch, nominal.

4. Centers: 2 inches, nominal.

D. Bird Screen:

1. Material: Aluminum, 3/4 inch x 0.051 inch, expanded, flattened.

2. Frame: Removable, rewireable.

3. Assembly: Factory assembled louver components.

E. Performance Data:

1. Based on testing 48 inch x 48 inch size unit in accordance with AMCA

500-L.

2. Free Area: 44 percent, nominal.

3. Free Area Size: 6.99 square feet.

4. Maximum Recommended Air Flow Thru Free Area: 1,139 fpm.

5. Maximum Pressure Drop (at 1,139 feet per minute): 0.21 inches w.g.

F. Wind Driven Water Penetration Performance:

1. Based on testing 39 inch x 39 inch core area, 41 inch x 44 inch nominal size unit in accordance with AMCA 500-L.

2. Wind Velocity: 29 mph.

3. Rainfall Rate: 3 inches/hour.

4. Air Volume: 6,207 cfm.

5. Core Velocity: 588 fpm.

6. Free Area Velocity: 1,139 feet per minute.

7. Water Resistance Effectiveness: 99.3% (AMCA Class A).

8. Discharge Loss Classification (Intake Test): Class 2 (.3 to .399).

9. Factory Finish:

A. Kynar 500 Fluoropolymer Coating:

1. Conform to AAMA 605.2.

2. Apply coating following cleaning and pretreatment.

3. Cleaning: AA-C12C42R1X.

4. Dry louvers before final finish application.

5. Total Dry Film Thickness: Approximately 1.2 mils, when baked at 450° F for 10 minutes.

10. Color: Color as selected by Architect from manufacturer's standard colors.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Equipment shall be installed in accordance with SMACNA Standards and manufacturer's recommendations.

B. See details for mounting instructions and accessories.

END OF SECTION 23 5870

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Section 23 58 80

FILTERS

PART 1 – GENERAL

1.01 SCOPE:

A. Provisions of this Section shall apply to all HVAC work.

PART 2 – PRODUCTS

2.01 FILTERS - AIR:

A. Pre-filters: 30% Filters, 2" Thick (Maximum allowed by MFR): Throwaway deep pleated filters, maximum face velocity 350 fpm. Maximum initial pressure drop 0.1" WG, UL Class 1, 30% efficiency per ASHRAE Test Standard 52-76, minimum ratio of media area to face area 4.4:1. Turn system over to Owner with clean filters and provide one (1) set of spare filters. Farr 30/30 or approved equal.

B. Filters shall be manufactured by Farr, American Air Filter, or approved equal.

PART 3 – EXECUTION

3.01 INSTALLATION:

A. Filters shall be installed in accordance with manufacturer's recommendations.

B. See details for mounting instructions and accessories.

END OF SECTION 23 5880

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SECTION 23 90 00

CONTROLS

PART 1 – GENERAL

1.01 SCOPE:

A. Include Section 23 0100 "GENERAL PROVISIONS", with this Section.

B. Provisions of this Section shall apply to all HVAC work.

PART 2 – PRODUCTS

2.01 CONTROL SYSTEMS:

A. Furnish and install complete and ready for operation a control system with control sequences specified below.

B. Products of a manufacturer maintaining complete service and parts facilities in Alabama continuously for the last three (3) years: Trane, Carrier, or approved equal.

C. Control equipment, except for items comprising an integral part of the water or refrigeration piping, shall be installed by trained mechanics employed by the Control Manufacturer.

D. Include the services of a full time control technician for calibrating and adjusting controls for the first 3 working days after Owner has occupied building.

E. Before installation, submit for approval five (5) copies of complete power and control wiring and piping diagrams. Hang a photostatic copy of the approved diagram, framed behind glass, in each equipment room. Provide one (1) set of reproducible sepias of "As-Built" control diagrams at completion of project for the Owner's use.

F. Provide permanent nameplates for control switches and motor starters. Nameplates: engraved laminated plastic with letters legible under normal operating conditions. (White on black).

G. Permanently identify control devices other than room thermostats, so they may be identified on control diagrams. Provide engraved plastic nameplates for items mounted outside of or on faces of panels. Mark other instruments with indelible ink.

2.02 CONTROL WIRING:

A. Include control and interlock wiring and power wiring for control panel in this Section.
Install in conduit in accordance with provisions of Electrical Work where exposed, concealed in walls or above ceilings other than lay-in type. Provide plenum rated cable above lay-in ceilings (for plenum or non-plenum).

B. Waterproof and firestop all conduit floor penetrations. Firestop conduit penetrations of fire rated walls partitions.

C. Wire all devices individually to terminal strips in control panels.

D. Furnish necessary relays and auxiliary contactors and other accessories required. Provide interlock relays per NEC. Coordinate start-stop stations, auxiliary contacts, etc., with supplier of Starters, Variable Frequency Drive (VFD) and Motors Control Centers specified in Electrical Work.

2.03 CONTROL DEVICES:

A. Room Thermostats: (Provide seven (7) day occupied/unoccupied, 24 hour, multi-stage programmable thermostats, with 3-hour override, and battery back-up. Thermostats to be provided with local control. Thermostat covers: lockable high impact plastic. Mount room thermostats with tops 4 feet above floors. Provide switches and Hand – Off – Auto switches (H-O-A) as required.

B. Remote Bulb Thermostats (DDC) and Temperature Transmitters (DDC): Unless otherwise shown use averaging elements not less than 12 feet long for duct or casing cross sections for each 24 square feet of face area.

C. Thermometers: Pipe line thermometers are specified in another Section. Install digital readout thermometers in ducts where shown on control diagrams, providing averaging bulbs where shown and/or required.

D. Freezestats: Manual reset, pneumatic not permitted. Locate freezestat bulbs between preheat and chilled water coils in units with chilled water coils and downstream from DX coils in units with DX coils. Provide coverage for each 3' X 3' coil face area section.

E. Firestats: Single pole double throw, electric, manual reset, pneumatic not permitted. Firestats shown to be connected to the fire alarm system: compatible with fire alarm system, furnished and installed under Controls, wired under Electrical Work. Firestats to be installed in all fans where smoke detectors are not furnished.

F. Program Clocks / Timers:
Provide digital time clock with 365 day holiday capabilities with 24 single dates, 99 setpoints, separate scheduling for each day of the week, AM/PM format, one minute programming resolution, portable memory module, optional programmer for integration into a Windows based PC for program duplication and

modifications, LCD display, daylight savings or standard time, automatic leap year correction, permanent schedule retention, 100 hours of backup, manual override, Nema 3 indoor/outdoor enclosure. Clock/Timer to be Tork or approved equal.

G. Valve and Damper Operators: Of sufficient power to close/open valves and dampers under operating conditions. Electric valve and damper motors shall have oil immersed gear trains and spring return to normal position. Valves and damper operators to have DDC Controls.

H. Wells: Install pipe line mounted control and indicating devices in stainless steel or brass thermometer wells.

I. Capillary Supports: Securely support all duct-mounted and casing- mounting thermostat capillaries using factory fabricated copper bulb supports.

J. Provide stand-offs for control devices mounted on externally insulated ducts and equipment.

K. Anchor all items mounted on gypsum board (dry-wall) using toggle bolts or moly bolts, not expansion shields.

L. Air flow Measuring Station (AFMS): Provide AFMS with probe, transmitter and cable. Unit to average velocity profile thru multiple probes and provide average readout in CFM on transmitters LED screen. Provide O-10VDC and 4-20MA output (field selectable) to BMCS. Sensor accuracy to be 2%, installed accuracy to be 3%. ARMS to be Ebrron model GTX116.

M. Hand-Off-Auto switches (H-O-A): Provide 3 position dial switches (one for each exhaust/supply fan as scheduled). Switches for fans shall be grouped together in panels by building section. Locate panels in nearest Mechanical / Electrical room or where shown (coordinate location with G.C. & owner).

2.04 CONTROL POWER:

A. All 120 Volt wiring shall be the responsibility of the Control Sub-Contractor from circuit furnished under Electrical Section. Coordinate circuit locations with General and Electrical Contractors.

B. Power wiring to all automatic dampers shall be included under this section.

C. Wiring and relays between light and fans for interlock shall be included under this section.

2.05 CONTROL PANELS:

A. Local Control Panels: Construct of galvanized steel with baked enamel finish or aluminum-plywood-aluminum fronts and backs and extruded tops, bottoms, and ends. All panels shall have piano hinges and key locking latches (key panels

alike). Permanently label instruments located in panels consistent with labeling on control diagram. Cement photostat of approved diagram inside each panel cover. (Include Local-Remote switching for control point adjusters on face of each panel).

2.06 INTERFACES WITH BUILDING MANAGEMENT CONTROL SYSTEM (BMCS):

A. Relays actuated by BMCS will be mounted in BMCS Panels located in Fan Rooms, Equipment Rooms, etc.

B. Wiring from local panels (and Engineer panels) to BMCS panels is included in this Section.

C. Control point adjusters actuated by BMCS system will be located in BMCS Panels.

2.07 CONTROL SEQUENCES:

A. As shown on drawings.

PART 3 – EXECUTION

3.01 INSTALLATION:

A. Control diagrams on drawings and/or Control Sequences are intended to indicate, in general, control arrangements. Provide all instruments, relays, operators, switches, etc. required to accomplish control sequences whether or not such devices are actually shown.

END OF SECTION 23 90 00

SECTION 26 00 10 - ELECTRICAL GENERAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The "General Conditions" and "Special Conditions" of Contract as written and referred to hereinbefore are adopted and made part of Division 16.

1.2 DESCRIPTION OF WORK:

A. Provide equipment, labor, etc., required to install complete working electrical system as shown and specified.

B. Provide equipment and/or wiring normally furnished or required for complete electrical systems but not specifically specified on the drawings or in specifications, as though specified by both.

C. All equipment and wiring shall be new and bear U.L. label.

D. Electrical work includes, but is not limited to:

1. Arrange with local utility companies for services as shown or specified.

2. Removal or relocation of electrical services located on or crossing through project property, above or below grade, obstructing construction of project or conflicting with completed project or any applicable code.

3. Complete 600 volt Distribution System. Provide meters, switchboards, panelboards, circuit breakers, power outlets, convenience outlets, switches, and/or other equipment forming part of system.

4. Complete raceway systems and terminal facilities for telephone system.

5. Connection of all appliances and equipment.

6. Complete empty raceway system(s) for auxiliary system(s) as shown.

7. Complete conduit for voice data system.

8. Complete interior and exterior lighting.

9. Provide temporary facilities for construction power.

10. Furnish power systems study consisting of short circuit, coordination and voltage stability analysis.

11. Testing of all systems

1.3 WORK NOT INCLUDED:

A. Furring for conduit and equipment.

B. Finish painting of conduit and equipment.

C. Installation of motors except where specifically noted.

D. Control wiring for mechanical systems, except where indicated to be provided by Electrical Contractor.

E. Flashing of conduits into roofs and outside walls. Inform General Contractor of number and size of roof penetrations prior to bidding.

1.4 RELATED WORK SPECIFIED ELSEWHERE:

A. Classification of excavation: Architectural Division.

B. Painting: Painting Division.

C. Concrete Work: Concrete Division.

1.5 REQUIREMENTS OF REGULATORY AGENCIES:

A. Obtain and pay for all permits required for work. Comply with all ordinances pertaining to work described herein.

B. Install work under this Division per drawings, specifications, latest edition of the National Electrical Code, Local Building Codes, and any special codes having jurisdiction over specific portions within complete installation. In event of conflict, install work per most stringent code requirements determined by Architect (or) Engineer.

C. Arrange, pay fees for and complete work to pass required tests by agencies having authority over work. Deliver to Architect (or) Engineer Certificates of Inspection and approval issued by authorities.

1.6 QUALIFICATIONS OF CONTRACTOR:

A. Has completed minimum two projects same size and scope in past five (5) years.

B. This qualification applies to Sub-Contractors.

C. Use workmen experienced in their respective trade. Submit qualifications of Superintendent for review.

D. Owner reserves right to reject bid of any Contractor failing to meet these qualifications.

1.7 GENERAL JOB REQUIREMENTS:

A. Drawings and Specifications:

1. Electrical work is shown on "E" series drawings inclusive. Follow any supplementary drawings as though listed above.

2. Drawings and specifications are complementary. Work called for by one is binding as if called for by both.

3. Drawings show general run of circuits and approximate location of equipment. Right is reserved to change location of equipment and devices, and routing of conduits to a reasonable extent, without extra cost to Owner.

4. Refer conflicts between drawings and specifications describing electrical work and work under other Divisions to Architect for remedial action.

5. Use dimensions in figures in preference to scaled dimensions. Do not scale drawings for exact sizes or locations.

6. Execution of Contract is evidence that Contractor has examined all drawings and specifications related to work, and is informed to extent and character of work. Later claims for labor and materials required due to difficulties encountered, which could have been foreseen had examination been made, will not be recognized.

7. Charges for extra work not allowed unless work authorized by written order from Architect approving charge for work.

B. Visit to Site:

1. Visit site to survey existing conditions affecting work. Include necessary materials and labor to accomplish the electrical work, including relocation of existing services and utilities on building site

in bid. No consideration given to future claims due to existing conditions.

C. Definitions:

1.	Provide:	Furnish, install and connect complete.
2.	Wire:	Furnish all necessary wiring and connect complete.
3.	Install:	Set in place and wire complete.
4.	Work:	Materials completely installed and connected.
5.	AWG:	American Wire Gage.
6.	NEC:	National Electrical Code (latest edition)
7.	NFPA:	National Fire Protection Association.
8.	OSHA:	Occupation Safety and Health Administration.
9.	UL:	Underwriters Laboratories, Inc.
10.	NEMA:	National Electrical Manufacturers Association.
11.	IEEE:	Institute of Electrical and Electronic Engineers.

D. Workmanship, Guarantee and Approval:

1. Work under this Division shall be first class with emphasis on neatness and workmanship.

2. Install work using competent mechanics, under supervision of foreman, all duly certified by local authorities. Installation subject to Architect (or) Engineer's constant observation, final approval, and acceptance. Engineer may reject unsuitable work.

3. Furnish Architect written guarantee, stating that if workmanship and/or material executed under this Division is proven defective within one (1) year after final acceptance, such defects and other work damaged will be repaired and/or replaced at no cost to the owner.

4. In event project is occupied or systems placed in operation in several phases at Owner's request, guarantee will begin on date each system or item of equipment is accepted by Owner.

E. Observations of Work and Demonstration of Operation:

1. At observations of work, open panel covers, junction box covers, pull box covers, device covers, and other equipment with removable plates for check. Provide sufficient personnel to expedite cover removal and replacement.

2. Contractor to assist Architect (or) Engineer in demonstration of operation of new systems to satisfaction of Owner. Contractor to have manufacturer available for demonstration of systems where requested by Owner.

F. Testing of Electrical Systems:

1. Test Completed work as follows:

a. Perform test required by Architect (or) Engineer to indicate compliance with specifications, drawings and applicable codes. Provide instruments, labor and materials for tests.

b. Insulation - use 1000 VDC insulation tester (0-500 megohm full-scale), equal to "Megger" as manufactured by Biddle Company. Test conductors and busses of all systems, including feeders, main service busway, branches, motors, devices, equipment, etc. Test branches for one (1) minute; test feeders, bus ducts, busses, etc., for 15 minutes with readings at one minute intervals.

c. Receptacles:

(1) Use Woodhead Ground Loop Impedance Tester. Test each receptacle. Record readings.

2. Ground Testing:

a. Testing of Made Ground Electrodes:

(1) Test Ground Systems Indicated.

(2) Using a measuring device which generates minimum of 500 VDC, calibrated in ohms (maximum 200 ohm scale) J.C. Biddle "Vibrotester" or approved equivalent.

(3) Provide test electrode in accordance with Measuring Device Manufacturer's instructions. Use ground rods

as specified in Section "Grounding".

(4) Follow instructions of measuring device manufacturer for proper results.

(5) Test grounds only when earth is dry.

(6) Record ambient temperature, date, time, approximate water table level (as obtained from local geologists); type of earth material.

3. High Potential "Hi Pot" Testing of Equipment:

a. Test cable and equipment indicated on plans or in specification. Use D.C. high potential tester, as manufactured by J.C. Biddle or approved equivalent. Test equipment used capable of producing minimum specified voltage plus 25% additional voltage.
b. Cable:

1) Test per IP CEA No. S-68-516 (NEMA WC8-1976).
2) Underwriters Laboratories Standard 1072.
3) Use voltage level as recommended by manufacturer of cable except not less than:

Cable Rating	**Test Voltage New Cable**	**Test Voltage Old Cable**
5 KV	35 KV	25 KV
8.7 KV	40 KV	30 KV
15 KV	55 KV	40 KV
35 KV	100 KV	50 KV

4. Dry Type Transformers:

a. Test in accordance with following standards as applicable:

(1) IEEE Standard 259
(2) IEEE Standard 262-1973
(3) ANSI C57.12.90.1973
(4) NEMA TRI-1968

b. Use voltage level as recommended by equipment manufacturer, except not less than:

Cable Rating	Test Voltage
600 V	1.5 KV
2.4 KV	6.1 KV
5 KV	12.75 KV
7.6 KV	19.3 KV
15 KV	38.25 KV

5. All material shall be new, with U.L. label. If U.L. label is not available, material shall be manufactured in accordance with applicable NEMA; IEEE and Federal Standards.

6. No material shall be substituted for specified, except by prior written approval of Architect. Specified catalog numbers are used for description of equipment and standard of quality only. Equivalent material given consideration only if adequate comparison data including samples are provided. Approval required prior to bid date. Bid substituted material only if approved in writing by Architect.

7. Submit to Architect within 30 days after award of contract a complete list of proposed material manufacturers. List does not preclude submission of shop drawings. Approval of manufacturer on list does not constitute approval of specific material or equipment.

G. Submittals, Shop and Erection Drawings:

1. Submit complete shop drawings for all material and equipment furnished under Division 26 of specifications, to Architect for review within (30) days after award of contract. Shop drawings shall be submitted on timely basis to allow adequate lead time for review, re-submission if necessary, manufacture and delivery to allow access of material to project at correct time based on schedule established by Architect/Contractor. Include complete descriptive data with dimensions, operating data and weight for each item of equipment. Carefully examine shop drawings to assure compliance with drawings and specifications prior to submittal to Architect. Shop drawings and submittals shall bear the stamp of approval of the Electrical and General Contractor as evidence drawings have been reviewed by both for compliance with the contract documents. Submittals without this stamp of approval will not be

considered and will be returned for proper resubmission.

2. Submittals, shop and erection drawings may be submitted as hard (paper) copies or as electronic portable document files (PDF) format.

3. Submit electronic copies as follows:
   a. Submit one (1) electronic file for review. Architect (or) Engineer will return electronic file to Contractor with comments. Contractor is responsible for reproducing the reviewed submittal for distribution.

4. Review of shop drawings does not relieve Contractor of responsibility for errors and omissions in shop drawings. Contractor is responsible for dimensions and sizes of equipment. Inform Architect in writing of equipment differing from that shown.

5. Prepare erection drawings when required by Architect (or) Engineer. Investigate thoroughly all conditions affecting work and indicate on drawing. Architect (or) Engineer will review erection drawings before work commences.

6. Provide for Owner (1) electronic copy in portable document file (PDF) format of final shop and erection drawings.

7. Coordination shop drawings are required for the following areas, drawn to a scale of not smaller than 1/4" - 1'-0":

   a. Electrical equipment rooms and areas.

   b. Electrical and mechanical equipment areas.

   c. Start drawings as HVAC shop drawings indicating all ductwork piping, equipment and locations of mechanical room floor drains, and electrical connections. Indicate elevations of all ductwork and piping. Draw sections as required to clarify congested situations.

   d. Next, the Plumbing Section shall add all piping and plumbing equipment to the drawings.

   e. Next, the Fire Protection Section shall add all sprinkler heads and fire protection piping.

   f. Next, the Electrical Sections shall add all electrical fixtures, conduit and equipment.

g. Next, the drawings shall be submitted to the General Contractor for final coordination.

h. Finally, after the General Contractor has approved the drawings they shall be submitted to the Architect for approval.

H. Cooperation:

1. Carefully coordinate work with other contractors. Refer conflicts between trades to Architect.

2. Work to be installed as progress of project will allow. Schedule of work determined by General Contractor and/or Architect (or) Engineer.

I. Maintenance and Operating Instructions for Equipment:

1. Submit to Architect data prepared by manufacturer for each item of electrical equipment completely describing equipment. Data to include parts lists, description of operation, shop drawings, wiring diagrams, maintenance procedures and other literature required for maintenance of equipment. Provide one (1) hard copy and one (1) electronic copy in portable document (PDF) format. Bind hard copy in booklet form for presentation and bind PDF copy in similar manner.

J. Record Drawings:

1. Provide "Record" drawings at the completion of job.

2. Keep a complete set of contract drawings on job and record day to day changes with red pencil. Indicate actual location of conduit systems, outlets, and equipment. Drawing set shall be maintained in good order Turn prints over to Architect at final observation.

3. Contractor shall transfer information from the marked-up record drawings to the AutoCAD files and turn both over to Architect as a part of the close-out documents.

K. Items for Owner:

1. Provide following items for Owner at time of substantial completion:
   a. Certificates of inspection and approval from authorities having jurisdiction.
   b. Written guarantees.
   c. Record drawings.

d. Final approved submittals and shop drawings, one (1) hard copy and one (1) electronic copy in PDF format.
e. Spare fuses (furnish receipt).
f. Maintenance data, one (1) hard copy and one (1) electronic copy in PDF format.
g. Affidavit of Owner Instruction (1 copy).

L. Marking:

1. Identify each starter, (including starters furnished under Mechanical Section), panelboard, cabinet, control device, breaker, disconnect and safety switch with 1/4" high black letters cut in a white laminated phenolic strip. Attach to enclosure with two (2) metal screws or with an epoxy adhesive.

2. Nameplates required for other items in this Division similar to those described above.

M. Protection and Storage:

1. Provide warning lights, bracing, shoring, rails, guards and covers necessary to prevent damage or injury.
2. Do not leave exposed or unprotected, electrical items carrying current. Protect personnel from exposure to contact with electricity.

3. Protect work and materials from damage by weather, entrance of water or dirt. Cap conduit during installation.

4. Avoid damage to materials and equipment in place. Repair, or remove and replace damaged work and materials.

5. Exercise particular care when working around telephone (electronic) equipment to prevent entrance of dust, moisture and debris into the equipment. Provide dust barriers and partitions as required.

6. Deliver equipment and materials to job site in original, unopened, labeled container. Store to prevent damage and injury. Store ferrous materials to prevent rusting. Store finished materials and equipment to prevent staining and discoloring. Store materials affected by condensation in warm dry areas. Provide heaters. Storage space on site and in building designated by Owner Architect.

7. Install equipment per manufacturer's recommendations. Conflicts between contract documents and these recommendations, referred to Architect.

N. Excavation and Backfill:

1. Excavate for work in this Division.

2. Avoid existing facilities in excavating. Contractor is responsible for repair and replacement of damaged facilities in executing work.

3. Backfill in twelve inch (12") lifts, wetted down and tamped. Compaction minimum 95% of adjacent earth.

4. Repairing to be comparable to work cut including new asphalt paving, concrete paving, sod, replanting shrubbery, etc. Architect will observe repair work, and reject unsuitable work.

O. Cutting and Repairing:

1. Cut and repair walls, floors, roof, etc., required to install work. Where work cut is finished, employ original installer of finish to repair finish. Do not cut structural members.

P. Anchors:

1. Provide anchors for all equipment, raceways, hangers, etc. to safely support weight of item involved. Anchors to consist of expansion type devices similar to "Redhead" or lead expansion anchors. Plastic anchors are not acceptable. Protect electronic equipment from drilling residue.

Q. Cleaning and Painting:

1. Clean equipment furnished in this Division after completion of work.

2. Touch-up or re-paint damaged painted finishes.

3. Remove debris, packing cartons, scrap, etc., from site.

R. "Contingency Items":

1. Provide in electrical pricing the following electrical devices or equipment including cost of labor and materials for complete installation:

a. **3** 20 amp single pole light switch complete with outlet box, coverplate and 30 feet of #12 wire in 1/2"C connected to control local lighting circuit.

b. **3** 20 amp three pole light switch complete with outlet box, coverplate and 30 feet of #12 wire in 1/2"C connected to control local lighting circuit.

c. **3** 20 amp duplex receptacle complete with outlet box, coverplate and 20 feet of 2#12 and 1#12(G)-1/2"C connected to nearest receptacle circuit.

d. **3** 20 amp double duplex receptacles complete with double gang outlet box, coverplate and 20 feet of 2#12 and 1#12 (G) – ½" C connected to nearest receptacle circuit.

e. **2** 20 to 50 amp, 3 pole breaker furnished and installed in a type 'BQL' panelboard.

f. **2** 60 to 100 amp, 3 pole breaker furnished and installed in a type 'BQL' panelboard.

g. **2** 20 to 50 amp, 3 pole breaker furnished and installed in a type 'BEF' panelboard.

h. **2** 60 to 100 amp, 3 pole breaker furnished and installed in a type 'BEF' panelboard.

i. **2** 100 amp frame, three pole breaker furnished and installed in type 'CCB' panel.

j. **3** LED exit lights edge-lit with integral battery furnished and installed with outlet box and 20 feet of conduit and wiring connected to nearest night light circuit or local lighting circuit ahead of switchleg.

2. Furnish and installed the following fire alarm system devices complete with outlet box, 30 feet of conduit, wiring and all necessary system programming required to be an integral part of fire alarm system:

a. **2** Manual pull stations.

b. **2** Ceiling mounted smoke detectors.

c. **1** Ceiling mounted fixed temperature and rate of rise heat detectors.

d. **2** Duct mounted smoke detectors complete with

housing and sampling tube.

e. **2** Audio/visual notification devices, speaker/strobe or horn/strobe, as required for project, each up to 75cd and 97 db.

3. All unused components will be turned over to Owner for attic stock.

U. Code Compliance:

1. Entire electrical installation shall comply with all aspects of code including local interpretations. This includes but is not limited to:

    a. Installation adjustment to meet all code clearances between electrical such as ductwork, other HVAC, plumbing, fire protection, and structural systems.

    b. Locations for items such as fire alarm initiating and signaling devices, exit lights, emergency egress lighting, disconnect switches, etc.

2. No additional compensation will be allowed for code compliance. Notify Architect of difficulty encountered for assistance.

END OF SECTION 26 00 10

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SECTION 26 05 30 – COORDINATION

PART 1 - GENERAL

1.1 PURPOSE

A. The contractor is responsible for coordinating system(s) installation and equipment requirements with other trades to avoid conflicts and to ensure that proper electrical connections are provided for equipment furnished by others. Failure to do so will not be considered as justification for additional cost.

1.2 COORDINATION WITH OTHER TRADES

A. Contract drawings contain diagrammatic layouts and indicate general arrangement of equipment, system components, devices, boxes, conduit, etc.

B. Prior to installation of material and equipment, review and coordinate work with Architectural, Structural, Mechanical, Plumbing, Fire Protection drawings and other Division work for exact space conditions; where not readily discernable request information from Architect before proceeding.

C. Check Drawings of all other trades to verify extent of material and equipment to be installed in spaces available and consider layout alternatives so that all requirements can be accommodated.

D. Maintain maximum headroom at all locations without finished ceilings.

E. Maintain finished ceiling heights as indicated on Architectural reflected ceiling plans, and building sections and elevation drawings.

F. Coordinate installations with other trades prior to proceeding to prevent conflict with work of other trades and cooperate in making reasonable modifications in layout as needed.

G. Where conflicts occur with placement of mechanical and electrical materials as they relate to placement of other building materials, the Architect shall be consulted for assistance in coordination of the available space to accommodate all trades.

H. Coordinate equipment installation to maintain manufacturer and code required working clearances.

1.3 PRIORITY OF CONSTRUCTION SPACE

A. Following is the Order of Priority for Construction Space:

1. First: Ductwork.
2. Second: Fire protection piping.
3. Third: Other piping.
4. Fourth: Conduit.

1.4 COORDINATION DRAWINGS

A. This Contractor, in cooperation with the General Contractor and other trades, shall prepare a scaled digital drawing using the latest edition of AutoCAD.

1. The construction documents in their original form, copies or electronic file, are the Architect's instrument of service and are protected under copyright laws. The reproduction of these documents for use as coordination drawings or shop drawings is prohibited without the Architect's written consent and authorization.

B. Each specialty trade listed below shall insert information on separate and unique layers relative to their work with appropriate elevations and grid dimensions.

C. Each specialty trade shall sign and date the coordination drawing after the addition of his information.

D. Fabrication shall not start until receipt of completed coordination drawings is acknowledged by the Contractor in writing to the Architect.

E. Specialty Trades:
1. Ductwork
2. Fire protection piping
3. Other piping
4. Electrical
5. Plumbing piping to include but not limited to sanitary, vent, pressure storm, natural gas, etc.

F. Coordination drawings showing all equipment, switchboards, panelboards and conduit (2" and larger), ductwork, piping required for all mechanical rooms, electrical rooms, equipment rooms, corridors, horizontal exits from duct shafts, cross-overs and any other areas where congestion of work may occur.

G. Coordination Schedule Drawing:

1. The electrical contractor shall obtain from the mechanical, plumbing, fire protection contractors a schedule drawing providing

the electrical characteristics of all MP/FP equipment requiring electrical connection. The information provided shall include:

a. Unit Designation
b. Voltage
c. MCA
d. MOCP/MFS
e. FLA
f. Disconnect
g. Requirement Starter
h. Requirement
i. Alarm Wiring Requirements

2. The electrical contractor, shall review the Coordination Schedule Drawing and all pertinent electrical accommodations indicated.
   a. Breaker size.
   b. Wire size / conduit size.
   c. Disconnect with fuse size.

3. Once the coordination schedule is completed forward to the engineers for review and approval.

H. Conflicts that arise due to the fact that the coordination schedule drawing was not completed shall be the sole responsibility of the contractors. All costs for correction or remedial work shall be done at the contractor's expense. No added cost to the owner will be allowed.

END OF SECTION 26 05 30

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SECTION 26 05 15 - CONDUCTORS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Furnishing, installing and testing 600 Volt conductors for lighting, power, and auxiliary systems.

B. Furnishing, installing and testing 600 Volt conductors for 2 hour fire rating.

PART 2 - PRODUCTS

2.1 CONDUCTORS:

A. 98% conductivity copper; #12 AWG minimum; #10 AWG and smaller solid, #8 and larger stranded.

B. Conductors furnished with NEC, 600 volt, insulation as follows:

Dry locations:
6 AWG and smaller - type THW, THWN or XHHW (do not intermix in circuits)
4 AWG and larger - type RHH-RHW-USE (cross linked polyethylene)]
Wet locations: type RHH-RHW-USE
2 Hour Fire Rating - type RHH UL 2196, UL 44 and F417 #25

C. Wiring for controls and auxiliary systems #14 AWG stranded minimum with NEC type THWN insulation.

D. Luminaire Wire: Incandescent - Use type SF-2, #16 for luminaires up to 300 watts, and #14 over 300 watts, except for luminaires in concrete pour use #12 or larger or as shown. Conductors in channels of, and flex to fluorescent luminaires type THHN or XHHW.

E. Ungrounded System Wiring: All wiring connected to the secondary side of isolating transformers: Cross-linked polyethylene insulation with dielectric constant of less than 3.5; 30 mills minimum thickness, resistance constant greater than 20,000 at 60 degrees F, shall be suitable for wet and dry locations. Cable - G.E. No. SI-58053 or approved equivalent.

F. Color Code as follows and/or per local ordinances. Conductors #10 and

smaller with colored insulation. For conductors #8, and larger color code with colored pressure sensitive tape. Apply minimum 2" of tape to each individual phase or neutral conductor in half lapped pattern. The equipment ground conductor shall be taped green for its entire exposed length. Color-code as follows:

Phase	120/208 V
A	Black
B	Red
C	Blue
Neutral	White
Equip. Ground	Green

G. Manufacturers of copper conductors: Pirelli, Phelps Dodge, Capital Cable, Rome Southwire, Senator, Essex, American, or approved equal.

H. Manufacturers of 2 Hour rated conductors “LIFELINE” 2 Hour fire rated RHH.

PART 3 - EXECUTION

A. Install wiring complete with connections to equipment.

B. No wiring installed until after plastering and similar work is complete and dry.

C. Install wiring so conductors are not in tension in completed system.

D. Form wiring neatly and group in circuits. Tie grouped conductors with nylon ties, T&B "Tyrap" or approved equal.

E. Use pulling compound of Ideal "Yellow 77", Minerallac No. 100, or approved equal. Do not use pulling compound for circuits on secondary side of ungrounded isolation transformers.

F. Join and terminate copper conductors individually.

1. Lugs in damp locations connected to copper bus: 98% conductivity copper or bronze Thomas & Betts "Locktite", Burndy "QA" or approved equivalent.

2. Lugs in damp locations connected to copper bus: Solid 98% conductivity long copper barrel, tin plated, compression type connectors, Thomas & Betts color keyed, Burndy "Hydent" or approved equal; applied with appropriate hydraulic tool.

3. Lugs in dry locations and lugs connected to aluminum bus - heavy casting aluminum, CU/AL rated, listed under UL Standard 486B, rated 90 degrees C; plated to prevent electrolysis, Thomas & Betts, Blackburn, Ilsco or approved equivalent.

G. Provide lugs where not furnished as part of equipment -furnish as specified above, to connect all conductors.

H. Furnish lugs for conductors #2/0 and larger with two bolt tongue or approved equivalent.

I. Make conductor taps #8 and larger from a second conductor with 98% conductivity bolted insulated connector, T&B "IDT", Ilsco "KUP-L-TAP" or approved equivalent. Insulate splices with 600 volt "heat shrink" covers T&B or equal.

J. Splice conductors #8 and larger with solid copper barrel, type fittings applied with an appropriate hydraulic tool. Splices used only where approved. Splice fittings: Burndy "Hydent". Insulate splices with 600 volt "heat shrink" covers T&B or equal.

K. Joints #10 and smaller: T&B Sta-Kon wire joints EPT66M, with insulating caps, installed with WT161 Tool or C nest of WT11M Tool; Ideal Super/Nuts; Ideal Wing Nuts; 3M "Scotchlock" or Buchanan Electric Products B Cap or Series 2000 Pressure connectors complete with nylon snap on insulators installed with C24 pressure tool. Where conductors are connected to screw terminals, use nylon insulated, locking fork, T&B Sta-Kon or approved equal. Where joints are made in damp or wet locations insulate splices with 600 volt "heat shrink" covers T&B or equal.

L. Provide cable supports: As required by NEC. Supports with malleable screwed conduit fitting and non-conductive wedges drilled for the conductors; O.Z. Manufacturing Company or approved equal. Furnish

pullbox, sized per NEC for each cable support.

