PROJECT MANUAL

CWA Project No. 2022-08

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PROJECT NAME: IRONDALE PUBLIC LIBRARY

PROJECT ADDRESS

1032 GRANTS MILL ROAD IRONDALE, AL 35210

A PROJECT FOR THE CITY OF IRONDALE

DATE ISSUED: NOVEMBER 16, 2023

VOLUME 2 OF 2

SET NO. _____





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SECTION 00 01 05

PROJECT DIRECTORY

CITY OF IRONDALE OWNER: 101 20th Street South Irondale, AL 35210 Phone: xxx.xxx.xxxx James Stewart, Mayor Del Wilson, Library Director **ARCHITECTS: CHARLES WILLIAMS & ASSOCIATES** 3601 8th Ave., S. Birmingham, Alabama 35222 Phone: 205.250.0700 Charles E. Williams, AIA, Principal Christa Vandiver, Project Architect **INTERIORS:** JILL HICKS DESIGN, LLC Phone: 205.871.0484 Jill Hicks, Interior Designer **CIVIL ENGINEER:** SARCOR 215 19th Street North, Suite 101 Birmingham, AL 35203 Phone: 205.706.8170 Jeff Havercroft, P.E., Civil Engineer LANDSCAPE **RENTA URBAN LAND DESIGN** ARCHITECT: 3325 Rocky Ridge Plaza, Suite 227 Birmingham, AL 35243 Phone: 205.545.7639 Jim Hogan, Landscape Architect STRUCTURAL: **MBA ENGINEERS, INC.** 300 20th Street North, Suite 100 Birmingham, AL 35203 Keith Owens, P.E., Structural Engineer MECHANICAL, **PLUMBING &** FIRE PROTECTION: **DEWBERRY ENGINEERING** 2 Riverchase Office Plaza, Suite 205 Birmingham, AL 35244 Phone: 205.988.2069 Adam Cone, P.E., Mechanical Jacob Cicero, P.E., Plumbing

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END OF SECTION 00 01 05

ENGINEER/ ARCHITECT PROFESSIONAL REGISTRATION STAMPS



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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: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
- 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. 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

22 04 05 – PLUMBING IDENTIFICATION

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 twothirds 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.

- Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive 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

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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.
- 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

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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. Waste piping 2 inch and smaller from fixture to trap to be galvanized steel, DWV copper tube, PVC, or cast iron.

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.
- 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

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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 $\frac{1}{4}$ " = 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.

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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 asbuilt 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

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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, workmanlike 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 $\frac{1}{2}$ 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:

<u>Equipment</u>	<u>Foundation</u>
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, gymasiums, 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.
 - 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. Provide automatic sprinkler coverage at the bottom of hydraulic elevator shafts and elevator machine room in Accordance with NFPA 13 and local requirements.
- T. Exterior exposed equipment shall be chrome plated.
- U. All fire department or maintenance connections shall be coordinated with the Fire Department.
- V. The fire protection contractor is responsible for coordination and labelling of fire devices supplied under this specification.
- W. Where pipes penetrate exterior or finished surfaces escutcheons shall be used. Escutcheons shall be chrome finished and single piece design.
- X. All devices and equipment shall be labelled as required by NFPA 13 and 24.

END OF SECTION 22 0455

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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:
 - a. Glass Fiber Pipe Insulation
 - 1) All pipe sizes: 1 inch thick.
 - 2) Pipes located in walls: 1 inch thick.
 - b. Foamed Plastic Pipe Insulation
 - 1) All pipe sizes: 1 inch thick.
 - 2) Pipes located in walls: 1 inch thick.
 - 2. Domestic Hot and Recirculating Water Interior, Above Grade:
 - a. Glass Fiber Pipe Insulation
 - 1) All pipe sizes: 1-1/2 inch thick.
 - 2) Pipe located in walls: 1 inch thick.
 - b. Foamed Plastic Pipe Insulation
 - 1) All pipe sizes: 1 inch thick.
 - 2) Pipes located in walls: 1 inch thick.
 - 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. Glass Fiber 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.

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- 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.
- B. Cold water piping, interior, above grade: "Fiberglass Pipe Covering", 1" thick. Pipe insulation in partitions and chases may be 1" thick "Arma-cell" or approved equal.
- 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.
- 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.
- 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

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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 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

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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 101 Life Safety Code.
 - 7. Other Standard as referenced in other Sections of Divisions 15.
 - 8. Local Building Code (International Building Code if no local Building Code in effect).
 - 9. Local Plumbing Code (International Plumbing Code if no local Plumbing Code in effect).
 - 10. Local Gas Code (International Gas Code if no local Gas Code in effect).
 - 11. 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.
 - 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.

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 forwhich 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.
- 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.

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 bothends

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.
- 1. 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.

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 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".

3.09 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.

3.10 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.

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

A. Duct Mounted Smoke Detectors: Install in duct.

3.12 EXHAUST FAN IDENTIFICATIONS:

A. 2" X 3" or larger laminated plastic nameplates with red letters and numbers on white background, identifying type of fans, number according to plans, and rooms served. Engrave on upper half of tag, leaving lower half for engraving by Owner. Fasten with acorn head screws.

3.13 USE OF HVAC SYSTEM DURING CONSTRUCTION:

- A. Ducted HVAC systems may be used during construction as long as the following conditions are met:
 - 1. All AC units shall have filters installed in the AC units that are equal to the filters that are scheduled for each piece of equipment. The contractor shall be responsible for changing the filters in all AC units during construction at a minimum of every 30 days starting from the day the AC units are started. At the completion of the project, the contractor shall replace all filters.
 - 2. All return air and outside air openings shall be protected with temporary filter media. The temporary filter media shall be changed by the contractor. Temporary filter media is required to protect the installed ductwork. During or after construction, if any ductwork is observed without temporary filter media, the contractor shall be solely responsible for cleaning the entire ductwork system and AC unit. Temporary filter media shall be changed bi-weekly at a minimum.
 - 3. All AC units shall have all correct motor overload elements installed and all safeties shall be wired and operational prior to temporary use of the AC unit.
 - 4. Temporary controls and temporary control sequences may be utilized by the contractor until the permanent controls and control sequences are installed. Temporary control methods shall be the sole responsibility of the contractor.
 - 5. All AC units required to have factory start-up shall have factory start-up completed prior to use.
 - 6. The building envelope for the area served by the AC units shall be substantially complete prior to using the AC units during construction.
- B. Ductless split systems shall NOT be used during construction. Protect all indoor sections of ductless split systems during construction to prevent dust, dirt, or water from entering the unit.

3.14 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).

3.15 **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. Air balance report (3).
 - 3. Equipment Submittal Data (3).
 - 4. Equipment operating and maintenance manuals (3).
 - 5. Maintenance schedule (3).

- 6. Equipment warranty dates and guarantees (3).
- 7. List of Owner's Personnel who have received maintenance instructions.
- 8. Factory start-up reports for equipment requiring factory start-up.

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 for rooftop equipment only, 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 waterpiping 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 **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 value in each liquid and hot gas bypass line. Hot gas solenoid value 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 (perTIMA 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., 2" thickness, installed R=6.0 minimum.

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 suitable for painting.
- B. AC Unit Drain Lines: "Foam Plastic Covering", 3/4" thick. Jacket piping located outdoors or 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" thickduct insulation on all sides, "external for concealed".

3.03 DUCT INSULATION INTERNAL (AND EXTERNAL WHERE INDICATED):
- A. Apply in accordance with SMACNA "Duct Liner Application Standard" over full coverage adhesive. Coat all edges with adhesive and seal all punctures or tears with mastic before installing ducts. Cut liner to assure overlapped and compressed longitudinal corner joints. Fasteners shall be sized appropriately for thickness of liner utilized. Provide mechanical fasteners and metal nosings as noted below:
 - 1. For all velocities, provide metal nosings on upstream edge of liner at connections to equipment: Fans, coils, dampers, AC Units, sound absorbers, etc.
 - 2. For velocities up to 2,000 feet per minute: Start fasteners within 3" of the upstream transverse edges of the liner and 3" from the longitudinal joints and space them a maximum of 12"o.c. around the perimeter of the duct, except that they may be a maximum of 12" from a corner

break. Elsewhere locate fasteners a maximum of 18" o.c., except that they shall be placed not more than 6" from a longitudinal joint of the liner nor more than 12" from a corner break.

- 3. For velocities from 2,001 to 4,000 feet per minute: Start fasteners within 3" of the upstream transverse edges of the liner and 3" from the longitudinal joints and space them a maximum of 6" o.c. around the perimeter of the duct, except that they may be a maximum of 6" from a corner break. Elsewhere locate fasteners a maximum of 16" o.c., except that they shall be placed not more than 6" from a longitudinal joints of the liner nor more than 12" from a corner break. In addition to the adhesive edge coating of transverse joints, coat and longitudinal joints with adhesive.
- 4. For velocities from 4,001 to 6,000 feet per minute: Same as 2 above except that metal nosing shall be installed to secure liner at all upstream transverse edges.
- 5. DUCT SIZES SHOWN ARE CLEAR INSIDE DIMENSIONS. INCREASE SHEETMETAL SIZE AS REQUIRED TO ALLOW FOR LINER THICKNESS.
- 6. Where ducts are listed to be lined and wrapped, install wrap per section below "Duct Insulation, External, for Concealed Ducts"
- B. Thickness and Extent:
 - 1. All return air ductwork: 1" thickliner.
 - 2. RTU 2, 3, 4, 5, 6 and 7 supply air ductwork: 1.5" thick liner.