M. Bond circuit ground wires where installed to all devices, equipment, outlet and junction boxes, and grounding bushings (where provided) with a full size conductor and screw type connection.

N. Securely fasten non-ferrous identifying tapes, pressure sensitive labels or engraved nameplates to all cables, feeders and power circuits in vaults, pull boxes, manholes, switchboard rooms, terminations of cables, etc.

O. Mark all branch circuit conductors at panel terminations including neutrals with pressure sensitive numbers to correspond to circuit numbers connected.

P. Connect circuits and feeders as shown on drawings. Drawings are diagrammatic and do not show every detail required in the wiring system. Detail wiring accomplished per NEC.

Q. All conductors making up parallel feeders to be same size, same type, and same insulation, all cut same length. Bond each group of conductors making up a phase or neutral at both ends in an approved manner.

R. DO NOT COMBINE CIRCUITS unless specifically approved by the Engineer. No more than 3 phase or current carrying conductors in a circuit.

END OF SECTION 26 05 15

SECTION 260521 – GROUNDING

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. Grounding Details

PART 2 - PRODUCTS

2.1 SYSTEM GROUNDING:

A. Bond and ground main service neutral, cabinets, equipment, conduits, metallic piping systems, etc., per the latest edition of NEC.

B. Ground conductors - 98% conductivity copper, either bare or with green THW insulation. Other conductor requirements same as described for low voltage, 600 volts, conductors.

C. Ground Connections:

1. Make with mechanical connectors where accessible and with "Cadweld" or approved equivalent where inaccessible.

2. Use high alloy cast copper and/or silicon bronze mechanical connectors with Hex or Allen head bolts where permitted.

3. Use Burndy "GAR" or approved equivalent.

4. Size as required for piping connections.

5. Thoroughly clean prior to installation of clamps and/or lugs.

6. Use bolted or screwed on mechanical connectors. Do not use clip-on connections.

7. Bond ground conductor to metal raceway at each end of the run.

8. Seal connections between dissimilar metals (i.e.: bronze to steel), with approved epoxy resin.

9. Coat connections with "No-OXID-A" compound as manufactured by Dearborn Chemical Company.

D. Provide lighting and power circuits larger than 20 amperes with green covered ground wire sized per NEC, or as shown, except not smaller than

#12 AWG. Bond ground wire to all outlet boxes, junction and pull boxes, cabinets, equipment, etc., with self-tapping screw or bolt and appropriate lug. See Section covering "Raceways" for use of grounding bushing.

2.2 DRIVEN GROUND SYSTEM:

A. Provide driven ground rods and buried ground conductor interconnecting ground rods as shown on drawings and required by code.

B. Ground rods 3/4"x10'-0" copper clad steel, Thompson #558 or approved equal]. Ground rods installed with tops driven to 1'-6" minimum below grade. Connect ground wire to ground rod with Cadweld or equal.

C. Exterior buried ground conductor #2/0, soft drawn, bare, tinned copper, installed 2'-0" minimum below grade.

D. Bond all masses of metal, i.e.: pipes, conduits, fence posts, etc., within 6'-0" of the buried ground conductor to ground conductor with #6 AWG bare, solid, tinned copper wire, attached to object with appropriate clamp, lug, etc., (Cadweld or equal). Obtain complete set of drawings to determine quantity and location of required connections.

E. All connectors lugs, hardware, etc., for building ground system similar to that for other grounding as described above.

PART 3 - EXECUTION

3.1 EQUIPMENT GROUND 'GREEN WIRE CONCEPT':

A. Ground electrical equipment enclosures and conductor enclosures including metal raceways, outlet boxes, cabinets, switch boxes, motor frames, diesel engine frame, transformer cases, metallic piping systems such as water, gas, waste, air and metallic enclosures for all electrical equipment.

B. Provide separate grounding conductor for all circuits to insure adequate ground fault return path.

C. Install separate ground conductors in conduit.

D. Bond green wire to equipment enclosure at source and at apparatus served.

E. Insulate grounding conductors size to carry ground fault current safely. Minimum size for green wire grounding lead per N.E.C. or as indicated.

F. Do not use grounded current return conductors (neutrals) for equipment grounding. Connect common grounding lead to supply side of service disconnect unit only.

G. Do not ground neutral conductor after it has been grounded at service entrance, transformer or generator.

H. Maintain electrical continuity of conduit systems by threaded fittings with joints made-up wrench tight. Install insulated bushing and locknuts on terminating conduits. Provide conduits containing ground wires with grounding bushings bonded to ground wire with short full size jumper.

I. Provide receptacles with approved green covered bonding jumper from the grounding terminal screw connected to outlet box.

J. Install ground rods in quantity to provide a maximum of [5] ohms ground resistance. Where multiple rods required, separate a minimum of 6 feet and interconnect with wire of ground size shown.

K. Test ground systems as specified in Section 16010.

L. Install tags on ground connections to piping or electrode systems for all telephone equipment grounds.

END OF SECTION 260521

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SECTION 26 05 30 – FIRESTOPPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Firestopping materials and accessories.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. Section 260010……..Basic Electrical Requirements
B. Section 260531……..Raceways

1.3 CODES AND STANDARDS

A. International Building Code.

B. Underwriters Laboratories - Fire Resistance Directory

1. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials (UL723).

2. ASTM E119 - Method for Fire Tests of Building Construction and Materials (UL263).

3. ASTM E814 - Test Method of Fire Tests of Through-Penetration Firestops (UL1479).

1.4 QUALITY ASSURANCE:

A. Fireproofing Materials:

1. ASTM E119 and/or ASTM E814 to achieve a fire rating as noted on Drawings.

2. All fireproofing shall be UL classified for the appropriate UL system number.

B. Surface Burning:

1. ASTM E84 with a flame spread smoke developed rating of 0/5.

C. Manufacturer:

1. Company specializing in manufacturing the products specified in this Section with minimum three years experience.

1.5 SUBMITTALS:

A. Submit under provisions of Section 260010 - Electrical General.

B. Product Data: Provide data on product characteristics, performance and limitation criteria.

C. Manufacturer's Installation Instructions: Indicate preparation and installation instructions. Include the UL System Numbers which apply to each application.

D. Conform to applicable code for fire resistance ratings and surface burning characteristics.

E. Provide certificate of compliance from authority having jurisdiction indicating approval.

F. Provide mock-up of applied firestopping material for each type of application.

G. If accepted, mock-up will demonstrate minimum standard for the work.

H. Mock-up may remain as part of the work.

I. Do not apply materials when temperature of substrate material and ambient air is below 40 degrees F.

J. Maintain this minimum temperature before, during, and for 3 days after installation of materials.

K. Provide ventilation in areas to receive solvent cured materials. Use water based materials in occupied areas.

L. Sequence work to permit firestopping materials to be installed after and surrounding work is complete.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, grade, and UL label where applicable.

B. Coordinate delivery with scheduled installation date to allow minimum storage time at site.

C. Store materials in clean, dry, ventilated location. Protect from soiling, abuse, and moisture. Follow manufacturer's instructions.

1.7 GUARANTEE:

A. Submit copies of written guarantee agreeing to repair or replace joint sealers which fail in adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability or appear or deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated. The guarantee period shall be one year from date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. 3M brand CP25 Fire Barrier Caulk, CS195 Composite Sheet, FS195 Wrap/Strip, RC-1 Restricting Collars, Interim Fire Dam 150 caulk or moldable putty. Other approved manufacturers are GE "Pensil" Systems and Dow Corning Fire Stop Systems.

B. Primer: Type recommended by firestopping manufacturer for specified substrate surfaces.

2.2 ACCESSORIES:

A. Dam Materials: Mineral fiberboard, mineral fiber matting, sheet metal or alumina silicate fire board.

PART 3 - EXECUTION

3.1 GENERAL:

A. Verify site conditions.

B. Verify that openings are ready to receive the Work of this Section.

3.2 PREPARATION:

A. Clean substrate surfaces of dirt, dust, grease, oil, loose materials or other matter which may affect bond of firestopping material.

B. Remove incompatible materials which affect bond.

3.3 INSTALLATION:

A. Install penetration seal materials in accordance with printed instructions of the UL Fire Resistance Directory and in accordance with manufacturer's instruction.

B. Seal holes or voids made by penetrations to ensure an effective smoke barrier.

C. Where floor openings without penetrating items are more than four inches in width and subject to traffic or loading, install fire stopping materials capable of supporting same loading as floor.

D. Protect materials from damage on surfaces subject to traffic.

E. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas.

F. Keep areas of work accessible until inspection by applicable code authorities.

G. Perform under this section patching and repairing of fire stopping caused by cutting or penetration by other trades

H. Install backing materials to arrest liquid material leakage.

3.4 APPLICATION:

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

B. Apply firestopping material in sufficient thickness to achieve rating to uniform density and texture.

C. Install material at floors, walls or partition openings which contain penetrating sleeves, piping, ductwork, conduit and other items requiring firestopping.

3.5 CLEANING:

A. Clean up spills of liquid components.

B. Neatly cut and trim materials as required.

C. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

D. Protect finished work.

E. Protect adjacent surfaces from damage by material installation.

3.6 SYSTEMS AND APPLICATION SCHEDULE:

Construction Condition	UL Designation
Metal Pipe or Conduit	C-AJ-1001, C-AJ-1007, C-AJ-1027, C-AJ-1044
Through Round Opening	W-J-1010
Metal Pipes or Conduits	C-AJ-1001, C-AJ-1006, C-BJ-1020, C-BJ-3017,
Through Large Opening	C-AJ-1044, W-J-1010
Busway Through Rectangular	F-A-6001, C-AJ-6001
Cables Through Opening	C-AJ-3021, C-AJ-3030
Cable Tray	C-AJ-4003
Blank Opening	C-AJ-0004, C-AJ-0009
Metal Pipe or Conduit Through Gypsum Board Wall	W-L-1001, W-L-1016
Cables Through Gypsum Board Wall	W-L-3001
Metal Pipe or Conduit Through Wood Construction	F-C-1002

A. The following sections have applications for fire ratings less than 2-hours: C-AJ-2001, C-AJ-5001, WL-L-1001, W-L-2002.

B. The following sections have applications for fire ratings of 4-hours: C-AJ-5001, C-AJ-1007, C-BJ-1020, and C-BJ-3017

C. All sections (including those previously listed) listed have applications for fire ratings of 2-hours or less.

END OF SECTION 26 05 30

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SECTION 26 05 31 – RACEWAYS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Installation of raceway systems and necessary fittings for all work in Division 26.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Metallic Raceways:

1. Republic
2. Wheatland
3. Allied
4. Clifton
5. Triangle
6. Walker
7. Western
8. AFC

B. Non-Metallic Raceways:

1. Carlon
2. National Pipe & plastics
3. Can-Tex
4. Allied

C. Fittings

1. Thomas & Betts
2. Hubbell: RACO; Killark
3. Appleton
4. Midwest
5. EFCOR
6. OZ Gedney
7. Bridgeport
8. AFC

2.2 RACEWAYS

A. Rigid galvanized steel conduit:

1. Conform to ASA Standard C80.1 and U.L. Standard No. 6 for rigid metallic conduit, except hot dipped galvanized after threading.

2. Fittings, ells, couplings, etc., galvanized threaded type meeting above standards. Threadless fittings not allowed.

3. Terminate rigid conduit with two locknuts, one inside, one outside of the cabinet, junction or outlet and a bushing. Bushing - malleable iron with smooth bakelite ring molded into edge of bushing to prevent damage to cable, OZ Mfg. Co., type "B" or

approved equal.

4. Where grounding bushings are required, construction of bushing similar to above except a lug provided for grounding connection, OZ type "BLG" or approved equal.

B. Rigid intermediate grade conduit, IMC, to conform to UL Standard No.1242; hot dipped galvanized or approved equivalent.

1. All fittings, ells, couplings, etc., constructed to same standards as rigid steel conduit. Fittings - threaded type with all threads engaged. Use "Uni-swivel" couplings in dry locations only.

2. Conduit terminations same as rigid steel conduit.

C. Flexible steel conduit:

1. Greenfield", continuous spirally wound and inter-locked, threadless, galvanized conforming to U.L. and CSA Standards for flexible steel conduit.

2. Connectors and fittings galvanized steel, threadless type with insulated throats, U.L. approved for grounding means.

D. Liquid tight flexible steel conduit constructed similar to flexible steel conduit above, except with polyvinyl chloride jacket.

1. Fitting Assembly - sealing type, with steel gland, nylon ring and ground cone inside locknut. All fittings with insulated throat, U.L. approved for grounding means.

E. Electrical metallic tubing, EMT, threadless, steel type conforming to ASA Standard C80.3 galvanized inside and out, and with additional corrosion resistant finish.

1. Fittings, connectors, couplings, etc., insulated throat ![galvanized steel, rain tight, compression type;] ![galvanized steel screw indenter].

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install conduit as follows:

1. Use rigid steel or intermediate grade conduit for:

a. Circuits run underground.

b. Circuits run in concrete in contact with earth.
c. Circuits in hazardous and wet locations.
d. Circuits exposed to mechanical damage.
e. All feeders (3" diameter and larger).
f. All motor circuits.

3. Use electrical metallic tubing, EMT, for:
   a. Branch circuits (conduit 2-1/2" diameter and smaller) in dry locations.
   b. Telephone circuits.
   c. Auxiliary systems and controls (low voltage systems such as fire alarm, telephone/data systems, etc.)
   d. Feeders run overhead in dry locations. Branch circuits in concrete slab above slab on grade.

4. Use PVC conduit for:

   g. Circuits run underground where indicated.
   h. For branch circuits in concrete slab.
   i. Where specifically shown on drawings.
   j. No PVC shall be exposed.

5. Use type EB conduit for exterior concrete encased application where shown.

B. Size conduit per NEC. Minimum size 3/4" diameter, but no more than three (3) #12 installed in 3/4" conduit.

C. Run conduit concealed where possible. Run concealed conduit above furred ceiling in an orderly manner. Multiple conduits grouped and run parallel.

D. In concrete slab: Install conduits in center of concrete slabs and tie to reinforcing steel with tie wires. Do not install conduit larger than 1" in concrete slabs unless approved by Engineer. Install with minimum of 2" between parallel runs. Do not cross conduits in slab unless necessary, then only one conduit crossover in 12" space.

E. Exposed Conduit: Use only where specifically shown or approved. Run perpendicular to building walls and partitions and tight against structure. Conceal vertical portion of conduits where possible.

F. Paint underground metal conduit with 2 coats of asphaltum or bituminous. Make underground conduit fittings watertight using Teflon tape. Do not use split couplings and similar fittings underground and exposed to moisture. Run underground conduits minimum 24" below grade. Do not run conduit in slag fill.

G. Paint conduit fittings and threads exposed to moisture with Rustoleum silver paint after installation.

H. Furnish offsets required to meet field conditions. Make bends in conduit in accordance with the National Electrical Code, except make minimum radius of 6 times conduit diameter or 6" whichever is greater. Bend IMC conduit without deforming.

I. Where conduit crosses expansion joints, install expansion type fittings OZ type EX with bonding jumper or approved equal.

J. Make connections to equipment away from wall with conduit extensions exposed from ceiling to floor, anchored with floor flange and/or angle frame as required. Make connections to equipment with flexible conduit from tee condulet in conduit riser.

K. Vibrating equipment and equipment requiring adjustment, i.e.: motors, transformers, etc: make final connections with flexible conduit.

L. Isolate conduit connections to equipment on roof from roof penetration of conduit with short section of flexible conduit between roof penetration and equipment.

M. Use liquidtight flexible conduit where exposed to moisture, oil, etc.

N. Install conduit to avoid hot water pipes. Maintain 9" clearance of such pipes, unless closer crossings are unavoidable. Maintain minimum 1" clearance from covering of pipe crossed.

O. Support conduit per NEC. Support individual conduits with galvanized hangers and rods as follows:

1" diameter and smaller.....¼" dia. rod
1-¼" to 3" diameter.....3/8" dia. rod
Larger than 3" diameter..... ½" dia. Rod

P. Individual conduit hangers - Minnerallac, or approved equal. Support EMT near each joint. Support for multiple conduit runs consist of Uni-strut channel as required with 1/2" diameter galvanized bolts or rods anchored to structure. Provide "U" bolt clamps for each conduit on hangers. Support vertical riser conduits with galvanized bolted clamps at each floor. Do not support conduit to ceiling support system.

Q. Terminate conduits entering sheet metal boxes with double locknuts and bushings. Terminate conduit exposed to moisture with watertight hubs.

R. Install appropriate seal-off where conduits exit hazardous areas, areas of temperature differential etc.

S. Where ground conductor installed in conduits 1-1/4" and larger provide grounding bushings, and bond full size ground wire to bushings and from bushing to box or cabinet. Bond with self-tapping screw and appropriate lug. Where ground wires are run in smaller conduits, bond to outlet and junction boxes with self-tapping screw lug. Provide other conduits with non-grounding bushings as described under another article. Provide all service entrance metallic raceways with grounding bushing and bond to ground bus; bond sized per N.E.C.

T. Install aluminum conduit using "No-OXID-A" compound (Dearborn Chemical Company) on all threads.

U. Conduit work in hazardous areas, or areas with large temperature differential: Use rigid steel or IMC conduit with sealing fittings, poured with hardening compound after conductors are pulled-in. Seals installed per NEC. Conduit seals Crouse-Hinds type EYS or approved equal.

V. PVC Conduit Installation:

1. Above ground: Allow for expansion and contraction.

2. Below grade: Encase in 3" sand fill. Backfill free of large rocks and debris.

3. Make elbows, bends, etc. with heated bender when factory bends are not available. When below slab, provide rigid elbows.

4. Make cuts with hacksaw and deburr ends.

5. Make joints as follows: Clean outside of conduit to depth of socket, and inside of socket with approved cleaner. Apply solvent cement to interior of socket and exterior of conduit, Insert conduit in socket and rotate 1/4 to 1/2 turn and allow to dry.

6. Where non-metallic conduit is used for power wiring install insulated ground wire, sized per NEC unless shown larger.

W. Sleeves:

1. Provide sleeves for raceways penetrating floor and structural members. Sleeves consist of Electrical Metallic Tubing set in forms. (Exception: Use Schedule 40 PVC for individual ground conductors).

2. Size sleeves to allow 1/2" clearance around raceway extending

from bottom of floor construction to 2" above floor, minimum sleeve size 2-1/2" diameter. After raceways are installed, seal space between the raceway and sleeve with non-hardening, fireproof, compound, CTC PR-855 sealant, T&B "Flame Safe" for 2 hour fire rating or approved equal.

END OF SECTION 26 05 31

SECTION 26 05 32 - OUTLET BOXES, JUNCTION BOXES AND GUTTERS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Outlet, junction boxes, conduit bodies, wiring gutters and their installation.

PART 2 - PRODUCTS

2.1 OUTLET AND JUNCTION BOXES

A. Provide outlet boxes for all wiring devices, fixtures and special system outlets.

1. Use galvanized steel for concealed boxes and exposed boxes in dry locations where conduit or 'MC' cable is used.

2. Use cast iron conduit fittings similar to "Condulets" or "Unilets" with threaded hubs for exposed boxes outside and exposed to moisture.

B. Metallic Outlet Boxes: Use for concealed and exposed outlets for lights, switches, wall receptacles, etc. where metallic conduit and armored (AC) cable metal clad (MC) cable are used. Provide standard galvanized steel outlet box with plaster rings where required.

1. Provide 1/16" thick boxes and covers of form and dimension suitable for its specific use and location, kind of fixture to be used and number, size and arrangement of connecting conduits.

2. Provide 3/8" fixture studs where required.

3. Ceiling Outlet Boxes: 4" octagonal or 4-11/16" square and 2" deep minimum. Plaster rings not required for ceiling outlet unless needed for device.

4. Switch and receptacle outlet boxes: For single devices use 14 cubic inch, 2 ¾" deep boxes with with plaster rings as necessary. Provide multi-gang boxes where shown or required.

5. Telecommunications outlets: Use double gang box with single gang plaster ring. Where double gang device plate is required use double gang plaster ring.

6. Steel City, Appleton, Raco, Bowers or approved equivalent.

C. Use surface type weatherproof boxes with appropriate gasketed cover for surface mounted wall outlets in the parking garage and other areas with surface mounted conduit and exposed to moisture conduit. Red Dot, Raco, Appleton or approved equal.

D. Use surface type galvanized steel handy/utility boxes for surface mounted wall outlets in areas with exposed EMT conduit with not exposed to moisture. Steel City, Raco, Appleton or approved equal.

2.2 LARGE JUNCTION BOXES

A. Furnish pull, tap and cable support boxes required by NEC for excessive number of 90 degree conduit bends, conductor taps and cable supports.

1. Box construction per NEC and manufactured with galvanized sheet steel, 12 gage minimum, with angle iron frame where required for rigidity; welded or bolted construction. Install bolts to prevent damage to cables in box.

2. Boxes with removable screw type covers and plated screws. Provide split covers where necessary for access. Maximum single piece cover - 36" x 36".

3. Provide separate junction boxes for each feeder. If conduit is installed so separate junction boxes are not practical, one large pull-box may be used with each set of feeder conductors separated by 12 gage steel barriers. Furnish junction box or each compartment in junction box with ground lug for connection of ground wire.

2.3 CONDUIT BODIES

A. Conduit bodies shall be installed to provide ease of pulling conductors and to provide neat appearance of conduit installation, and as shown on drawings. Conduit bodies constructed of malleable iron or copper free aluminum castings. Bodies shall be finished with standard durable exterior coatings of manufacturer specified. Provide rollers in type "C" and type "LB" bodies, 1-1/4" size and larger. Provide gasketed plated steel or malleable iron covers.

B. Conduit bodies shall be manufactured by Crouse-Hinds, Pyle National, Killark, Appleton or approved equivalent.

2.5 SURFACE METAL RACEWAYS:

A. Where indicated on the drawings, wiring shall be run in exposed surface metal raceways complete with outlet boxes and fittings. All circuits run in surface metal raceways shall have a ground conductor with

green insulation sized per the NEC, but not smaller than No. 12 AWG screw connected to each outlet box. All wiring in surface metal race ways shall be type "THWN: conductors.

PART 3 - EXECUTION

3.1 INSTALLATION OF OUTLET BOXES

A. Fasten outlet boxes securely to structure.

B. Set all flush outlet boxes so edge of device flange is flush with finished surface.

C. Open no more knockouts in outlet box than required. Any un-used openings in the box shall be plugged.

D. Seal boxes during construction.

E. Stagger back to back boxes 3" minimum. In rated walls use appropriate U.L. spacing.

F. Coordinate and verify rough-in location and mounting height of all boxes with drawings and other trades prior to installation.

G. Where code requires maximum spacing of receptacles the contractor is responsible for adjusting rough-in locations as required to ensure compliance.

H. Support All Boxes:

1. Outlet boxes - with 1/4" diameter galvanized rods or bolts anchored to structure.

2. Outlet boxes for surface mounted luminaires on furred ceilings with 3/4" channel iron fastened to ceiling channels. See Section covering "Luminaires".

3. Pull, junction and cable boxes with 3/8" diameter galvanized rods or bolts (4 minimum).

4. Support outlet boxes in steel stud partitions with Caddy "BHA" bar hangers or approved equivalent.

I. Install adjacent outlets at different levels in one vertical line where possible.

J. Provide green covered bonding jumper, screw connected to outlet box in

all receptacle boxes.

K. Paint wiring connections in ground mounted outlets or floor outlets in wet locations with "Scotchkote" and fill box with "Duxseal".

L. Mark outlet box covers with permanent ink markers to indicate circuit number(s) and panel of origination. Use black markers for normal service circuits and orange for emergency service.

M. Use 4" octagonal boxes with blank covers for master outlets, installed to permit installation of collars by others.

N. Where outlet boxes installed in unfinished concrete walls or columns, provide 1" deep plaster ring with box and ring set in position before the concrete is poured so concrete will fill around the ring and cover plate can be installed flush with the unfinished surface. In case of brick walls, follow same procedure with mason filling around the plaster ring with mortar.

O. Install all outlets located on columns on centerline of column and bend or shift reinforcing so that the outlet box will be flush with the finished concrete. Provide plaster rings as required so that the plate is flush with the finished plaster or exterior concrete surface.

P. Where outlets installed in waterproofed columns or walls, provide 6"x6"x3" deep wood box placed in the forms before concrete is poured. Box will be removed before waterproofing is applied. General Contractor will waterproof wall and opening, after which Electrical Contractor will install outlet box. General Contractor will grout around box. Set boxes carefully so that cover plates will be flush.

Q. Install conduit bodies where shown or where required for sharp bends and/or aesthetics in raceway system. Do not use in lieu of pullboxes except in limited space or as directed by Engineer.

3.2 INSTALLATION OF JUNCTION BOXES:

I. All junction boxes shall be accessible.

J. Securely fastened to structure.

K. Exterior below grade boxes shall be embedded 6" of concrete on sides and bottom. Top shall be level with finished grade unless shown otherwise.

L. There shall be no more knockouts opened in any box than are actually required.

M. Protection during construction.

N. Provide identification (See Section 26 00 10).

END OF SECTION 26 05 32

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SECTION 26 05 73 – SHORT CIRCUIT, PROTECTIVE DEVICE COORDINATION ARC-FLASH STUDY

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide a short circuit, protective device coordination arc-flash study for the electrical distribution systems. Verify specified and supplied equipment are properly rated, correctly applied, within industry and manufacturer's tolerances.

B. The short circuit study shall include all portions of the electrical distribution system from normal and alternate sources of power throughout the distribution system down to the smallest protective device. The short circuit study shall consider operation during normal conditions, emergency power conditions, and other operations which could result in maximum fault conditions.

C. The Coordination study will determine correct settings for protective devices which minimize damage caused by an electrical fault and allow for selective coordination between devices. The coordination study shall include closest upstream utility protective device down to panelboard main, branch, or feeder circuit breakers. Coordination study shall consider operation during normal conditions, and during emergency power conditions including emergency generator response

D. The arc-flash study will determine the resultant available arc- flash value available to all distribution devices.

E. STUDIES shall be accomplished using software equal in SKM methodology.

F. Study is subject to review by engineer of record and may require revision / modification as directed by engineer without any additional cost.

1.2 QUALIFICATIONS

A. Manufacturer of electrical distribution equipment shall preform studies using a qualified Professional Registered Engineer employed by manufacturer of equipment with at least 10 years experience in preforming power systems studies.

PART 2 - EXECUTION

2.1 IMPEDANCE ONE-LINE DIAGRAM

A. Create an impedance one-line diagram. All electrical equipment wiring to be protected by the overcurrent devices installed under this project and each location where the fault current will be calculated shall be shown. Clearly show, on the one-line, the schematic wiring of the electrical distribution system.

B. Show reference nodes on the one-line diagram referring to a formal report, to include the following specific information:

1. X/R ratios, utility contribution, and short circuit values (asymmetrical and symmetrical) at the bus of the main service, and all downstream equipment containing overcurrent devices.

2. Transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.

3. Voltage at each bus.

4. Identifications of each bus.

5. Conduit material, feeder sizes, and length.

2.2 SHORT CIRCUIT STUDY

A. Pertinent data, rationale employed, and assumptions in developing the calculations shall be incorporated in the introductory remarks of the study.

B. The study shall be in accordance with applicable ANSI and IEEE Standards.

C. Determine the available 3 phase short circuit and ground fault currents at each bus. Incorporate the motor contribution in determining the momentary and interrupting ratings of the protective devices.

D. Present the data determined by the short circuit study in a table format. Include:

1. Node & Device identification.

2. Operating voltage.

3. Type of Protective device. (i.e. fuse, molded case circuit breaker.etc.)

4. Device short circuit rating.

5. Calculated maximum short circuit current, 3 phase and ground fault, asymmetrical and symmetrical, and X/R ratio.

6. De-rate the devices where the tested X/R ratio is less than the calculated X/R ratio.

7. Comments section indicating that device is underrated.

8. Preparer of study shall obtain all input data from utility, contractor or other manufacturers.

9. SERES RATINGS ARE NOT ALLOWED, All devices/components shall be fully rated

2.3 PROTECTIVE DEVICE COORDINATION STUDY

A. Obtain available fault current from utility company or other manufacturers as required.

B. The study shall adhere to all requirements of the current National Electrical Code.

C. The coordination study shall include the closest upstream utility protective device down to the panelboard main, branch, or feeder circuit breakers. Prepare the coordination curves to determine the required settings of protective devices to assure selective coordination.

D. The phase and ground overcurrent protection shall be included, as well as settings for all other adjustable protective devices.

E. Graphically illustrate on log-log paper that adequate time separation exists between devices. Sufficient curves shall be used to clearly indicate the coordination achieved between devices. Reasonable coordination intervals and separation of characteristic curves shall be maintained. Plot the specific time-current characteristics of each protective device in such a manner that the upstream devices will be clearly depicted on the sheet.

F. The plots shall include complete titles, representative one-line diagram and legends, associated power company's relays or fuse characteristics, and complete parameters of transformers. There shall be a maximum of eight protective devices per sheet.

G. The following specific information shall also be shown on the coordination curves:

1. Device identifications.

    a. Time and current ratio for curves.

    b. Fuse, circuit breaker, and relay curves, showing complete operating bands of low-voltage circuit breaker trip curves. Cable damage curves.

    c. ANSI transformer magnetizing inrush and withstand curves per ANSI C37.91 and transformer damage curves.

    d. Motor starting curves.

    e. Generator damage and decrement curves.

    f. Significant maximum symmetrical or asymmetrical short circuit cutoff point.

    g. Electric utility's relays and/or fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.

    h. Medium voltage equipment relays.

    i. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.

    j. Low voltage equipment circuit breaker trip devices, including manufacturer’s tolerance bands.

    k. Pertinent transformer full-load currents at 100 and 600 percent.

    l. Ground fault protective device settings.

    m. Other system load protective devices for largest branch circuit and feeder circuit breaker in each motor control center and panelboard.

H. Develop a table to summarize the settings selected for the protective devices. Include in the table the following:

1. Device identification.

2. Current transformer ratio, relay tap, time delay, and instantaneous

pickup.

3. Circuit breaker sensor rating, long-time, short-time, and instantaneous settings, and time bands.

4. Fuse rating and type.

5. Ground fault pickup and time delay

2.4 ARC-Flash Study

Shall be preformed to IEEE Guide for For preforming ARC-Flash Hazzard calculations. And result in Labeling in compliance with NFPA and NEC requirements

PART 3 - SUMMARY

3.1 ANALYSIS

A. Analyze the short circuit calculations and highlight any equipment determined to be underrated or not coordinated. Propose approaches to effectively protect the underrated equipment or alter equipment.

B. Contractor and his suppliers are responsible to provide a fully coordinated system including cost of equipment system modifications.

3.2 REPORT

A. The results of the power system study shall be summarized in a final report. The report shall include the following sections:
   1. Introduction, executive summary and recommendations, assumptions, impedance one line drawing, and copies of the project one line drawings.

   2. Tabulations of equipment ratings versus calculated short circuit values and X/R ratios, and commentary regarding same.

   3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.

   4. Copies of the manufacturers time current curves for the devices studied and plotted on the time current curves.

3.3 SUBMITTALS

A. The contractor shall submit the completed power system studies within 30

days after the electrical equipment submittals have been received for review by the Engineer. The electrical submittals will be reviewed but will not be approved until the power system studies have been received and reviewed.

B. Submit three (3) copies of the study to the Architect (or) Engineer for review. Electronic submittal in portable document file (PDF) format is acceptable.

3.4 LABLES FOR ARC-flash

A. Install lables responding to the arc-flash studies report on all panels

3.4 ENGINEER'S RESPONSE

A. Engineer of record will review report for compliance and return "approved", "approved with comments" or "revise and resubmit" or "rejected".

B. Should report be returned "rejected" study shall be reworked as required and resubmitted for review.

C. After approval, modifications to equipment shall be made at no cost to owner.

END OF SECTION 260573

SECTION 26 24 16 – PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Furnish and install all lighting and power panelboards as shown on the drawings and described herein.

1.2 SUBMITTALS:

A. Provide shop drawings including an individual diagram of each panelboard showing all specified requirements.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Panelboards shown on the drawings are based on Square D's published information relative to physical size and arrangement. The contractor shall verify that equipment to be furnished can be mounted in space provided and meet the requirements of the National Electric Code for clearances.

B. Panelboards to be constructed in accordance with latest NEMA and UL standards.

C. All panelboards to be of the same manufacturer as other distribution equipment.

D. Panelboard assembly to be UL labeled, and UL labeled as service entrance equipment where used for that purpose.

E. Panelboards to have integrated equipment fault rating equal to interrupting rating of lowest rated overcurrent device.

F. Panelboards shall be factory assembled and breakers shall be arranged exactly as shown on the drawings.

2.2 PANEL INTERIOR:

A. Bussing:

1. 98% conductivity copper, silver-plated at joints or equivalent plated 55% conductivity aluminum.

2. Bus assembly designed for a maximum temperature rise of 55

degree C above 40 degree C ambient temperature when carrying rated current.

3. Minimum thickness of bus bars - 3/32".

4. Bussing braced to withstand a fault current equal to the highest device interrupting capacity in the panel.

5. Neutral bus full size copper or aluminum sized on same basis as phase busses and insulated from the cabinet.

6. Arrange bus bar connections so that adjacent vertical circuit protective devices are consecutively connected to phases A, B, and C throughout panel. Provide full capacity ground bus in each panel bolted to cabinet.

B. Cable terminations:

1. Include neutral and ground connections as shown.

2. Make with separate, individual heavy casting aluminum, AL/CU rated lugs, Thomas & Betts, Ilsco, Blackburn or approved equivalent.

3. Make with separate, individual heavy duty copper or bronze lugs Thomas & Betts "Lock-tite", solid copper barrel compression type, Thomas & Betts color keyed, Burndy "Hydent", or approved equivalent.

4. Use 2 bolt tongue or equivalent connection to bus for #1/0 or larger cables.

5. Securely bolt lugs to bus with bolts, nuts and lock washers.

6. Provide double lugs on main bus where shown.

7. Feed-through lugs (one set of lugs on each end of main vertical bus) is not acceptable unless approved by Engineer

C. Circuit breakers:

1. Molded case, thermal-magnetic, quick-make, quick-break, trip free on faults, thermal-inverse time delay element and magnetic instantaneous trip coil in each ungrounded phase conductor, or approved equivalent solid state trip unit.

2. Engrave breaker ampere rating on handle or trip unit.

3. Furnish multi-pole breakers with internal common trip.

4. Ground fault breakers class "A" type to trip on fault currents of 4-6 ma.

5. Main circuit breakers UL rated for service entrance use.

6. Switch "SWD" rated where required by NEC.

D. Surge Protection Device / Transient Voltage Surge Suppression:

1. Panelboard shall be provided by UL 1449 listed and CSA 22.2 certified transient voltage surge suppressor where shown. The panelboard SPD/TVSS shall be tested and suitable for ANSI/IEEE C62.41 Cat. C1 (6kV, 3kA) environments.

2. Suppressor shall be included and mounted within the panelboards by the manufacturer of the equipment. See panelboard schedule for panelboard with TVSS.

3. The panelboard shall be constructed using a direct bus bar connection (no cable connection between bus bar and SPD/TVSS). Panelboards that use a wire connection do not meet the intent of this specification

4. All monitoring diagnostics features such as indicator lights, trouble alarms and surge counter shall be visible from the front of the panelboard.

E. Panelboards classified by type over-current protection as follows:

1. BQL Bolted quick-lag circuit breaker distribution, 0-100 ampere branches, with minimum interrupting rating of 10,000 symmetrical amperes at 208 volts. Equivalent to Square D type “NQOD”, Siemens type “S1”, General Electric type ‘AQ’ or Eaton/Cutler-Hammer type ‘PRL2a’.

2. CCB Heavy duty convertible circuit breaker distribution, 0-800 ampere branches with minimum interrupting rating of 42,000 symmetrical amperes at 480 volts. Equivalent to Square D type ‘I-Line’, Siemens type ‘S5’, General Electric ‘Sectra series or Eaton/Cutler-Hammer type ‘PRL4’.

F. All space in panelboards usable. Panelboard space provided with necessary connections for future installation of overcurrent devices.

2.3 CABINETS:

A. Code thickness, hot dip galvanized steel or painted with trim and door. Hardware: combination latch and cylinder lock, all keyed the same. Provide celluloid or plastic covered directory card holder on the inside of door. Trim, door and exposed interior shall be finished with factory prime and smooth finish coat of the color selected by Architect. Reinforce cabinets as necessary for service and short circuit rating intended.

B. Flush or surface as indicated of sufficient size to allow minimum 3" gutter space each side of panel and eight inches (8") at top and bottom, minimum 20" wide. Provide adjustable trim clamp, semi-flush hinges and inside rabbet.

C. Provide panels with fully hinged front cover.

2.4 MANUFACTURERS:

A. Panelboards manufactured by Square D, Siemens, and General Electric, or Eaton/Cutler-Hammer.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Mount panelboards securely to building structure with 3/8" minimum diameter galvanized bolts and inserts number as required for size of panel, but not less than 4. Mount panelboards with top at 6'-0" above finished floor. For panels taller than 6'-0" mount panel as low as possible.

B. Where two sets of feeder cables are required in panel gutter space, run one set in each side of panel.

C. Close all unused openings.

3.2 IDENTIFICATION:

A. Provide and engraved laminated plastic nameplate showing name and voltage on each panelboard.

B. Permanently attach nameplates and circuit numbers to panel using screws or an epoxy adhesive.

C. Use horizontal consecutive circuit numbers for lighting and appliance panels as shown in panelboard schedules.

D. Provide typewritten circuit directories describing service of each circuit in Types 'BQL' and 'BEF' panels.

E. Provide engraved laminated plastic nameplate circuit identification for each circuit in Types 'CCB' and 'FDP' panels.

F. Provide Arc-Flash warning label that complies with NEC 110.16.

END OF SECTION 26 24 16

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SECTION 26 27 26 – SWITCHES AND RECEPTACLES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Furnish and install all wiring devices, complete with coverplates, shown on drawings and/or as required for equipment.

1.2 QUALITY ASSURANCE

A. Source Limitations: Insofar as they are available all devices and coverplates shall be from a single manufacturer.

1.3 SUBMITTALS:

A. Provide manufacturer product data for each device to be furnished. Submittal data shall include device ratings, materials, construction. Provide samples when requested.

PART 2 - PRODUCTS

2.1 DEVICES:

A. Light Switches:

1. Light switches shall be toggle quiet AC type, 120/277 volts, 20 amp specification grade, contacts shall be silver alloy and switch shall have one piece Lexan lever and cam. Terminals shall be spring loaded, color coded and suitable for side wiring.

2. Wall mounted dimmer switches shall be preset slide type with an 'off' status LED. Device shall be U.L. listed for 120 VAC, 600 to 2000 watts to control Fluorescent, LED, incandescent, quartz halogen or low voltage loads. Device operation shall include manual intensity control and instant 'on to preset' and 'off'. Device shall mount in a single gang wall box and be supplied with a thin profile faceplate.

B. Receptacles:

1. General purpose receptacles shall be automatic grounding type, finder-grove face, specification grade, nylon face and back, single

piece wraparound galvanized steel strap with provisions for back wiring by means of spring-staked screwed or side wiring with captive held binding screws, shall be constructed of arc-resistant material. Provide tamper resistant and weather resistant where shown on the drawings and/or where required by code.

2. Ground fault interrupting (GFI) type receptacles shall be self contained, automatic grounding type, NEMA 5-20R configuration, specification grade, with trip indicator light, test and reset buttons. Device shall meet all UL943 and UL498 requirements for GFI receptacles. Trip threshold shall be 4-6 milliamperes and trip within .025 seconds of fault detection.

3. TVSS Receptacles shall be multiple metal-oxide varistors, with a nominal calmp level rating of 400 volts and minimum single transient pulse energy dissipation 240 J, according to IEEE C62.41.2 and IEEE C62.45. Device to be equipped with visual and audible indication to indicate device is "active" or "or no longer in service".

4. Isolated ground (IG) type receptacles shall be automatic grounding type, NEMA 5-20R configuration, 20-amp, specification grade, with grounding system isolated from the common building ground. Device shall be orange unless specifically noted otherwise. Hubbell #IG 5362 or equal.

C. All devices shall be gray in color unless on emergency system or isolated ground type. Emergency system outlets shall be red, IG outlets shall be orange, TVSS devices shall be blue.

D. Plugstrip shall be Wiremold 2000 series, or equal by Hubbell, with single or dual circuit snap in outlets. Outlet spacing shall be as noted on the drawings.

E. Exterior outlets and outlets marked "WP" (weatherproof) shall be complete with weatherproof plate with hinged cover or covers in accordance with NEC 410-57(b) and a neoprene gasket between the plate, box and mounting surface. Red Dot CKS series or equal.

2.2 DEVICE PLATES:

A. All outlets shall have a standard coverplate, blank, receptacle, switch, or cord hole as required by outlet symbol. Multiple devices shall be

mounted on a one piece gang-plate of appropriate design. No sectionalized plates will be permitted. All plates throughout building shall be of the same manufacture and design unless shown otherwise.

B. Furnish devices with stainless steel cover plates.

C. Device plates manufactured by Sierra or Hubbell.

D. Exterior outlets shall be complete with weatherproof plate with hinged cover or covers in accordance with NEC 410-57(b) and a neoprene gasket between the plate, box and mounting surface. Red Dot CKS series or equal.

PART 3 - EXECUTION

A. Install receptacles with ground wire from ground screw connected to outlet box.

B. Install devices vertical unless shown otherwise.

C. The Architect reserves the right to change location of any outlet a distance of six (6) feet in any direction from plan location, before work is actually roughed-in, at no extra charge.

D. All devices shall be installed plumb.

E. Devices of the same or different types including telephone, TV, data, etc. shall be installed at exactly the same height to the top of the device.

F. Devices located in same vicinity, but at a different mounting height shall be aligned vertically along the same centerline.

G. Coverplates shall fit tight against the finished wall surface.

H. Install receptacles with ground slot up.

I. Furnish devices as follows:

TABLE 1 – BASIS-OF-DESIGN WIRING DEVICES

DEVICE	NEMA` CONFIGURATION	MANUFACTURER	HEAVY DUTY SPEC GRADE CATALOG NO.
Single Receptacle 20A, 120V	5-20R	P&S	5351
Hospital Grade Duplex 20 amp 120V	5-20R	P&S	PS8300HS
Duplex Receptacle 20A, 120V	5-20R	P&S	5362
Duplex Receptacle, Isolated Ground 20A, 120V	5-20R IG	P&S	IG5362
GFCI Duplex Receptacle 20 A, 120V	5-20R GF	P&S	2095
Wall Switch 20 A, 120/277V	Single Pole Toggle	P&S	CSB20AC1
20 A, 120/277V Wall Switch 2-Pole	Single Pole Toggle	P&S	CSB20AC2
20 A, 120/277V Wall Switch 3 way-Pole	Single Pole Toggle	P&S	CSB20AC3
20 A, 120/277V Wall Switch 4 way-Pole	Single Pole Toggle	P&S	CSB20AC4
Wall Switch, SPDT Momentary Contact, Center OFF	20A,120/277V	P&S	1251

J. Testing

1. Test all outlets with Woodhead ground loop impedance tester and/or

Woodhead 1751 receptacle tester. Record testing results.

3.2 RECEPTACLES

- 20 amp 125 volt NEMA 5-20R duplex outlet P&S 5362
- 20 amp 125 volt NEMA 5-20R double duplex outlet P&S 5362
- 20 amp 125 volt NEMA 5-20R duplex outlet P&S 5362. Mount above counter.
- 20 amp 125 volt NEMA 5-20R double duplex outlet mounted above counter.
- 20 amp 125 volt NEMA 5-20R tamper proof duplex outlet P&S TR 5362
- 20 amp 125 volt NEMA 5-20R single outlet P&S 5361
- 20 amp 125 volt NEMA 5-20R tamper proof duplex outlet mounted above counter
- 20 amp 125 volt NEMA 5-20R tamper proof duplex outlet with 2 USB outlets
- 20 amp 125 volt Hospital Grade NEMA 5-20R duplex outlet P&S PS8300HS
- 20 amp 125 volt Hospital Grade NEMA 5-20R duplex outlet P&S PS8300HS mounted above counter
- 20 amp 125 volt Hospital Grade NEMA 5-20R tamper proof duplex outlet P&S TR63H
- 20 amp 125 volt Hospital Grade NEMA 5-20R tamper proof duplex outlet P&S TR63H mount above counter
- 20 amp 125 volt NEMA 5-20R ground fault duplex outlet P&S 2095
- 20 amp 125 volt NEMA 5-20R ground fault double duplex outlet P&S 2095
- 20 amp 125 volt NEMA 5-20R ground fault double duplex outlet P&S 2095 mount above counter
- 20 amp 125 volt NEMA 5-20R ground fault duplex outlet P&S 2095 mounted above counter 44 inches high

- ❖ 20 amp 125 volt NEMA 5-20R ground fault duplex outlet with in use weather proof cover P&S 2095/WIUCAST1
- ❖ 20 amp 250 volt NEMA 6-20R grounding single outlet P&S 5871
- ❖ 30 amp 250 volt NEMA 6-30 single grounding outlet P&S 3801
- ❖ 30 amp 120/250 volt NEMA 14-30 3 grounding pole 4 wire P&S 3844
- ❖ 30 amp dryer outlet NEMA 10-30 single outlet P&S 3860
- ❖ 50 amp range outlet NEMA 10-50 single outlet P&S 3890
- ❖ 30 amp 3 pole 4 wire NEMA 15-30 single outlet grounding P&S 5740

3.3 SWITCHES

- ❖ Single pole 20 amp 120/277 volt AC type P&S CSB20AC1
- ❖ Two Pole 20 amp 120/277 volt AC type P&S CSB20AC2
- ❖ Three way 20 amp 120/277 volt AC type P&S CSB20AC3
- ❖ Four way 20 amp 120/277 volt AC type P&S CSB20AC4
- ❖ Momentary contact 20 amp 3 position switch P&S 1251
- ❖ Dimmer incandescent
- ❖ Dimmer LED
- ❖ Occupancy sensor switch dual technology passxxxx infrared with dimmer
- ❖ Occupancy sensor switch dual technology passiave infrared
- ❖ Occupancy sensor Ceiling mounted dual technology passiave infrared
- ❖ Occupancy sensor wall mounted dual technology passiave infrared
- ❖ Occupancy sensor power pack

END OF SECTION 26 27 26

SECTION 26 28 13 – FUSES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Furnish and install fuses rated 600V and less in switches as shown on the drawings and described herein or as required by the equipment served.

B. Furnish and install a spare fuse cabinet.

1.2 RELATED DOCUMENTS

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

1.3 SUBMITTALS

A. Product Data: Include the following for each fuse type indicated:
1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
2. Let-through current curves for fuses with current-limiting characteristics.
3. Time-current curves, coordination charts and tables, and related data.
4. Fuse size for elevator feeders and elevator disconnect switches.

B. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

C. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
a. Let-through current curves for fuses with current-limiting characteristics.
b. Time-current curves, coordination charts and tables, and related data.

c. Ambient temperature adjustment information.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA FU 1.

D. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Bussman, Inc.
2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
3. Ferraz Shawmut, Inc.
4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

B. Basis of design products:
1. Class L, current-limiting time delay – Bussman "Low Peak" KRP-C
2. Class RK1, time-delay, dual-element – Bussman "Low Peak", LPS-RK
3. Class RK5, time-delay, dual-element – Bussman "Fusetron" FRS-R
4. Class J, time-delay, dual-element – Bussman "Low Peak" LPJ
5. Class L, fast-acting, current-limiting, Bussman "Limitron" KTU

2.3 SPARE-FUSE CABINET

A. Cabinet: Wall-mounted, 0.05-inch- (1.27-mm-) thick steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
   1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
   2. Finish: Gray, baked enamel.
   3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
   4. Fuse Pullers: For each size of fuse.
   5. Place in the main electrical room.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Motor Branch Circuits:
   1. Motors larger than 5 hp – RK1
   2. Motors 5 hp and smaller – RK5

B. Other Branch Circuits: Class RK5, time delay.

C. Feeders:
   1. 600 amp and smaller – RK1
   2. Larger than 600 amp – Class L time-delay

D. Service Entrance:
   1. Larger than 600 amp – Class L fast-acting
   2. 600 amp and smaller – Class RK1

E. Low-Voltage Transformer: Class RK1

F. Elevator Machine Disconnect – Class J dual-element, time-delay

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 26 28 13

SECTION 26 28 16 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Furnish and install enclosed safety switches, disconnects and separately mounted enclosed circuit breakers as shown on the drawings and/or where required by code to serve as a means of disconnect for equipment.

1.2 SUBMITTALS:

A. Provide manufacturer product data for each device to be furnished. Submittal data shall include device ratings, materials, construction and physical characteristics. Provide samples when requested by Architect.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES:

A. Heavy duty rated 250 or 600 volts as required; quick-make, quick-break operation; horsepower rated. If switch is not available with proper horsepower rating, classify switch as isolating switch only and provide nameplate reading "DO NOT OPEN UNDER LOAD". Operating handle interlocked with switch door to prevent opening door with switch closed. Provide mechanical over-ride for authorized personnel to open switch door without operating switch handle.

B. Fusible or non-fusible as shown. Furnish Busman "Fuse-Tron" fuses for each fusible position, size as shown. Furnish 3 spare fuses for each size.

C. Furnish with provisions for locking with padlock. Enclosures for switches shall be NEMA 1 (general purpose indoor), NEMA 3R (rain tight outdoor), or special enclosure as indicated.

D. Standard product of Siemens, Square "D", General Electric, or Eaton/Cutler Hammer.

PART 3 - EXECUTION

A. Secure disconnect switches to building or equipment surface as shown. If location shown is not suitable for installing, provide Unistrut P-1000 rack mounted as directed to secure switch.

B. Disconnects shall be located to be accessible and within 5 feet or closer to equipment served.

C. Provide engraved nameplates identifying equipment served fuse or breaker size. Refer to Specification Section 26 05 10.

END OF SECTION 26 28 16

SECTION 263210 - EMERGENCY STANDBY POWER SYSTEM

PART 1 - GENERAL

1.1 SCOPE:

A. Furnish and install a complete, operational packaged emergency generator consisting of a natural gas fueled engine directly coupled to an electric generator in a sound attenuating weatherproof housing, with transfer switch, control wiring, piping, fuel system cooling, exhaust and all appurtenances necessary to provide automatic and continuous electric power during failure of normal power source.

B. Emergency power system shall meet all requirements the International Building Code, National Electric Code and Life Safety Code.

C. Include all testing and owner instruction for operation and maintenance requirements of generator.

1.2 QUALITY AND EXPERIENCE:

A. Selling agency to provide shop drawings, furnish components and supervise of installation start-up and testing by factory trained service technician.

B. Selling agency to have 24 hour, franchised service and parts within a radius of 100 miles of project. Selling agency franchised for manufacturer for past 5 years. Furnish nearest location of permanent parts outlets.

C. Architect will judge qualifications and give approval of installer.

1.3 SUBMITTALS:

A. Furnish factory data sheets covering all components of generator equipment, engine generator, battery charger, fuel tank, transfer switch, remote alarm, muffler, etc.

B. Shop drawings for engine-generator to indicate all requirements of this Section.

C. Submit with the shop drawings an erection drawing of generator enclosure showing physical arrangement of equipment, piping, electrical work, etc., at a minimum scale of 1/2" = 1'-0".

D. Provide calculations showing the performance of the generator with connected loads as shown and described on the drawings. All loads shall be coordinated and verified with other trades.

E. Furnish system free of injurious torsional and bending vibrations within entire speed range from 0 to 125% of synchronous speed.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Generator shall be manufactured by Caterpillar, Onan or Generac. Other manufacturers must obtain approval in writing no less than 10 days before bid opening. No consideration will be given for approval within 10 days of bid or after bid are received.

2.2 ENGINE:

A. General purpose, industrial, diesel, solid injection, water cooled, two or four cycle, compression ignition type. To operate using diesel fuel per ASTM specifications. Engine naturally aspirated, scavenged or pressure charged. Scavenger units of pressure chargers quiet under full load operating conditions.

B. Engine Power Rating:

1. Provide rated net horsepower at generator synchronous speed, with all accessories attached, required to produce KW specified, taking into account generator efficiency.
2. Set to produce specified KW without overheating for minimum 24 hours under the following conditions:
   a. Altitude: 1,000 ft.
   b. Air temperature at engine intake: 95 degree F.
3. Maximum engine speed - 1800 rpm.

C. Engine Speed Control:

1. Engine equipped with mechanical flyweight, 5% droop governor to maintain frequency within limits controlling engine and generator speed. Adjust governor to +3% speed regulation.

D. Provide manual speed adjusting control.

1. Governor - Onan, Caterpillar, Woodward, Barber Coleman or approved equal.

E. Crank-Start System:

1. Electric starting motor with solenoid and Bendix or overrunning clutch drive.

2. Starting motor voltage and ampere rating as recommended by engine manufacturer to start engine without overheating or continuous starting for 60 seconds.
   a. Provide 24 volt battery system for engine starting.
   b. Mount batteries on separate rack located beside engine with battery cables and connections. Provide High discharge rate Lead Acid type, 24 volts, with ampere rating required to start engine charger without connected 8 times at 30 degrees F, minimum 300 ampere hours; Exide, C&D, Chloride or approved equal.
3. Provide 10 ampere battery charger to maintain batteries at full charge.
4. Charger to operate from normal or emergency power source.
5. Furnish high and low (float) rates manually switchable.
6. Provide crank limiter designed to prevent damage during engine cranking (cranking circuit disconnect relay).
7. Provide with D.C. failure relay for connection to alarm panels.
8. Battery charger - LaMarche A-46 set for Lead Acid batteries or approved equal, wall mounted in the engine room or in generator enclosure.

F. Engine Cooling System:

1. Engine liquid cooled with engine mounted, air cooled radiator.
2. Cooling liquid to circulate through engine block, inter-cooler, oil cooler, etc., as required to completely cool engine system.
3. Discharge water to air cooled radiator by engine driven pump.
4. Radiator capacity and cooling characteristics to cool engine discharge liquid adequately for engine to carry rated load with 125 degree F intake air.
5. Furnish engine coolant with ethylene-glycol anti-freeze to prevent freezing to temperature of -10 degree F.
6. Furnish electric jacket water heater recommended by manufacturer to maintain cooling water at 90 degree F. at engine ambient temperature of 10 degree F. Heater rated for generator supply voltage, 1 phase with automatic thermostat, Chromalox or approved equal.

G. Engine Protective Devices:

1. Provide engine protective devices each with indicating light.
   a. Combination alarm and shutdown system for high water temperature and/or low oil pressure.
   b. Engine overspeed automatic shutdown and alarm.
   c. Engine failed to start (over crank), and shutdown.
2. Provide instrument board with following equipment properly connected for service and identified with permanent marking:
   a. Pressure gage - lubricating oil.
   b. Temperature gage - coolant outlet.
   c. Temperature gage - lubricating oil.
   d. Emergency stop switch.

e. Running time meter and tachometer (0 - 125% rated speed).

3. Furnish oil lubrication system with oil cooler, oil filter with bypass valve, positive displacement oil pump, gear driven from engine, and bayonet level gage.
4. Shield moving engine parts to prevent contact by personnel. Engine manufactured by Caterpillar, Kohler, Cummins, or Onan.

H. Air Supply/Exhaust System:

1. Provide Air Cleaner: As recommended by engine manufacturer. A drip-proof crankcase breather tube may terminate in the air cleaner intake.

I. Exhaust System:

1. Silencer - high degree industrial grade silencing, Maxim M21 or approved equal.
2. Size exhaust line to prevent excessive back pressure per engine manufacturer's recommendation.
3. Provide steel flexible connection mounted between engine exhaust manifold and silencer.
4. Exhaust piping - schedule 40 black steel, gas tight with welded connections except at silencer use flanged gas connection.
5. Test pipe for gas tightness. Paint exposed pipe with two coats "Tenemec" high temperature paint over rust free surface.
6. Insulate muffler and exhaust pipe with 3" of formed calcium silicate taped and plastered with 85% calcium silicate cement. Furnish aluminum sleeves to protect insulation foam suspension system and vibration.

2.3 FUEL SYSTEM:

A. Provide fuel piping, valves, safety device fittings, regulator and safety cut off.

B. Fuel piping shall be schedule to black with screwed connection and fittings pipe joint compound suitable for fuel.

C. Verify BTU contact of fuel and make appropriate adjustments.

2.4 GENERATOR:

A. Generator kW/kVA rating and output voltage shall be as shown on the drawings.

B. Engine-driven, single or two bearing, open, dripproof, revolving field, continuous duty, synchronous, brushless, and statically excited conforming to the applicable standards of IEEE and NEMA. Connected to the engine

flywheel with flexible type coupling. Output not to deviate from standard sine wave more than 5% or less than 5%; TIF (Telephone Influence Factor) less than 50 based on the 1961 weighting curve.

C. Winding insulation - Class F with a maximum winding temperature rise of 130 degrees C. above 40 degree C. ambient.

D. Provide factory installed output circuit breakers as indicated on the drawings or as sized by the manufacturer.

2.5 VOLTAGE REGULATOR (Mounted in Engine Control Panel):

A. Provide solid state voltage regulator to maintain voltage within limits as specified below:

1. Stability: More than or less than 1.0% maximum voltage variation at any constant load from no load to full load.
2. Regulation: More than or less than 1.0% maximum voltage deviation between no-load steady state and full-load steady state.
3. Transient: 20.0% maximum voltage dip or rise on one-step application or removal of 0.8 power factory full load.
4. Transient: 0.0% maximum voltage dip in most severe motor starting condition.
5. Transient: 2.0 seconds maximum voltage recovery time with application or removal of 0.8 power factory full load.

B. Regulator: Basler, Onan, Caterpillar, or approved equal.

2.6 VIBRATION ISOLATION:

A. Engine-generator set mounted on combination neoprene/cork vibration isolators.

B. Vibration isolators: Vibration Mountings "Cork-Rib" or approved equal, number and area required for weight as recommended by pad manufacturer.

2.7 ENGINE CONTROL AND TRANSFER PANEL:

A. Housing for engine-generator controls and transfer devices NEMA 1, generator mounted, front accessible construction. Isolate control panel from engine-generator to prevent vibration damage to control panel components.

B. Control and Transfer Panel with hinged front doors, three point catch and vault type lockable handle.

C. Components: Industrial quality, capable of operating at 50% of battery voltage.

D. Engine Start Panel (Solid State):

1. Automatically initiate engine cranking on receiving signal from transfer switch.
2. Cycle cranking timer to crank engine for 10 seconds and interrupt cranking for 10 seconds until engine starts. Failure to start within four cycles of cranking, engine to discontinue cranking and signal an alarm condition (overcrank).
3. Shut down engine on occurrence of the abnormal conditions overspeed, high coolant temperature and low oil pressure, and alarm for all conditions. Do not allow recranking of engine until control panel is manually reset.
4. Equipped with a manual four position selector switch (automatic-off-manual-engine test), alarm pilot lights for alarms, and alarm contacts for remote annunciator, alarm horn, and alarm silence and reset switches.
5. Provide auxiliary contacts for control of auxiliary systems required for operation of engine such as ventilation, fuel system and governor, etc. Provide two normally closed 24 VDC contacts for operation of intake and exhaust air dampers.
6. Manufacturer: ASCO, Russell, Caterpillar, Onan, Kohler or approved equal.

E. Furnish audible and visual annunciation of following alarm events:

1. Low oil pressure
2. High water temperature
3. Overspeed
4. Overcrank
5. Low fuel - daytank
6. Battery charger malfunction

F. Furnish alarms with manual resetting relays and common alarm horn and horn silence switch. Alarm lights to remain lighted until alarm condition is corrected and controls manually reset. All controls and alarms operated on battery voltage.

G. Automatic Transfer Switches:

1. Automatic transfer switch with ampere ratings shall be as shown on the drawings.
2. Automatic transfer switch shall be rated 600 volts with withstand current rating of 100 kAIC unless shown otherwise on the drawings.
3. Mechanically held, electrically operated, rated for continuous loads with main contacts on common shaft.
4. 3-pole, using silver alloy wiping contacts and separate arcing contacts.
5. Operation Time shall be less than 1/15 of a second.
6. Sensing and control relays - continuous duty, industrial type with minimum contact rating of 10 amperes.

H. Controls as follows:

1. One second time delay for overriding voltage dips.
2. Test switch (engine start and transfer).
3. Auxiliary contact - closes when normal source fails after one second delay.
4. Auxiliary contact - opens when normal source fails after one second delay.
5. Two auxiliary contacts, one closed on normal, one closed on emergency.
6. Adjustable time delay on retransfer to normal source (2-25 minutes) with 5 minute unloading engine running time.
7. Full phase protection with drop-out at 85% of rated voltage and pickup at 95% of rated voltage.
8. Pilot lights indicating switch position.

I. ASCO Bulletin 940, Russell model RMT-VS, Onan OT-11, Zenith ZTS or approved equivalent, bussed for front connection.

J. Sequence of transfer operations:

1. On loss of normal power to the transfer switch, after a one second delay, contact in the transfer switch closes, starting engine-generator.
2. Engine-generator reaches proper speed and voltage, transfer switch transfers loads to generator.
3. After return of normal voltage, and after a time delay of 5 minutes, load re-transferred to normal source.
4. Engine-generator to run unloaded for five minutes after retransfer before shutdown.
5. Control relays, etc., reset instantaneously.

K. Remote Control Alarm Annunciation:

1. Remote alarm annunciator automatic reset, with audible signal, silence switch and 1" square backlighted annunciator blocks. Edwards, Ronan or approved equal.
2. Provide alarm points and wiring to give alarm indications as follows:
   a Emergency generator carrying load.
   b Battery charger malfunction.
   c Low oil pressure.
   d High coolant temperature.
   e Overcrank.
   f Overspeed.
   g Start/Stop Switch.
   h transfer / Normal Switch

2.8 ENCLOSURE:

A. Weatherproof enclosure to hold all generator components including muffler,

batteries and generator breaker.

B. Housing shall be same manufacturer as generator.

C. Housing shall be sound attenuating type limited sound of set to 70 DB at 23 feet.

D. Housing shall be weather proof with heavy duty latches lockable and tamper proof.

E. Enclosure shall be rated for 150 mph wind speed.

PART 3 - EXECUTION

3.1 ENGINE-GENERATOR LOAD TEST:

A. Conduct field load test supervised by manufacturer. The test shall consist of the following items as specified by NFPA 110:

B. Load Test: The on-site installation test shall be conducted in the following manner:

1. With prime mover in a "cold start" condition and emergency load at normal operating level, initiate a normal power failure by opening all switches or breakers supplying the normal power to the building or facility. Test load shall be that load which is served by the generator.
2. Observe and record the time delay on start.
3. Observe and record the cranking time until the prime mover starts and runs.
4. Observe and record the time required to come up to operating speed.
5. Record voltage and frequency overshoot.
6. Observe and record time required to achieve steady-state condition with all switches transferred to the emergency position.
7. Record voltage, frequency, and amperes.
8. Record prime mover oil pressure, water temperature, and battery charge rate at 5 minute intervals for the first 15 minutes, and at 15 minute intervals thereafter.
9. Continue load test with building load for one hour, observing and recording load changes and the resultant effect on voltage and frequency.
10. Return normal power to the building or facility, record the time delay on retransfer to normal for each switch (15 minutes minimum), and the time delay on prime mover cool down period and shutdown.

C. After completion of the test, the prime mover shall be allowed to cool for 5 minutes.

D. Full Load Test: A load shall be applied for a (6) six-hour full-load test. Provide a load equal to 100 percent of the nameplate KW rating of the generator. The full-load test shall be initiated immediately after cooling time by any method which will start the prime mover and, immediately upon reaching rated RPM, pick up 100 percent of nameplate KW rating on one step.

E. Cycle Crank Test: Utilize any method recommended by the manufacturer to prevent the prime mover from running. Put the control switch into "run" to cause the prime mover to crank. Cycle crank until alarm.

F. Test all safeties specified in NFPA 110.

G. Furnish the following to the Engineer at the time of the acceptance test:

1. Copy of certified torsion analysis test of engine and generator. Prototype tests are acceptable.
2. Furnish short circuit current capability at the output of the installed generator.

H. Conduct test at 95% ambient temperature demonstrating specified load carrying capacity without overheating.

I. Furnish load testing apparatus, connections, load bank, etc., for tests.

J. If the tests are stopped for any reason, repeat entire 8 hour test until satisfactory results are obtained.

K. Architect and Engineer to witness tests. Minimum 72 hour notice required.

3.2 GUARANTEE:

A. Manufacturer and Electrical Contractor guarantee the engine-generator system to be free from defects in workmanship and material for one year from date of substantial completion. Replace defective parts without charge to Owner in guarantee period.

END OF SECTION 263210

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SECTION 26 50 00 – LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:
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A. Furnish and install all lighting luminaires, with all necessary accessories and lamps, as shown, specified, and/or scheduled.

1.2 RELATED SECTIONS:

A. Refer Division 1 for allowances and Owner-furnished items to be installed under this Section.

1.3 ABBREVIATIONS:

A.	IC Rated	Lighting fixture rated for direct contact with insulation
B.	LED	Light Emitting Diode
C.	PF	Power Factor
D.	RLO	Relative Light Output

1.4 SUBMITTALS:

A. Refer to Section 260510 for submittal requirements.

B. Shop drawing submittals for luminaires shall include the following for each Luminaire: complete construction details including all dimensions, complete Description of materials used, complete electrical data (including operating Voltage), photometric test report from an independent testing lab, complete description of finish, and manufacturer catalog cutsheet of lamp to be used.

PART 2 - PRODUCTS

2.1 LUMINAIRES:

A. Furnish and install luminaires as shown in luminaire schedule, or otherwise indicated on the drawings. Manufacturer catalog numbers shown are for general descriptive purposes, and are only intended to establish the standard of quality.

B. Locations of luminaires shown on electrical drawings are diagrammatic. Verify location of luminaires with architectural drawings prior to installation. Conflicts between electrical and architectural drawings shall be referred to the Architect for resolution prior to installation.

C. Provide luminaires complete with all options, accessories and other appurtenances required for a complete installation. Contractor shall coordinate fixture mounting with type ceiling and wall construction, and provide luminaires with all necessary installation hardware properly configured for the type construction.

D. Pendant stem mounted luminaires shall be furnished with ball aligner swivel, 30 degrees from vertical minimum with swivel below canopy, with ½" diameter metal tube (stem)

E. Luminaire support wires shall be zinc-coated, soft temper ASTM A641/A641M steel, 12 gage.

F. Luminaires with aircraft cable suspension system shall use 1/16" diameter (minimum) stainless steel aircraft cable and adjustable cable gripper with swaged cable stop at ceiling canopy. Cable size shall be selected by luminaire manufacturer to provide adequate support.

G. All luminaires shall be UL listed for the application.

H. Metal luminaire housings shall be free of tool marks, dents, burrs and sharp edges. All metal parts shall be painted, galvanized, or otherwise corrosion-resistant.

I. Reflector surfaces shall be finished specular, semi-specular, diffuse or painted as indicated. Specular finish materials shall have a minimum reflectance value of 83%. Semi-specular or diffuse finish shall have

reflectance of 75% and white painted finish materials shall have reflectance of 88%.

J. Plastic lenses and shielding shall meet NFPA and local building code requirements for light transmitting plastics.

K. Exit signs shall be furnished with 6" high letters with ¾" stroke. Verify color of signage required by local code authorities. Signs shall meet all NFPA, UL and local building code requirements.

2.2 LED PRODUCTS

A. LEDs shall be manufactured by Nichia. Other manufacturers will be considered if submitted for review at least 10 days prior to bid.

B. Lumen Output:

1. Minimum initial delivered lumen output of the luminaire shall be as follows for the lumens exiting the luminaire in the 0 to 360 degree zone, as measured by IESNA Standard LM-79-08 in an accredited lab. Exact testing lumen output shall be clearly noted on the shop drawings.

a. Type XX – 8 ¼" x 4' – 3400 (30 watts max.) or 4800 (45 watts max.) nominal delivered lumens at 3500k per specification.

b. Type YY – 8 ¼" x 8' – 6800 (60 watts max.) or 9600 (90 watts max.) nominal delivered lumens at 3500k per specification.

c. Lumen output shall not decrease by no more than 20% over the minimum operational life of 50,000 hours at the rated ambient operating temperature.

2. Individual LEDs shall be connected such that a catastrophic loss or the failure of one LED will not result in the loss of all LEDs within the luminaire.

3. LED boards shall be suitable for field maintenance and have plug-in connectors. LED boards shall be upgradeable.

4. Light Color/Quality:

a. Correlated Color Temperature (CCT) range as specification, between 3000K, 3500K and 4000K shall be correlated to chromaticity as defined by the absolute (X,Y) coordinates on the 2-D CIE chromaticity chart. (Edit color temperature per project specification)

b. Color shift over 6,000 hours shall be <0.007 change in u' v' as demonstrated in IES LM80 report.

c. The Color Rendition Index (CRI) shall be 80 or greater.

d. LED boards to be tested for color consistency and shall be within a space of 2.5 MacAdam ellipses on the CIE chromaticity chart.