3.04 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. All supply ductwork: 2" 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.

3.05 INSULATION WETTED DURING CONSTRUCTION:

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

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 Mitsubishi Electric, Trane, Daikin, Samsung, Bryant, 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.

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Section 23 57 70

PACKAGED UNITS

PART 1 - GENERAL

1.01 SCOPE:

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

PART 2 - PRODUCTS

2.01 PACKAGED ROOF TOP AIR CONDITIONING UNITS

- A. Air Handling Units: Supply fans, coils, filters, and drip pan, horizontal or vertical as shown.
- B. Casings: Galvanized steel not lighter than 22-gauge, reinforced with angles or formed shapes with baked enamel finish over bonderizing. Casing panels: removable for access to fans, motors, coils, and bearings. Provide knockouts for piping and electrical connections. Casing shall be insulated with 1" thick neoprene coated duct liner meeting the requirements of NFPA 90A.
- C. Provide statically and dynamically balanced belt driven centrifugal fans with selfaligning ball bearings, adjustable pitch motor and adjustable motor base. Size belt drives for 50% overload. Fan motor and drive shall be located inside unit cabinet. Provide fan starting relay for each unit.
- D. Coils include direct expansion coils. Refrigerant and hydronic coils shall consist of non-ferrous fins securely bonded to seamless copper tubes, and shall bear ARI approved ratings.
- E. Drain Pans: Provide corrosion resistant coating and insulating corrosion-resistant fill.
- F. Filters: 2" thick throwaway filter. Turn equipment over to Owner with clean filters.
- G. Gas Heating Section:
 - The natural gas fired heating section shall utilize a stainless steel heat exchanger with pilotless spark ignition and forced combustion blower. Safety controls shall prevent continued gas flow if spark ignition fails. Heating section shall be factory pressure and leak tested and shall bear AGA approval.
- H. Modulating outside air damper motor with adjustable minimum position switch and

23 57 70 – PACKAGED UNITS

outside air hood shall be provided.

- I. Provide five (5) year non-pro-rated compressor parts warranty and 10-year heat exchanger warranty.
- J. Units shall be manufactured by Trane, Daikin, Bryant, Carrier or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Packaged units shall be installed in accordance with manufacturer's recommendations.
- B. See details for mounting instructions and accessories.

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).

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- 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 ROOF EXHAUST:

- A. Centrifugal power roof ventilators with AMCA certified air and sound ratings, belt or direct driven as shown. Provide permanently oiled bearings, statically and dynamically balanced backward curved blade wheels and spun aluminum housing with curb cap, disconnect switches, back-draft damper and outlet birdscreen. For belt driven fans provide V-belt drive sized for 50% overload, adjustable pitch motor pulley and adjustable motor base. For each fan furnish an 18 gauge galvanized steel insulated prefabricated curb with integral cant. Furnish baffled sound absorbing curbs where required to obtain noise level specified. Static pressure scheduled are external to sound curbs.
- B. For kitchen range hood furnish up-blast discharge fan without sound curb, UL-762 labeled for grease laden air and fan wheels are to be Teflon coated. Fan shall be hinged onto curb for access to cleaning the fan.
- C. All roof mounted fans to be factory painted to match louvers, color by Architect
- D. Fans shall be manufactured by Greenheck, Cook, Acme, Penn, Twin City or approved equal.

2.03 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.
- B. Fans shall be manufactured by Greenheck, Cook, Acme, Penn, Twin City, 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.

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Section 23 58 30

ELECTRIC HEATERS - HVAC

PART 1 – GENERAL

1.1 <u>SCOPE:</u>

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

PART 2 - PRODUCTS:

2.1 ELECTRIC UNIT HEATERS:

- A. UL listed electric heater having capacity shown with resiliently mounted direct driven propeller fan with guard, finned-sheathed heating elements, and enameled steel enclosure not lighter than 20 gauge. Heater shall be equipped with automatic reset high limit controls, power contactors and control transformer for 24 volt control, factory wired to terminal strips.
- B. For horizontal heaters provide adjustable horizontal louvers. For vertical heaters provide louver.
- C. For each unit heater provide room thermostat to cycle contactor and fan.
- D. Electric Unit Heater shall be manufactured by Chromalox, Markel, Berko, or approved equal.

2.2 ELECTRIC WALL HEATERS:

- A. UL listed recessed convection heaters with finned sheathed heating elements, resiliently mounted direct driven propeller fan with motor heat shield, circuit breaker, line voltage wall mounted thermostat, concealed "On-Off" switch, high limit controls, and junction box for connecting power wiring.
- B. Cabinets: 16-gauge steel, with pencil proof welded steel bar grilles (bars 1/16" X 3/8" minimum). Equip cabinet with adjustable recessing frame. Finish: Baked enamel, over bonderizing. Architect will select the color from manufacturer's standard selections.
- C. Electric Wall Heaters: Markel Series 3450, or approved equal.

PART 3 - EXECUTION:

3.1 INSTALLATION:

- A. Units shall be installed in accordance with manufacturer's recommendations.
- B. See Details for mounting instructions and accessories.

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 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

23 58 40 - DUCTWORK - HVAC

indicated.

C. See details for mounting instructions and accessories.

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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 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 or equal.
- 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.

2.03 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.

C. Install access door in low pressure ducts at each fire damper. Install wall or ceiling access door for access to fire dampers not accessible through lift-out ceilings. See sub-section 2.05 "ACCESS DOORS", below.

2.04 SMOKE DETECTORS:

- A. Smoke detectors will be furnished and wired under Electrical Work but shall be installed in ducts under this Section.
- B. Locate smoke detectors so that indicating lights are visible and so that they will not be affected by moisture from coils or humidifiers.
- C. Install access door in duct at each smoke detector. (See sub-section 2.05 "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. 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 GRAVITY ROOF VENTILATORS:

A. Factory fabricated spun aluminum ventilator with integral curb cap and birdscreen. Equip hood with galvanized steel curb with wood nailer. Minimum material gauges, hood 20 gauge, base 18 gauge, curb 18 gauge.

B. Gravity Roof Ventilators shall be manufactured by Greenheck RSP, or approved 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.

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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 272.
- 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".

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- F. 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.
- Linear Supply Diffusers (LSD): Fixed pattern extruded aluminum, 2-way throw diffusers G. (designed for variable use), concealed attachment (no visible screws), mounted on outlet of galvanized steel boot with 1/2" internal insulation and round side inlet collar. Manual damper shall be provided at inlet collar or at branch duct spin-in connection for each diffuser with provisions for access to manual dampers for balancing. Where manual dampers are not accessible through lay-in ceiling provide manual damper in boot plenum above linear slot diffuser with screw driver adjustment through face of linear slot diffuser. Provide all necessary mounting clips and accessories for concealed attachment (no visible screws). Coordinate mounting frame with type ceilings shown on Architectural plans. Provide surface mounted with frame for plaster, gypboard or concealed spline type ceilings. Coordinate mounting for lay-in ceiling application including mitered corners, recessed end cap as may be required for diffuser to rest on grid and be flush with ceiling tile. Boot insulation shall comply with the requirements for internal duct insulation. Slot width to be 1/2" and NC less than 30. Finish off-white enamel Titus "ML" with "MP" plenum.

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.

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: MERV 8 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.

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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 a controls system, complete and ready for operation with control sequences specified on drawings. The controls shall be provided by the unit manufacturer.
- 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 5 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 layin 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 proportional action relay thermostats with digital readout without and accessible DDC adjustments. Thermostats to be provided with local control. Thermostat covers: high impact plastic. Mount room thermostats with tops 4 feet above floors.
- B. 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.
- C. Provide stand-offs for control devices mounted on externally insulated ducts and equipment.

2.04 CONTROL POWER:

- A. Direct Digital Control (DDC) with pneumatic power for valves and damper operators. All 120 Volt wiring shall be the responsibility of the Control Sub-Contractor from circuit furnished under Electrical Section.
- 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 STAND-ALONE DIGITAL CONTROLLERS (SDC) (IF REQUIRED):

- A. SDC Hardware Requirements:
 - 1. Stand-Alone Digital Controllers shall be 16-bit microcomputer based, providing a multi-tasking operating system for control functions simultaneous with all other facility management, operator interface, and system communications functions. SDC's shall include integral devices with full alphanumeric display and a keypad for password controlled access to various levels of operational capability, from simple information access, to full programmability of SDC functions.
 - 2. SDC's shall provide true floating point arithmetic calculations. To accommodate accumulation of large totalized values, the SDC shall support calculation and accumulation of values up to 10 to the thirty-eight power.
 - 3. Application Program Protection:
 - a. All programming defining the functions to be performed by the SDC, including but not limited to application programs and point database, shall be protected from loss due to power failure for a minimum of 10 months. Provide EE Prom nonvolatile memory for these functions.
 - 4. Multi-tasking: SDC's shall provide the capability to simultaneously perform at least, but not limited to, the following functions.
 - a. Downloading of application program changes to the SDC without affecting the simultaneous operation of existing operating application programming.
 - b. Printing of scheduled or on-demand reports without preempting operator functions.
 - 5. Automatic Temperature Control: The SDC's shall interface to additional panels of equipment as required to provide the performance specified for local Control Panels.

- 6. Local Control Panel: Each control panel shall be a fully electronic analog control or digital control system, providing all control functions for the equipment specified to be controlled from that panel. Control functions to be performed by control panels are as described in this specification in the sequences of operation, in the point charts, and other relevant sections of these specifications. Every control panel shall be constructed and provided to perform the facilities management requirements of this specifications.
- 7. Local Control Panel Functions:
 - a. It is the intent of this specification to provide the Owner with the ability to read out temperatures and other values, and to adjust specific items from localized, as well as centralized locations. In order to provide this capability, control panels are specified to be placed in specific locations with readout gauges and adjustments to be mounted directly in the control panel.
 - b. Every control panel shall provide readouts for the temperatures, or other information, specified. Every control panel shall provide adjustments for the setpoints, parameters, and other adjustment functions specified.
- 8. Read Out of Items:
 - a. Items specified for read out shall be under continuous display on the face of the panel with either a digital display or analog electronic meter. Read out of sensed variables used in control sequences shall be from the same sensors used for control. As an alternate, provide either a duplicate sensor for the read out, or provide a transducer for each sensed signal which can provide both a read out signal and a signal compatible with the controller.
 - b. Each read out items shall be individually named and labeled. Name label shall be directly adjacent to the actual display value of that item. Label shall be a part of the digital display of that value, or a Bakelite label mounted directly above the value display. Display readout requirements are in addition to capabilities provided by plug-in operator devices which are provided as part of digital controller-

- 9. Adjustments: Every control panel shall provide adjustments for the functions specified. In general, adjustments shall be provided for all setpoints used by controllers within each control panel. In addition, adjustments shall be provided for throttling ranges, mixed air damper minimum positions, or other items as specified. Adjustments shall be integral to each control panel. As an alternate provide a ADumb CRT@ and keyboard.
- 10. Spare Point Capacity: Digital controller based control panel bids shall include in every panel, additional capacity for future installation of desired equipment at the Owners discretion. Provide expansion capacity of at least 10% for every panel. Expansion capacity shall include equal quantities of every point type; Analog input, Digital input, Digital output, and Analog output. Systems providing modulating outputs via pulse width modulation techniques, shall provide within each panel all the components required to implement the functions equivalent to an analog output.
- B. Sensing and Control Output Requirements:
 - 1. Sensing:
 - a. All sensing inputs shall be provided via industry standard signals. Temperatures, humidities, differential pressure signals and all other signal inputs shall be one (1) of the following types:
 - 0-20 mA 4-20 mA 0-5 VDC 0-12 VDC Resistance Signals
 - b. All signal inputs shall be compatible with the controllers used, and with the requirement for readout of variables as specified.
- C. Control Outputs:
 - On/Off Outputs: Control panel shall internally provide test points for the circuit driving the equipment contactor, for the purpose of troubleshooting whether the 120 VAC circuit to the contactor is active. All such relays or digital output modules shall provide a pilot light or LED display of this same status.

- 2. Modulating Output:
 - a. Modulating outputs shall be industry standard 0-5 VDC, or 0-12 VDC. Milliamp outputs of 0-20 mA or 4-20 mA are also acceptable. Drive open/Drive closed type modulating outputs are acceptable provided that they also comply with the following requirements.
 - b. All modulating outputs shall provide within the control panel, a metric gauge, or display indication of the commanded position signal to the actuating device. This meter, gauge or display must provide either a 0-100 percent position indication, or read out directly in the engineering units of the signal being used. Drive open/Drive closed type controllers shall include sufficient components and control algorithms to comply with this requirement.
- 3. Standard Software Function Libraries: All SDC's shall have a standard feature of their system software, complete libraries of control algorithms for DDC, Energy Management, and Building Management functions. These resident libraries of algorithms shall be drawn from for the creation of the application programming of each individual SDC.
- 4. Application Software Documentation: Control shall provide a blueprint documentation of the software application program for each SDC. Documentation provided shall include block software flowchart showing the interconnection between each of the control algorithms and sequences. For systems utilizing program listings. A program listing shall be printed onto the same blueprint shall be stored and maintained in each SDC panel. System acceptance shall not be completed until this documentation is provided and located in each panel.
- 5. Energy Management Control: The SDC's shall individually perform Time of Day Scheduling, Optimum start/stop, Enthalpy optimization, and all control optimization strategies, such as Supply Air Reset and Soft Start Ramp-up, for their connected systems of equipment.

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

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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. <u>3</u> 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. <u>3</u> 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. <u>3</u> 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. <u>3</u> 20 amp double duplex receptacles complete with double gang outlet box, coverplate and 20 feet of 2#12 and 1#12 (G) $\frac{1}{2}$ " C connected to nearest receptacle circuit.
- e. <u>2</u> 20 to 50 amp, 3 pole breaker furnished and installed in a type 'BQL' panelboard.
- f. <u>2</u> 60 to 100 amp, 3 pole breaker furnished and installed in a type 'BQL' panelboard.
- g. <u>2</u> 20 to 50 amp, 3 pole breaker furnished and installed in a type 'BEF' panelboard.
- h. <u>2</u> 60 to 100 amp, 3 pole breaker furnished and installed in a type 'BEF' panelboard.
- i. <u>2</u> 100 amp frame, three pole breaker furnished and installed in type 'CCB' panel.
- j. <u>3</u> 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. <u>2</u> Manual pull stations.
 - b. <u>2</u> Ceiling mounted smoke detectors.
 - c. <u>1</u> Ceiling mounted fixed temperature and rate of rise heat detectors.
 - d. <u>2</u> Duct mounted smoke detectors complete with

housing and sampling tube.

- e. <u>2</u> 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: Unit Designation

Disconnect f.

- Voltage b.
- **Requirement Starter** g. Requirement h.
- MCA MOCP/MFS d.
- e. FLA

a.

C.

- Alarm Wiring Requirements i.
- 2. The electrical contractor, shall review the Coordination Schedule Drawing and all pertinent electrical accommodations indicated.
 - Breaker size. a.
 - Wire size / conduit size. b.
 - Disconnect with fuse size. C.
- 3. Once the coordination schedule is completed forward to the engineers for review and approval.
- Η. 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

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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:

<u>Phase</u>	<u>120/208</u> ⊻
А	Black
В	Red
С	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.

- 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, llsco 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

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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 clipon 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

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#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.

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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:**
 - Installation of raceway systems and necessary fittings for all work in Α. Division 16.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- Α. Metallic Raceways:
 - 1. Republic 5. Triangle
 - Wheatland Walker 2. 6.
 - 3. Allied 7. Western AFC
 - 4. Clifton 8.
- Β. Non-Metallic Raceways:
 - Carlon Can-Tex 1. 3. 2.
 - Allied National Pipe & plastics 4.
- C. Fittings
 - Thomas & Betts EFCOR 1. 5.
 - Hubbell: RACO: Killark 2.
 - 3. Appleton
 - Midwest 4.

2.2 RACEWAYS

- Α. Rigid galvanized steel conduit:
 - Conform to ASA Standard C80.1 and U.L. Standard No. 6 for rigid 1. metallic conduit, except hot dipped galvanized after threading.

6.

7.

8.

- 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

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OZ Gedney

Bridgeport

AFC

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	¹ /4" dia. rod
1-1/4" to 3" diameter	3/8" dia. rod
Larger than 3" diameter	¹ / ₂ " 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

26 05 31 - RACEWAYS

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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 ³/₄" 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.

- Κ. Paint wiring connections in ground mounted outlets or floor outlets in wet locations with "Scotchkote" and fill box with "Duxseal".
- Mark outlet box covers with permanent ink markers to indicate circuit L. number(s) and panel of origination. Use black markers for normal service circuits and orange for emergency service.
- Use 4" octagonal boxes with blank covers for master outlets, installed to Μ. 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.
- О. 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.
- Ρ. 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:

- Ι. All junction boxes shall be accessible.
- J. Securely fastened to structure.
- Κ. 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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<u>SECTION 26 05 73 –</u> 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

26 05 73 – SHORT CIRCUIT, PROTECTIVE DEVICE COORDINATION ARC-FLASH STUDY

- 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.

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- 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:

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- 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.
 - I. 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

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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

26 05 73 – SHORT CIRCUIT, PROTECTIVE DEVICE COORDINATION ARC-FLASH STUDY

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

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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:
 - 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 26 27 26 - WIRING DEVICES

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.

- 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:

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DEVICE	NEMA`	MANUFACTURER	HEAVY DUTY SPEC GRADE
	CONFIGURATION		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

TABLE 1 – BASIS-OF-DESIGN WIRING DEVICES

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

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- ✤ 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

<u>SECTION 26 28 13 – FUSES</u>

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

26 28 13 – FUSES

2.3 SPARE-FUSE CABINET

- A. Cabinet: Wall-mounted, 0.05-inch- (1.27-mm-) thick steel unit with fulllength, 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.