C. LED Power Supply and Drive

1. Driver: Acceptable manufacturer: eldoLED

2. Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.

3. Drive shall be UL Recognized under the component program and shall be modular for simple field replacement. Drivers that do not meet these requirements will not be accepted.

4. Electrical characteristics: 120 – 277 volt, UL Listed, CSA Certified, Sound Rated A+. Driver shall be > 80% efficient at full load across all input voltages. Input wires shall be 18AWG solid copper minimum.

5. Dimming: Driver shall be suitable for full-range dimming. LED dimming shall be equal in range and quality to a commercial grade incandescent dimmer. The luminaire shall be capable of continuous dimming without perceivable flicker over a range of 100 percent to 0.1 percent of rated lumen output with a smooth shut off function.

6. Dimming Quality to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, inaudible in 26db environment, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment. Demonstration of this compliance to dimming performance will be necessary for substitutions or prior approval.

    a. Dimming shall be controlled by a 0-10V signal.

    b. Driver shall include ability to provide no light output when the analog control signal drops below 0.5V, or the DALI/DMS digital signal calls for light to be extinguished and shall consume 0.5 watts or less in this standby. Control deadband between .5 and .65V shall be included to allow for voltage variation of incoming signal without causing noticeable variation in luminaire to luminaire output.

    c. Driver shall be capable of configuring a linear or logarithmic dimming curve, allowing fine grained resolution at low light levels.

    d. Driver must be capable of 20 bit dimming resolution for white light LED driver

    e. Driver shall track evenly across multiple luminaires at all light levels, and shall have an input signal to output light level that allows smooth adjustment over the entire dimming range.

7. Flicker: Driver and luminaire electronics shall deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10). At all points within the dimming range from 100-0.1 percent luminaire shall have:

    a. Less than 1 percent flicker index at frequencies below 120 Hz.
    b. Less than 12 percent flicker index at 120 Hz, and shall not increase at greater than 0.1 percent per Hz to a maximum of 80 percent flicker index at 800Hz.

8. Driver disconnect shall be provided where required to comply with codes.

9. The electronics/power supply enclosure shall be internal to the SSL luminaire and be accessible per UL requirements.

10. The surge protection which resides within the drive shall protect the luminaire from damage and failure for transient voltages and currents as defined in ANSI/IEEE C64.41 2002 for Location Category A, where failure does not mean a momentary loss of light during the transient event.

D. Electrical

1. Power Consumption: Maximum power consumption, +/- 5% when operating between 120 – 277V (or 346V) shall be as follows:

   a. Type XX – 8 ¼" x 4' – 30 watts and 45 watts nominal

   b. Type YY – 8 ¼" x 8' – 60 watts and 90 watts nominal

2. Operation Voltage – The luminaire shall operate from a 60 Hz ± 3 Hz AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage of (+/= 10%) shall have no visible effect on the luminous output.

3. Power Factor: The luminaire shall have a power factor of 90% or greater at all standard operating voltages and full luminaire output.

4. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent at any standard input boltage and meet ANSI C82.11 maximum allowable THD requirements at full output. THD shall at no point in the dimming curve allow imbalance current to exceed full output THD.

5. Surge Suppression: The luminaire shall include surge protection to withstand high repetition noise and other interference and withstand up to a 1,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A.

6. Inrush Current: Meet or exceed NEMA 410 driver inrush standard of 430 Amps per 10 Amps load with a maximum of 370 A^2s.

7. RF Interference: The luminaire and associated on-board circuitry must meet Class A emission limits referred to in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 Non-Consumer requirements for EMI/RFI emissions.

8. Driver must support automatic adaptation, allowing for future luminaire upgrades and enhancements and deliver improved performance:

    a. Adjustment of forward LED voltage, supporting 3V through 60V.
    b. Adjustment of LED current from 200mA to 1.05A at the 100 percent control input point in increments of 1mA.
    c. Adjustment for operating hours to maintain constant lumens (within 5 percent) over the 50,000 hour design life of the system, and deliver up to 20 percent energy savings early in the life cycle.

9. Electrical connections between normal power and driver must be modular utilizing a snap fit connector. All electrical components must be easily accessible after installation and be replaceable without lowering the luminaire.

10. All electrical components shall be RoHS compliant.

E. Photometric Requirements

1. Luminaire performance shall be tested as described herein.

2. Luminaire performance shall be judged against the specified minimum illuminance in the specified pattern for a particular application.

3. Luminaire lighting performance shall be adjusted (depreciated) for the minimum life expectancy (Section 2.2.4).

a. The performance shall be adjusted (depreciated) by using the LED manufacturer's data or the data from the IESNA Standard TM-21 test report, whichever one results in a higher level of lumen depreciation.

b. The ratio of the peak-to-zenith maximum candela ratios shall be- 1.94:1 @ 127.5 degrees.

c. The luminaire may be determined to be compliant photometrically, if:

(1) The initial minimum illuminance level is achieved in 100% of the area of the specified lighting pattern.
(2) The measurements shall be calibrated to standard photopic calibrations.

F. Thermal Management

1. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life (Section 2.2.7 (c)).

2. The LED manufacturer's maximum junction temperature for the expected life (Section 2.2.7 (c)) shall not be exceeded at the average operating ambient (Section 2.2.2)

3. The LED manufacturer's maximum junction temperature for the catastrophic failure shall not be exceeded at the maximum operating ambient temperature (Section 2.2.3).

4. The luminaire shall have a UL or CSA rating.

5. The Driver manufacturer's maximum case temperature shall not be exceeded at the maximum operating ambient temperature. Thermal management shall be passive by design. The use of fans or other mechanical cooling devices shall not be allowed.

G. Optics

1. Optics shall consist of high performance advanced optical film, diffuser, and metal reflector.
2. Optics shall eliminate source image.

H. Digital Controls

1. Each luminaire shall be equipped with one (1) digital RJ45 port and interface with other digital control equipment.

2. Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6ma per driver at a low end of 0.3V. Limit the number of drivers on each 0-10V control output based on voltage drop and control capacity.

3. Digital manual wall control shall integrate with the SSL luminaire via CAT5E cable and be self-commissioning.

4. Digital occupancy sensor shall integrate with the SSL luminaire via CAT5E cable and be self-commissioning.

5. Digital photocell shall integrate with the SSL luminaire via CAT5E cable and be self-commissioning.

6. Integral Daylight Dimming or Daylighting Dimming with Occupancy Detection sensors shall be provided as per specification. Sensor shall be designed to be low profile to minimize appearance in luminaire.

7. Lumen Management: The luminaire shall be capable of continuously monitoring system performance to allow for constant lumen management/compensation function. Lumen output to be maintained at 80% for life of the luminaire, initial input to be 80% of rated input watts and climb to rated watts by end of rated life. Energy savings shall be 20% initially and 10% over the rated life of the luminaire.

8. Each luminaire shall be supplied with a unique network address. This address shall be printed on two identification labels. One label shall be permanently affixed to the luminaire and one label shall be easily removed for network control commissioning purposes. Both labels shall be in a location which is easily accessible by the installing contractor.

9. Control Input:

   a. 4-Wire (0-10V DC Voltage Controlled) dimming Drivers:

(1) Must meet IEC 60929 Annex E for General White Lighting LED drivers
(2) Must meet ESTA E1.3 for RGBW LED drivers.

b. Digital (DALI Low Voltage Controlled) Dimming Drivers:
(1) Must meet IEC 62386

I. Luminaire Identification

1. Each luminaire shall have the manufacturer's name, trademark, model number, serial number, date of manufacture (month-year), and lot number as identification permanently marked inside each unit and the outside of each packaging box.

2. The following operating characteristics shall be permanently marked inside each unit: rated voltage and rated power in Watts and Volt-Ampere.

J. Quality Assurance

1. The luminaires shall be manufactured in accordance with a manufacturer quality assurance (QA) program. The QA program shall include two types of quality assurance: (1) design quality assurance and (2) production quality assurance. The production quality assurance shall include statistically controlled routine tests to ensure minimum performance levels of the modules built to meet this specification. These tests shall include: CCT, CRI, lumen output, and wattage. Test shall be recorded, analyzed and maintained for future reference.

2. QA process and test results documentation shall be kept on file for a minimum period of seven years.

3. LED luminaire designs not satisfying design qualification testing and the production quality assurance testing performance requirements described below shall not be labeled, advertised, or sold as conforming to this specification.

K. Design Qualification Testing

1. Design Qualification Testing shall be performed by a National Voluntary Laboratory Accreditation Program (NVLAP) testing facility. Such testing may be performed by the manufacturer or an independent testing lab hired by the manufacturer on new luminaire designs and when a major design change has been implemented on an existing design. A major design change is defined as a design change (electrical or physical), which changes any of the performance characteristic of the luminaire, results in a different circuit configuration for the power supply, or changes the layout of the individual LEDs in the module.

2. A quantity of two units for each design shall be submitted for Design Qualification Testing.

3. Product submittals shall be accompanied by product specification sheets or other documentation that includes the designed parameters as detailed in this specification. These parameters include (but are not limited to):

    a. Maximum power in Watts.
    b. L80 in hours, when extrapolated for the worse case operating temperature (section 2.2.3). TM21 report shall be submitted to demonstrate this.

4. Luminaire shall be tested per IESNA LM 79-08.

L. WARRANTY

1. The manufacturer shall provide a single source, 5 year limited warranty against loss of performance and defects in materials and workmanship for all components of the luminaire. Warranty is from the time of acceptance of the luminaires. All warranty documentation shall be provided to customer prior to the first shipment.

2. Provide manufacturer's warranty covering 5 years on drivers from date of purchase. Refer to manufacturer's terms and conditions on the website for detailed information.

2.3 EMERGENCY LIGHTING:

A. Provide luminaires and exit signs with self-contained battery power supplies as indicated. All equipment shall conform to UL924-Emergency Lighting and Power Equipment.

B. Battery shall be sealed, maintenance-free lead-acid type (indoors) or nickel-cadmium (outdoors or unconditioned spaces) with 10-year nominal life. Unit shall incorporate a fully-automatic solid state charger and automatic transformer relay to transformer to backup battery power supply upon failure of normal power.

C. All emergency lighting equipment shall be equipped with means to test operation and an LED indicating battery status.

2.4 POLES AND STANDARDS:

D. Poles should conform to AASHTO LTS-3 standards for structural design. Poles shall be designed to withstand prevailing wind conditions with a gust factor of 1.3.

E. Pole manufacturer shall coordinate with luminaire manufacturer to ensure adequate strength to support the fixtures specified. Pole shall be furnished with all appropriate mounting hardware, fasteners and supports for installation of the luminaire(s).

F. All pole hardware and fasteners shall be stainless steel or other corrosion-resistant materials if stainless steel is not compatible with structural material.

G. Pole manufacturer shall provide a plywood or steel anchor-bolt template to assist installer in preparing pole foundation. Template shall indicate luminaire orientation to ensure proper light distribution.

H. Provide power-installed screw foundation where indicated. Screw foundation shall be fabricated with hot-dip galvanized structural steel (ASTM A36/A36M) of sufficient strength to support pole and luminaire. Mounting plate and bolts shall be coordinated to match pole.

I. All poles shall be provided with a wiring handhole per National Electrical Code requirements.

J. All poles shall be provided with grounding lug bonded to metal components of the pole. The lug shall be accessible through the handhole.

K. All poles shall be furnished with anchor bolt/base plate covers. Cover shall match pole match pole material and finish.

L. Steel poles shall be pre-finished inside and out, either hot-dip galvanized or prime-coat enamel to prevent corrosion.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Support luminaires from structure of the building, independent from the ceiling membrane or finish material. Luminaire shall be set level, plumb, and square with ceilings and walls.

B. Recessed lay-in luminaires in suspended grid ceilings shall be supported from the ceiling grid. Provide devices for securing the luminaire to the ceiling grid to comply with the National Electrical Code ("earthquake clips"). Luminaires heavier than 30 pounds shall have supplemental support wires anchored to the structure above the ceiling. Provide independent support wires, anchored to a structure above and attached to fixture at each corner.

C. Recessed luminaires in fire-rated ceiling assemblies shall be installed in accordance with the UL listing of the assembly.

D. Recessed luminaires (non lay-in or hard ceiling types) shall be supported by ¾" steel ceiling channel, or factory-supplied hanger bars one on each side of the luminaire, anchored to ceiling structure. Recessed luminaires heavier than 20 pounds shall have supplemental support anchored to the structure above the ceiling. Do not use conduit to support luminaire.

E. Provide recessed luminaires with appropriate frames, hardware and trim for the ceiling installed.

F. Install luminaires free and clear of structural and mechanical interferences above the ceiling. If location indicated on the drawing conflicts with other elements, notify the Architect for directions for remedial action.

G. Attach surface and pendant mounted luminaires to 3/16" fixture stud in outlet box. Luminaires in excess of 20 pounds shall have supplemental support anchored to the structure above the ceiling.

H. Luminaires surface mounted to grid-type ceilings shall be mounted with Caddy IDS type clips anchored to structure above.

I. Wall mounted luminaires shall be anchored to wall structure. Luminaire shall fully conceal the outlet box.

J. Wiring to luminaires shall be with flexible metallic conduit to junction box. Do not wire luminaire to luminaire unless noted otherwise, or if using manufactured wiring systems.

K. Individual flexible connections, less than 6 feet in length, shall consist of 2#14 and 1#14 (ground) in 3/8" flexible metallic conduit (for circuits 20A or less). Bond ground wire and conduit at each end.

L. Recessed luminaires in insulated ceilings shall be installed so that insulation is no less than 3 inches away from the fixture enclosure unless the luminaire is listed for direct contact with insulation (IC rated).

M. Provide equipment, labor and materials, as needed for final aiming of adjustable luminaires. Aiming shall take place immediately before final occupancy by the Owner.

N. Exterior pole-mounted luminaire with anchor base type poles shall be installed on a reinforced concrete foundation designed to withstand fixture weight and prevailing wind conditions. Conduit raceway shall be pre-set in the foundation and terminate inside the pole.

O. Provide a copper-clad steel grounding rod, installed and bonded at each lighting pole.

P. Exterior pole-mounted luminaires with direct-embedment type poles shall be installed in carefully compacted earth per pole manufacturer's recommendations.

Q. All poles shall be installed so that the pole is plumb to the earth, with the bottom of the base flush to the foundation, paving, or finished grade, unless indicated otherwise. Verify soil conditions at each pole location to ensure adequacy of soil to support pole. Advise Architect if soil conditions are not adequate.

R. All pole-mounted luminaires shall have in-line fuse installed at the hand hole of the pole with weatherproof fuse holder. Provide sufficient slack in conductors to allow servicing outside of pole.

S. Reflectors, trim cones, and other visible trim of luminaires shall not be installed until completion of ceiling work, and shall be clean and free of dust, fingerprints, scratches, dents etc. upon substantial completion.

END OF SECTION 26 50 00

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SECTION 27 05 00 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Pathways for voice data system (communications) are provided under division 26.

B. The 27 00 00 communications documents cover the furnishing of:

1. Voice data outlets as shown on plans.
2. Wiring for from outlets to existing communications cabinets in existing data room.
3. Installation of patch panels and their patch cards in existing cabinets.
4. Appropriate connections.
5. Testing of installed system from outlet to patch panel.
6. Coaxial cable installation.

C. The data communications network equipment systems (Cisco Network Switch, Security Cameras, and Wireless Access Point Units) are to be provided by the Owner for this project. It will not be the responsibility of the telecommunications special systems contractor to provide or install this equipment.

D. SPECIAL SERVICE / SYSTEMS

1. Pathway provisions and some/limited cabling only are provided for this section as noted on drawings. It will not be the responsibility of the telecommunications special systems contractor to provide or install audio visual equipment.

2. These items are to be provided by the Owner for this project. It will not be the responsibility of the telecommunications special systems contractor to provide or install this equipment.

1.2 COORDINATION

A. Coordinate arrangement, mounting, and support of communications equipment.

B. Coordinate installation of required supporting devices in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate selection and application of Firestopping specified in Electrical Division 26 05 34 Section "Firestopping."

PART 2 - EXECUTION

2.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Right of Way: Give to piping systems installed at a required slope.

END OF SECTION 27 05 00

SECTION 27 05 53 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the equipment and execution requirements relating to Identification for Communications Systems.

C. Equipment specifications, general considerations, and guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.2 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 - LABELING

2.1 LABELING REQUIREMENTS

A. Labeling shall be done in accordance with the recommendations made in the ANSI/TIA-606-A document, manufacturer's recommendations and best industry practices.

B. All spaces, pathways, outlets, cables, termination hardware, grounding system and equipment shall be labeled with machine-generated labels.

C. All labels shall be clear with black text.

D. All cables shall be labeled with machine generated, wrap around labels.

E. A total of two (2) labels per horizontal cable are required at the following: 18" from outlet' 12" from termination block/patch panel.

F. Labeling scheme shall be alphanumeric.

Such as:
Voice Panels/ Outlets V1-01/V1-48, V2-01/V2-48, and V3-01/V3-48

Data Panels/ Outlets D1-01/D1-48, D2-01/D2-48, D3-01/D3-48, and D4-01/D4-48
WAP Panel/ Outlets WAP-01/WAP-24
CAM Panel/ Outlets CAM-01/CAM-24

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 27 05 53

SECTION 271500 – COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL REQUIREMENTS

1.01 Objective

A. The purpose of this standards document is to enable consistency in planning and installation of structured cabling systems for our facilities. We recognize that the installation of cabling systems during building construction or renovation is significantly less expensive and less disruptive than after the building is occupied. Having consistent infrastructure at all of our facilities that meet our goals and objectives for bandwidth and capacity is critical to our global IT planning. This specification document will define the systems, products, installation practices and warranty support required of all Structured Cabling.

B. Product specifications, general design considerations, and installation guidelines are provided in this written document. Quantities of telecommunications outlets, typical installation details, cable routing and outlet types for a specified Company Name facility will be provided as a separate submission for each specific project

1.02 CODES AND STANDARDS COMPLIANCE

A. All materials shall comply with the applicable sections of all Local, State and Federal building codes, fire safety codes, amendments, and ordinances for installation of telecommunications cabling.

B. All materials shall comply with the applicable sections of the following Codes for installation of telecommunications cabling:

1. Uniform Building Code (UBC)
2. National Electrical Code – NFPA 70 (NEC)
3. National Fire Alarm and Signaling Code – NFPA 72
4. Federal Communications Commission (FCC) Part 15 and Part 68

C. All materials and installation practices shall comply with the most current version of the applicable sections of the following Telecommunications Industry Standards and Manuals as appropriate.

D. Telecommunication Industry Association (TIA)

1. ANSI/TIA-568.0-E Generic Telecommunications Cabling for Customer Premises
2. ANSI/TIA-568.1-E Commercial Building Telecommunications Cabling Standard
3. ANSI/TIA-568.2-D Balanced Twisted-Pair Telecommunications Cabling and Components Standards
4. ANSI/TIA-568.3-D Optical Fiber Cabling and Components Standard
5. ANSI/TIA-568.4-D Coaxial Components
6. ANSI/TIA-569-E, Telecommunications Pathways and Spaces.
7. ANSI/TIA-526-7-A, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant

8. ANSI/TIA-606-C, Administration Standard for Commercial Telecommunications Infrastructure.
9. ANSI/TIA-607-D, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
10. ANSI/TIA-758-B, Customer-Owned Outside Plant Telecommunications Infrastructure Standard
11. ANSI/TIA TSB-162-B Telecommunications Cabling Guidelines for Wireless Access Points
12. ANSI/TIA-862-B, Structured Cabling Infrastructure Standard For Intelligent Building Systems
13. ANSI/TIA-942-B, Data Center Cabling
14. ANSI/TIA-1005-A, Telecommunications Infrastructure Standard for Industrial Premises
15. ANSI/TIA-1152-A, Requirements for Field Test Instruments and Measurements for Balanced Twisted Pair Cabling
16. ANSI/TIA-5017, Telecommunications Physical Network Security Standard
17. ANSI/TIA-5018, Distributed Antenna Systems (DAS)
18. TIA TSB-184-A Power Delivery (4-pair)

E. BICSI

1. Telecommunications Distribution Methods Manual (TDMM), 14th Edition
2. Information Technology Systems Installation Methods Manual (ITSIMM), 7th Edition
3. ANSI/BICSI 002-2019- Data Center Design and Implementation Best Practices
4. ANSI/BICSI 001-2017, Information and Communication Technology Systems Design and Implementation Best Practices for Educational Institutions and Facilities
5. ANSI/BICSI 004-2018, Communication Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities
6. ANSI/BICSI 006-2020, Distributed Antena System (DAS) Design and Implementation
7. ANSI/BICSI 007-2017- Information Communication Technology Design and Implementation Practices for Intelligent Buildings and Premises
8. ANSI/BICSI 008-2018 - Wireless Local Area Network (WLAN) Systems Design and Implementation Best Practices
9. ANSI/BICSI N1-2019: Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure
10. ANSI/BICSI N2-17: Installation of Telecommunications and ICT Cabling to Support Remote Power Applications
11. ANSI/BICSI N3-20: Planning and Installation Methods for the Bonding and Grounding of Telecommunications and ICT Systems and Infrastructure

12. BICSI G1-17, ICT Outside Plant Construction and Installation: General Practices

F. This document does not replace any Code, local or otherwise. The contractor must be aware of local Codes that may impact this project.

1.03 CONTRACTOR QUALIFICATIONS

A. The Contractor shall be a company specializing in the installation of Telecommunications Structured Cabling Systems.

B. The Contractor shall have total responsibility for the coordination and installation of the work shown and described in the Drawings and these Specifications.

C. The Contractor shall demostrate the following qualification requirements:

1. Demonstrate that they have a minimum of 5 years experience installing structured cabling for telecommunications.

2. Reference list of at least 5 previous successful projects of this scope, size and nature; including names and location of projects, description of work, time of completion and names of contact persons for reference.

3. Demonstrate that they are a current Leviton Certified Contractor.

4. Installers/technicians working on this project will be able to produce documentation from Leviton indicating that they have successfully completed the appropriate Copper and Optical Fiber Communications Cabling System training courses.

5. The Contractor must have a current BICSI certified Registered Communications Distribution Designer (RCDD) on staff as a full-time employee – copy of RCDD certificate required. It is the Owner's discretion, on a project by project basis, an RCDD consultant may be hired by the Owner to inspect work during and after completion. Based upon inspection by Owner's hired RCDD consultant or IT Staff the Contractor will be responsible for correcting any work that does not meet requirements detailed in this document.

6. The Contractor must have a supervisor on premises with the authority to act for the Contractor. The supervisor must be a current Leviton certified installer. Copy of certificate required.

D. Bidding Contractor shall be a licensed to install telecommunications systems in the locale where work will be performed.

E. Bidding Contractor shall be able to provide insurance in the types and values requested by the owner.

F. Bidding Contractor shall be able to procure bonding in the type and values as required by the owner.

1.04 ADMINISTRATIVE REQUIREMENTS

A. SCHEDULING AND COORDINATION WITH OTHER TRADES

1. The Contractor shall coordinate Structured Cabling Systems work with that of other trades as required ensuring that the entire communications work will be carried out in an orderly, complete and coordinated fashion.

2. Contractor shall attend project coordination meetings as necessary.

3. Upon contract award Contractor shall provide a detailed construction schedule with hard dates for completion of cable placement, terminations, and testing and submit to Owner's Project Manager for approval.
4. Cabling schedule submittals shall be in a format as designated by the Owner's Project Manager.
5. Inform General Contractor and Owner's Project Manager immediately of any delays or potential delays related to material procurement, delivery or labor related issues.
6. Include premium time required to comply with the project scheduling and phasing.

B. SITE INVESTIGATION

1. Prior to submitting bids for the project, and where practicable, contractor shall visit the work site to become aware of any conditions that may affect the cost of the project.
2. Contractor shall obtain a complete set of Project Drawings and Specifications for coordination and to determine the full scope of work.

C. PERMITS

1. Contractor shall obtain all permits and required inspections for the installation of this work and pay all charges associated.
2. Deliver to the Owner all certificates, permits and inspection reports issued by authorities having jurisdiction (AHJ).

D. DELIVERY, STORAGE, AND PROTECTION

1. Materials and equipment furnished shall be delivered in new condition and be of current production lots.
2. Contractor shall ensure that material deliveries to work site shall be coordinated with construction manager responsible for materials distribution to all trades. Handle in accordance with Manufacturer's recommendations and instructions to avoid damaging equipment, installed devices and finish.
3. Contractor is responsible for all materials, tools and vehicles left on the job site.
4. Contractor shall coordinate for the removal of all rubbish and packing materials produced by the Contractor's activities during the project.
5. Contractor shall ensure materials are stored according to Manufacturer's recommendations. In addition, materials must be stored in a location protected from vandalism and weather.
6. Inspect and report concealed damage to carrier within specified time.

E. PROJECT CONDITIONS

1. Environmental Requirements
    a. Contractor shall ensure that any rubbish produced by the structured cabling work are is of according to local, state or national regulations.

b. It is preferred that the Communications Contractor recycle any used or un-used components during the course of the construction project.

2. Telecommunications Bonding and Grounding System

a. Contractor shall confirm with electrical engineer on project that a Telecommunications Grounding and Bonding System meeting industry standards has been provided.

b. All relevant telecommunications equipment installed must be bonded to the Telecommunications Grounding and Bonding System per industry standards and Manufacturers recommendations.

1.05 SUBMITTAL REQUIREMENTS

A. Contractor shall submit with bid for approval, Leviton specification sheets for all products to be furnished. Work shall not proceed without the Owner and/or the Project Manager's approval of the submitted items.

B. Any materials and equipment submitted that are not in accordance with this specification may be rejected.

C. Successful contractor shall generate shop drawings for approval prior to commencement of work. Shop drawings shall include cable routes, conduit penetration locations, elevation drawings of equipment racks, patch panels, termination blocks, connection details, rack mounting details and other relevant details not included in the project drawings.

D. Upon completion of project contractor shall modify initially reviewed and accepted shop drawings to include revisions based upon change orders and approved field conditions and submit a final drawing as an as-built submittal.

1.06 END-TO-END SYSTEMS REQUIREMENT

A. All cables, connectors, patch panels, and patch cords provided must manufactured by the same Leviton to provide for a complete end-to-end solution. Other manuafcturers solutions will not be accepted.

1.07 WARRANTY

A. Contractor warrants to the end-user that their installation practices and workmanship will adhere to all standards and Leviton requirements. Contractor shall fix or repair any installation faults at their own cost..

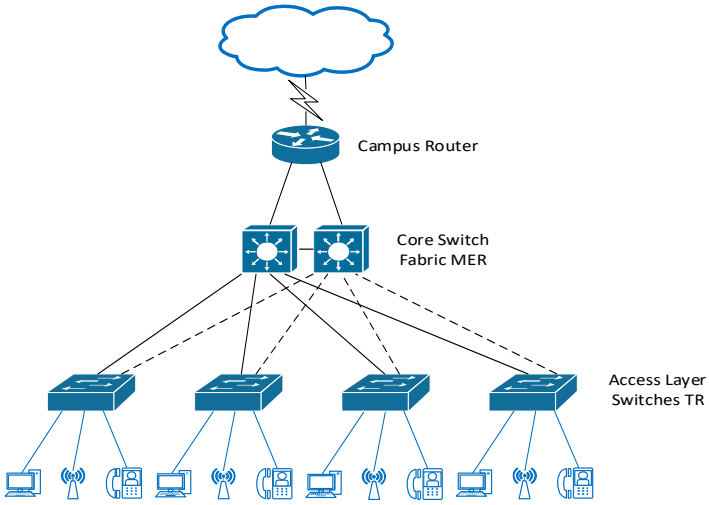
B. A Leviton Limited Lifetime Product and Performance Warranty shall be obtained by the Contractor on behalf of the Owner covering all applicable structured cabling components of the installed system. It is the responsibility of the contractor to provide all forms/documents necessary to obtain the system warranty. Evidence of such warranty will be provided by Contractor as part of their contractual obligation and final retainage payments are contingent upon delivery to Owner of Leviton's site warranty certificate.

1.08 Network TOPOLOGY

A. City of Hunstville deploys a LAN (Local Area Network) based on a switched ethernet collapsed backbone design consisting of core switches located at the Main Equipment Room (MER) feeding distribution switches located at floor

Telecommunications Rooms (TR) . Interswitch links (ISL) between core switches and access switches are connected via fiber optic cabling.

B. Workstation, WAP and IoT devices connect to access switches via horizontal twisted pair connections.



1.09 HORIZONTAL CABLING

A. All workstations, Wireless Access Points (WAP's), security devices, and IoT devices shall be cabled with Category 6 UTP horizontal cabling as indicated on communications plans.

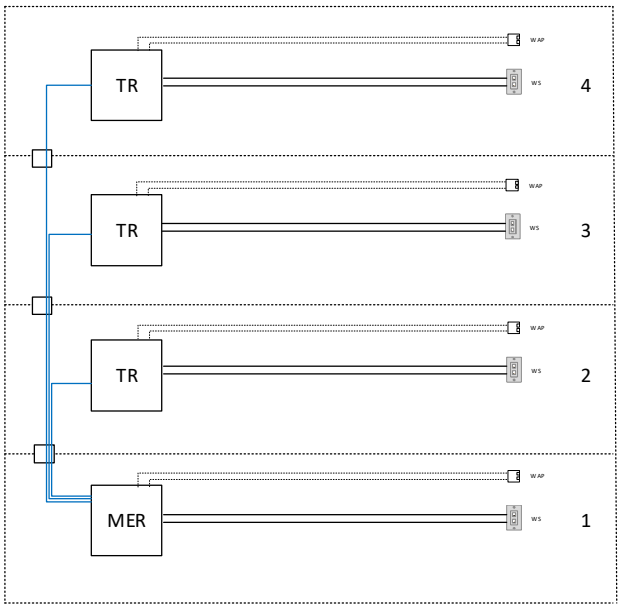
B. A minimum of two (2) horizontal cables shall be run to each workstation or WAP unless indicated otherwise on project plans

C. Horizontal cables shall be terminated with RJ45 connector modules installed in rackmount patch panels located in the Telecommunications Room (TR).

D. Horizontal cables shall be terminated with RJ45 connector modules installed in appropriate color and decor.

E. Locations of telecommunications outlets and outlet types are indicated on project plans.

1.10 NETWORK SCHEMATICS



1.11 Manufacturer Specific Declaration

A. City of Hunstville has specified Leviton Network Solutions as the product brand required to meet their design requirements. Product support questions can be directed to Leviton contacts below:

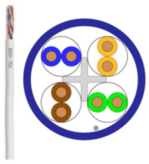
1. Leviton Network Solutions
2. 2222 - 222nd St SE, Bothell, WA 98021-4422
3. Customer Service 1-800-722-2082, 1-425-486-2222
4. Product Support 1-800-824-3005
5. www.leviton.com/ns

LEVITON PRODUCTS ORDERING GUIDE

2.01 CATEGORY 6 CABLE

A. Category 6 cable shall be 23awg U/UTP construction

B. Cable shall meet fire rating appropriate to local building codes.



Category 6 U/UTP Cable		
Part Number	Description	Comment/Attribute
1003209x	LANmark-1000 Plenum (see drawings for color)	Work Area Outlets (WA), Wireless Access Points (WAPs)
11072213	LANmark-1000 OSP	All wet or exposed locations

2.02 CATEGORY 6 CONNECTOR MODULES

A. eXtreme connector modules shall be used

B. 110-style, component-rated, non-shuttered

Category 6 connector modules		
Part Number	Description	Comment/Attribute
61110-Rx6	eXtreme Category 6 UTP Connector Module, (see drawings for color)	Work Area Outlets (WA), Wireless Access Points (WAPs), TR Patch Panels

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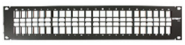
2.03 COPPER PATCH PANELS

A. Patch panels shall be flat QuickPort style, 2RU 48 Port



Patch panels and Horizontal cable managers		
Part Number	Description	Comment/Attribute
49255-H48	48 port 2RU Quickport flat patch panel	Includes rear wire management bar

2.04 COPPER PATCH CORDS

A. Cat 6 patch cords shall be High-Flex, 28-gauge stranded conductor with a maximum OD of 0.15"

B. VXC plenum-rated coupler assembly for WAPs

Product Title		
Part Number	Description	Comment/Attribute
6H460-07x	eXtreme® High-Flex Cat 6 Patch Cord, 7 ft (see drawings for color)	Telecom Room (TR)
6H460-10x	eXtreme® High-Flex Cat 6 Patch Cord, 10 ft (see drawings for color)	WA
SBCPI-18W	VXC Plenum Assembly, VXC coupler with 18" plenum patch cable connected, White	WAP

2.05 FACEPLATES (WALLPLATES)

A. Stainless steel QuickPort, manufactured from 304 stainless steel in a brushed finish

Product Title		
Part Number	Description	Comment/Attribute
43080-1L2	Stainless Steel QuickPort Wallplate, Single Gang, 2-Port, with Designation Windows	
43080-1L3	Stainless Steel QuickPort Wallplate, Single Gang, 3-Port, with Designation Windows	
43080-1L4	Stainless Steel QuickPort Wallplate, Single Gang, 4-Port, with Designation Windows	

2.06 CABLE MANAGEMENT

A. 8"wide vertical cable management for 19"x 84" racks

B. 5"wide vertical cable management for 19"x 84" racks

C. Horizontal cable management for 19" racks

Product Title		
Part Number	Description	Comment/Attribute

8980L-VFR	Vertical Front and Rear Cable Management, 8" Channel x 80" Long. Black Hinge Cover.	Use between racks
4940L-VFR	Vertical Front and Rear Cable Management, 5" channel x 40" Long. Black Snap-On Cover.	Use on end of rack row
491RU-HFO	Horizontal Cable Management, 1RU, 1.5"x3" Front Only	1:1 with patch panels

2.07 RACKS & ENCLOSURES

A. MDF - One (1) 4 Post Rack.

Product Title		
Part Number	Description	Comment/Attribute
RSN4261B	42 RU High, 600 mm wide, 1100 mm deep cabinet (MDF)	Manufacturer – Eaton

Part 3 – INSTALLATION PRACTICES

3.01 HORIZONTAL CABLES

A. Cable shall be installed in accordance with most current ANSI/TIA-568 Series, BICSI TDMM, manufacturer's recommendations, and best industry practices.

B. A plastic or nylon pull cord with a minimum test rating of 90 Kg (200 lb.) shall be co-installed with all cable installed in any conduit.

C. Cable raceways shall not be filled greater than the maximum fill for the particular raceway type.

D. Cables shall be installed in continuous lengths from origin to destination (no splices) except for approved connection points.

E. Where connection points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.

F. The cable's minimum bend radius and maximum pulling tension shall not be exceeded. Refer to manufacturer's requirements.

G. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 1.0 to 1.5 meter intervals and be randomly spaced. J hooks shall be properly sized to accommodate the immediate need and future growth of the cable pathway. J Hooks shall be designed to control bend radius requirements of the cable categories being installed.

H. Cable supports shall be self-supporting and utilize independent wires, support rods and associated hardware for suspension. At no point shall cable(s) rest on acoustic ceiling grids, T-bars, ceiling support wires, acoustical panels or other components of the suspended ceiling.

I. Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.

J. The bundle size recommendations of ANSI/TIA TSB-184-A shall be followed as it pertains to current or future support for POE applications.

K. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

L. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the Contractor prior to final acceptance at no cost to the Owner.

M. When cables are being installed, slack (service loops) shall be provided to accommodate future changes in the structured cabling system. Slack should be included in all length calculations to ensure that the permanent link does not exceed 90 m (295 ft). The amount of cable slack required will depend on the size and layout of the connecting hardware at the TR, TE or TO.

The recommended amount of cable slack shall be:

3m (10 ft) in telecom spaces (ER, TR, TE) and ceiling above TO

30cm at the work area outlet

N. Cables shall be neatly bundled and dressed to their respective termination device. Each terminating device shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

O. Cable bundles shall not be painted.

P. Each cable shall be clearly labeled on the cable jacket behind the termination device at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.02 EMI/RFI AVOIDANCE

A. Cables shall be routed such that the minimum separation distances from EMI/RFI and electrical power sources, as detailed in, are maintained and in accordance with most current ANSI/TIA-568 Series, BICSI TDMM, manufacturer's recommendations, and best industry practices.

B. To avoid electromagnetic interference (EMI) route cables to maintain the following minimum distances:

1. Three-inches from power lines of 2 KVA or less installed in conduits or grounded flexible armor below access floors.
2. Three-inches from fluorescent fixtures with remotely installed ballasts.
3. Five inches from standard fixtures.
4. Five-inches from power lines 2 KVA of less.
5. Twelve-inches from power lines of between 2 to 5 KVA.
6. Twelve-inches from 110 to 277 volt lighting.

7. Twenty-four inches from power lines of 5 KVA or greater.
8. Three-feet from transformers or motors.
9. Maintain minimum a twelve inch separation between telecommunication cables running exposed in ceiling or floor voids and parallel electrical cables/conduits.

C. Telecommunication cables shall cross electrical cables/conduits at 90 degree angles.

3.03 VOICE AND DATA MODULAR JACKS

A. 8-position, 8-contact (8P8C) modular jacks shall be installed in accordance with manufacturer's recommendations and installation guides, and best industry practices.

B. Pair untwist at the termination shall not exceed 6.35 mm (0.25 inch).

C. Data jacks, unless otherwise noted in Drawings shall be located in the bottom position(s) of each faceplate. Data jacks in horizontally oriented faceplates shall occupy the right-most position(s).

D. Voice jacks, unless otherwise noted in Drawings, shall occupy the top position(s) on the faceplate. Voice jacks in horizontally oriented faceplates shall occupy the left-most position(s).

3.04 PATCH PANELS

A. Cables shall be dressed and terminated in accordance with the recommendations made by manufacturer's recommendations and best industry practice.

B. Cables shall be separated into groups of twelve and routed symmetrically from both sides of the patch panel (e.g. split panel)

C. Cables shall be properly supported vertically in the rack or cabinet and supported at the rear of the patch panel using a cable management bar or a rear horizontal cable management to retain terminations

D. Pair untwist at the termination shall not exceed 12.7 mm (.5 inch) for Cat 5e cabling

E. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.

3.05 PATCH CORD INSTALLATION

A. Patch cords shall be installed at IT room end and at workstation end with cords of appropriate length such that cables are routed through proper cable management ducts and patch ways in a consistent manner. Cords should be routed so as not to block panel labels where possible

B. Patch cords shall be installed with the proper color to match the adopted color scheme for the organization.

C. Patch cords shall be labeled at both ends according to the adopted labeling scheme for the organization. Labeling scheme shall adhere to most current ANSI/TIA-606 standard.

D. Patching schedules and or records shall be updated by the Structured Cabling Plant Administrator after patching has been completed.

E. Patch cords that are no longer in use shall be removed from the patching frame and properly stored. Patch cords to be harvested for reuse shall have unique ID labeling removed and be retested prior to being made available for re-use.

F. Patch cords installed in plenum air handling spaces must meet appropriate fire/building codes.

3.06 FACEPLATES

A. Blank inserts shall be installed where ports are not used.

B. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation.

C. Faceplates shall be installed straight and level.

D. Faceplates shall be installed at the same heights as electrical faceplates or as designated on architectural and construction plans.

3.07 FIELD QUALITY CONTROL

A. OPTICAL FIBER TESTING AND QUALITY ASSURANCE

1. Testing procedures shall be in accordance with the following:
    a. ANSI/TIA-568-C.3.
    b. ANSI/TIA-526-7, Method B.
    c. Proposed TSB-140 Tier One Fiber Certification, C.
    d. Encircled Flux testing per the TSB-4979 and TIA-526-14-B standard.
2. Testing:
    a. Test optical Fibers at both 1310 nm and 1550 nm wavelengths for singlemode, end-to-end insertion loss,
    b. Maximum channel insertion loss for Fiber optic cables without consolidation point: 2.0 db.
3. All OLTS units shall be of current calibration, submit calibration certificate with test results to Manufacturer.

B. HORIZONTAL

1. Test 100 percent of all cable runs for defects in installation and verify cabling system performance under installed conditions in accordance with most current ANSI/TIA-568 Series, BICSI TDMM, manufacturer's recommendations, and best industry practices.
2. Defects in cabling system installation, including but not limited to cables, connectors, patch panels, and connector blocks shall be repaired or replaced to ensure 100 percent useable conductors in all cables installed.
3. Performance Certification Testing of Twisted-Pair Cables: (NOTE: Permanent Link Test results are recommended and are the expected norm).
    a. Test twisted-pair copper cable links for continuity, pair reversals, shorts, opens, and performance as specified.
    b. Test horizontal cabling using appropriate Level certification tester in accordance with TIA-1062-A.

c. Basic Tests Required:
   i. Wire map.
   ii. Length (feet).
   iii. Insertion loss (dB), formerly attenuation.
   iv. NEXT (Near end crosstalk) (dB).
   v. Return loss (dB).
   vi. ELFEXT (dB).
   vii. Propagation delay (ns).
   viii. Delay skew (ns).
   ix. PSNEXT (Power sum near-end crosstalk loss) (dB).
   x. PSELFEXT (Power sum equal level far-end crosstalk loss) (dB).

b. Provide test results in approved certification testers original software format on CD, with the following minimum information per cable:
   i. Circuit ID.
   ii. Information from specified basic tests required.
   iii. Test Result: "Pass" or "Fail".
   iv. Date and time of test.
   v. Project name.
   vi. NVP.
   vii. Software version.

c. Submit fully functional version of tester software for use by the Owner in reviewing test results.

d. Report in writing to the Owner immediately, along with copy of test results, failed test results that cannot be remedied through re-termination (as in the case of reversed or split pairs).

3.08 LABELING

1. All labeling is to be in accordance with ANSI/TIA-606-C, adopted labelling schema, and manufacturer's instructions.
2. Label horizontal cables using machine-printed label at each end of cable at approximately 12 inches from termination point and again at approximately 48 inches from termination point.
3. Handwritten Labels: Not acceptable.
4. Label patch panel ports and TO ports with cable identifier.

END OF SECTION 27 15 00

SECTION 28 31 10 – ADDRESSABLE FIRE ALARM SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION:

A. Furnishing, installing, and testing a microprocessor controlled, intelligent reporting fire alarm system forming a complete, system. It shall include, but not limited to, alarm initiating devices, alarm notification appliances, Fire Alarm Control Panel (FACP), auxiliary control devices and wiring as shown on drawings and specified herein

B. Fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises signaling systems and NFPA 101 Life Safe TV.

C. Installing company must be licensed as certified contractor employing NICET (minimum Level II Fire Alarm Technology) technicians guiding final checkout and ensure systems integrity on site.

D. Installing company shall furnish proof of compliance with State Requirements for having a Certified Fire Alarm Contractor License and is licensed with State Fire Marshall.

E. Installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to wire all devices and final checkout and to ensure the systems integrity. A NICET LEVEL III PERSON SHALL PREPARE THE INSTALLATION DOCUMENTS.

1.2 SCOPE:

A. System Basic Performance:
   1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on Class B Signaling Line Circuits (SLC).
   2. Initiation Device Circuits (IDC) shall be wired Class B as part of an addressable device connected by the SLC Circuit.
   3. Notification Appliance Circuits (NAC) shall be wired Class B as part of an addressable device connected by the SLC Circuit.
   4. Alarm signals arriving at the FACP shall not be lost following a power loss until alarm signal is processed and recorded.

B. A fire alarm condition detected and reported by a system initiating device the following functions shall immediately occur:

1. The system alarm LED on control panel system display shall flash.

2. Local piezo electric signal in the control panel shall sound.

3. Backlit LCD display shall indicate all information associated with fire alarm condition, including type of alarm point and its location within the protected premises.

4. General alarm shall be activated through local sounders and strobe lights.

5. System will supply signal to remote monitoring location.

1.3 SHOP DRAWINGS:

A. General:
   1. Digital copy of shop drawings shall be submitted to Architect for review.

B. All references to manufacturer's model numbers and other pertinent information herein establishes minimum standards of performance, function and quality. Equivalent compatible UL-listed equipment from other manufacturers may be substituted if minimum standards are met.

C. For equipment other than specified, contractor shall supply proof substitute equipment equals or exceeds features, functions, performance, and quality of specified equipment.

D. Drawings:

   1. Information shall be included for compliance with drawings and specifications.
      a. Include manufacturer's name, model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts to bid document scale.

      b. Show Fire Alarm Control Panel layout, configurations and terminations.

      c. Submit Shop Drawing to Architect/Engineer for review and then to AUTHORITY HAVING JURISDICTION. All comments from AUTHORITY HAVING JURSIDICTION shall be submitted to Engineer promptly. Changes to Fire Alarm design shall be reviewed by Engineer prior to resubmitting to

AUTHORITY HAVING JURISDICTION. No additional compensation for meeting AHJ requirements.

E. Manuals:
1. Submit with shop drawings, complete operating and maintenance manuals listing manufacturer's name(s), including technical data sheets.
2. Wiring diagrams shall indicated internal wiring for each device and the interconnections between items of equipment
3. All calculations required ie battery cal. Etc..

F. System startup and testing
1. Factory trained authorized technician shall perform system start up and testing.

G. Certifications:
1. Include with shop drawings a certification from system supplier supervisor of installation and performer of contract maintenance is an authorized representative of equipment manufacturer. Include names and addressed in certification.

1.5 GUARANTY:

A. All materials and work performed under contract shall be warranted for a period of one (1) year from date of acceptance

1.8 RELATED SECTIONS

A. Conduit, raceways.
B. Fire stopping penetration through rated construction
C. Electrical, cabling, and wiring.

1.9 REFERENCES

A. NFPA 70 – National Electric Code
B. NFPA 101 – Life Safety Code
C. NFPA72 – National Fire Alarm and Signaling Code
D. Americans with disabilities Act – Public Law 101.336
E. FCC
F. CE

1.10 APPLICABLE STANDARDS AND SPECIFICATIONS:

A. The specifications and standards listed below form a part of this specification. The system shall fully comply with latest issue of standards, where applicable.

B. National Fire Protection Association (NFPA) – USA:
   1. No. 13 Sprinkler Systems
   2. Underwriters Laboratories Inc. (UL) – USA:
   3. No. 28 Smoke Detectors for Fire Protective Signaling Systems
   4. No. 864 Control Units for Fire Protective Signaling Systems
   5. No. 346 Waterflow Indicators for Fire Protective Signaling Systems

C. Local and State Building Codes.

D. All requirements of the Authority Having Jurisdiction (AHJ).

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIAL, GENERAL:

A. Components shall be new, manufacturer's current model. Materials, appliances, equipment shall be tested and listed by a nationally recognized approvals agency for use as part of a protective signaling system, meeting National Fire Alarm Code.

B. All components shall be installed in compliance with manufacturer's recommendations.

2.2 CONDUIT AND WIRE:

A. Conduit:
   1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements. Conduit required in walls and inaccessible ceilings.
   2. MC cable U.L. listed for fire alarm, color coded, to be used above lay-in ceilings.
   3. Cable must be separated from open conductors of power, or Class 1 circuits, and not placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760-29.

B. Wire:
   1. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) as recommended by fire alarm manufacturer.

C. Fire alarm control panel shall be connected to a separate branch circuit, rated 20 amperes. Circuit shall be labeled at main power distribution panel as FIRE

ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. Control panel cabinet shall be grounded.

2.3 MAIN FIRE ALARM CONTROL PANEL:

A. Main FACP or network node shall be a NOTIFIER Model NSP-25/E or equal products of FCI, EDWARDS, or Siemens containing microprocessor based Central Processing Unit (CPU) and power supply. CPU shall communicate with and control the following types of equipment used for system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, and other system controlled devices

B. Waterflow Operation:
   1. Alarm from a waterflow device shall activate appropriate alarm message on the main panel display, turn on all programmed notification appliance circuits and not be affected by signal silence switch.

C. Supervisory Operation:
   1. Alarm from a supervisory device shall cause appropriate indication on system display, light a common supervisory LED, but will not cause system to enter trouble mode.

D. Signal Silence Operation:
   1. FACP shall have the ability to program each output circuit (notification, relay, speaker etc) to deactivate upon depression of signal silence switch.

E. Non-Alarm Input Operation:
   1. Addressable initiating device in system may be used as a non-alarm input to monitor normally open contact type devices. Non-alarm functions are a lower priority than fire alarm initiating devices.

F. Combo Zone:
   1. A special code shall be available to allow waterflow and supervisory devices to share common addressable module. Waterflow devices shall be wired in parallel, supervisory devices in series.

2.4 SYSTEM COMPONENTS:

A. Sounders:
   1. Electronic sounders shall operate on 24 VDC nominal.
   2. Electronic sounders shall be field programmable without the use of special tools, at a sound level of at least 87 dBA measured at 10 feet from the device

3. Shall be flush or surface mounted as shown on plans.

B. Strobe lights shall meet requirements of the ADA, UL Standard 1971, be fully synchronized, and shall meet following criteria:
   1. Maximum pulse duration shall be 2/10 of one second
   2. Strobe intensity meets requirements of UL 1971. (MIN 75CD)
   3. Flash rate shall meet requirements of UL 1971

2.5 SYSTEM COMPONENTS – ADDRESSABLE DEVICES:

A. Addressable Devices – General:
   1. Addressable devices use simple to install and maintain decade, decimal address switches. Devices capable of being set to an address in a range of 001 to 1

B. Intelligent Photoelectric Smoke Detector:
   1. Detectors shall use photoelectric (light-scattering) principal to measure smoke density and on command from control panel, send data to panel representing analog level of smoke density and shall initiate general alarm on activation.

C. Intelligent photoelectric duct smoke detectors shall measure smoke density and on command from control panel send data to panel showing analog level of smoke and cause AC unit to shut down and sound general alarm.

D. Two Wire Detector Monitor Module:
   1. Addressable monitor modules shall connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).

E. Two wire activation module will provide control functions needed to accomplish system activation ie, elevator return on lock controlled doors etc…

2.6 BATTERIES:

A. Battery shall have sufficient capacity to power the fire alarm system for twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.
B. Batteries completely maintenance free.
C. If necessary to meet standby requirements, external battery, charger systems may be used.

PART 3 EXECUTIION

3.1 INSTALLATION:

A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and ma

3.2 TEST:

A. Service of a competent, factory-trained engineer or technician authorized by manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72, Chapter 7.

B. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

C. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.

D. Verify activation of all waterflow switches.

E. Open initiating device circuits and verify that the trouble signal actuates.

F. Open and short signaling line circuits and verify that the trouble signal actuates.

G. Open and short notification appliance circuits and verify that trouble signal actuates.

H. Ground all circuits and verify response of trouble signals.

I. Check presence and audibility of tone at all alarm notification devices.

J. Check installation, supervision, and operation of all intelligent smoke detectors using walk test.

K. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and proper processing of signal at FACP and correct activation control points.

3.3 FINAL INSPECTION:

A. At final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate system functions properly in every respect

INSTRUCTION:

Instruction shall be provided as required for operating system. Hands-on demonstrations of the operation of all system components and the entire system

END OF SECTION 28 31 10

SECTION 28 55 00 - RF SURVEY FOR IN-BUILDING TWO-WAY EMERGENCY RESPONDER COMMUNICATION ENHANCEMENT SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. The purpose of this specification is to establish the requirements and standards for initial survey for public safety radio signal strength per NFPA and IFC

B. Survey should be performed after the building is substantially completed, and prior to start of installation of electrical wiring.

C. Conduct a survey using a RF Spectrum Analyzer, a calibrated, system-compatible radio or another suitable instrument with traceable certificate of calibration to analyze the RF signal strength of Emergency Responder Radio Signal into the building and determine if amplification of the signal is required. Both inbound and outbound signal strength shall be determined, measured, calculated and documented as required by code.

1.02 SURVEY CRITERIA IF REQUIRED

A. The required Public Safety Radio Signal Level inside the Owner's facility must be determined per code, ordinance or AHJ

B. Survey shall be performed by an FCC licensed technician holding a current GROL license. Honeywell Fire Systems have distributors that meet these requirements.

1.03 REGULATIONS

A. Codes, regulations and standards referenced in the Section are:
1. NFPA 1 – The National Fire Code (including Annex O from 2009)
2. NFPA 70 – The National Electrical Code
3. IFC 510- Emergency Responder Radio Coverage
4. NFPA 101, Life Safety Code, the Ohio Building Code, and Local Code and Building Authority requirements.
5. NFPA 72 National Fire Alarm Code
6. FCC 47 CFR Private Land Mobile Radio
7. 90.219 Services-Use of Signal Boosters

8. ICC International Fire Code, Code and Commentary
9. Local or State Promulgated Fire Code
10. ADA "Americans with Disabilities Act"
11. FCC's OET 65 Standards "Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields"
12. FCC Rules Part 22, Part 90 and Part 101
13. NFPA 1221 2016 Edition or later
14. International Building Code 2012 / 2015 / 2018 or later
15. UL 2524 2nd Edition

1.04 DEFINITIONS

A. Definitions:
1. Bi-Directional Amplifier BDA / Fiber DAS Master/Remote: Device used to amplify band-selective or multi-band RF signals in the uplink, to the base station and in the downlink from the base station to subscriber devices for enhanced signals and improved coverage.
2. In-building Two-way Emergency Responder Communication Enhancement System: A two-way radio communication system installed to assure the effective operation of radio communications systems for fire, emergency medical services, or law enforcement agencies within a building or structure. A system used by firefighters, police, and other emergency services personnel.
3. FCC: Federal Communications Commission
4. OET 65 Standards: FCC's Bulletin 65 provides Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
5. Public Safety/First Responder: Public Safety or First Responder agencies that are charged with the responsibility of responding to emergency situations. These include, but are not limited to law enforcement departments, fire departments, and emergency medical companies.
6. RSSI: Received signal strength indicator RSSI is a measurement of the power present in a received radio signal.
7. BER: Bit Error Rate is the number of bit errors per unit time
8. GROL- FCC General Radio Operators License
9. ERCES- Emergency Responder Communication Enhancement System
10. DAS-Distributed Antenna System

1.05 EXECUTION

A. Testing Procedures
1. Minimum Signal Strength: For testing system signal strength and quality, the testing shall be based on the. -95dBm nominal signal at 100%.
2. Spectrum Analyzer or Calibrated Handheld Radio or Scanning Receiver shall be used as basis for signal measurements or other method as approved by AHJ.

3. Testing should be based on a minimum of 20 grid locations per floor OR maximum of 1600 SQ ft. areas if the floor exceeds 32,000 Sq. Ft. Also, testing should include all critical areas per NFPA. See 1.02 of this specification and NFPA 72 2013 or NFPA 1221 2016. OR per any method determined by the AHJ, local code or ordinance.

4. A minimum signal strength of -95 dBm shall be provided throughout the coverage area for both uplink and downlink by the Local Fire Department.
   a. RSSI measurement only

1.06 SURVEY SUBMITTALS

A. Submit testing data for each level of the building.
   1. An RF measurement drawing of each floor of the building which indicates relative RF field strength for each frequency band of interest must be submitted to the AHJ.
   2. The drawing should indicate clearly the areas that have passed or failed based on the above parameters.

END OF SECTION 28 55 00

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SECTION 311000

SITE CLEARING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Protecting existing vegetation to remain.
   2. Removing existing vegetation.
   3. Clearing and grubbing.
   4. Stripping and stockpiling topsoil.
   5. Removing above- and below-grade site improvements.
   6. Temporary erosion- and sedimentation-control measures.

B. Related Sections:
   1. Division 01 Section "Temporary Facilities and Controls" for temporary utility services, construction and support facilities, security and protection facilities.
   2. Division 01 Section "Execution Requirements" for field engineering and surveying.

1.3 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.

D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain on Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
   1. Use sufficiently detailed photographs or videotape.
   2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
   1. Do not proceed with work on adjoining property until directed by Architect.

C. Salvable Improvements: Carefully remove items indicated to be salvaged and store at Owner's direction.

D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.

F. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

G. Do not direct vehicle or equipment exhaust towards protection zones.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

I. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 31 Section "Earth Moving."
   1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain. Flag each tree trunk at 54 inches above the ground.

C. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. General: Employ erosion control management practices as required by the General Permit for Storm Water Discharges. The Contractor is responsible for obtaining any required erosion control permits for construction activity. The Contractor will be responsible for application and maintenance of all conditions required by the Permit. Submit name of the Professional Engineer and/or Engineering firm to the Architect that is to be responsible for oversight of all requirements of the Permit until acceptance of all work under this Contract. The Owner or others working under the direction of the Owner may be working on this site during this Contract. Work by others will not relieve the Contractor of complying with all requirements of the Permit.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

3.4 EXISTING UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
   1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.
   1. Arrange with utility companies to shut off indicated utilities.

C. Locate, identify, and disconnect utilities indicated to be abandoned in place.

D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Architect not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Architect's written permission.

E. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
   1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
   2. Grind down stumps and remove roots, obstructions, and debris to a depth of 24 inches below exposed subgrade.
   3. Use only hand methods for grubbing within protection zones.
   4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
   1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.
   1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
   1. Limit height of topsoil stockpiles to 72 inches.

2. Do not stockpile topsoil within protection zones.
3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
   1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
   2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

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SECTION 312000

EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Alabama Department of Transportation (ALDOT) Standard Specifications for Highway Construction (latest edition).

1.2 SUMMARY

A. Section Includes:
1. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses and plants.
2. Excavating and backfilling for buildings and structures.
3. Undercutting and replacement of unsuitable soils.
4. Moisture conditioning of existing soils.
5. Drainage course for concrete slabs-on-grade.
6. Subbase course for concrete walks, pavements.
7. Subbase course and base course for asphalt paving.
8. Subsurface drainage backfill for walls and trenches.
9. Excavating and backfilling trenches for utilities and pits for buried utility structures.
10. Removal and replacement of unsuitable soils
11. Removal and replacement of mass and trench rock.

B. Related Sections:
1. Division 01 Section "Construction Progress Documentation" for recording pre-excavation and earth moving progress.
2. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.
3. Division 31 Section "Site Clearing" for site stripping, grubbing, stripping topsoil, and removal of above and below-grade improvements and utilities.

1.3 UNIT PRICES

A. All excavation and import/export of material is to be unclassified to the "Cut Line" regardless of material encountered.

B. However, a certain portion of the work will be handled with a quantity allowance with unit price being provided on Attachment B to the proposal form to be included in the base bid. Below is a brief description of the requirements associated with the unit prices referenced above:
1. The unit price for "excavation and haul off of "unsuitable materials" shall include all cost associated with removing unsuitable soil from below "cut

line" elevations and off-site disposal of the unsuitable material. Unsuitable materials refers to material that is not suitable for building or pavement support for reasons associated with material properties, such as highly plastic soils, "fat" clays, old fill material or alluvium. Material which is otherwise suitable, but above the optimum moisture and requires moisture conditioning prior to use as engineered fill shall not be considered as "unsuitable". The owner's onsite geotechnical engineer will be solely responsible for determining the suitability of soils encountered.

2. The unit price for "replacement with crushed stone" shall include all cost associated with the purchasing, transporting, installation and compacting of ALDOT #57 stone or dense-graded aggregate base material for soil stabilization and/or backfill at the discretion of the owner's onsite geotechnical engineer. Pipe bedding material will not apply to this allowance.
3. The unit price for "replacement with offsite suitable material" shall include all cost associated with purchasing, importing, placing and compacting of material conforming to the project specifications from an offsite source in the event that adequate suitable material is not present on the project site.
4. The unit price for "Surge Material (ALDOT #1 Stone)" shall include all cost associated with the purchasing, transporting, installation and compacting of ALDOT #1 stone for soil stabilization at the discretion of the owner's onsite geotechnical engineer.
5. The unit price for installation of stabilization fabric shall include all cost associated with the purchase and installation of geogrid for soil stabilization. This material shall be Tensar BX1100 (Tensar Biaxial type 1) or approved equal. All installations shall be at the discretion of the owner's onsite geotechnical engineer and per the manufacturer's recommendations.
6. Note the unit prices are being provided for the addition to and deletion from the contract base bid as required by changing field conditions during construction. The application of these allowances and unit prices shall be at the sole discretion of the owner's Construction Manager. Payment for all items will be made based on actual in place material.
7. The contractor is to provide a topographic map of actual field conditions prior to and upon completion of excavation. (Prior to replacing material) An additional topographic map will be necessary at the point that the replacement source transitions from onsite material to imported material and/or crushed stone.

1.4 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
   2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

   1. In Footings,Trench and Pit Excavation: Any material occupying an original volume of more than ½ cubic yard which cannot be excavated with a track excavator having a bucket curling rate of not less than 25,700 pounds, using a rock bucket and rock teeth (Caterpillar 225 or larger.)
   2. Mass Excavation: Any material occupying an original volume of more than 1 cubic yard which cannot be excavated with a single-tooth ripper drawn by a crawler tractor having a minimum draw bar pull rating of not less than 56,000 pounds usable pull (Caterpillar D-8K or larger) or the excavator listed below.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

L. Cut Line: The cut line shall be defined in a "cut section" to the bottom of the proposed subgrade elevation, trench excavation, footing excavation, or other specified hold down elevation. The cut line shall be defined in a "fill section" as the elevation established after removal of topsoil and similar organics as approved by the owner's onsite geotechnical engineer prior to beginning the process of placing fill materials.

M. Control Areas: Areas beneath the building footprint and extending 10 feet beyond the building limits and areas beneath paving areas and extending 5 feet beyond the paved areas.

N. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 SUBMITTALS

A. Product Data: For each type of the following manufactured products required:
1. Geotextiles.
2. Controlled low-strength material, including design mixture.
3. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:
1. Geotextile: 12 by 12 inches.
2. Warning Tape: 12 inches long; of each color.

C. Qualification Data: For qualified testing agency.

D. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
1. Classification according to ASTM D 2487.
2. Laboratory compaction curve according to ASTM D 698.

E. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

F. Blasting Plan: For record purposes; approved by authorities having jurisdiction.

G. Seismic Survey Report: For record purposes; from seismic survey agency (i.e., pre-blast survey).

H. Rock Fill Management Plan: Since the proper placement and compaction of rock can become a critical item when creating rock fill embankments, the grading contractor shall submit a plan for the management of rock created during excavation. Included in the plan should be a description of the typical placement procedure, compaction equipment, measures for water addition, etc. This plan will be reviewed by the project design team, and if found acceptable, be utilized as a performance guideline.

1.6 QUALITY ASSURANCE

A. Blasting: Comply with applicable requirements in NFPA 495, "Explosive Materials Code," and prepare a blasting plan reporting the following:
   1. Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
   2. Seismographic monitoring during blasting operations.

B. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:
   1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
   2. Seismographic monitoring during blasting operations.

C. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
   1. Do not proceed with work on adjoining property until directed by Architect.

C. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations. Provide private utility location services if public services do not serve affected private properties.

D. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 31 Section "Site Clearing," are in place.

E. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.

6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

F. Do not direct vehicle or equipment exhaust towards protection zones.

G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, GC, SC, SW, SP, SM, ML, and CL according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 4 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
1. Liquid Limit: less than 50
2. Plasticity Index: less than 30
3. Maximum dry density greater than 100 pcf
4. Moisture content: withing -2 to +2% of optimum per ASTM D-698

C. Unsatisfactory Soils: Soil Classification Groups OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
1. Unsatisfactory soils also include satisfactory soils not maintained within -2 to +2% of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: ALDOT 825B

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. Bedding Course: ALDOT #78 Stone

H. Drainage Course: ALDOT #57 Stone Washed

I. Sand: ASTM C 33; fine aggregate.

J. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
   1. Survivability: Class 2; AASHTO M 288.
   2. Grab Tensile Strength: 157 lbf (700 N); ASTM D 4632.
   3. Sewn Seam Strength: 142 lbf (630 N); ASTM D 4632.
   4. Tear Strength: 56 lbf (250 N); ASTM D 4533.
   5. Puncture Strength: 56 lbf (250 N); ASTM D 4833.
   6. Apparent Opening Size: No. 60 (0.250-mm) sieve, maximum; ASTM D 4751.
   7. Permittivity: 0.2 per second, minimum; ASTM D 4491.
   8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
   1. Survivability: Class 2; AASHTO M 288.
   2. Grab Tensile Strength: 200 lbf; ASTM D 4632.
   3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
   4. Tear Strength: 90 lbf; ASTM D 4533.
   5. Puncture Strength: 90 lbf; ASTM D 4833.
   6. Apparent Opening Size: No. 40 sieve, maximum; ASTM D 4751.
   7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
   8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:
   1. Red: Electric.
   2. Yellow: Gas, oil, steam, and dangerous materials.
   3. Orange: Telephone and other communications.
   4. Blue: Water systems.
   5. Green: Sewer systems.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
   1. Red: Electric.
   2. Yellow: Gas, oil, steam, and dangerous materials.
   3. Orange: Telephone and other communications.
   4. Blue: Water systems.

5. Green: Sewer systems.

PART 3 - EXECUTION

3.4 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.5 DEWATERING

A. Dewatering is solely the responsibility of the contractor

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
   1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.6 EXPLOSIVES

A. Comply with all laws, rules, and regulations of Federal, State and local municipalities and insurer governing keeping, storage, use, manufacture, safe handing transportation, or other disposition of explosives. Conduct all operations involving handling, storage, and use of explosives under supervision of properly licensed individual. Take special precautions for proper use of explosives in order to prevent harm to human life and damage to surface structures, all utility lines, or other subsurfaces structures. Do not use explosives until all persons in vicinity are notified and have reached safety.

B. Hold a pre-blast meeting at the jobsite prior to commencement of any drilling and blasting operations with the Contractor, the Blaster and representatives of the Owner. Discuss the Blasting Plan and visit such specific sites as are necessary to familiarize the participants with the details of the blasting operations.

C. Submit a Safety Plan that includes descriptions of road closures, warning signals, and plans for notification of affected local, state and federal agencies. Discuss the Safety Plan methods for protection of life and health, public and private property, new work or existing work on the project, nearby structures, wetlands, waters and wildlife. Hold a safety meeting prior to commencement of blasting operations to address safety issues. The contractor is totally and solely

responsible for jobsite safety and for correction of any damage due to construction and blasting activities.

D. Contractor must hold a license with the State of Alabama to perform blasting. Provide Owner and Architect with a copy of the Contractor's current State of Alabama Blasting License.

E. Indemnify and hold harmless the Owner, Architect, Engineer, Owner's representatives, and their agents and employees from any claim growing out of use, transportation and storage of explosives. Removal of any items of material of any nature by blasting should be done in such a manner and such time as to avoid damage affecting integrity of the design and to avoid damage to any new or existing structure included in or adjacent to the work. It is the Contractor's responsibility to determine method of operation to ensure desired results and integrity of completed work.

F. Notify and coordinate with existing utility companies before blasting.

G. Submit request to the Architect and Geotechnical Engineer for blasting within 800' of green concrete. This request will be reviewed and approved on a case-by-case basis.

H. Use suitable mats or methods to smother blasts and eliminate projectile "fly" rock. If flyrock occurs, suspend all blasting operations and resubmit a revised plan to the Owner, Architect and Geotechnical Engineer for approval to eliminate any future occurrence of flyrock. Flyrock is defined as any projectile material and is not limited to but includes soil, rock, or debris (organic or inorganic) that extends beyond the controlled blasting zone. Controlled blasting holes are closely spaced, lightly loaded holes drilled along the plane of the final design slope. Controlled blasting is either preshear blasting with holes detonated before the production blasting or cushion (trim) blasting with holes detonated after the production blasting. Use controlled blasting techniques for all rock slopes higher than 10 feet to produce a stable cut face sheared along the designed neat excavation line. If at any time during the progress of the work blasting and drilling fail to produce the desired result of a smooth, stable backslope, modify the blasting method to achieve the desired result.

I. The Owner may also employ an independent consultant to monitor all blasts with seismograph and/or overpressure devices. This does not relieve the contractor from providing blasting monitoring and pre-blast surveys. Employment of an independent consultant does not relieve the Contractor from obligations, duties and responsibilities required by the governing authorities and this specification.

J. Contractor will record a log of each blast daily. Log is to comply with the requirements and format of the State of Alabama. Submit logs to the Owner, Architect, Civil Engineer and Geotechnical Engineer weekly.

K. Cover all shots with heavy blasting mats and/or a minimum of 36" of soil overburden as needed to control flyrock.
   1. Do not blast within 25' of pipe already laid in the trench. Protect pipe already laid using earth backfill.

L. Control blasting so as not to unduly disturb or loosen materials outside the lines of excavation.

1. Scale rock surfaces and remove any loose, fractured, or broken rock immediately after blasting. Eliminate hazards to personnel and construction operations. After initial scaling of permanent rock faces, maintain scaled condition satisfactory to Civil Engineer for duration of Work. Do not commence work on subsequent lifts or shots until scaling is complete. Accomplish scaling with hand tools, hydraulic splitters, machine scaling with excavators or other equipment, high pressure water spray, light explosive charges, or other approved methods.
2. Check side slopes for slips which may have taken place; remove any dislodged material.
3. Use rockfall mitigation methods such as rock catchment fences, wire mesh draping, flexible or rigid barriers and other techniques to intercept rockfall and control it before it reaches the roadway or other facilities.

M. Review and comment by the Civil Engineer and Geotechnical Engineer of the Contractor's blasting plans and/or inspection of the performance of the work by the Civil Engineer and Geotechnical Engineer does not relieve the Contractor of responsibilities, liability for injuries and/or damages resulting from blasting.