26 28 16 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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 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.

26 50 00 – LIGHTING 1 OF 16

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 1/2" 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 ³/₄" 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 plugin 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 $XX 8\frac{1}{4}$ " x 4' 30 watts and 45 watts nominal
 - b. Type $YY 8\frac{1}{4}$ " x 8' 60 watts and 90 watts nominal
 - 2. Operation Voltage The luminaire shall operate from a 60 Hz \pm 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 A²s.
- 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:

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- (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 corrosionresistant 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 ³/₄" 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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IRONDALE, ALABAMA

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.

27 05 10 – COMMON WORK RESULTS FOR COMMUNICATIONS

IRONDALE, ALABAMA

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

27 05 10 – COMMON WORK RESULTS FOR COMMUNICATIONS

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

27 05 53 – IDENTIFICATION FOR COMMUNICATION SYSTEMS

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
 - 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
 - City of Hunstville has specified Leviton Network Solutions as the product brand Α. 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

- Category 6 cable shall be 23awg U/UTP construction Α.
- Β. Cable shall meet fire rating appropriate to local building codes.

Category 6 U/UTP Cable			
Part Number	Description	Comment/Attribute	
		Work Area Outlets (WA),	
	LANmark-1000 Plenum (see drawings for	Wireless Access Points	
1003209x	color)	(WAPs)	
		All wet or exposed	
11072213	LANmark-1000 OSP	locations	

CATEGORY 6 CONNECTOR MODULES 2.02

- eXtreme connector modules shall be used Α.
- Β. 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

2.03 COPPER PATCH PANELS

Patch panels shall be flat QuickPort style, 2RU 48 Port Α.

Patch panels and Horizontal cable managers		
Part Number	Description	Comment/Attribute
49255-H48	48 port 2RU Quickport flat patch panel	Includes rear wire

-

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"	Use between racks
	Channel x 80" Long. Black Hinge Cover.	
4940L-VFR	Vertical Front and Rear Cable Management, 5"	Use on end of rack
	channel x 40" Long. Black Snap-On Cover.	row
491RU-HFO	Horizontal Cable Management, 1RU, 1.5"x3" Front	1:1 with patch panels
	Only	

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 retermination (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:

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- 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 <u>bid document scale.</u>
 - 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:
 - 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.

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- 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

28 31 10 – ADDRESSABLE FIRE ALARM SYSTEM
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

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- 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:
 - 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 twentyfour 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.

28 31 10 – ADDRESSABLE FIRE ALARM SYSTEM

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, systemcompatible 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

28 55 00 – RF SURVEY FOR IN-BUILDING TWO-WAY EMERGENCY RESPONDER COMMUNICATION ENHANCEMENT SYSTEM

- 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.

28 55 00 – RF SURVEY FOR IN-BUILDING TWO-WAY EMERGENCY RESPONDER COMMUNICATION ENHANCEMENT SYSTEM

- 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 31 10 00 SITE CLEARING

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to clear and grub the site of existing vegetation as required in these specifications and on the drawings. Included are the following topics:

PART 1 - General

Scope

Related Work

Clearing Limits

PART 2 - Materials

Not Used

PART 3 - Execution

General

Cutting

Removal Methods

Grubbing

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

SECTION 31 10 00 - SITE CLEARING

Related work specified elsewhere:

Section 30 05 00 – Common Work Results for All Exterior Improvements

Section 31 13 16 - Selective Tree and Shrub Protection and Trimming

Section 31 20 00 – Earthmoving

Section 31 25 00 – Erosion Control

CLEARING LIMITS

Confine clearing and grubbing operations to the limits as indicated on the drawings. In the absence of such a designation on the drawings, confine work to the minimum area reasonably necessary to undertake the work as determined by the Owner's Project Representative. Clearing and grubbing operations shall not extend past the property line or easement line without prior approval of the Owner's Project Representative.

PART 2 - MATERIALS

Not Used

PART 3 - EXECUTION

GENERAL

Limits of clearing and grubbing shall be as shown on drawings. When selective pruning and removal is specified, limit work to only those plants or limbs shown on the drawings or detailed in the specifications.

Remove and dispose of trees, stumps, roots, brush, vegetation, debris, and other items that interfere with new construction as shown on the drawings.

SECTION 31 10 00 - SITE CLEARING

To minimize erosion, limit heavy equipment travel only to areas that are necessary to complete clearing and grubbing operations.

Repair damaged erosion control features immediately.

CUTTING

Fell and prune trees in manner so as not to damage adjacent structures, site features or other plants not scheduled for removal.

If trees scheduled to remain are injured notify the Owner's Project Representative.

REMOVAL METHODS

Unless the drawings specify otherwise, the Contractor owns all trees, brush and debris removed from the site. All cleared material shall be disposed of offsite unless otherwise specified on the drawings or agreed upon by the Owner and Owner's Project Representative prior to any clearing and grubbing taking place.

Clearing and grubbing debris shall be disposed of at facilities designed to accept the material that is being disposed. Follow all local, state and federal regulations.

GRUBBING

Grubbing operations may be completed by removal of stump section or by grinding.

Remove stumps, logs, roots, other organic matter located within proposed building excavations completely.

Remove stumps, logs, roots, other organic matter located within proposed pavements and structures to the depth indicated:

SECTION 31 10 00 - SITE CLEARING

Walks: 24 inches below subgrade

Roads and drives and parking areas: 36 inches below subgrade

Concrete slabs: 24 inches below subgrade

Lawn areas: 12 inches

Footings and foundations for signs, lights, etc.: 18 inches below footing base

Depressions resulting from grubbing operations shall be backfilled in accordance with Section 31 20 00 – Earthwork.

END OF SECTION 31 10 00

SECTION 31 13 00

SELECTIVE TREE AND SHRUB REMOVAL AND TRANSPLANTING

BASED ON DFD MASTER SPECIFICATION DATED 02/17/2016

This section has been written to cover most (but not all) situations that you will encounter. Depending on the requirements of your specific project, you may have to add material, delete items, or modify what is currently written. The Division of Facilities Development expects changes and comments from you.

PART 1 - GENERAL

SCOPE

Work includes the felling or removal by tree spade of trees or larger shrubs designated in the contract to be removed from the project site, and related work as indicated in the drawings.

PART 1 - General

Scope

Related Work

Definitions

Quality Assurance

PART 2 - Products

Materials

PART 3 - Execution

Felling Pruning Transplanting by Tree Spade Transplanting by Hand Digging Finishing Transplanting Cleaning

RELATED WORK

Applicable provisions of Division 1 shall govern all work under this section.

Related Work Specified Elsewhere:

Section 31 10 00 – Site Clearing

Section 31 12 16 - Selective Tree and Shrub Protection and Trimming

Section 32 93 00 - Plants

DEFINITIONS

Caliper: Diameter of a trunk measured by a diameter tape at 4'-6" above the ground or DBH (diameter at breast height). (Standard as defined by the ISA – International Society for Arboriculture).

Arborist or Certified Arborist: As referenced here in all "arborists" or "certified arborists" shall be at minimum an ISA Certified Arborist or and ASCA Registered Consulting Arborist unless other specified.

QUALITY ASSURANCE

Tree Pruning Standard: Comply with ANSI A300 Pruning Standards.

Oak Wilt Prevention: Alabama Department of Natural Resources Forestry Division Publication PUB-FR-127 2009.

PART 2 - PRODUCTS

MATERIALS

Tree caliper measurements shall be taken 4'-6" (1.4 m) above ground level.

Wood chips or shredded bark (as specified on plans) mulch, free of material detrimental to healthy plant growth. Wood chips shall be 1/8" (3.2 mm) nominal thickness, with at least 50% having an area of not less than 1 sq. inch (6.45 sq. cm), and no piece having an area of more than 6 sq. inches (38.7 sq. cm). (Note to Specifier: either wood chips OR shredded bark mulch should be specified.)

Adequate supplies of water suitable for irrigation and free of harmful materials.

Staking materials shall be as follows: stakes shall be 6-8 ft. (1.8 - 2.4 m) long sections of unflanged metal, or 2" x 2" (5.1 cm x 5.1 cm) hardwood. Support ties shall be 2" (5.1 cm) or wider bands of polypropylene, or elasticized or webbed strapping.

Biodegradable geotextile (fabric) trunk wrap or waterproofed crepe wrapping paper, secured with 1" (2.5 cm) wide masking tape.

PART 3 - EXECUTION

FELLING

Fell trees to prevent damage to adjacent structures and to those trees and shrubs designated to remain. Remove stumps and roots to a clear depth of 36" (0.9 m) below existing grades in areas of lawn, and to full depth in areas of paving, building footings, or utility structures.

PRUNING

Only those branches of existing trees that interfere in some way with the Contractor's operations or with the spading operation are to be pruned.

Pruning shall be performed by a certified arborist. Prune trees over winter, between the months of November and March. Trees may be pruned at other times of the year, provided that the Contractor submits to the owner for acceptance a scheduled time, and a description of pruning methods and materials.

Prune trees according to ANSI A300 Pruning Standards.

To prevent Oak wilt, do not prune, cut or injure Oaks between April 1 and October 1. If an Oak is wounded during this period, cover the wound immediately with tree wound paint (water-based paint). November through March is the preferred period for pruning and tree removal. Refer to Alabama Department of Natural Resources Forestry Division Publication PUB-FR-127 2009 for further Oak tree protection information.

Where necessary, repairs to damaged wood shall be performed under the direction of the Owner, or a certified arborist.

Evergreens shall only be pruned to remove dead, broken or damaged branches.

Perform pruning using scissors-style cutting devices, and not anvil-style hand pruners, pole pruners or loppers.

TRANSPLANTING WITH TREE SPADE

Stake all planting areas and notify Digger's Hotline (1-800-242-8511 statewide) to verify the location of all underground utilities prior to excavation.

To minimize soil compaction, damage from tires, etc., the Contractor shall lay down wood planking as surface protection during tree spade operations.

For trees up to 10" (25.4 cm) caliper, the tree spade size used should allow a minimum root area equivalent of 9-10" (22.9-25.4 cm) of soil per inch of trunk diameter. (Example: A 4" caliper tree should be dug with a 40" tree spade.)

Tree spades or mechanical diggers shall be in good operating condition, with properly aligned, sharpened and damage-free blades. Hydraulic systems shall be free of leaks.

In preparing a tree for removal by tree spade, branches are to be tied up or down to allow access by spade. Presoaking the area around the tree for 24-48 hours prior to removal is advisable. Two to three hours prior to transplanting spray tree to run-off with an approved anti-transpirant at a 1:10 dilution rate.

Carefully set trees into pits to the same elevation as the tree's original grade, with no more than 1/8 of rootball higher than grade. Level and straighten tree as tree spades are being removed. Fill voids between the pit and the rootball with clean excavated soil.

Pack excess soil tightly around rootball edge using a shovel handle or similar tool, creating a saucer surrounding the tree. Fertilizer shall be applied as per soil test recommendations.

In slope situations, dig the pit with the base of the tree spade level with the upper side. Carefully shave certain areas of rootball as necessary to avoid root exposure on lower side. Fill voids with topsoil, and pack saucer around tree.

Remove weeds and excess topsoil from the root ball prior to removal. Match the size of the root ball with the hole dug for transplanting.

Barricade with proper warning devices any planting pit left open when planting work is not in progress, and that poses a hazard to vehicles and/or pedestrians.

Prior to transporting, wrap tarp around both the upper portion of tree to prevent moisture loss from leaves and stems and around the bottom of the root ball.

Spade blades are to be dropped one at a time, alternating one side with the other to ensure even penetration. After lifting tree, cut any roots protruding from spades with sharp hand tools.

TRANSPLANTING BY HAND DIGGING

Stake all planting areas and notify Digger's Hotline (1-800-242-8511 statewide) to verify the location of all underground utilities prior to excavation.

Prior to transporting, wrap tarp around both the upper portion of tree to prevent moisture loss from leaves and stems and around the bottom of the root ball.

Excavate planting areas where shown in the contract drawings. The planting pit shall be at least 2.5 to 3 times the diameter of the soil ball, or to a dimension otherwise specified, with the soil loosened around the sides of the pit. The soil at the base of the planting pit is to remain undisturbed, the depth of which shall correspond to the distance from the bottom of the soil ball to the root flare, or slightly less.

The walls of the planting pit are to be sufficiently roughened prior to setting.

Notify DFD's Project Representative in writing of any soil conditions, obstructions, or concerns about water drainage deemed detrimental to healthy plant growth. These conditions or obstructions must be detailed, along with any suggestions for correction,

removal or relocation. Where problems of soil conditions, poor drainage or other obstructions cannot be easily remedied, the Architect/Engineer and the DFD Construction Representative will designate alternate transplanting locations.

FINISHING TRANSPLANTING

Finish-grade planting areas to the specified elevation after the plant has fully settled.

Only trees so designated shall be protected with tree wrap. Secure wrapping at a minimum of 5 locations, including the top, middle and bottom of the trunk. Cover the trunk's entire surface in a spiral manner, starting at the tree's base and extending to just above the height of the lowest main branches. Overlap material at 1/2-1" (1.3 -2.5 cm). Owner will be responsible for removing the tree wrap after the recommended period.

No soil is to cover the top of the root ball. All plants shall be completely mulched over the root system with a 3" (7.6 cm) layer of specified mulching material immediately after planting. The mulch shall be pulled back no less than 3" (7.6 cm) and no more than 6" (15.2 cm) from the trunk.

Plants shall be thoroughly watered by the Contractor immediately after planting and before mulching.

All twine and rope shall be removed after planting, along with any labels attached around the trunk or branches.

CLEANING

All trimmed branches and other debris shall be removed from the site by the Contractor at the end of each work day.

END OF SECTION 31 13 00

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SECTION 31 13 16

SELECTIVE TREE AND SHRUB PROTECTION AND TRIMMING

PART 1- GENERAL

SCOPE

This Section includes the protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction. The contractor shall: Protect trees and plants indicated on the drawings to remain in location from all damage during construction. Do not injure trunks, branches or roots of trees and plants to remain. Perform cutting and pruning only as approved and as directed by the Owner's Project Representative.

PART 1 – GENERAL

Scope

Related Work

Definitions

Submittals

Quality Assurance

Project Conditions

PART 2 - MATERIALS

Topsoil

Organic Mulch

Tree Protection Zone Fencing

Tree Protection Zone Signage

PART 3 – EXECUTION

Examination Preparation Tree and Plant Protection Zones Excavation Root Pruning Crown Pruning Regrading Field Quality Control Repair and Replacement Disposal of Surplus and Waste Materials

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 02 41 13 - Demolition

Section 31 10 00 - Site Clearing

Section 31 13 00 – Selective Tree and Shrub Removal and Transplanting

Section 31 20 00 – Earthmoving

Section 31 23 16 13 - Trenching

Section 31 23 16 26 – Rock Removal

Section 31 23 19 – Dewatering

Section 31 25 00 - Erosion Control

Section 32 92 00 - Plants

DEFINITIONS

Arborist or Certified Arborist: As referenced here in all "arborists" or "certified arborists" shall be at minimum an ISA Certified Arborist or and ASCA Registered Consulting Arborist unless other specified.

Caliper: Diameter of a trunk in inches measured by a diameter tape at 4'-6" above the ground or DBH (diameter at breast height). (Standard as defined by the ISA – International Society for Arboriculture).

Tree Protection Zone (TPZ): Area surrounding individual trees or groups of trees to be protected during construction, and defined by calculating the critical root radius (crr). The crr is the tree trunk caliper (diameter in inches) at 4'-6" above the ground multiplied by 1.5, the result expressed in feet.

The root protection zone is the outside edge of a concentric circle with the crr as its radius extending from the truck of the tree or as indicated on the drawings which ever is larger. Note that a particular tree/plant sensitivity or tolerance to construction disturbance may require a larger TPZ area than the area based on this calculation. This is to ensure that both the feeder and structural support roots are undamaged to maintain the integrity of the tree.

Vegetation: Trees, shrubs, groundcovers, grass and other plants.

SUBMITTALS

Product Data: For each type of product indicated.

Existing Tree and Plant Inventory and Condition Report: Documentation of existing trees and plantings by a certified arborist for the vegetation indicated to remain, which establishes preconstruction conditions and plant health. Arborist should also verify that none of the trees marked for protection are a potential hazard tree per ISA - International Society for Arboriculture standards.

Include detailed photographs or videotape.

Include notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

Indicate specimen trees and shrubs recommended for protection by the arborist that may not have been included in the tree protection plan.

Tree Pruning Schedule: Written schedule from arborist detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction. Include description of pruning to be performed and maintenance following pruning.

Tree Protection Plan:

Should correspond to the tree protection/site demolition plan which includes the trees and plants to be removed or protected and their related tree protection zones. Include species and size of tree or plant, location on plan, include unique identifier for each, indicate removal with an "x" through the plant symbol, indicate protection with the tree protection zone and fence location, indicate location of pruning of branches or roots outside of tree protection zones to avoid damage during construction or for the health of the tree, and include typical tree protection measures.

Maintenance Recommendations: From a certified arborist, for the care and protection of trees affected by construction during and after completing the Work. Written maintenance recommendations should be provided to the Owner and the Maintenance Contractor prior to the end of construction.

QUALITY ASSURANCE

Arborist Qualifications: An arborist certified by ISA-International Society of Arboriculture.

Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

Tree Pruning Standard: Comply with ANSI A300 Pruning Standards.

Tree Protection Standard: Reference and Comply with "Arboriculture", Harris, Mathey and Clark, 3rd Edition, Simon & Schuster Adult Publishing Group, July 31, 1998, Sections: 7 – Modifying and Managing the Site, 10 – Special Management Situations, 11 – Preserving Existing Trees, 16 – Tree Hazard Management, 17 – Preventative Maintenance and Repair.

Protect Your Trees From Oak Wilt: Wisconsin Department of Natural Resources Forestry Division Publication PUB-FR-127 2009 for f Oak tree protection information.