N. Contractor shall perform a pre-blast survey of all existing residences, structures, etc. that fall within a 1,500' radius as measured from the center of the blast pattern. Pre-blast survey shall be performed by a licensed engineer registered in the State of Alabama. Pre-blast survey shall have inspect reports for each structure visited with photographs and video taping as a minimum with an interview with the current property owner which describes the reason for the survey. Additional investigations /surveys may be required due to complaints or claims as a result of the blasting activity at no additional cost to the owner.

O. A minimum of four seismographs shall be accounted for in the base bid and shall be placed on the subject property as well as key areas adjacent to and off of the site to assure that blasts do not exceed local, state and federal guidelines. Additional seismographs may be required due to complaints or claims as a result of the blasting activity at no additional cost to the owner.

3.7 EXCAVATION, GENERAL

A. Unclassified Excavation: All excavation to the "Cut Line" is unclassified regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.

B. The contractor shall anticipate encountering unsuitable materials above and below the cut line elevation. Unsuitable material encountered above the cut line shall be removed from the project site as a part of the unclassified base bid amount. Unsuitable material encountered below the cut line elevation shall be undercut and replaced as a part of the quantity allowance/unit prices previously established.

C. Material encountered in grading operation that, in the opinion of the Geotechnical Engineer or Owner, is unsuitable or undesirable shall be as follows:
   1. The removal of unsuitable material will be directed by the Geotechnical Engineer or his field representative. All unsuitable material that is removed by the Contractor shall become the property of the Contractor and be disposed of off site or in a manner satisfactory to the Owner.
   2. Back fill for these areas will be with material approved by the Geotechnical Engineer, with layers of acceptable material compacted to the requirements set forth in these specifications.

D. Where Rock is encountered within 18" of subgrade in paving areas and 36" of subgrade in the building pad area, the "cut line" shall be 18" below subgrade in paving areas and 36" below subgrade in the building pad area. This over excavation shall be backfilled with select fill material at the direction of the onsite geotechnical engineer and shall be performed as a part of the contractor's base bid.

E. Excerpts from the Geotechnical Report:
   1. "Excavation of the upper level soils can generally be achieved with heavy earth moving equipment (dozers, scrapers, front-end loaders, backhoes, etc.). Decomposed/weathered rock can usually be excavated in large open excavations with a D-8 or D-9 dozer using a single shank hydraulic excavator. Excavations below the test pit refusal levels will require blasting or the use of pneumatic hammers for rock removal. Based on the "Site Grading Plan" the deepest excavations will occur in the northeast portion of the site. The deepest cut planned in this area is approximately 13 feet. The nearest test pits in the area were TP-1 and TP-6 where test pit refusal was encountered at a depth of 5.5 feet in TP-1 but no refusal was encountered in TP-6 to a depth of 10 feet."
   2. "Although groundwater was not encountered in the borings, it should be acknowledged that due to fractured, dipping, and stratified beds of the Pottsville Formation, trapped water is often present in substantial quantities. This water can be released by springs along the flanks and at the bottom of valleys or may be encountered during excavations. We suggest that the grading budget include provisions for the installation of temporary interceptor ditches to channel both seepage and surface runoff away from construction areas in a controlled manner. "
   3. "It is common in this geologic formation for groundwater seepage from rock cuts. We suggest that permanent "French drains" be planned near the toe of cut excavation to intercept this water before it reaches structual areas or pavement base layers. The "French drains" typically consist of a 12" minimum wide trench about 2' to 3' deep, covered with a non-woven geotextile with a 4" diameter perforated pipe installed in the bottom and backfilled with #57 crushed stone. The drain could then slope to the nearest drainage ditch or stormwater culvert/catch basin. "
   4. "The soils at the site are moisture sensitive and can become easily disturbed causing loss of strength. Proper surface drainage will be very important during grading at the site. If the soils become wet after being exposed it

may become necessary to undercut or recondition. On many projects reworking of disturbed soils becomes a point of controversy. We recommend that the specifications for this project provide performance guidelines for protection of exposed soils and correction of disturbed areas."

3.8 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 0.1 ft. Extend excavations a minimum of 10' in distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
   1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
   2. Rock shall be over excavated, backfilled and compacted with structural fill when encountered within 36" of the building subgrade. This works shall be a part of the unclassified base bid amount.

3.9 EXCAVATION FOR WALK AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades, to a distance of 5' beyond the edge of these walks and pavements.
   1. Rock shall be over excavated, backfilled and compacted with structural fill when encountered within 18" of paving subgrade. This works shall be a part of the unclassified base bid amount.

3.10 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.
   1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
   1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
   1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.11 SUBGRADE INSPECTION

A. Notify owner's geotechnical engineer when excavations have reached required subgrade.

B. If owner's geotechnical engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
   1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
   2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.12 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 3000 psi, may be used when approved by Architect.
   1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.13 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.14 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:
   1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
   2. Surveying locations of underground utilities for Record Documents.
   3. Testing and inspecting underground utilities.
   4. Removing concrete formwork.
   5. Removing trash and debris.

6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.15 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 Section "Cast-in-Place Concrete."

D. Trenches under Roadways: Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Division 03 Section "Cast-in-Place Concrete."

E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
   1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

G. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing.

H. Place and compact final backfill of satisfactory soil to final subgrade elevation.

I. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.

J. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.16 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:
   1. Under grass and planted areas, use satisfactory soil material.
   2. Under walks and pavements, use satisfactory soil material.
   3. Under steps and ramps, use engineered fill.

4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.17 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
   1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
   2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.18 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
   1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 98 percent.
   2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 98 percent.
   3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 98 percent.
   4. For utility trenches, compact each layer of initial and final backfill soil material at 98 percent.

3.19 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Provide a smooth transition between adjacent existing grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Turf or Unpaved Areas: Plus or minus 1 inch.
   2. Walks: Plus or minus 1 inch.

3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.20 SUBSURFACE DRAINAGE

A. Subdrainage Pipe: Specified in Division 33 Section "Subdrainage."

B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
   1. Compact each filter material layer to 95 percent of maximum dry unit weight according to ASTM D 698.

C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
   1. Compact each filter material layer to 95 percent of maximum dry unit weight according to ASTM D 698.
   2. Place and compact impervious fill over drainage backfill in 6-inch- thick compacted layers to final subgrade.

3.21 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
   1. Place base course material over subbase course under hot-mix asphalt pavement.
   2. Shape subbase course and base course to required crown elevations and cross-slope grades.
   3. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
   4. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
   5. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

3.22 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
   1. Place drainage course 6 inches or less in compacted thickness in a single layer.
   2. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
   3. Compact each layer of drainage course to required cross sections and thicknesses to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

3.23 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
   1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
   2. Determine that fill material and maximum lift thickness comply with requirements.
   3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
   1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2500 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
   2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length, but no fewer than two tests.
   3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests.

F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and

replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.24 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
   1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.25 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, organic material and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 321313

CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concrete paving for:
      a. Concrete sidewalks.
      b. Concrete stair steps.
      c. Concrete integral curbs and gutters.
      d. Concrete parking areas and roads.

B. Related Requirements:
   1. Section 079000 - Joint Protection: Sealant for joints.
   2. Section 312213 - Rough Grading: Preparation of site for paving.
   3. Section 312323 - Fill: Compacted subbase for paving.
   4. Section 321123 - Aggregate Base Courses: base course.
   5. Section 321216 - Asphalt Paving: Asphalt wearing course.
   6. Section 321713 - Parking Bumpers: Precast concrete parking bumpers.

1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:
   1. AASHTO M324 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

B. American Concrete Institute:
   1. ACI 301 - Specifications for Structural Concrete.
   2. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

1.3 PRE-INSTALLATION MEETINGS

A. Section 013000 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit data on concrete materials, joint filler, admixtures, and curing compounds.

C. Design Data:

1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for the following:

a. Hot and cold weather concrete work.

2. Identify mix ingredients and proportions, including admixtures.
3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.

D. Source Quality Control Submittals: Indicate results of factory tests and inspections.

1.5 QUALITY ASSURANCE

A. Perform Work according to ACI 301.

B. Obtain cementitious materials from same source throughout.

C. Perform Work according to State of Alabama Department of Transportation standards.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum 3 years' documented experience.

1.7 MOCKUP

A. Section 014000 - Quality Requirements: Requirements for mockup.

B. Construct mockup, 5 x 5 feet, including paving, joints, and surface texture.

C. Locate where directed by Architect/Engineer.

D. Incorporate accepted mockup as part of Work.

1.8 AMBIENT CONDITIONS

A. Section 015000 - Temporary Facilities and Controls: Ambient conditions control facilities for product storage and installation.

B. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 - PRODUCTS

2.1 AGGREGATE BASE COURSE

A. Aggregate Base Course: As specified in Section 321123.

2.2 CONCRETE PAVING

A. Form Materials:

1. Form Materials: Conform to ACI 301.

B. Reinforcement:
1. Welded Plain Wire Fabric: ASTM A185/A185M; in flat sheets; galvanized finish.
2. Dowels: ASTM A615/A615M; 60 ksi yield strength, plain steel bars; cut to length indicated on Drawings, square ends with burrs removed; galvanized finish.
3. Tie Wire: Minimum 16 gage annealed type
4. Epoxy Coating Patching Material: Type as recommended by coating manufacturer.

C. Concrete Materials:

1. Concrete Materials: Provide according to State of Alabama Department of Transportation standards.
2. Fine and Coarse Aggregates: ASTM C33, Class 4M.
3. Water: ASTM C94/C94M; potable, without deleterious amounts of chloride ions.
4. Air Entrainment: ASTM C260.

2.3 FABRICATION

A. Fabricate reinforcing according to State of Alabama Department of Transportation standards.

2.4 MIXES

A. Concrete Mix - By Performance Criteria:

1. Mix and deliver concrete according to ASTM C94/C94M, Option A.
2. Select proportions for normal weight concrete according to ACI 301 Method 1.
3. Provide concrete to the following criteria:

    a. Compressive Strength: 3,500 psi at 7 days.
    b. Compressive Strength: 4,000 psi at 28 days.
    c. Slump: 3 to 5 inches.
    d. Air Entrainment: ASTM C94/C94M; for moderate exposure condition; maximum variation of 1.5 percent from required air content.

4. Limit the following cementitious materials to maximum percentage by mass of all cementitious materials:

    a. Fly Ash: 25 percent.
    b. Blast Furnace Slag: 25 percent.
    c. Fly Ash and Blast Furnace Slag: 35 percent.

5. Use accelerating admixtures in cold weather only when approved by the Architect/Engineer in writing. Use of admixtures will not relax cold weather placement requirements.
6. Use calcium chloride only when approved by the Architect/Engineer in writing.
7. Use set retarding admixtures during hot weather only when approved by the Architect/Engineer in writing.

2.5 FINISHES

A. Shop Finishing - Reinforcement:

1. Galvanized Finish for Steel Bars: ASTM A767/A767M, Class I, hot dip galvanized after fabrication.

2.6 ACCESSORIES

A. Curing Compound: ASTM C309, Type 1, Class A.

B. Joint Sealers: ASTM D6690, Type II or Type III; hot applied type.

2.7 SOURCE QUALITY CONTROL

A. Submit proposed mix design of each class of concrete to appointed firm for review prior to commencement of Work.

B. Tests on cement, aggregates, and mixes will be performed to ensure conformance with specified requirements.

C. Test samples according to ASTM C94/C94M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify compacted subgrade subbase is dry and ready to support paving and imposed loads.

1. Proof roll subbase with loaded tri-axle truck in minimum two perpendicular passes to identify soft spots.
2. Remove soft subbase and replace with compacted fill as specified in Section 312323.

C. Verify gradients and elevations of base are correct.

3.2 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Moisten substrate to minimize absorption of water from fresh concrete.

C. Coat surfaces of manhole and catch basin frames with oil to prevent bond with concrete paving.

D. Notify Architect/Engineer minimum 24 hours prior to commencement of concreting operations.

3.3 INSTALLATION

A. Base Course:

1. Aggregate Base Course: Install as specified in Section 321123.

B. Forms:

1. Place and secure forms and screeds to correct location, dimension, profile, and gradient.
2. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

C. Reinforcement:

1. Place reinforcing at mid-height of paving.
2. Place reinforcing as indicated on Drawings.
3. Interrupt reinforcing at expansion joints.
4. Place dowels and reinforcing to achieve paving and curb alignment as detailed.
5. Provide doweled joints at 18 inch spacing at interruptions of concrete with one end of dowel set in capped sleeve to allow longitudinal movement.
6. Repair damaged galvanizing to match shop finish.

D. Placing Concrete:

1. Coordinate installation of snow melting components.
2. Place concrete according to ACI 301.
3. Ensure reinforcing, inserts, embedded part and formed joints are not disturbed during concrete placement.
4. Place concrete continuously over the full width of the panel and between predetermined construction joints.

E. Joints

1. Place control joints at maximum 12 foot intervals. Align curb, gutter, and sidewalk joints.
2. Place joint filler between paving components and building or other appurtenances. Recess top of filler 1/16 to 1/4 inch for liquid sealant installation.
3. Provide sawn joints at 5 feet intervals between sidewalks and curbs, between curbs and paving,
4. Saw cut contraction joints 1/8 inch wide at an optimum time after finishing. Cut 1/4 into depth of slab +/- 1/2 inch.

F. Finishing:

1. Paving: Light broom.
2. Sidewalk Paving: Light broom, radius to 1/8 inch radius, and trowel joint edges.
3. Curbs and Gutters: Light broom.
4. Direction of Texturing: Transverse to paving direction.
5. Inclined Vehicular Ramps: Broomed perpendicular to slope.
6. Place curing compound on exposed concrete surfaces immediately after finishing.

G. Curing and Protection

1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
2. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.4 TOLERANCES

A. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.

B. Maximum Variation From True Position: 1/2 inch.

3.5 FIELD QUALITY CONTROL

A. Section 017000 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

B. Perform field inspection and testing according to ASTM C94/C94M.

C. Inspect reinforcing placement for size, spacing, location, support.

D. Testing firm will take cylinders and perform slump and air entrainment tests according to ACI 301.

E. Strength Test Samples:

1. Sampling Procedures: ASTM C172.
2. Cylinder Molding and Curing Procedures: ASTM C31/C31M, cylinder specimens, standard cured.
3. Sample concrete and make one set of three cylinders for every 150 cu yds or less of each class of concrete placed each day and for every 5,000 sf of surface area paving.
4. Make one additional cylinder during cold weather concreting, and field cure.

F. Field Testing:

1. Slump Test Method: ASTM C143/C143M.
2. Air Content Test Method: ASTM C173/C173M.
3. Temperature Test Method: ASTM C1064/C1064M.
4. Measure slump and temperature for each compressive strength concrete sample.
5. Measure air content in air entrained concrete for each compressive strength concrete sample.

G. Cylinder Compressive Strength Testing:

1. Test Method: ASTM C39/C39M.
2. Test Acceptance: Average compressive strength of three consecutive test maximum 500 psi less than specified compressive strength according to State of Alabama Department of Transportation standards.
3. Test one cylinder at 7 days.
4. Test two cylinders at 28 days.

5. Retain one cylinder for 45 days for testing when requested by Architect/Engineer.
6. Dispose remaining cylinders when testing is not required.

H. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.6 PROTECTION

A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Immediately after placement, protect paving from premature drying, excessive hot or cold temperatures, and mechanical injury.

C. Do not permit vehicular traffic over paving for 7 days minimum after finishing. until 75 percent design strength of concrete has been achieved.

END OF SECTION 321313

SECTION 328000
LANDSCAPE WORK

1.0 GENERAL

1.01 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to the work specified herein.

B. Section 328400, Irrigation.

C. Section 329400, Maintenance.

1.02 DESCRIPTION

A. Provide all labor, equipment, materials and services necessary to complete the Work of this Section, including:
   1. Providing, placing, grading topsoil for landscape grading as indicated in the Drawings.
   2. Providing and installing trees, shrubs, seeding and solid sod for landscape planting.
   3. Maintenance until Substantial Completion, and One Year Warranty Period.

1.03 SUBMITTALS

A. Qualification Data for firms specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include a list of a minimum of five similar projects completed within the last five years with project name, address, names of Architects and Owners, overall description of scope of work, and contract value.

B. Materials Lists:
   1. Within ten (10) days of award of Contract, submit a complete list of materials and unit prices demonstrating proposed source, availability, and complete conformance with requirements specified.
   2. Submit to Landscape Architect within thirty (30) days from date contract is awarded to General Contractor confirmed orders for materials from approved nurseries (listed on plant schedule and/or drawings). Contractor is responsible for payment of deposits required by approved nurseries.

C. Certificates: Deliver all certificates of inspection to the Landscape Architect.

D. Product Data:

1. Submit manufacturer's product literature, instructions and guaranteed analysis for fertilizer.

1.04 DEFINITIONS

A. Trees, shrubs, groundcovers, seed and solid sod are plant materials listed in Plant Schedule on Drawings.

1.05 JOB CONDITIONS

A. Coordinate the Work of this Section with that of other trades.

B. Examine conditions under which Work is to be performed and notify Landscape Architect in writing of unsatisfactory conditions.

C. Do not perform Work until conditions are satisfactory and acceptable.

D. Determine locations of underground utilities and perform Work in a manner which will avoid all possible damage. Hand excavate as required.

E. Maintain stakes set by others until removal is mutually agreed upon by all parties.

1.06 QUALITY ASSURANCE

A. Codes and Standards:
1. Applicable Sections of Alabama Highway Department (AHD) Standard Specifications for Highway Construction, 1992 Edition.
2. All plant materials to comply with State and Federal laws relating to inspection for disease and insect control.
3. Plant material quality to conform to American Standard for Nursery Stock, American Association of Nurserymen, Inc., 1986, ANSI Z-60.1.
4. Plant Material nomenclature to conform to:
   a. Hortus Third, a Concise Dictionary of Plants Cultivated in the United States and Canada, MacMillan Publishing Company, Inc., New York, 1976 Edition.
   b. Names not listed in the above standard to comply with those most commonly used in the trade.
   c. In all cases, botanical names take precedence over common names.

B. Installer Qualifications: Firm experienced in the successful installation of a minimum of five projects within the past five years similar in scope, quality, and contract value to that indicated for this project. Firm shall have sufficient manpower, equipment and financial resources to complete the Work of this Section.

C. Personnel: Use adequate numbers of skilled workmen trained and experienced in the Work and familiar with requirements and methods needed for performance of the Work. At all times during planting operations, have on the site a person knowledgeable in horticultural practices as a superintendent.

D. Review:
1. All plant material is subject to review in the field or nursery before digging, by the Landscape Architect.
2. All plant materials and other materials are subject to review at the site before planting or placing, or at any other time.
3. Attach secure, durable, legible waterproof labels, stating correct botanical and common names as specified, to at least one plant, bundle or container of each plant variety.
4. Immediately remove from site plant materials or other materials not complying with specified requirements.
5. Review is for visual qualities only and does not relieve the Contractor of his obligation to provide materials and workmanship in full compliance with the requirements of the Contract Documents.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver packaged materials in manufacturer's original containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at the site.

B. Deliver all non-packaged or non-containerized materials to site in a manner that will prevent loss, damage, deterioration or contamination.

C. Store all materials in approved locations to prevent loss, damage, deterioration or contamination.

D. Delivery, storage and handling of all plant materials shall conform to AHD Specification Section 860.06(c) and the following:
1. Deliver freshly dug plants, which have not been in cold storage or heeled-in.
2. Deliver plants after preparations for planting have been completed and approved, and plant immediately.

1.08 SITE MAINTENANCE

A. Keep roads, paving and structures adjacent to planting operations clean and free of obstructions, mud and debris at all times.

B. Do not permit flushing of roads or disposal of dirt or debris into sewers or drainage ditches.

C. Control dust from planting operations.

2.0 PRODUCTS

2.01 SOIL MATERIALS

A. Topsoil:
1. This Contractor shall furnish topsoil in sufficient quantity, to complete grading and planting operations as specified.
2. Two types of topsoil, stockpiled and furnished topsoil, may be used as necessary as part of the Landscape Work. The term topsoil refers to both types.
4. Characteristics of topsoil to be furnished:
   a. Fertile, friable naturally occurring topsoil (from wooded area; topsoil from open fields will not be accepted), free of stones, clay lumps, hardpan, roots, stumps, branches, sticks and other debris larger than one and one-half inches in any dimension; free of noxious weeds, grasses, seeds, plants, extraneous matter and any substance harmful to plant growth.
   b. pH 5.0 to 7.0
   c. Organic matter 5% to 10%
   d. Sand 50% to 70%
   e. Silt less than 30%
   f. Clay 10% to 25%
   g. Permeability Rate of 5×10^{-3} centimeters or greater at 85% compaction.

B. Notify Landscape Architect of location of proposed topsoil for his review before testing or transporting to site.

C. Granular Fertilizer:
1. Characteristics:
   a. Uniform in composition.
   b. Dry and free-flowing.
   c. Commercially available.
   d. Conforming to State and Federal fertilizer laws.
2. Of the formulation recommended in the Soil Test Report as specified.
3. Acceptable Manufacturers:
   a. Sta-Green Plant Food Co., Nursery Special, 12-6-6.
   b. The Scotts Company, Scott's.
   c. Approved equal.

C. Slow-release Fertilizer:
1. Characteristics:
   a. Resin-coated, homogenous or heterogeneous controlled release fertilizer for ornamental plants.

b. Chemical components (14-14-14): Ammonium nitrate, ammonium phosphate, calcium phosphate, and potassium sulfate.
c. Commercially available.
d. Conforming to State and Federal fertilizer laws.

2. Acceptable Manufacturers:
a. The Scotts Company: Osmocote.
b. Sta-Green Plant Food Co.: Polyon.
c. Approved equal.

2.03 LANDSCAPE PLANTING MATERIALS

A. Water:
1. Provide fresh water, free of impurities or any substance harmful to plant growth.
2. Provide all hose, attachments, and accessories necessary to complete the Work as specified.

B. Topsoil: Refer to paragraph 2.1.A, this Section, for specified topsoil for use in all planting operations.

C. Topsoil Mix:
1. Prepare all topsoil mix used in tree and shrub pits and ground cover beds in the following proportions:

4 parts by volume topsoil as specified
2 parts by volume decomposed organic matter
2 parts by volume sand

2. Add 6 lbs. 14-14-14 Osmocote to each cubic yard of topsoil mix during mixing process, for all plants.

OR

Add 3 lbs. of 12-6-6 granular fertilizer to each cubic yard of topsoil mix during the mixing process, for all plants.

D. Sand: Fine aggregate meeting ASTM C-144; free of substances harmful to plant growth.

H. Solid Sod:
1. Obtain solid sod from sources having growing conditions similar to the area to be planted.
2. Sod shall be true to name and type of the species named in the Plant Schedule.
3. Sod shall contain no more than 5% other grasses.
4. Sod shall be well cultivated and weed, disease and insect-free, of good texture, and free from extraneous roots, stones and other

foreign material. The presence of nutgrass or other weeds shall be cause for rejection and replacement prior to Substantial Completion, or during the Warranty Period.

4. Plant material will be rejected for:
   a. Lack of compactness or proper proportion;
   b. Weak, thin growth in rows too close together;
   c. Cut back from larger stock to meet specified requirements;
   d. Undersized, dry, cracked or broken balls, or plants that are loose in their ball;
   e. Any balled & burlapped material not root-pruned within the last two years;
   f. Root bound within container or ball;
   g. Lacking proper proportion as to height and spread and specified characteristics or plant material;
   h. Not acceptable to Landscape Architect; or Owner
5. Size:
   a. Sizes and proportions of all plant materials shall equal those recommended by the American Standard for Nursery Stock for specified grades.
   b. Measure plants before pruning and with branches in normal position.
   c. Equal or exceed measurements specified in Plant Schedule, which are the minimum acceptable; provide 50% of plant material maximum size specified.
   d. Height and spread dimensions: General body mass of plant, not from branch tip to tip.
   e. Well-proportioned as to height; reject plants which meet specified measurements but do not possess an overall balance.
   f. Take caliper measurements on trunk 6 inches above natural ground level up to and including 4-inch caliper size; 12 inches above natural ground level for larger sizes.
   g. B&B plants shall have firm natural balls of a diameter and depth not less than that recommended in American Standard For Nursery Stock.
   h. Container-grown plants: Conform to standards set forth in American Standard For Nursery Stock for container-grown plants.
6. Quantity: Furnish plants in sufficient quantity to satisfy the intent of the Drawings and Specifications. Locate in sufficient quantity so that time is not lost if some plants are rejected.

3.0 EXECUTION

3.01 INSTALLATION

A. Planting Season:

1. A period of acceptable weather conditions, during seasons in which satisfactory results can be expected as determined by acceptable practice in the locality and approved by the Landscape Architect.
2. Commence planting operations as soon as portions of the site are available, as reviewed by the Landscape Architect.

B. Site Inspection:
1. Examine areas and conditions under which Work is to take place.
2. Inform Landscape Architect in writing, prior to planting, of conditions existing which could be considered detrimental to the successful planting and growth of any plant material, including but not limited to, subsurface drainage conditions, utility locations, subgrade compaction, percolation rate and elevations.

C. Site Preparation:
1. Subgrade will be established by others at four (4) inches below finished grade in all areas to receive planting, seeding or sodding, unless greater topsoil depth is indicated herein or on Drawings for berming or deeper bed preparation.
   a. Topsoil berming, if required, is by this Contractor.
   b. Topsoil depth for shrub and groundcover beds is six (6) inches (unless otherwise specified) and is by this Contractor. Do not place or spread topsoil in an area until subgrade is reviewed by Landscape Architect and is acceptable to this Contractor.
2. Remove all vegetative growth from topsoil by approved means before commencing with planting operations.
3. Remove all unwanted vegetative growth from areas designated to receive new planting, sod or seeding with chemical herbicide or by other approved means, prior to scarifying and placing topsoil.
4. Scarify subsoil for a depth of 4" before spreading topsoil. Refer to Ground Preparation for Seeding as specified herein.
5. Place and spread approved topsoil to specified finished grades (depth of 4") in all areas to receive seeding, sodding or planting, unless greater depth is indicated.
6. Remove extraneous matter measuring 1-1/2" or larger in any dimension from top four inches (4") of placed topsoil.
7. Uniformly grade areas including adjacent transition areas to line and grade shown on Drawings.
8. Obtain approval of finished grades before proceeding with planting operations; eliminate irregularities and ponding.
9. Protect stockpiled or spread topsoil from erosion by force of wind, water, or other force; re-establish eroded, rutted or settled grades to proper finished grade.

G. Seeding:

1. Furnish, sow, establish and maintain an acceptable growth of specified grass over all disturbed areas not otherwise designated to receive planting, mulch or sod.
2. Ground Preparation: Spread and scarify amended topsoil as specified. Ground preparation shall consist of cultivation to loose depth approximately four (4) inches (minimum). The plowing, harrowing, cultivating, and all other operations shall be performed with proper equipment and in such a manner as to break up all clods, lumps or earth balls, and remove all boulders, stumps, large roots, or other particles which will interfere with the Work. The resultant surface is to be smooth, uniform, loose, well broken, and fine grained soil providing a suitable bed for seed grass. The ground shall be plowed to the required depth, then cultivated with a rotary tiller and/or disc harrow, in both directions if feasible, until approved. In small or inaccessible areas use of hand tools will be permitted. After removal of all large particles which cannot be broken, the surface shall then be harrowed and tilled. Add sufficient water to wet the soil in order to prepare the ground.

I. Solid Sod:
   1. Procure and handle sod per AHD, Section 860.05(b) 1-4.
   2. Preparation of Sod Bed:
      a. Spread and scarify amended topsoil as specified.
      b. Rake and otherwise manipulate to form smooth-draining grades, remove all stones and clay lumps 1" in diameter or larger.
      c. Leave the surface of the topsoil 1-1/2" below finished grade.
      d. Do not move heavy objects over areas to be sodded after the soil has been prepared. Planting in compacted areas will not be permitted.
      e. The finished surface of the areas to be sodded shall be reviewed by the Landscape Architect prior to sod placement.
   3. Solid Sod Placement:
      a. Lay sod when sod bed is not excessively wet or frozen, but when soil is damp for a depth of 4".
      b. Immediately upon approval of bed preparation, lay sod smoothly, edge-to-edge, with staggered joints.
      c. Press firmly into contact with sod bed by tamping or rolling by approved means to eliminate all air pockets, providing a true and even surface, and assuring knitting.
      d. Fill cracks between sod blocks with strips of living sod, topsoil, or humus.
      e. Water thoroughly by use of sprinkler or spray, without erosive force.

3.02 LANDSCAPE MAINTENANCE

A. Provide labor, materials, equipment and means for proper maintenance of all materials and workmanship included in the Work of this Section until Substantial Completion and the beginning of any contracted maintenance period.

B. Maintenance until Substantial Completion is included in the Work of this Section, and will be performed in accordance with Section 02499 Maintenance.

3.03 SUBSTANTIAL COMPLETION AND WARRANTY

A. Substantial Completion and Payment:
1. Submit request for inspection of Substantial Completion, with a punch list of contract items to complete, to the Landscape Architect at least one week prior to anticipated date of inspection.
2. Review the Work jointly with the Landscape Architect for Substantial Completion.
3. Upon completion of repairs and replacements found necessary at time of review, the Landscape Architect will confirm the Date of Substantial Completion of the Work.
4. Substantial Completion constitutes the beginning date of the One-Year Warranty Period.

B. Basis of Acceptance:
1. Landscape Grading will be counted as a separate lump sum item for payment.
2. Planted trees and shrubs will be counted as individual units, complete, in place and planted in accordance with plans and specifications. Each unit will include the installed plant, topsoil, topsoil mix, mulch and staking apparatus.
3. Satisfactory stand of seeding will be counted as a lump sum and includes ground preparation, topsoil, seed and mulch in accordance with plans and specifications.
4. Solid sod will be counted in square yards provided and installed, including sod, ground preparation and topsoil, in accordance with plans and specifications.
5. Plant pit drainage will be counted as incidental to the Work, and will not be counted separately for payment.
6. The cost of mobilization (including all provisions of General Requirements and General and Supplementary Conditions), Clean-up, Warranty, and Maintenance until Substantial Completion as specified herein are considered incidental to the Work and will not be counted as separate items for payment.

C. Warranty:
1. Warranty all materials and workmanship for a period of one (1) year from the Date of Substantial Completion.

2. When Work is substantially completed in parts, the Warranty Period extends from each Substantial Completion date to the terminal date of the last Warranty Period. Thus, all Warranty Periods terminate at the same time.
3. During the period of the Warranty, replace with no additional compensation, and as soon as weather permits, all dead plant materials and all materials not in a thriving condition; replace all other workmanship and materials which are unsatisfactory in the opinion of the Landscape Architect; make good any other damage, loss, destruction, or failure to flourish sufficiently as the result of inferior or defective materials or workmanship, including, but not limited to inadequate drainage.
4. All replacement material shall match the size attained by original materials at the time of the replacement.
5. Remove dead or dying material from the site within one week of notice from the Landscape Architect.
6. Repair grades and other Work necessitated due to planting replacements.
7. If the replacement is not acceptable during or at the end of the Warranty Period, the Owner may elect either subsequent replacement or credit. Replacements shall have a similar one-year Warranty from date of replacement.
8. Warranty applies to losses or damage other than those due to vandalism, Owner neglect, or Acts of Nature, as determined by the Landscape Architect. Acts of Nature include, but may not be limited to, high winds of hurricane or tornado force, sleet, hail, freezing rain, and extreme cold (as determined by the Landscape Architect). The Contractor agrees to replace losses due to Acts of Nature at fifteen percent (15%) less than original contract price for the damaged Work.

3.04 FINAL INSPECTION AND ACCEPTANCE

A. Contractor is responsible for contacting the Landscape Architect at the end of the Warranty Period to schedule final inspection. Should the Contractor fail to contact the Landscape Architect at this time, the Warranty Period is automatically extended until he does so.

B. At the end of the Warranty Period submit request for inspection for Final Acceptance to the Landscape Architect at least one week prior to anticipated date of inspection; include list of Work substantially accepted and list of Work replaced during Warranty Period.

C. Upon request for inspection, jointly review with Landscape Architect all Warranteed Work for Final Acceptance.

E. Upon completion by the Contractor of all required repairs and replacements, the Landscape Architect will confirm the date of Final Acceptance of the Work.

END OF SECTION 02800.

SECTION 328400
LANDSCAPE IRRIGATION

1.0 GENERAL

1.1 RELATED DOCUMENTS:

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

B. Section 329300, Landscape Work.

1.2 DESCRIPTION OF WORK:

A. Furnish all labor, materials, equipment and services necessary for the complete installation of the landscape irrigation system as drawn and specified. The work includes, but is not limited to:
1. Trenching, backfill and compaction for irrigation lines.
2. Automatically controlled landscape irrigation system: Backflow prevention; water tap; water meter; pressure regulator; drain valves and isolation gate valves; piping and sleeves under paving and sidewalks, repair of paving, main and lateral lines; electrical valves and wiring, valve boxes and controllers; sprinklers, couplings, connectors and fittings.
3. Test all systems and make operative.
4. Submit Record Drawings and Maintenance Manual.
5. One-year Guarantee Period.
6. Maintain and Operate for one year beyond Date of Substantial Completion.

1.3 QUALITY CONTROL:

A. Installer Qualifications: Firms experienced in the successful installation of a minimum of five projects within the past five years similar in scope, quality, and contract value to that indicated for this project. Firm shall have sufficient manpower, equipment and financial resources to complete the Work of this Section.

B. The Owner and the Landscape Architect reserve the right to reject any and all materials and workmanship which they deem to be not in accordance with Drawings and Specifications. Rejected materials and work shall be removed from site immediately and replaced with that of the specified quality.

C. Applicable Standards:

ASTM
D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, SDR/PR, Class 200 and 160.

D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40.
D2464 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Threaded, Schedule 40.
D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Socket Type, Schedule 40.
D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

C. Applicable Codes:
1. Most current edition of Uniform Plumbing Code.
2. Applicable Building Code.
3. All applicable local codes and ordinances.
4. National Electrical Code.
5. Should Drawing's or Specification's requirements differ from local requirements, consider Contract Document requirements to be minimum acceptable and comply with any more stringent local requirements.

D. Permits and Fees:
1. Obtain all permits and pay required fees to any agency having jurisdiction over the work.
2. Arrange inspections required by local ordinances during the course of construction.
3. Upon completion of the work, furnish satisfactory evidence to show that all work has been installed in accordance with the ordinances and code requirements.

E. Testing:
1. Perform testing and inspections required by specifications and by regulating authorities.
2. Give 24 hours notice that such tests are to be conducted.

1.4 SUBMITTALS:

A. Qualification data for firms specified in "Quality Control" article to demonstrate their capabilities and experience. Include a list of a minimum of five similar projects completed within the last five years with project name, address, names of Architects and Owners, overall description of scope of work and contract value.

B. Substitutions:
1. The sprinkler system has been designed specifically for use with irrigation equipment as manufactured by RainBird Sales Inc., Turf Division and other irrigation manufacturers. Pipe sizes have been determined by computation of pressure losses in piping based on consumption and required operating pressure of specified sprinklers. Positioning and placement of sprinklers have also been determined by operating characteristics of specified sprinklers.
2. PROPOSALS FOR ALTERNATE SYSTEMS ARE WELCOMED. Substitutions of sprinklers of another make will be approved upon submittal of data

outlined below to establish that proposed alternate will produce equivalent operation and intent of design.

3. Use of materials differing in quality, size or performance from those specified will only be allowed upon written approval of Landscape Architect, provided they are submitted at least 7 days prior to bid opening. Landscape Architect's decision will be based on comparative ability of material or article to perform fully all purposes of mechanics and general design considered to be possessed by item specified.
4. Bidders desiring to make a substitution for specified sprinklers shall submit the following to the Landscape Architect:
    a. Actual samples of each type of sprinkler head proposed as a substitute.
    b. Manufacturer's catalog sheet showing full specifications of each type sprinkler proposed as a substitute, including discharge of GPM, minimum allowable operating pressure at sprinkler, maximum allowable spacing and distance of throw (coverage).
    c. If a design change is required, detailed Drawings must accompany the request for approval of the substitute.
    d. Approval of substitute sprinkler shall not relieve the Contractor of his responsibility to demonstrate that final installed sprinkler system will operate according to intent of originally designed and specified system.

B. Record Drawings:
1. Prepare and submit a reproducible Record Drawing showing deviations from the Contract Documents made during construction affecting the main line pipe, controller location, valve locations, and all sprinkler head locations. Record Drawings shall also indicate and show approved substitutions of size, material, and manufacturer's name and catalog number and name.
2. Deliver Record Drawings with request for inspection and acceptance.

C. Maintenance Manual:
1. Prepare and submit irrigation system maintenance and operating instructions, with relevant manufacturer's literature. Include complete parts list covering all operating equipment.
2. Submit in a hard-cover, three-ring binder.
3. Include full name, address, and telephone number of Installer.

1.5 COORDINATION:

A. Coordinate and cooperate with the Landscape Architect and other contractors and trades to enable the work to proceed as rapidly and efficiently as possible, and to be completed on schedule.

B. Anticipate last minute delays which may necessitate overtime work to complete the work on schedule.

C. Sleeves under paving sidewalks and curbs shall be placed by this Contractor. Coordinate with other trades on site for sequencing of work.

1.6 SITE INSPECTION:

A. Become familiar with all site conditions.

B. Should utilities not shown on plans be found during excavations, promptly notify the Landscape Architect for instructions as to further action.

C. Make necessary adjustments in the layout as may be required, 1) to connect to existing stubouts (should such stubs not be located exactly as shown) or 2) to work around existing work. Such adjustments shall be made with no increase in cost to the Owner.

1.7 PROTECTION OF EXISTING CONDITIONS:

A. Take necessary precautions to protect site conditions to remain.

B. Should damage be incurred, repair the work to its original condition at no additional cost to the Owner.

2.0 PRODUCTS:

2.1 PVC PIPE (Polyvinyl Chloride Pipe):

A. PVC pipe shall be manufactured in accordance with standards noted herein.

B. Marking and Identification: PVC pipe shall be continuously and permanently marked with the following information: Manufacturer's name, pipe, size, type of pipe and material, SDR number, ASTM standard number and NSF (National Sanitation Foundation) seal.

C. Irrigation Water Piping:
1. Main Lines: ASTM D-1785, Schedule 40
2. Lateral Lines: ASTM D2241, class 160 or 200.

D. Sleeves under paving sidewalks and curbs: PVC pipe meeting ASTM D-1785, Schedule 40.

2.2 PIPE FITTINGS:

A. PVC: Meeting specified standards, Schedule 40, Standard Weight, at PVC pipe; joints solvent welded as recommended by manufacturer, except swing joints and riser to head, which shall be threaded with Teflon Tape.

2.3 SOLVENT CEMENT: Meeting ASTM D-2564 and of proper consistency.

2.4 RISERS:

A. Spray Heads in all areas use triple elbow swing joint. Submit sample of swing joint for approval. No "funny pipe" will be accepted.

B. Gear driven rotary head: triple elbow swing joint, submit sample of swing joint for approval.

2.5 VALVES: Electric Circuit Control valve sized as shown on Drawings, mechanical joint.

2.6 BACKFILL UNDER PAVING: Crushed stone of the following gradation, placed and compacted to 100%:

100% passing 1/2" sieve
90-100% passing 3/8" sieve
60-85% passing #4 sieve
40-70% passing #8 sieve
10-25% passing #50 sieve
1-5% passing #200 sieve

2.7 VALVE BOX AND COVER: Ametek or equal with provision for locking.

2.8 BACKFLOW PREVENTION: As indicated in the Drawings.

2.9 PRESSURE REGULATOR: As indicated in the Drawings.

2.10 AUTOMATIC CONTROLLER: As shown on Drawings; 120 volt power will be supplied by others.

2.11 SCHEDULE OF IRRIGATION EQUIPMENT: As indicated in the Drawings.

3.0 EXECUTION:

3.1 GENERAL:

A. Verify existing and proposed locations of all site utilities (i.e. gas, water, electric, telephone) prior to any trenching and laying of pipe.

B. Coordinate all irrigation work with that of all other site work trades and contractors.

C. Piping and head layout is shown in schematic form only. All piping to be installed directly behind curb where possible and in all cases to be routed around existing or proposed site elements, including root balls of proposed trees and shrubs. Refer to the landscape planting Drawings for approximate tree locations and closely coordinate work and schedule with grading and planting work.

D. Contractor is responsible for full and complete coverage of all areas designated on the Drawings to be irrigated and shall make any necessary adjustments at any time, at no additional cost to the Owner.

E. Exact location and configuration of islands and other features may vary from that shown on these Drawings. Verify location and configuration at the site prior to trenching for sleeves and piping under paving, and make any minor adjustments to irrigation system layout. Notify Landscape Architect of substantial changes.

F. Maintain all warning signs, barricades, bracing, flares, and red lanterns as required by safety regulations and local ordinances.

3.2 INSTALLATION:

A. General:
1. Lay out according to site coordinates and actual field dimensional control; verify piping and sleeve locations before trenching.
2. Refer to Drawings for source points of irrigation system.

B. Excavating and Trenching:
1. Perform all excavation required for installation of the work included under this Section, including shoring and bracing of earth banks to prevent cave-in.
2. Restore all surfaces and existing underground installations damaged or cut as a result of the excavations, to their original condition and in a manner approved by the Owner.
3. All excavation shall be unclassified. Trenches shall be 4" wide and to the depth required as specified herein and shown in the Drawings.
4. Over-excavation shall be backfilled at the Contractor's expense with cushion sand. Remove all unsuitable or excess material from the site.
5. Dewater excavations as required for dry work including both surface and ground water.
6. Trenches shall have sides as nearly vertical as possible and bottoms shall be shaped to provide continuous bedding of each section of pipe along its entire length in undisturbed soil or thoroughly compacted fill.
7. Trenches for pipe lines shall be of sufficient depths to provide 12" minimum cover for pipes from finished grade. In Public Right-Of-

Way, provide 18" minimum cover over top of main and lateral lines, or greater depth if required by local authorities.

C. Sleeve Installation: Sleeving under pavement is by this Contractor.

1. Coordinate with other contractors to install sleeves before curbs, base and paving are installed.
2. Verify exact locations of curbs and other features at site prior to trenching. Adjust as necessary.
3. Install sleeve so that 18" extends from back of curb. Cap all ends tightly.
4. Backfill and compact as specified.
5. Stake and flag all sleeve locations.

D. Pipe Installation:
1. Pipe installation includes all irrigation piping required for water and electrical wiring to complete the automatic irrigation system.
2. Provide firm, uniform bearing for entire length of each pipeline to prevent uneven settlement. Wedging or blocking of pipe will not be permitted. Remove foreign matter or dirt from inside of pipe before joining and keep piping clean by approved means during and after laying of pipe.
3. Assemble pipe and solvent weld. Clean joint thoroughly of dust, dirt and moisture before applying solvent with non-synthetic bristle brush.
4. Install all pipe and wiring under paving in sleeves as specified, whether or not shown on Drawings. Pressure test all piping under paving prior to paving. All mains and piping under pavement to be pressure tested and activated immediately.

E. Pipe Fitting:
1. Solvent: Use only solvent recommended by manufacturer to make solvent welded joints. Thoroughly clean pipe and fittings of dirt, dust and moisture with a high etch PVC primer before applying solvent.
2. PVC to Metal Connection: Work metal connection first. Use a TEFLON pipe fitting tape on threaded PVC to metal joints. Use only light wrench pressure.
3. Threaded PVC Connections: Where required, use threaded PVC adapters into which pipe may be welded.

F. Irrigation Heads:
1. Prior to installation, verify configuration of planting areas and tree locations, and stake head layout accordingly. Obtain approval of staked head locations from Landscape Architect before proceeding.
2. Fixed and Pop-up Spray Heads: Attach sprinkler as specified. Adjust riser height after planting.

G. Wiring:
1. Supply #14 UL listed single strand U.F. direct burial wire from automatic controllers to the valves in accordance with the Specifications. Use PVC conduit for all locations of wire under paving; in landscaped areas, the Contractor may add conduit for wires at his option, in lieu of tucking wire under main lines and lateral lines.
2. Secure all wire-to-wire connections by approved means.
3. All wire from controllers to valves shall be tucked under piping.
4. Test wires prior to backfilling to insure continuity from valve location to controller location. Any wire not indicating continuity shall be repaired or replaced immediately.

H. Controller:
1. Install the specified controller in the location shown on the Drawings.
2. Power connection will be provided by others. This Contractor shall make power available for system.
3. Pull valve wires, program controller, and put controller in operation.

I. Electric Valves:
1. Supply and install in accordance with the materials list and the manufacturer's recommendations; set in a level position.

J. Valve Boxes: Set flush with finish grade (adjust as necessary); set over all valves.

K. Drainage: Place a minimum 12" depth of crushed stone under each box containing either water meter, pressure regulator, valve or backflow preventer.

3.3 TESTING:

A. Conduct test in presence of Architect. Notify Architect 48 hours
1. Hydrostatic Test: Before backfilling trenches, test mainline piping and valves to hydrostatic pressure of at least 100 psi. Test when solvent welded joints have cured at least in advance of testing date and time 24 hours. Repair or replace elements which fail. Repeat test.
2. Thoroughly flush out all water lines before installing heads, valves and other hydrants.
3. Operational Test: After backfilling and adjusting heads to final positions, show that system meets coverage requirements and controls function properly. Adjust heads to be not more than 1/2" above finish grade.

3.4 BACKFILL AND COMPACTING:

A. Do not backfill until pipe systems have been hydrostatic tested and approved.

B. After system is operating and required tests and inspections have been made, backfill excavations and trenches as follows:
   1. Backfill Under Paving:
      a. Backfill for full depth of excavation with the specified crushed stone. Compact in lifts. Backfill shall be free of debris, large clods, roots or other deleterious material.
      b. Place backfill material evenly in lifts not to exceed six inches (6") and compact to 100% of maximum density.
      c. Contractor is responsible for establishing compaction in trenches equal to or exceeding overall compaction of paving base. Leave top of trench ready for asphalt by others.
   2. Backfill In Landscape Areas:
      a. Backfill trenches with material removed during excavation, compacted to 85% except where rock is encountered. In this case lay pipe in a cushion sand bed surrounding the pipe, a minimum of 4" deep.
      b. Compact all excavation to prevent settling. Hand rake excavation areas and adjoining areas to leave grade at the previous elevation and in a good or better condition than before installation. Water-flood compaction will not be permitted.
      c. Repair settled areas throughout Guarantee Period, including repair of affected landscape work.

3.5 FINAL ADJUSTMENT:

A. After planting and irrigation installation has been completed, make final adjustment to irrigation system prior to the Landscape Architect's final inspection.

B. The system shall be completely flushed to remove any and all debris from the lines by removing nozzles from all heads on ends of lines and turning on the system.

C. Check all heads for correct operation, alignment, and direction of throw.

D. Check each section of spray heads for operating pressure, and balance in relation to all other sections by use of the flow adjustment on top of each valve.

E. Check nozzles for complete coverage. Prevailing wind or other conditions may indicate the arc or angle of spray should be other than as shown on

plan. In this case, revise nozzle degree to provide correct coverage, at the Contractor's expense.

F. Adjust head and valve heights as necessary.

G. Make any other adjustments determined necessary by the Landscape Architect to provide complete and uninterrupted coverage.

3.6 CLEAN-UP:

A. Keep site clean on a daily basis by removing trash and debris resulting from construction operation.

B. Keep all walks, roads, and circulation routes free from debris, materials, and equipment at all times.

C. Upon completion of the irrigation work, clean up all work and storage areas by removing trash piles, surplus material, or other material from site.

D. Restore pavement, curbs, ground and any other disturbed surface to its original condition.

3.7 MAINTENANCE AND COMPLETION OF THE WORK:

A. Complete the irrigation system as specified and operate and maintain same from time of installation until Substantial Completion and for a period of one year beyond Substantial Completion.

B. Instruct Owner's personnel in complete operation and maintenance of irrigation system.

4.0 ACCEPTANCE AND GUARANTEE:

4.1 SUBSTANTIAL COMPLETION:

A. Submit request for inspection for Substantial Completion to the Landscape Architect at least twenty-four hours prior to anticipated date of inspection and testing (refer to Paragraph 3.3 TESTING, herein).

B. Submit Record Drawings and Maintenance Manual to the Landscape Architect with request for inspection (refer to Paragraph 1.4 SUBMITTALS, B. and C., herein).

C. Review the work jointly with the Owner and Landscape Architect for Substantial Completion.

D. Upon completion of repairs and replacements found necessary at time of review, the Owner and Landscape Architect will confirm the date of Substantial Completion of the work.

E. The date of Substantial Completion will constitute the beginning date of the One-Year Guarantee.

4.2 GUARANTEE:

A. Guarantee all work, products, equipment and materials for one (1) year, beginning at Date of Substantial Completion.

B. During the period of the Guarantee, replace immediately, with no additional compensation, all work not functioning correctly; make adjustments as necessary to maintain complete coverage; make good any other damage, loss, destruction, or failure. Repairs and replacements shall be done promptly and at no additional cost to the Owner.

C. Repair damage to grade, plants, and other work or property as necessitated due to irrigation defects, repairs, replacement or adjustment.

D. If the replacement is not acceptable during or at the end of the Guarantee Period, the Owner may elect either subsequent replacement or credit. Replacement products shall have a similar one-year guarantee from time of replacement.

E. Guarantee applies to all losses with the exception of those due to Acts of God, vandalism, or Owner neglect, as determined by the Landscape Architect.

4.3 FINAL INSPECTION AND ACCEPTANCE:

A. At end of Guarantee Period and upon request for inspection, jointly review all guaranteed work for Final Acceptance.

B. Submit written request for inspection for Final Acceptance to the Landscape Architect at least two weeks prior to anticipated date of inspection; include list of work provisionally accepted and list of work replaced during Guarantee Period.

C. Upon completion by the Contractor of all required repairs and replacements, the Owner and the Landscape Architect will confirm the date of Final Acceptance of the work.

END OF SECTION 328400.

SECTION 329400
MAINTENANCE

1.0 GENERAL

1.1 RELATED DOCUMENTS:

A. The general provisions of the Contract, including General and Supplementary Conditions, and General Requirements, apply to the work specified herein.

B. Section 328400, Irrigation.

C. Section 328000, Landscape Work.

1.2 DESCRIPTION:

A. Scope:
1. Provide all labor, products, equipment and services necessary to maintain site landscape work for thirty days beyond Substantial Completion of the Landscape Work, or other date agreed upon by the Owner, Landscape Architect and Contractor.
2. Maintenance includes maintaining all landscape and site work as described herein; it does not include sweeping, hosing or cleaning of walks, parking lots or other areas to remove trash, litter, debris, etc. However, the removal of trash, litter, blowing paper, debris, dust and mud from landscape areas and other areas littered as a result of maintenance operations is included.
3. Maintain all plants in a growing, well formed, healthy and thriving condition, by watering, fertilizing, pruning, spraying, weeding, mowing, straightening, replacement, or by other necessary maintenance operations.

1.3 SUBMITTALS:

A. Qualification data for firms specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include a list of a minimum of five similar projects completed within the last five years with project name, address, names of Architects and Owners, overall description of scope of work, and contract value.

B. Product Data:
1. Submit manufacturer's product label literature, instructions and guaranteed analysis for fertilizer.
2. Submit manufacturer's labels, instructions and material safety data sheets for pesticides.

C. Maintenance Manual: In 3-ring binder, typewritten schedule and procedures for annual landscape maintenance program and procedures, with monthly maintenance guidelines, by Contractor.

1.4 DEFINITIONS:

A. Trees, shrubs, groundcovers, seed and solid sod are plant materials listed in the Plant Schedule on the Drawings.

1.5 JOB CONDITIONS:

A. Coordinate the Work of this Section with that of other trades.

B. Examine conditions under which Work is to be performed and notify Landscape Architect in writing of unsatisfactory conditions.

C. Do not perform Work until conditions are satisfactory and acceptable.

D. Maintain stakes set by others until removal is mutually agreed upon by all parties.

E. Determine the extent of underground utilities and impact on proposed installation and maintenance operations.

1.6 QUALITY ASSURANCE:

A. Codes and Standards:
1. All plant materials to comply with State and Federal laws relating to inspection for disease and insect control.
2. Plant material quality to conform to American Standard for Nursery Stock, American Association of Nurserymen, Inc., 1986, ANSI Z-60.1.
3. Plant Material nomenclature to conform to:
   a. Hortus Third, a Concise Dictionary of Plants Cultivated in the United States and Canada, MacMillan Publishing Company, Inc., New York, 1976 Edition.
   b. Names not listed in the above standard to comply with those most commonly used in the trade.
   c. In all cases, botanical names take precedence over common names.
4. Applicable Sections of the Alabama Highway Department (AHD) Standard Specification for Highway Construction, 1992 edition.
5. Alabama Pest Management Handbook, Vol. 2, 1997, or latest edition.

B. Contractor Qualifications: Firm experienced in the successful installation of a minimum of five projects within the past five years similar in scope, quality, and contract value to that indicated for this project. Firm shall have sufficient manpower, equipment and financial resources to complete the Work of this Section.

C. Supervision:
   1. Scheduling, operations, installation, and maintenance shall be supervised by a person(s) having one or more of the following qualifications:
      a. Is a Nurseryman certified by the Alabama Nurserymen's Association.
      b. Holds a Bachelor degree in Horticulture from an accredited college or university.
      c. Has a State Setting and Maintenance License.
      d. Holds a Commercial Applicator Permit in the category of Ornamental and Turf Pest Control from the Alabama Department of Agriculture and Industries.

D. Inspection and Approval:
   1. All plant material is subject to inspection and approval by the Landscape Architect in the field prior to digging, in the nursery in containers, before planting and installation, any time during the installation and completion of this phase of work.
   2. Immediately remove from site plant materials or other materials not complying with specified requirements.
   3. Approval is for visual qualities only and does not relieve the Contractor of his obligation to provide materials and workmanship in full compliance with the requirements of the Contract Documents.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver packaged materials in manufacturer's original containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at the site.

B. Deliver all non-packaged or non-containerized materials to site in a manner that will prevent loss, damage, deterioration or contamination.

C. Store all materials in approved locations to prevent loss, damage, deterioration or contamination.

D. Delivery, storage and handling of all plant materials shall conform to AHD Specification Section 860.06(c) and the following:
   1. Deliver freshly dug plants, which have not been in cold storage or heeled-in.
   2. Do not prune prior to delivery.
   3. Do not bend or bind trees or shrubs in such a manner as to damage bark, break branches or destroy natural shape.
   4. Provide protective covering during delivery.
   5. Deliver plants after preparations for planting have been completed and approved, and plant immediately.

1.8 SITE MAINTENANCE:

A. Keep roads, paving and structures adjacent to maintenance operations clean and free of obstructions, mud and debris at all times.

B. Do not permit flushing of roads or disposal of dirt or debris into sewers or drainage ditches.

C. Control dust from maintenance operations.

2.0 PRODUCTS

2.1 WATER

A. Owner provides potable water.

B. Contractor provides necessary hose, attachments and accessories.

2.2 TOPSOIL:

A. Topsoil necessary to perform or complete maintenance operations, repair or replacements is to be provided by Contractor. Furnish from approved off-site source in sufficient quantity to complete all operations.

B. Prepare all topsoil used in tree and shrub pits and ground cover beds in the following proportions:
1. 4 parts by volume topsoil as specified.
2. 2 parts by volume decomposed organic matter.
3. 2 parts by volume sand.

C. Add 6 lbs. 14-14-14 Osmocote to each cubic yard of topsoil mix during mixing process, for all plants.

OR

Add 3 lbs. of 12-6-6 granular fertilizer to each cubic yard of topsoil mix during the mixing process, for all plants.

D. Test at least three (3) samples for compliance.

E. Characteristics:
1. Fertile, friable, naturally occurring. Free of stones, clay, lumps, hardpan, roots, stumps, branches, sticks and other debris larger than two inches in any dimension; free of noxious weeds, grasses, seeds, plants, extraneous matter and any substance harmful to plant growth. Topsoil from open fields will not be accepted.
2. pH 5.0 to 7.0
3. Organic matter 5% to 10%
4. Sand 50% to 70%
5. Silt less than 30%
6. Clay 10% to 25%

7. Permeability Rate of 5 x 10 <-3> centimeters or greater at 85% compaction.

2.3 SOIL AMENDMENTS:

A. Granular Fertilizer:
1. Characteristics:
a. Uniform in composition.
b. Dry and free-flowing.
c. Commercially available.
d. Conforming to State and Federal fertilizer laws.
2. Of the formulation recommended in the Soil Test Report as specified.
3. Acceptable Manufacturers:
a. Sta-Green Plant Food Co., Nursery Special, 12-6-6.
b. The Scotts Company, Scott's.
c. Approved equal.

B. Slow-release Fertilizer:
1. Characteristics:
a. Resin-coated, homogenous or heterogeneous controlled release fertilizer for ornamental plants.
b. Chemical components (14-14-14): Ammonium nitrate, ammonium phosphate, calcium phosphate, and potassium sulfate.
c. Commercially available.
d. Conforming to State and Federal fertilizer laws.
2. Acceptable Manufacturers:
a. The Scotts Company: Osmocote.
b. Sta-Green Plant Food Co.: Polyon.
c. Approved equal.

C. Plant nutrient solution:
1. Characteristics:
a. Water based nutrient solution for soil application on newly installed trees.
b. Chemical analysis (6-20-5):

Total Nitrogen (N)	6.00%
Available Phosphoric Acid ($P_2 0_3$)	20.00%
Soluble Potash (K_2O)	5.00%
Iron (Fe)	.10%
.10% Iron (Fe) Chelated	
Zinc (Zn)	.05%
.05% Zinc (Zn) Chelated	
Manganese (Mn)	.05%
.05% Manganese (Mn) Chelated	
Boron (B)	.02%
Copper (Cu)	.05%
Molybdenum (Mo)	.0005%

c. Commercially available.
d. Conforming to State and Federal fertilizer laws.

2. Acceptable Manufacturers:
   a. Asset RTU by
      Helena Chemical Company
      Memphis, TN 38119
   b. Approved equal.

D. Lime
1. Ground or crushed agricultural lime.
2. Containing not less than 85% of total carbonates.
3. 90% passing 10-mesh screen.
4. Not less than 25% passing a 100-mesh screen.
5. Dry and free-flowing.
6. Apply at rate specified in Soil Test Report.

E. Decomposed Organic Matter:
1. Well rotted.
2. Containing no weeds, grasses or plants, their seeds, or any substance harmful to plant growth.
3. Of uniform composition.
4. Acceptable manufacturers:
   a. Klumb Company, "Soil Conditioner."
   b. Approved equal.

2.4 MULCH:

A. 100% shredded pine bark (tree, plant and groundcover pits and beds):
1. Free from wood, cambium, sawdust, leaves, twigs, insects, grasses or weeds, their seeds, other foreign material and any substance harmful to plant growth.
2. Acceptable manufacturers:
   a. Klumb Company, Shredded Mulch.
   b. Approved substitution:

B. Pine Straw (pine tree plantings):
Free from leaves, twigs, insects, grasses, weeds, plants and their seeds, other foreign material and any substances harmful to plant growth.

C. Provide hay or straw mulch for seeding per AHD Section 860.03, Class A Mulch.

2.5 PLANT MATERIALS:

A. Seed:
1. Species indicated in the Plant List on the Drawings and meeting AHD 860.01(a).
2. Temporary grass to cover, if necessary, until the season is right for specified permanent cover.

B. Solid Sod:
   1. Obtain from sources with growing conditions similar to area to be planted.
   2. Type as shown and scheduled.
   3. Containing no more than 5% other grasses.
   4. Well cultivated and free from weeds, disease, insects, extraneous roots, stones and other foreign material; of good texture.
   5. Containing no nutgrass.

C. Plant material:
   1. Trees, shrubs and ground-covers as shown and scheduled. Provide and install species, sizes and quantities shown and scheduled; standard quality, first-class representatives of each species or variety, true to name and type; nursery-grown, unless otherwise shown or scheduled.
   2. Conforming to standards in American Standard for Nursery Stock.
   3. Having normal, well-developed branches and vigorous root systems.
   4. Complying with State and federal laws for disease and insect infestation.
   5. Healthy, vigorous, free from defects, decay, disfigurements, sunscald injuries, abrasions of the bark, plant diseases, insect pests or eggs, borers, and all forms of infestations or objectionable disfigurements.
   6. Reject plants lacking compactness or proper proportions, plants which are weak, thin or injured from too close planting in nursery rows.
   7. Plants which have been cut back from larger grades to meet certain specified requirements will be rejected.
   8. Plants with undersized, dry, cracked, or broken balls, or which are loose in their balls will be rejected.
   9. Balled and burlapped material: Root-pruned within last two years.
   10. Container-grown material: Grown for one growing season in the container in which it is delivered; free from weeds and grasses. Root-bound material will be rejected.
   11. Size:
      a. In accordance with American Standard for Nursery Stock.
      b. Measure plants before pruning, with branches in normal position.
      c. All replacement material shall match the size attained by original materials at the time of replacement.
      d. Height and spread dimensions: General body mass of plant, not from branch tip to tip.
      e. Well-proportioned as to height; reject plants which meet specified measurements but do not possess an overall balance.

f. Take caliper measurement on trunk 6 inches above natural ground level up to and including 4-inch caliper size; 12 inches above natural ground level for larger sizes.
g. Balled and burlapped plants shall have firm natural balls of a diameter and depth not less than per American Standard for Nursery Stock.

2.6 CHEMICAL WEED CONTROL:

A. Pre-Emergent (in grass areas):
1. Selective pre-emergent with no residual soil activity. Select from chemicals recommended by the Alabama Pest Management Handbook.
2. Commercially available.
3. Adhere to manufacturer's recommendations for strength, rate and method of application.

B. Pre-Emergent (in bed areas):
1. Selective pre-emergent with no residual soil activity. Select from chemicals recommended by the Alabama Pest Management Handbook.
2. Commercially available.
3. Adhere to manufacturer's recommendations for strength, rate, and method of application.

C. Herbicide:
1. Non-selective post-emergent with no residual soil activity. Active ingredient:
Isopropylamine salt of Glyphosate.
2. Commercially available.
3. Adhere to manufacturer's recommendations for strength, rate and method of application.
4. Acceptable manufacturers:
a. Monsanto Agricultural Products Company: Roundup.
b. Approved substitution.

2.7 GUYING AND STAKING:

A. Wood Stakes:
1. Pressure-treated Southern Yellow Pine, or other approved wood, 2" x 4" x length specified in the Drawings, pointed at one end.
2. Above-ground portion painted black.
3. Free from insects and fungi.

B. Wire: Pliable #10 or #12 gauge galvanized steel wire, doubled and twisted.

C. Turnbuckles: As detailed and approved by Architect.

D. Protective Hose:
1. Reinforced fiber-bearing rubber hose.
2. Black.
3. May be second-hand.
4. Not less than 1/2" inside diameter.

2.8 TREE PIT DRAINAGE:

A. Washed crushed No. 57 limestone for drainage fill.

B. Filter Fabric: SUPAC 5-P manufactured by Phillips Fibers Corporation, or approved substitution.

C. Corrugated perforated drainage tubing: 4" diameter corrugated polyethylene drainage tubing, wrapped in filter fabric.
1. Acceptable product: ADS Drain Guard #472 manufactured by Advanced Drainage Systems, Inc.
2. Approved substitution.

3.0 EXECUTION

3.1 GENERAL:

A. Provide maintenance according to:
1. Guideline performance specifications herein.
2. Monthly maintenance guidelines herein.
3. Accepted horticultural practices and techniques.
4. Manufacturer's recommendations for material use.
5. Applicable State laws and local ordinances.

3.2 WATERING:

A. General Watering:
1. Water during early morning hours (2:00 a.m. - 7:00 a.m.).
2. Should irrigation system, or any portion of that system, fail to function, hand water until system is made functional again.
3. Do not over-water; water should never be allowed to stand in any areas for long periods of time.
4. Maintain uniform moisture in all planting areas during winter, especially when a freeze is expected.
5. Heavy clay soils hold moisture longer periods of time; sandy lighter soils drain rapidly and need to be watered more frequently.

B. Trees: Deep water all newly planted trees once every week during the summer, and in the winter as necessary. This schedule should be adjusted to the amount of rain. However, unless it has rained at least 1/2" in 24 hours, continue to deep water. Check trees monthly to determine if root ball is well drained. Take permanent corrective measures.

C. Shrubs: Water shrubs as necessary to maintain sufficient uniform moisture in bed; usually 3-4 times weekly or more frequently if needed during the summer.

D. Lawns: Water newly planted lawns as necessary to keep the top 2" of soil moist. After grass is established, apply water approximately 3-4 times weekly during summer (1/4" - 1/2" per application). Cut back during the fall, spring and winter.

3.3 FERTILIZING:

A. Fertilize trees, shrubs and lawns per manufacturer's recommended rates in accordance with the monthly maintenance guideline herein.

B. Cultivate and water beds or pits thoroughly after application.

C. Adjust fertilizer in accordance with interim Soil Test Reports.

D. Plant Nutrient Solution:
Apply nutrient solution (Asset RTU) to all transplanted trees within twenty-four (24) hours of planting.
Mix rate: 1 pint/100 gallons of water.
Application rate: 20 gallons/each tree.

3.4 PRUNING:

A. Remove dead wood and sucker growth as it becomes evident.

B. Do not top or remove terminal growing point or 'leader' of any plant.

C. Review pruning practices with Architect before pruning any living portion of any plants.

3.5 INSECT AND DISEASE CONTROL:

A. Maintain all plants and grass in a pest and disease-free condition by approved means.

B. Observe all applicable laws, statutes, and ordinances regulating the purchase, use, application and licensing for all pesticides.

C. Where possible, combine approved insecticide and fungicide to provide maximum protection for all plants. Observe accepted integrated pest management practices.

D. Follow manufacturer's recommendations.

E Application by licensed personnel.

F. Observe all safety precautions.

G. Trees: Inspect for pests and diseases. Spray for insect and disease control only as infestations are noted. Control shall be specific.

H. Shrubs: If insect or disease infestation occurs, treat and continue treatment until complete eradication.

3.6 WEEDING:

A. Minimum weeding:
1. Two applications of chemical pre-emergent spray.
2. New Installations: Eight applications (during growing season) of chemical contact spray (Round-Up by Monsanto, or approved equal).
3. Established plantings: Six applications (during growing season) of chemical contact spray (Round-Up by Monsanto, or approved equal).
4. One day per month hand weed during the period from March 1 through September 30; remove all visible weeds.
5. Weed to remove visible weeds during the winter.

3.7 SELECTIVE CLEARING:

A. Maintain on-going spraying, pruning and mulching program, using approved means, to continually eliminate unwanted vegetation, sucker growth and sprouts from stumps.

B. Selectively apply approved herbicide minimum of two times per year during the growing season.

3.8 SOD MAINTENANCE:

A. Mowing: Mow and edge lawn areas during the growing season, approximately April 1 through November 15 (year-round if overseeded with Winter Rye). Remove grass clippings from the site. Adhere to the following mowing schedule:
1. Mow and edge sod areas weekly as needed.
2. Change mowing directions to prevent rutting of grass.
3. Mowing heights: Bermuda -- 1"-1 ½"
Zoysia -- 1 ½"-2"
Fescue -- 2 ½"-3 ½"

B. Thatch Removal:
1. Thatch removal shall occur once each year at all sod areas or as required by the Owner. Thatch shall be generally removed during

early spring or mid-autumn. De-thatch using approved equipment for this purpose.

C. Core Aerating:
1. Aeration of sod areas shall occur once each year during mid-spring or late summer using approved core aeration equipment, especially manufactured for this specific purpose. Remove cores from site.

3.9 SEEDED AREA MAINTENANCE:

A. Extent of seeding maintenance includes all seeded areas of the site, whether or not established as part of the Work of the Contract or whether pre-existing.

B. Fill washes and otherwise protect and maintain the seeded areas including any mulch or cover used until satisfactory stand is accepted in all areas.

C. Repair damage caused by erosion, pedestrian or vehicular traffic, or other causes.

D. Maintain slope and control run-off by approved means.

E. Immediately reseed, re-mulch and repair rutted or eroded areas, replace erosion control netting, or take any other measures necessary to repair unacceptable or damaged grassed areas.

3.10 MULCHING:

A. Keep planting areas neat and uniformly mulched to a depth of 4" on a continuous basis. Remove old mulch as necessary. Do need exceed 6" depth of mulch.

B. In addition to replacing and re-spreading mulch as necessary, completely replenish mulch in all planting areas one time each year between late December to early March.

3.11 STRAIGHTENING:

A. Maintain plants in their stable upright position and at the proper grade by straightening and tightening staking and guying apparatus, raising plants which have settled, and by other means.