Preinstallation Conference: Conduct conference at Project site. Before tree protection and trimming operations and construction activities begin, meet with OWNER'S Construction Representative, Agency Representative, Architect/Engineer, Arborist, Tree Service Firm and other concerned entities to review tree protection and trimming procedures and responsibilities. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:

Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.

Enforcing requirements for protection zones.

Arborist's responsibilities.

Field quality control.

PROJECT CONDITIONS

The following practices are prohibited within tree protection zones:

Storage of construction materials, debris, or excavated material.

Parking vehicles or equipment.

Foot traffic.

Erection of sheds or structures.

Impoundment of water or excessive wetting.

Spillage of noxious material while mixing, placing or storing construction materials.

Excavation or other digging unless otherwise indicated.

Compaction of soil over root systems.

Fill in excess of one inch over tree roots.

Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

Do not direct vehicle or equipment exhaust toward tree protection zones.

Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

MATERIALS

TOPSOIL

Natural or cultivated top layer of the soil profile or manufactured topsoil: containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch (25 mm) in diameter; and free of weeds, roots, and toxic and other non-soil materials.

Obtain topsoil only from well-drained sites where topsoil is 4 inches (100 mm) deep or more; do not obtain from bogs or marshes.

Topsoil shall conform to the testing requirements and standards outlined in Section 32 91 13 Soil

Preparation, or ASTM D5268 if Section 32 91 13 is not included in this project.

ORGANIC MULCH: Shredded hardwood, free of deleterious materials.

TREE PROTECTION ZONE FENCING

Fencing fixed in position and meeting the following requirements:

Galvanized-steel chain-link fencing fabricated from minimum 2-inch opening, 0.148inch diameter wire chain link fabric; with pipe posts, minimum 1.9-inch OD line posts, and 2-3/8-inch OD Corner and pull posts; with 1-5/8-inch OD top rails and 0.177-inch diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system. [4 foot] <Insert requirement> minimum height.

TREE PROTECTION ZONE SIGNAGE

Shop fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:

Sign Size and Text: [as shown on drawings] < Insert requirement>. TREE PROTECTION ZONE

Lettering: [3-inch] <Insert dimension> high minimum, <Insert color> characters on <Insert color> background.

EXECUTION

EXAMINATION

Erosion and Sedimentation Control: Examine the site to verify that temporary erosion and sedimentation control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree protection zones.

PREPARATION

Prior to all construction trees, shrubs and other plantings to be protected are to be fenced.

Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. [Flag] [Tie a 1-inch blue-vinyl tape around] each tree trunk at 54 inches above the ground.

Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

Tree Protection Zones: Mulch areas inside tree protection zones and other areas indicated.

Apply 2-inch average thickness of organic mulch. Do not place mulch within 6 inches of tree trunks.

TREE AND PLANT PROTECTION ZONES

Tree Protection Zone Fencing: Install protection zone fencing along edges of protection zones in a manner that will prevent people from easily entering protected area. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

Tree Protection Zones include the canopy area above and beyond all tree protection areas as indicated in the construction documents. Canopy damage to protected vegetation is not acceptable. Contractor shall take extraordinary measures to protect tree canopies and trunks from aerial construction equipment and shall maintain an aerial clear zone over the tree for the extent of the entire tree protection area and beyond to the edge of each individual tree canopy. Tree protection zone fencing shall be erected before any construction activities commence and remain until construction has concluded and shall be installed and removed without harm to trees or shrubs. If trees scheduled to remain are injured notify OWNER'S Construction Representative immediately. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.

Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing pavement or concrete to remain, provide appropriate means of post support acceptable to OWNER'S construction representative. Other means of support may be required in archaeological areas where excavation is not allowed or where tree roots may be damaged. Alternative fence support not designated on the Tree Protection Plan / Details will need approval by Architect/Engineer and OWNER'S construction representative.

Tree Protection Zone Signage: Install protection zone signage in visible prominent locations in a manner approved by Architect/Engineer. Install one sign spaced approximately every [20 feet] [35 feet] [50 feet] <Insert dimension> on tree protection fencing, but no fewer than [four] <Insert number] signs each facing a different direction.

Maintain tree protection zones free of weeds and trash.

Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations. Repair should occur within 24 hours of the damage. Treat damaged trunks, limbs, and roots according to certified arborist's written instructions and Architect/Engineer's approval.

Maintain tree protection zone fencing and signage in good condition as acceptable to Architect/Engineer and remove when construction operations are complete and equipment has been removed from the site.

Do not remove tree protection fencing to allow for deliveries or equipment access through the protection zone.

Temporary access may be permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

Roots torn or damaged by construction operations shall be repaired according to the standards outlined in this section and by a certified arborist.

Silt fence may not be trenched within the Tree Protection Zone of any tree or shrub. In areas where silt fence is shown within Tree Protection Areas as indicated on drawings, silt fence shall be folded toward the flow direction and secured at grade-level by pinning or backfilling with a 6" layer of clear stone.

Contractors will be responsible for setting up tree maintenance programs to maintain trees and surfaces within construction boundaries for the duration of construction and until tree protection measures are completely removed from the site. This includes watering, preconstruction pruning, clearance pruning during construction, mowing, and re-mulching. Coordinate tree maintenance programs with OWNER'S Construction Representative.

EXCAVATION

General: Excavate at edge or beyond tree protection zones. Install shoring or other protective support systems to minimize sloping or benching of excavations.

Trenching near trees: Where utility trenches are required within tree protection zones, tunnel under the roots a minimum of 24" below the soil surface by drilling, auger boring, pipe jacking or digging by hand. Do not cut main lateral tree roots or tap roots; cut only smaller roots in the within the proposed utility line area. Cut roots as required for root pruning.

Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction as required for root pruning.

Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and

maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

ROOT PRUNING

Prune roots that are affected by temporary and permanent construction. Prune roots as follows:

Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.

Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.

Cover exposed roots with burlap and water regularly.

Backfill as soon as possible with topsoil or planting mixture as outlined in Section 32 91 13 Soil Preparation. Tamp to settle soil and eliminate voids and air pockets. When the area is approximately one-half filled with topsoil, water thoroughly then place the remaining topsoil required to fill around the exposed roots.

Root pruning at edge of tree protection zone: Prune roots 12 inches outside of the protection zone, by cleanly cutting all roots to the depth of required excavation.

CROWN PRUNING

Coordinate all pruning of trees and shrubs and/or repairs to damaged limbs with OWNER'S Construction

Representative. Pruning shall be performed by a certified arborist.

Prune branches that are affected by temporary and permanent construction. Pruning should be the minimum necessary and not more than ¹/₄ of the live foliage/branches of a mature tree. Prune branches as follows:

Prune trees to remain to compensate for root loss caused by damaging or cutting root system.

Prune the minimum amount necessary. Do not remove more than $\frac{1}{4}$ of the live foliage or branches of a mature tree.

Pruning standards: Prune trees according to ANSI A300 Pruning Standards.

Cut branches with sharp pruning instruments; do not chop or break.

Remove tree branches and dispose of off-site.

REGRADING

Grade Lowering: Where new finish grade is indicated below existing grade around trees slope grade away beyond tree protection zones. Maintain existing grades within tree protection zones.

Root Pruning: Prune tree roots exposed during grade lowering. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots with sharp pruning instruments; do not break or chop.

Minor Fill: Where existing grade is 1 inch or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations. Note raising grade within a tree protection zone should be minimal in area and depth and can be fatal to trees. No grade change is acceptable over Oak tree roots.

FIELD QUALITY CONTROL

Inspections: Engage a certified arborist to direct plant protection measures in the vicinity of trees, shrubs and other vegetation indicated to remain and to prepare inspection reports.

REPAIR AND REPLACEMENT

The value of trees destroyed or damaged will be charged against the account of the contractor responsible for the damage in an amount determined by the Owner's certified arborist using the ISA-International Society of Arboriculture, Council of Tree & Landscape Appraiser's **Guide for Plant Appraisal, Current Edition**. If a replacement tree is provided, the amount charged against the contractor will be reduced by the value of the replacement tree.

Repair trees, shrubs and other vegetation indicated to remain or be relocated that are damaged by construction operations, in accordance with a certified arborist's written instructions and approved by the project Architect/Engineer and OWNER'S Construction Representative.

Submit details of proposed root cutting and tree and shrub repairs.

Have certified arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.

Treat damaged trucks, limbs and roots according to certified arborist's written instructions.

Perform repairs within 24 hours.

Remove and replace trees, shrubs and other vegetation indicated to remain that die or are damaged during construction operations that a certified arborist determines are incapable of restoring to normal growth pattern and approved by the project Architect/Engineer.

Provide new trees of same size and species as those being replaced at a minimum 2 inches caliper size per ANSI Z.60.1.

Plant and maintain as specified in Division 32 Section 92 00 "Plants."

Soil Aeration: Aerate surface soil compacted during construction in lawn areas . Aerate compacted lawn areas beyond the tree protection zones. Drill 2-inch- (50-mm-) diameter holes a minimum of 12 inches (300 mm) deep at 24 inches (600 mm) on center. Backfill holes with an equal mix of augured soil and sand.

DISPOSAL OF SURPLUS AND WASTE MATERIALS

Disposal: Remove excess excavated material, displaced trees, trash and debris and legally dispose of them off Owner's property.