3.12 CLEAN-UP:

A. Keep all planting areas neat, weeded and uniformly mulched on a continuous basis.

B. Clean up adjacent walks and pavement where littered as a result of maintenance operations.

C. Remove trash and debris from surface of planting areas, whether as a result of maintenance operations or otherwise.

3.13 MONTHLY MAINTENANCE GUIDELINES:

A. January:
1. Prune trees and shrubs that have become too large or out-of-shape.
2. Inspect plants, shrubs and trees and remove any damaged or dead wood.
3. Inspect planting areas and remove any debris or litter.
4. Water semi-weekly under eaves of roof if necessary.
5. Check staking and weather protection of first year plants.
6. Remove leaf and litter on all lawn areas weekly.
7. Mulch bed areas as needed to replenish mulch levels.
8. Spray herbicides on winter weeds around January 15th.
9. Take soil samples.
10. Transplant any trees and shrubs.
11. Replace any damaged or dead trees and shrubs.
12. Prune boxwoods and fertilize boxwoods with cottonseed meal and cow manure.
13. Check moisture level in all planted areas and water if necessary.
14. Check drainage of planted areas, correct if excessive water persists.
15. Fertilize pansies every two weeks or as needed to maintain heavy growth and flowering. Use nitrate based fertilizer.
16. Protect plants susceptible to winter damage where possible during extreme cold periods.
17. Mow lawn areas every ten days if overseeded with winter grass.

B. February
1. Prune trees and shrubs that have become too large or out-of-shape.
2. Inspect plants, trees and shrubs and remove any damaged or dead wood.
3. Inspect planted areas and remove any debris or litter.
4. Water weekly under eaves or roofs.
5. Check staking and weather protection for first year plants.
6. Remove leaf and litter on all lawn areas weekly.
7. Apply pre-emerge herbicides to lawn to prevent crabgrass.
8. Apply pre-emerge herbicides to beds to prevent weeds.
9. Replace any damaged or dead trees or shrubs.
10. Check moisture level in all planted areas and water if necessary (weekly).
11. Protect plants susceptible to cold damage during excessive cold periods if possible.

12. Mow lawn area every ten days if overseeded with winter grasses.
13. Remove any staking on one-year old plantings.
14. Spot spray any existing weeds with Round-Up.
15. Establish a good edge on all bed areas.
16. Completely replace and replenish mulch in all planting areas.

C. March

1. Dethatch all lawn areas that have thatch build-up.
2. Mow and trim all lawn areas as needed.
3. Inspect plants, trees and shrubs and remove any damaged or dead wood.
4. Water weekly under eaves of roofs.
5. Litter removal on all lawn areas.
6. Check moisture level in all planted areas and water if necessary (weekly).
7. Reseed lawn areas where necessary.
8. Start pruning where necessary to maintain shape and form (do not shear).
9. All Liriope should be cut back to allow new growth to come out and remove winter damage to old growth.
10. Hand weed all bed areas as needed.
11. Deep-root feed all trees except pines (Peter's 20-20-20) as requested or approved by the Landscape Architect.

D. April

1. Aerate all sod areas using approved means.
2. Fertilize all lawn areas with 32-3-12 analysis, with 50% slow release nitrogen, or equal to soil sample reports.
3. Lime lawn areas as per soil sample reports.
4. Mow and edge lawn areas weekly.
5. Fertilize shrubs, trees, groundcover area with Nursery Special by Sta-Green or equal.
6. Cultivate and weed all planted areas.
7. Inspect all planted areas and remove any dead plants and replace.
8. Inspect all plant material (shrubs and trees) and prune any dead limbs.
9. Spot spray any weed problem areas.
10. Clean up any litter on lawn.
11. Inspect all areas for insect and disease damage and treat as necessary (weekly).
12. Prepare bed areas for any annual color and plant after mid-April.
13. Remove any winter and/or early spring color after blooming.
14. Water lawns and planted areas as needed.
15. Prune shrubs after they have bloomed.
16. Inspect all plants and trees for insects and/or diseases and treat as necessary.
17. Cut natural areas with weed eaters to keep undergrowth down. Apply pre-emergent to natural area and mulch if requested by Landscape Architect or Owner.
18. Prune hedges to keep shape and form as necessary.
19. Hand weed all bed areas as needed.

20. Apply preventive spray for lacebug and leafminer.
21. Spray Elaeagnus with growth retardant (Atrimec) when new growth is 2"-3" long.

E. May
1. Prune and fertilize Azalea varieties that have completed blooming.
2. Irrigate all planted and lawn areas as needed.
3. Mow and edge all lawn areas weekly.
4. Spot spray for weeds in planted and natural areas with Round-Up.
5. Weed all groundcover and bed areas as necessary.
6. Clean up litter on lawn and hard surface areas (weekly).
7. Inspect all lawn and planted areas for insects and/or disease and treat as necessary.
8. Plant annual color beds for the summer.
9. Prune shrubs and hedges as necessary to keep shape and form.
10. Apply selective herbicides for weed control particular to each variety of lawn.
11. Prune any damaged plants.
12. Seed any Bermuda grass or Centipede areas or overseed with Bermuda grass or Centipede on any weak or damaged areas. (Protect seeded areas until acceptable coverage of grass is present).

F. June
1. Prune and fertilize Azalea varieties that have completed blooming.
2. Irrigate all planted and lawn areas as needed.
3. Mow and edge all lawn areas weekly.
4. Trim all lawn areas as needed.
5. Spot spray for weeds in all planted areas with Round-Up.
6. Weed all groundcover and bed areas as necessary.
7. Clean up litter on all lawn areas.
8. Inspect all lawn and planted areas for insects and/or disease and treat as necessary.
9. Prune shrubs and hedges as necessary to keep shape and form.
10. Apply selective herbicides for weed control particular to each variety of lawn.
11. Any damaged plants, prune and paint with a pruning sealer.
12. Fertilize lawn areas except for Centipede.
13. Fertilize all bed areas.
14. Hand weed all bed areas as needed.

G. July
1. Irrigate all planted and lawn areas as needed.
2. Mow and edge all lawn areas weekly.
3. Hand weed all bed areas as needed.
4. Spot spray with Round-Up on weeds in all planted areas where applicable.
5. Clean up litter on all hard surface and lawn areas weekly.
6. Inspect all lawn and plant areas for insect and/or disease and treat as necessary.

7. Prune shrubs and hedges as necessary to keep shape and form.
8. Check all bed areas for mulch replacement as needed.

H. August
1. Irrigate all planted and lawn areas as needed.
2. Mow and edge all lawn areas weekly.
3. Hand weed all bed areas as needed.
4. Spot spray with Round-Up on weeds in all planted areas where applicable.
5. Clean up litter on lawn areas weekly.
6. Inspect all lawn and plant areas for insect and/or disease and treat as necessary.
7. Prune shrubs and hedges as necessary to keep shape and form.
8. Fertilize all lawn areas in late August-early September with 8-8-25 analysis (low nitrogen).
9. Fertilize all groundcovers and bed areas.
10. Check all bed areas for mulch replacement as needed.

I. September
1. Irrigate all lawn and planted areas as necessary.
2. Mow and edge all lawn areas weekly.
3. Hand weed bed areas as needed.
4. Clean up litter on lawn areas.
5. Inspect all lawn and planted areas for insects and/or disease and treat as necessary.
6. Prune shrubs and hedges as necessary to keep shape and form.
7. Apply pre-emergent to all Bermuda or Zoysia lawns unless over seeding with Winter Rye.
8. Apply pre-emergent to all bed areas.
9. Apply lime if soil tests show pH is low on lawn areas.
10. Fertilize fall color beds.
11. Overseed any Fescue lawns.
12. Remove any summer color beds and replace with fall color (Mums).
13. Take soil test if necessary for lime and fertilizer requirements.
14. Core aerate all sod areas using approved meansas needed and approved by the Lanadscape Architect.

J. October
1. Mow and edge all lawn areas weekly.
2. Monitor water needs.
3. Clean up litter on all lawn areas.
4. Inspect all lawn and planted areas for insects and/or disease and treat as necessary.
5. Prune any damaged plants.
6. Remove leaves from all planted and lawn areas.
7. Plant pansies for winter color.
8. Seed Bermuda or Zoysia lawns with Rye for winter color.
9. Replace and/or plant any new trees or shrubs.

10. Fertilize any cool season grasses.
11. Dethatch all lawn areas that have thatch build-up.

K. November
1. Clean up all litter and leaves on lawns.
2. Mow, edge and trim all lawn areas where applicable.
3. Check mulch in beds and replace where necessary after fall leaf drop.
4. Check all planted areas for water requirements.
5. Weed and cultivate beds for winter.
6. Plant spring bulbs in late November for spring color. Fertilize at planting. Maintain bulbs in cool storage from time of purchase until time of planting.
7. Apply approved anti-desiccant to all evergreen trees (except pines) during the first two weeks in November as necessary or as requested by the Landscape Architect or Owner.

L. December
1. Clean up all litter and leaves on lawns.
2. Mow, edge and trim all lawn areas where applicable.
3. Check all planted areas for water requirements.
4. Fertilize winter color beds with liquid fertilizer two times.

3.14 INSPECTION AND ACCEPTANCE:

A. Monthly Review:
1. Submit a request for inspection of Maintenance Work to the Landscape Architect once a month April through September and every two months October through March.
2. Review the previous month's work jointly with the Landscape Architect.
3. Submit a written log of fertilizer applications, and chemical insect, disease or weed control applications with each Application for Payment. This log will be a complete account of each fertilizer and chemical application performed within the month covered by that Application for Payment including date, time, weather conditions, and specific purpose and product of each application.

B. Basis of Acceptance:
1. Contractor is responsible for landscape maintenance work as specified herein and in keeping with acceptable horticultural practices.
2. During the period of the maintenance contract, replace with no additional compensation, and as soon as weather permits, all dead plant materials and all materials not in a thriving condition; replace all other workmanship and materials which are unsatisfactory in the opinion of the Landscape Architect; make good any other damage, loss, destruction or failure to flourish

sufficiently as the result of inferior or defective materials or workmanship, including, but not limited to, inadequate drainage.

3. All replacement material shall match the size attained by the original material at the time of replacement.
4. Remove dead or dying material from the site within one week of notice from the Landscape Architect.
5. Repair grades and other work necessitated due to planting replacements.
6. If the replacement is not acceptable during or at the end of the maintenance period, the Owner may elect either subsequent replacement or credit.
7. Responsibility for replacement or repair work applies to losses or damage other than those due to vandalism, Owner neglect, or Acts of Nature, as determined by the Landscape Architect. Acts of Nature include, but may not be limited to, high winds of hurricane or tornado force, sleet, hail, freezing rain, and extreme cold (as determined by the Landscape Architect). Contractor agrees to replace losses due to Acts of Nature at fifteen percent (15%) less than original contract price for the damaged work.
8. The cost of mobilization (including the provisions of General Requirements and General and Supplementary Conditions) as specified herein is considered incidental to the Work and will not be counted as a separate item for payment.

3.15 FINAL INSPECTION AND ACCEPTANCE

A. At the end of the maintenance period, submit request for inspection for Final Acceptance to the Landscape Architect at least one week prior to anticipated date of inspection.

B. Upon request for inspection, jointly review with Landscape Architect all Work for Final Acceptance.

C. Remove tree staking apparatus and saucers from all trees, unless otherwise directed. Replace mulch to specified thickness.

D. Submit Maintenance Manual (3 copies) for Owner's information and Landscape Architect's approval, containing full details for care and maintenance of landscape work, personnel and procedures, and weekly schedule for maintenance.

E. Upon completion by the Contractor of all required repairs and replacements, the Landscape Architect will confirm the date of Final Acceptance of the Work.

END OF SECTION 02499.

SECTION 331416

SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All water systems shall be in accordance with Birmingham Water Works Board requirements.

1.2 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for water service and fire-service mains.

1.3 DEFINITIONS

A. EPDM: Ethylene propylene diene terpolymer rubber.

B. LLDPE: Linear, low-density polyethylene plastic.

C. PA: Polyamide (nylon) plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. PVC: Polyvinyl chloride plastic.

G. RTRF: Reinforced thermosetting resin (fiberglass) fittings.

H. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 ACTION SUBMITTALS

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

B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of Birmingham Water Works Board. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

D. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

1.9 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC, Schedule 40 Pipe: ASTM D 1785.

1. PVC, Schedule 40 Socket Fittings: ASTM D 2466.
2. PVC Pressure Piping:
   Pipe: AWWA C900, Class 150 PVC pipe with bell-and-spigot ends for gasketed joints.
3. Fittings: AWWA C900, Class 150 PVC pipe with bell ends.

2.2 JOINING MATERIALS

A. Refer to Section 330500 "Common Work Results for Utilities" for commonly used joining materials.

B. Brazing Filler Metals: AWS A5.8, BCuP Series.

2.3 CORROSION-PROTECTION PIPING ENCASEMENT

A. Encasement for Underground Metal Piping:

1. Standards: ASTM A 674 or AWWA C105.
2. Form: Sheet or tube.
3. Material: LLDPE film of 0.008-inch minimum thickness, or high-density, cross laminated PE film of 0.004-inch minimum thickness.
4. Color: Black.

2.4 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Nonrising-Stem, Resilient-Seated Gate Valves:

a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.

1) Standard: AWWA C509.
2) Minimum Pressure Rating: 200 psig.
3) End Connections: Mechanical joint.
4) Interior Coating: Complying with AWWA C550.

2. Nonrising-Stem, High-Pressure, Resilient-Seated Gate Valves:

a. Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.

1) Standard: AWWA C509.
2) Minimum Pressure Rating: 250 psig.
3) End Connections: Push on or mechanical joint.
4) Interior Coating: Complying with AWWA C550.

3. OS&Y, Rising-Stem, Resilient-Seated Gate Valves:

a. Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.

1) Standard: AWWA C509.
2) Minimum Pressure Rating: 200 psig.
3) End Connections: Flanged.

B. UL/FMG, Cast-Iron Gate Valves:

1. UL/FMG, Nonrising-Stem Gate Valves:

a. Description: Iron body and bonnet with flange for indicator post, bronze seating material, and inside screw.

1) Standards: UL 262 and FMG approved.
2) Minimum Pressure Rating: 175 psig.
3) End Connections: Flanged.

2. OS&Y, Rising-Stem Gate Valves:

a. Description: Iron body and bonnet and bronze seating material.

1) Standards: UL 262 and FMG approved.
2) Minimum Pressure Rating: 175 psig.
3) End Connections: Flanged.

2.5 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Per Birmingham Water Works Board requirements.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.6 CHECK VALVES

A. AWWA Check Valves:

1. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.

a. Standard: AWWA C508.
b. Pressure Rating: 175 psig.

B. UL/FMG, Check Valves:

1. Description: Swing-check type with pressure rating; rubber-face checks, unless otherwise indicated; and ends matching piping.

a. Standards: UL 312 and FMG approved.
b. Pressure Rating: 250 psig.

2.7 FIRE HYDRANTS

A. Dry-Barrel Fire Hydrants:

1. Description: M&H Valve - Model 129 Fire Hydrant with Integral STORZ. Freestanding, with one NPS 4-1/2 and two NPS 2-1/2 outlets, 5-1/4-inch main valve, drain valve, and NPS 6 mechanical-joint inlet. Include interior coating according to AWWA C550. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure. The nozzle section shall consist of two hose nozzles and one 5" STORZ coupling.

    a. Standard: AWWA C502.
    b. Pressure Rating: 250 psig.
    c. Outlet Threads: NFPA 1963, with external hose thread used by local Fire Department. Include cast-iron caps with steel chains.
    d. Operating and Cap Nuts: Pentagon, 1-1/2 inches point to flat.
    e. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.
    f. Exterior Finish: The inside of all hydrants shall be coated in accordance with AWWA standards except for bronze and threaded machined surfaces. Exterior on hydrant nozzle section shall be painted Safety Yellow or as otherwise specified. Hydrant shoes shall have an interior and exterior thermosetting epoxy coating of 5 to 6 mils meeting AWWAC550.
    g. Markings: Hydrant shall be marked with the name of the manufacturer, size of valve opening, direction of opening and the year of manufacture all in accordance with the AWWA C-502. Country of origin shall be cast on all major hydrant castings.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Underground water-service piping NPS 3/4 to NPS 2.5 shall be the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

F. Underground water-service piping NPS 3 to NPS 8 shall be the following:

1. Ductile-iron, push-on-joint pipe; ductile-iron, mechanical joint fittings; and gasketed joints.

G. Water Meter Box Water-Service Piping NPS 3/4 to NPS 2 shall be same as underground water-service piping.

H. Aboveground and Vault Water-Service Piping NPS 3/4 to NPS 3 shall be the following:

1. Hard copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

I. Aboveground and vault water-service piping NPS 3 to NPS 8 shall be the following:

1. Ductile-iron, grooved-end pipe; ductile-iron, grooved-end appurtenances; and grooved joints.

J. Underground Fire-Service-Main Piping NPS 4 to NPS 12 shall be the following:

1. Ductile-iron, push-on-joint pipe; ductile-iron, mechanical joint fittings; and gasketed joints.

K. Aboveground and Vault Fire-Service-Main Piping NPS 4 to NPS 12 shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.

3.3 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.

B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, resilient-seated gate valves with valve box.
2. Underground Valves, NPS 4 and Larger, for Indicator Posts: UL/FMG, cast-iron, nonrising-stem gate valves with indicator post.
3. Use the following for valves in vaults and aboveground:

a. Gate Valves, NPS 2 and Smaller: Bronze, nonrising stem.

b. Gate Valves, NPS 3 and Larger: AWWA, cast iron, OS&Y rising stem, resilient seated.
c. Check Valves: AWWA C508, swing type.

4. Pressure-Reducing Valves: Use for water-service piping in vaults and aboveground to control water pressure.

5. Detector Check Valves: Use for water-service piping in vaults and aboveground to detect unauthorized use of water.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

A. See Section 330500 "Common Work Results for Utilities" for piping-system common requirements.

3.5 PIPING INSTALLATION

A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.

B. Comply with NFPA 24 for fire-service-main piping materials and installation.

C. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

D. Bury piping with depth of cover over top at least 30 inches, with top at least 12 inches below level of maximum frost penetration, and according to the following:

1. Under Driveways: With at least 36 inches cover over top.
2. Under Railroad Tracks: With at least 48 inches cover over top.
3. In Loose Gravelly Soil and Rock: With at least 12 inches additional cover.

E. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

F. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

G. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.6 JOINT CONSTRUCTION

A. See Section 330500 "Common Work Results for Utilities" for basic piping joint construction.

B. Make pipe joints according to the following:

1. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.
2. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
3. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
4. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.

3.7 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.
2. Locking mechanical joints.
3. Set-screw mechanical retainer glands.
4. Bolted flanged joints.
5. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
2. Fire-Service-Main Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.8 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.

3.9 FIRE HYDRANT INSTALLATION

A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.

B. AWWA Fire Hydrants: Comply with AWWA M17.

C. UL/FMG Fire Hydrants: Comply with NFPA 24.

3.10 CONNECTIONS

A. See Section 330500 "Common Work Results for Utilities" for piping connections to valves and equipment.

B. Connect water-distribution piping to utility water main per Birmingham Water Works Board Requirements.

C. Connect water-distribution piping to interior domestic water piping with cut in tee.

D. Connect waste piping from concrete vault drains to storm-drainage system. See Section 334200 "Stormwater Conveyance" for connection to storm-sewer piping.

E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.11 FIELD QUALITY CONTROL

A. Testing shall be per the water providers requirements. Where no specific requirements are provided, testing shall be as follows:

B. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

C. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

D. Prepare reports of testing activities.

3.12 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

    a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 331416

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SECTION 333100

SANITARY SEWERAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sanitary sewerage piping.
2. Flexible couplings.
3. Flexible pipe boots for manhole pipe entrances.

1.2 DEFINITIONS

A. Bedding: Fill placed under, beside, and directly over pipe, prior to subsequent backfill operations.

1.3 COORDINATION

A. Coordinate Work of this Section with termination of sanitary sewer connection outside building, connection to municipal sewer utility service, and trenching.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 SUBMITTALS

A. Product Data:

1. Sanitary sewerage piping.
2. Flexible couplings.
3. Flexible pipe boots for manhole pipe entrances.

B. Source Quality-Control Reports: For piping and accessories.

C. Field Quality-Control Reports: For piping and accessories.

D. Qualifications Statements: For manufacturer and installer.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record finished locations of pipe runs, connections, cleanouts, and invert elevations.

1.7 QUALITY ASSURANCE

A. Manufacturers Qualifications: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Installers Qualifications: Company specializing in performing Work of this Section with minimum three years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Storage:

1. Store materials according to manufacturer instructions.
2. Store valves in shipping containers with labeling in place.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Block individual and stockpiled pipe lengths to prevent moving.
3. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Perform Work according to:
1. Jefferson County Environmental Services standards.

2.2 SANITARY SEWERAGE PIPING

A. Plastic Pipe with Bell and Spigot End Connections with Rubber-Ring-Sealed Gasket Joint:

1. Material: PVC.
2. Comply with ASTM D3034, SDR-35.
3. Inside Nominal Diameter: See Plan.
4. Fittings: PVC.

5. Joints:

    a. Elastomeric gaskets.
    b. Comply with ASTM F477.

2.3 FLEXIBLE COUPLINGS

A. Material: Resilient, chemical-resistant, elastomeric PVC.

B. Attachment: Two Series-300 stainless-steel clamps, screws, and housings.

2.4 FLEXIBLE PIPE BOOTS FOR MANHOLE PIPE ENTRANCES

A. Material: EPDM.

B. Comply with ASTM C923.

C. Attachment: Series-300 stainless-steel clamp and hardware.

2.5 MATERIALS

A. Bedding and Cover:

1. Bedding: Fill Type A2.
2. Cover: Fill Type A1.
3. Soil Backfill from Above Pipe to Finish Grade:

    a. Soil Type S1, as specified in Section 312000 "Earth Moving".
    b. Subsoil with no rocks more than 6 inches in diameter, frozen earth, or foreign matter.

2.6 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of pipe.

B. Owner Inspection:

1. Make completed pipe sections available for inspection at manufacturer's factory prior to packaging for shipment.
2. Notify Owner at least seven days before inspection is allowed.

C. Owner Witnessing:

1. Allow witnessing of factory inspections and tests at manufacturer's test facility.
2. Notify Owner at least seven days before inspections and tests are scheduled.

D. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify that trench cut is ready to receive Work of this Section.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

B. Correct over-excavation with fine aggregate.

C. Remove large stones or other hard materials that could damage pipe or impede consistent backfilling or compaction.

D. Protect and support existing sewer lines, utilities, and appurtenances.

E. Utilities:

1. Maintain profiles of utilities.
2. Coordinate with other utilities to eliminate interference.
3. Notify Architect/Engineer if crossing conflicts occur.

3.3 INSTALLATION OF PIPING AND MANHOLES

A. Bedding:

1. Excavate pipe trench as specified in Section 312000 “Earth Moving.
2. Place bedding material at trench bottom.
3. Level materials in continuous layer not exceeding 6 inches.

4. Maintain optimum moisture content of bedding material to attain required compaction density.

B. Piping:

1. Install pipe, fittings, and accessories according to ASTM D2321, and seal joints watertight.
2. Lay pipe to slope gradients as indicated on Drawings.
3. Begin at downstream end of system and progress upstream.
4. Bedding:

    a. Install at sides and over top of pipe, to minimum compacted thickness of 12 inches.
    b. As indicated on Drawings.

5. Lay bell-and-spigot pipe with bells upstream.
6. Backfill and compact as specified in Section 312000 "Earth Moving."
7. Do not displace or damage pipe when compacting.
8. Connect to building sanitary sewer outlet and existing pump station through installed sleeves.
9. Pipe Markers: As specified in Section 330597 "Identification and Signage for Utilities."
10. Install Site sanitary sewage system piping to within 5 feet of building, and connect to building sanitary waste system as specified in Section 221300 "Facility Sanitary Sewerage."

C. Backfilling:

1. Backfill around sides and to top of pipe with cover fill in minimum lifts of 6 inches.
2. Tamp fill in place, and compact to 95 percent of maximum density.
3. Place and compact material immediately adjacent to pipes to avoid damage to pipe and prevent pipe misalignment.
4. Maintain optimum moisture content of bedding material as required to attain specified compaction density.
5. As specified in Section 312000 "Earth Moving."

3.4 TOLERANCES

A. Maximum Variation from Indicated Slope: 1/8 inch in 10 feet.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing:

1. If tests indicate that Work does not meet specified requirements, remove Work, replace, and retest.
2. Perform testing on Site sanitary sewage system according to local code of Jefferson County Environmental Services standards.
3. Pipe Testing:

    a. Pressure Testing: Per Jefferson County Environmental Services Standards.
    b. Infiltration and Exfiltration Testing: Per Jefferson County Environmental Services Standards.
    c. Deflection Testing: Per Jefferson County Environmental Services Standards.

4. Compaction Testing:

    a. Comply with ASTM D698.
    b. Testing Frequency: 1 Test per 250 linear feet of trench

C. Prepare test and inspection reports.

3.6 PROTECTION

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

B. Cap open ends of piping during periods of Work stoppage.

END OF SECTION 333100

SECTION 334200

STORMWATER CONVEYANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions

1.2 SUMMARY

A. This Section includes gravity-flow, non-pressure storm drainage outside the building, with the following components:
   1. Special fittings for expansion and deflection.
   2. Cleanouts.
   3. Drains.
   4. Precast concrete manholes.

1.3 DEFINITIONS

A. DIP: Ductile Iron Pipe

B. PVC: Polyvinyl chloride plastic.

C. RCP: Reinforced Concrete Pipe

D. HDPE: Double wall smooth lined high density polyethylene

1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Non-pressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least silt-tight, unless otherwise indicated.

1.5 SUBMITTALS

A. Product Data: For the following:

   1. Special pipe fittings.
   2. Drains.
   3. Channel drainage systems.

B. Shop Drawings: For the following:

1. Manholes: Include plans, elevations, sections, details, and frames and covers. Contractor is solely responsible for sizing base and riser sections to accommodate intersecting pipes.
2. Catch Basins and Stormwater Inlets. Include plans, elevations, sections, details, and frames, covers, and grates. Contractor is solely responsible for sizing base and riser sections to accommodate intersecting pipes.
3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames and covers, design calculations, and concrete design-mix report.

C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

D. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

E. Field quality-control test reports, as-built survey and inspection video.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.2 DUCTILE IRON, CULVERT PIPE AND FITTINGS

A. Pipe: ASTM A 716, for push-on joints.

B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.

C. Compact Fittings: AWWA C153, for push-on joints.

D. Gaskets: AWWA C111, rubber.

2.3 PVC PIPE AND FITTINGS

A. PVC Water-Service Pipe and Fittings: ASTM D 1785, Schedule 40 pipe, with plain ends for solvent-cemented joints with ASTM D 2466, Schedule 40 ASTM D 2467, Schedule 80, socket-type fittings.

2.4 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76, with groove and tongue ends and gasketed joints with ASTM C 443, rubber gaskets.

1. Class III, Wall B.

2.5 PE PIPE AND FITTINGS

A. Corrugated PE Drainage Pipe and Fittings NPS 3 to NPS 10: AASHTO M 252M, Type S, with smooth waterway for coupling joints.

1. Watertight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.

B. Corrugated PE Pipe and Fittings NPS 12 to NPS 60: AASHTO M 294M, Type S, with smooth waterway for coupling joints.

1. Watertight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.

2.6 HP STORM

A. Pipe Requirements
1. ADS HP Storm pipe shall have a smooth interior and annular exterior corrugations.
2. 12- through 60-inch (300 to 1500 mm) pipe shall meet ASTM F2881 or AASHTO M330
3. Manning's "n" value for use in design shall be 0.012

B. Joint Performance
1. Pipe shall be joined using a bell & spigot joint meeting the requirements of ASTM F2881 or AASHTO M330. The joint shall be watertight according to the

requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Gasket shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly. 12- through 60-inch (300 to 1500 mm) diameters shall have an exterior bell wrap installed by the manufacturer.

C. Fittings
   1. Fittings shall conform to ASTM F2881 or AASHTO M330. Bell and spigot connections shall utilize a welded or integral bell and valley or inline gaskets meeting the watertight joint performance requirements of ASTM D3212.

2.7 CLEANOUTS

A. Cast-Iron Cleanouts:

   1. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
   2. Top-Loading Classification(s): Heavy Duty and Extra-Heavy Duty.
   3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.8 MANHOLES

A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

   1. Diameter: 48 inches minimum, unless otherwise indicated.
   2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
   3. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
   4. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
   5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
   6. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
   7. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.

8. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
9. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch- minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
10.
    a. Material: ASTM A 536, Grade 60-40-18 ductile iron, unless otherwise
    b. indicated.

2.9 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.10 CATCH BASINS

A. Standard Precast Concrete Catch Basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
2. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
3. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
4. Joint Sealant: ASTM C 990, bitumen or butyl rubber.

5. Grade Rings: Include 2 or 3 reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and grate.
6. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches.
7. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings.

1. Size: 24 by 24 inches minimum, unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

2.11 STORMWATER INLETS

A. Curb Inlets: Vertical curb opening, of materials and dimensions indicated.

B. Gutter Inlets: Horizontal gutter opening, of materials and dimensions indicated. Include heavy-duty frames and grates.

C. Combination Inlets: Vertical curb and horizontal gutter openings, of materials and dimensions indicated. Include heavy-duty frames and grates.

D. Frames and Grates: Dimensions, opening pattern, free area, and other attributes indicated.

2.12 PIPE OUTLETS

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

B. Riprap Basins:

1. ALDOT Class I or II as indicated on drawings.

C. Filter Stone: ALDOT # 57.

D. Energy Dissipaters: According to NSSGA's "Quarried Stone for Erosion and Sediment Control," No. A-1, 3-ton average weight armor stone, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING APPLICATIONS

A. Gravity-Flow, Non-pressure Sewer Piping: Use any of the following pipe materials for each size range:

1. NPS 4 to NPS 12: Smooth lined HDPE or A-2000 sewer pipe and fittings, gaskets, and gasketed joints.
2. NPS 15 to NPS 60: HP Storm or reinforced-concrete sewer pipe and fittings, gaskets, and gasketed joints as indicated on the plans.

3.3 PIPING INSTALLATION

A. Piping installation, bedding and backfill shall be per the manufacturers recommendations.

B. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

D. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

E. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

F. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

G. Install gravity-flow, non-pressure drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
3. Install piping with 36-inch minimum cover.
4. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
5. Install HP Storm in accordance with ASTM D2321 and ADS recommended installation guidelines.
6. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
7. Provide bedding and backfill per the manufacturer's requirements to accommodate proposed fill height.

3.4 PIPE JOINT CONSTRUCTION

A. Basic pipe joint construction is specified in Division 2 Section "Piped Utilities - Basic Materials and Methods." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Join gravity-flow, non-pressure drainage piping according to the following:

1. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric gasket joints.
2. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
3. Join dissimilar pipe materials with non-pressure-type flexible or rigid couplings.

3.5 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections according to ASTM C 891.

C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

3.6 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.7 STORMWATER INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Construct riprap of broken stone, as indicated.

C. Install outlets that spill onto grade, anchored with concrete, where indicated.

D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

E. Construct energy dissipaters at outlets, as indicated.

3.8 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318/318R.

3.9 CONNECTIONS

A. Connect non-pressure, gravity-flow drainage piping in building's storm building drains specified in Division 15 Section "Storm Drainage Piping."

3.10 IDENTIFICATION

A. Materials and their installation are specified in division 2 Section "Earthwork." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.11 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
c. Crushed, broken, cracked, or otherwise damaged piping.
d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Re-inspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

a. Exception: Piping with soil-tight joints unless required by authorities having jurisdiction.
b. Option: Test plastic piping according to ASTM F 1417.
c. Option: Test concrete piping according to ASTM C 924.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.12 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION 334100

SECTION 33 71 73 – ELECTRICAL UTILITY SERVICE

PART 1 - GENERAL

1.1 RATING:

A. Secondary Service: 120/208 volts, 3 phase, 4 wire, grounded neutral, wye connected.

1.2 SERVICE AND UTILITIES:

A. Arrange with local electric service company for service to be brought to project, and for the installation of meter. Pay all charges (if any) in connection therewith, including permanent meter deposit, which deposit will be refunded to Contractor at time of Owner's occupancy of the building.

B. It is responsibility of this Section, prior to bid, to re-affirm with Utility Companies involved, that locations, arrangement, Power Company voltage, phase, metering required, and connections to utility service are in accordance with their regulations and requirements. If their requirements are at variance with these drawings and specifications, contract price shall include an additional cost necessary to meet those regulations without extra cost to Owner after bids are accepted.

C. Obtain from Utility Company any additional charges for service of type, size and location called for. Include charges in bid to be paid by Contractor to appropriate party. Provide payment of these charges so as to allow logical progression of construction and avoid delay of completion.

D. Should cost above not be available prior to bid, submit with bid a letter signed by responsible Utility Company personnel stating that cost is not available. Prime Contractor shall submit letter with his bid to Owner. Cost will then be omitted from contract and become responsibility of Owner.

E. Furnish with shop drawings a signed document from each utility company describing location and type of service to be supplied and requirements for service. Document shall be signed by the appropriate responsible representative of the respective Utility Company.

PART 2 – PRODUCTS

Not Applicable:

PART 3 - EXECUTION

3.1 PAD MOUNTED TRANSFORMER SERVICE:

A. Service to facility consists of underground primary service from riser pole to new pad mounted transformer, with underground secondary service from transformer(s) to main distribution equipment.

B. Power Company furnishes and installs following:

1. All facilities on primary riser pole.

2. Primary cable from the riser pole to pad mounted transformer complete with connections at each end.

3. Pad mounted transformer complete.

C. Provide the following:

1. Primary duct bank from riser pole to transformer. Duct bank consists of PVC duct encased in concrete as shown. See Section covering "Raceways". Use long radius, 36" minimum, PVC elbows, same as duct. Terminate ducts at pole with cast iron double hubs as directed by Power Company. Terminate ducts in transformer pad with approved bushings.

2. Transformer pad: Build transformer pad to Power Company's specifications. Pad consists of 3000# concrete reinforced with #4 steel bars 12" o.c. in both horizontal directions. Provide 1" x 45 degree chamfer on all top edges. Obtain detail drawings from Power Company for location of anchor bolts, and complete pad details. Pad construction to conform to the Power Company details. Provide two (2) 3/4" x 10" copper clad steel ground rods in pad as shown.

3. Underground secondary service from transformer consists of conductors in conduit. Terminate conduits inside transformer. Make secondary connections to transformer. Leave necessary slack conductors for secondary connections.

4. Coordinate all service work with Power Company and install the work in accordance with their requirements and recommendations.

3.2 METERING:

A. Install devices and conduit for Power Company metering of secondary service as shown. Power Company will furnish meter, meter socket, donut CT's and meter conductors to Contractor for installation. Install any additional conduit, junction boxes, etc., as required by Power Company.

B. Meter center assembly to by furnished and installed by the electrical contractor in accordance with the power company's requirements.

C. Install meter equipment in accordance with Power Company requirements.

END OF SECTION 33 71 73

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