Burning of surplus and waste materials is not permitted.

END OF SECTION 31 13 16

SECTION 31 20 00 EARTHMOVING

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to complete earthwork required in these specifications and on the drawings. Included are the following topics:

PART 1 - General

Scope

Related Work

Reference Standards

Quality Assurance

Submittals

Quantities

PART 2 - Materials

General

Satisfactory Soils

Unsatisfactory Soils

Imported Select Soils

Bedding

Accessories

PART 3 - Execution

General

Topsoil Removal

SECTION 31 20 00- EARTHMOVING

Excavation Placing and Compacting Material Grading Grading Around Trees Soil Stabilization Clean Up

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related work specified elsewhere:

Section 30 05 00 - Common Work Results For All Exterior Improvements

Section 31 10 00 – Site Clearing

Section 31 22 16.15 – Roadway Subgrade Preparation

Section 31 23 16.13 - Trenching

Section 31 23 16.16 – Structure Excavation for Minor Structures

Section 31 25 00 – Erosion Control

Section 32 91 13 – Soil Preparation

REFERENCE STANDARDS

American Society for Testing and Materials (ASTM):

- D422-63 Standard Test Method for Particle Size Analysis of Soils
- D4318 Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils
- D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³)

SECTION 31 20 00- EARTHMOVING
	ECT NO. 2022-08	
	LCT NO. 2022-00	IRONDALE, ALABAMA
D1140	Standard Test Methods for Determining the Am 75-µm (No. 200) Sieve in Soils by Washing	ount of Material Finer than
D2922	Standard Test Methods for Density of Soil and So Nuclear Methods (Shallow Depth)	oil-Aggregate In-Place by
D3017	Standard Test Method for Water Content of Soi Nuclear Methods (Shallow Depth)	and Rock In-Place by
D4253	Standard Test Methods for Maximum Index Der Using a Vibratory Table	nsity and Unit Weight of Soils
D6938	Standard Test Method for In-Place Density and Soil-Aggregate by Nuclear Methods (Shallow D	Water Content of Soil and epth)
D6913	Standard Test Methods for Particle-Size Distribut Using Sieve Analysis	ion (Gradation) of Soils
E329	Standard Specification for Agencies Engaged i	n Construction Inspection,

Testing, or Special Inspection

QUALITY ASSURANCE

The Contractor shall conduct sampling, testing, and analysis as required by this section and elsewhere in the Contract Documents either by retaining the services of an independent construction materials testing consultant or with internal certified testers. The materials testing personnel shall meet the requirements of ASTM E329.

The Contractor's construction materials testing personnel shall complete material testing as outlined in Table 31 20 00 -1.

Material	Test Required	Test/Sample
		Frequency
Imported Select Soil	ASTM D2487 Standard Classification of Soils for	1 test/500 CY
	Engineering Purposes	placed
Imported Select Soil	ASTM D698 Standard Test Method for Laboratory	1 test/500 CY
	Compaction Characteristics of Soil Using	placed
	Standard Effort	

Table 31 20 00 -1

SUBMITTALS

Provide copies of all material testing reports completed for the project within 48 hours of completing the individual tests. Along with each individual test result, provide a running spreadsheet of all individual test results.

QUANTITIES

Finished topsoil depth shall be 4", or as specified in Section 32 91 13 – Soil Preparation.

Contractor shall be solely responsible for determining all earthwork quantities based on the existing and proposed elevations provided on the drawings. Any geotechnical investigations provided by the Owner apply only to those locations that the data was collected, and may not be indicative of conditions elsewhere on the site. The Contractor is responsible for collecting any additional geotechnical or survey data he deems necessary to complete an accurate estimate of earthwork quantities.

If onsite grading, excavation and borrow operations do not provide enough suitable material for fill areas, Contractor shall coordinate and pay for excavation, transport and placement of imported material meeting the specifications of the contract documents. If excavation results in excess materials, Contractor shall coordinate and pay for loading, transport and offsite disposal of excess materials.

Contractor shall notify the OWNER'S Project Representative immediately if geotechnical information, existing grades, or proposed grades shown on the drawings appears to be inaccurate.

PART 2 - MATERIALS

SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3" in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
 - 1. The top 6 inches of satisfactory soil shall be free of all debris and any rock or gravel larger than 1/4 inch in any dimension.
- C. Unsatisfactory Soils: ASTM D2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2% of optimum moisture content at time of compaction.
- D. Imported Select Soils: Naturally or artificially graded mixture of inorganic sands with no more than 20 percent passing a No. 200 sieve and with a plasticity index of no more than six.
- E. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100% passing a 1" sieve and not more than 8% passing a No. 200 sieve.

ACCESSORIES

A. Detectable Warning Tape: Acid and alkali resistant polyethylene film warning tape manufactured for making and identifying underground utilities, minimum 6" wide and 4-mils thick, continuously inscribed with a description of utility, with metallic core

encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30" 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
- 6. Purple: Reclaimed water system

PART 3 - EXECUTION

GENERAL

Complete earthwork excavation for elevation changes, utility trenches, minor structures and building foundations in accordance with this section and the following applicable sections:

- Section 31 22 16.15 Roadway Subgrade Preparation
- Section 31 23 16.13 Trenching
- Section 31 23 16.16 Structure Excavation for Minor Structures

TOPSOIL REMOVAL

Comply with erosion control requirements of Section 31 25 00 – Erosion Control and as shown on the plan relative topsoil removal and storage.

Complete clearing and grubbing work as required by the Contract Documents and as specified in Section 31 10 00 – Site Clearing.

Coordinate topsoil stockpile locations with Owner and other contractors working onsite.

Remove all topsoil from proposed locations of buildings, structures, roads, walks and other paved areas. Also, remove topsoil from proposed lawn or turf areas where the proposed elevation exceeds the existing elevation by 1' or greater, or where fill will be placed.

Stockpile reusable topsoil for use in restoration. Salvaged topsoil shall not be removed from the site without prior approval of the OWNER'S Project Representative.

Do not excavate, grade or work topsoil in frozen or muddy condition.

Minimize compaction of topsoil to the extent possible.

EXCAVATION

Excavate to the elevations shown on the drawings. Allow for placement of fill, base course, pavements, and topsoil as required by the drawings and other Contract Documents.

Transfer lines and grades as shown on the drawings.

Excavate areas to provide positive drainage. Contractor shall notify the OWNER'S Project Representative immediately if the final proposed elevations shown on the drawings do not provide drainage away from buildings, structures, roads, walks and other paved areas.

Remove excess and spoil material from the site in a timely fashion.

Do not excavate below design grades without prior authorization by the OWNER'S Project Representative.

PLACING AND COMPACTING MATERIAL

Place material in fill areas only after all topsoil has been removed.

Place fill to the elevations shown on drawings; allow for placement of base course, pavements and topsoil as required by the drawings and other Contract Documents.

Fill type shall be as indicated on Table 31 20 00 -2, or as shown on the drawings.

Do not place fill on areas consisting of organic soil, debris or soft and yielding material.

Do not place fill on frozen or muddy areas.

Moisture condition subgrade as necessary to provide a firm surface prior to placing fill.

Place fill in horizontal lifts having thickness as shown on Table 31 20 00 - 2.

Compact fill material as required by Table 31 20 00 - 2 for given use.

Moisture condition fill material as necessary to achieve density required for given use.

Place and compact backfill so as to minimize settlement and avoid damage to walls, utility lines and other work in place. Place backfill simultaneously on both sides of free-standing structures.

It is the responsibility of the Contractor to provide all necessary compaction equipment and other grading equipment that may be required to obtain the specified compaction. Compaction of controlled backfill by travel of grading equipment will not

be considered adequate for uniform compaction. Hand guided vibratory or tamping compactors will be required whenever controlled backfill may be placed adjacent to walls, footings, and columns or in confined areas.

Location	Required Material	Maximum Compacted Lift Thickness	Minimum Proctor Compaction
Areas Beneath Footings, Floor Slabs, or	Imported Select	8"	100%
Structures	Soils		Standard
Footing, Foundation and Structure	Imported Select	8"	95%
Backfill	Soils		Standard
Areas within 10' of Existing or Proposed	Imported Select	8"	95%
Building or Structure Footing or Slab	Soils		Standard
Paved drive and parking areas	Imported Select Soils	8"	95% Standard
Turf Areas	Suitable Material	12"	90 % Standard

Table 31 20 00 -2

GRADING

Grading shall include areas necessary to establish new grades as required, additional areas disturbed by construction activities, storage, equipment including all trenching, where excess fill is deposited and where cutting is required.

New grades are designed to produce desired configuration of site and do not represent a balance between cut and fill.

Excavated materials shall be disposed of by contractor at a suitable off-site location. Contractor shall be responsible for securing suitable disposal site(s) and for all off-site disposal costs. Grades not indicated shall be uniform levels or slopes between point elevations as shown. Adjust all grades as necessary to provide positive drainage away from structures.

Grades for earthwork shall not deviate from established elevations, as shown in excess of 1 inch unless otherwise directed by OWNER'S Project Representative.

Do all cutting, filling, compacting fill, and rough grading required to bring entire project to within respective base course elevations or 6 inches below finished topsoil elevations.

GRADING AROUND TREES

Limit excavation, filling and grading near trees or other vegetation to the extent possible. When tree roots are encountered, cut roots cleanly and squarely.

For trees within the grading limits that are to remain, install tree protection fencing as noted in the drawings.

CLEAN UP

Level off all waste disposal areas and clean up all areas used for the storage of materials or the temporary deposit of excavated earth. Remove all surplus material, tools and equipment.

Thoroughly clean all drainage ways, roads, parking lots, sidewalks, and paved surfaces and remove and dispose of all debris and mud.

END OF SECTION 31 20 00

SECTION 31 22 16.15

ROADWAY SUBGRADE PREPARATION

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to complete pavement subgrade preparation and provide a surface ready for constructing and supporting the Dense Graded Base, as required in these specifications, on the drawings and as otherwise deemed necessary to complete the work. Included are the following topics:

PART 1 - GENERAL

Scope

Related Work

Reference Documents

Quality Assurance

Permits/Fees

PART 2 - MATERIALS

General

PART 3 - EXECUTION

General

Preparation

Excavation

Preparing the Foundation

Subgrade Approval/Proof-Rolling

Undercutting/Excavation Below Subgrade (EBS)

Restoration

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related work specified elsewhere:

- Section 30 05 00 Common Work Results For All Exterior Work
- Section 02 32 00 Geo Technical Investigation
- Section 03 30 00 Cast-In-Place Concrete
- Section 31 20 00 Earthmoving
- Section 31 23 16.13 Trenching
- Section 31 25 00 Erosion Control
- Section 32 11 23.33 Dense Graded Base

REFERENCE DOCUMENTS

Alabama Department of Transportation (ALDOT) Standard Specifications (2022), Section 230 (Roadbed Processing, Improved Roadbed)

QUALITY ASSURANCE

The Contractor shall conduct sampling, testing, and analysis as required by this section and elsewhere in the Contract Documents either by retaining the services of an independent construction materials testing consultant or with internal certified testers. The materials testing consultant shall meet the requirements of ASTM E329.

SECTION 31 22 16.15 - ROADWAY SUBGRADE PREPARATION

The A/E and Contactor's construction materials testing personnel shall observe all proofrolling operations. The OWNER'S Project Representative shall also be informed of all proof-rolling operations. Provide minimum of 48 hours confirmed notice for all parties.

PERMITS/FEES

Contractor shall be solely responsible for obtaining all permits necessary to complete the work. Contractor shall pay all fees associated with obtaining permits. These include, but are not limited to permits for work within public right-of-way, land disturbance permits and building permits.

PART 2 – MATERIALS

GENERAL

Alabama Department of Transportation (ALDOT) Standard Specifications (2022), Section 230 (Roadbed Processing, Improved Roadbed), and the recommendations contained in the project geotechnical report will govern the materials for this work.

PART 3 – EXECUTION

GENERAL

Alabama Department of Transportation (ALDOT) Standard Specifications (2022), Section 230 (Roadbed Processing, Improved Roadbed), and the recommendations contained in the project geotechnical report will govern the execution of this work.

PREPARATION

Review drawings and prepare work plan and schedule. Coordinate any necessary interruptions in site access with OWNER'S Project Representative, in accordance with other specification sections.

Remove topsoil from work area. Sawcut and remove pavement from work area as indicated on the drawings. Sawcuts shall be made for the full depth of pavement.

Grade roadways and parking areas to drain water away from buildings.

EXCAVATION

Excavate to elevations and dimensions as shown on the drawings and as necessary to complete construction. Excavations shall be sufficiently deep to provide for placement of Imported Select Soils per the project Geotechnical Report recommendations, and the depth of base course and pavement.

Stones over 6-inches in size shall be removed from the loosened portion of the subgrade.

Notify OWNER'S Project Representative if correction of unauthorized excavation or over-excavation is necessary. Said excavations will be corrected by placement of Dense Grade Base Aggregate. Contractor will be responsible for all costs associated with correcting these excavations.

Segregate the various materials excavated. Excavated material that does not meet the requirements of backfill and excess excavated material, shall be removed from the site and disposed by the Contractor, unless directed otherwise by other specification sections or the OWNER'S Project Representative.

Locate spoil piles so they do not interfere with public travel, adjacent landowners or other construction activities.

PREPARING THE FOUNDATION

The subgrade shall be constructed to have a uniform stability throughout. Construct the foundation to the required elevation with equipment and methods adapted for the purpose. Shape and compact to provide a smooth foundation, at required density, and at the proper elevation to receive the Dense Grade Base (See Section 32 11 23.33).

Compact material to minimize settlement and avoid damage to structures, pipes, utility lines and other features. Hand-place and compact material as necessary.

It is the responsibility of the Contractor to provide all necessary compaction equipment and other grading equipment that may be required to obtain a subgrade that satisfies the conditions of a satisfactory subgrade as defined below. Vibratory plate or tamping type walk behind compactors will be required whenever backfill is placed adjacent to structures, pipes, utility lines and other features.

The prepared foundation shall be tested for compaction as defined in the paragraph entitled 'Subgrade Approval / Proof Rolling'.

SUBGRADE APPROVAL / PROOF ROLLING

Prior to undercutting or excavating below subgrade (EBS) or placing any Dense Grade Base (See Section 32 11 23.33), contact the OWNER'S Project Representative to schedule inspection of the subgrade and proof rolling of the subgrade. All proof rolling shall be completed in accordance with the requirements of the paragraph entitled 'Quality Assurance' and shall meet the criteria as defined below.

To complete proof rolling, entire pavement subgrade shall be provided with a relatively smooth surface, suitable for observing soil reaction during proof rolling.

Contractor shall schedule and provide a fully loaded tri-axle dump truck for proof – rolling. Loaded truck shall have a minimum gross operating weight of 30 tons. Test shall be conducted with "tag" or "pusher" axles retracted from the ground.

Proof rolling shall be accomplished in a series of traverses parallel to the centerline of the driveway, street, or parking area. The truck shall traverse the length of the street or parking area once for each 12' of width at speeds less than 5 mph. Additional passes along the traverse shall be completed as directed by the OWNER'S Project Representative to further define unsatisfactory subgrade.

Soft areas, yielding areas, cracked areas or areas where rolling or wave action is observed shall be considered indicative of an unsatisfactory subgrade. Such areas shall be undercut as outlined in subsequent subsections of this specification.

Once the subgrade has been proof-rolled and approved, protect the soils from becoming saturated, frozen, or adversely altered.

UNDERCUTTING/EXCAVATION BELOW SUBGRADE (EBS)

Undercutting/EBS shall be completed where required in the project Geotechnical Report. Measure and document undercut areas and depths in consultation with OWNER'S Project Representative.

Excavate undercut areas to the depth specified by A/E or OWNER'S Project Representative using equipment with smooth cutting edge. Excavated undercut material that does not meet the specifications for fill needed elsewhere on site shall be removed from the site and legally disposed.

Undercut areas shall be backfilled with Imported Select Fill as indicated in the project Geotechnical Report.

Following installation and compaction of Imported Select Fill the area shall be subject to the work defined in the paragraph entitled 'Subgrade Approval / Proof – Rolling'.

SECTION 31 22 16.15 - ROADWAY SUBGRADE PREPARATION

Undercutting/Excavation Below Subgrade (EBS) work shall include all materials, labor, equipment and supervision necessary to remove the soils from the Project Site considered to be poor from the proof roll and backfill and compact with Imported Select Fill material brought to the Project Site. EBS shall be measured in its original position. The cost of the compacted Imported Select Fill is incidental to the unit price item for Undercutting/Excavation Below Subgrade (EBS).

RESTORATION

Roll all pavement subgrade surfaces using a smooth drum roller to promote an impervious surface and minimize percolation of water into the subgrade.

END OF SECTION 31 22 16.15

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SECTION 31 23 16.13 TRENCHING

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to complete trenching for utilities and other work, as required in these specifications, on the drawings and as otherwise deemed necessary to complete the work. Included are the following topics:

PART 1 - GENERAL

Scope Related Work Reference Standards Quality Assurance Submittals Permits/Fees

PART 2 - MATERIALS

General

PART 3 - EXECUTION

General

Grading

Grading Around Trees

SECTION 31 23 16.13 - TRENCHING

Clean Up

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related work specified elsewhere:

- Section 02 32 00 Geo Technical Investigation
- Section 30 05 00 Common Work Results for All Exterior Improvements
- Section 31 25 00 Erosion Control
- Section 31 20 00 Earthmoving
- Section 31 23 19 Dewatering
- Section 31 25 00 Erosion Control
- Section 33 11 00 Water Utility Distribution Piping
- Section 33 30 00 Sanitary Sewerage Utilities
- Section 33 40 00 Storm Drainage Utilities

REFERENCE STANDARDS

American Society for Testing and Materials (ASTM):

D422	Standard Test Method for Particle Size Analysis of Soils
D4318	Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils
D698	Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort

SECTION 31 23 16.13 - TRENCHING

CWA PROJECT NO. 2022-0	8 IRONDALE LIBRARY
	IRONDALE, ALABAMA
D1557	Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort
D2922	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods
D3017	Standard Test Methods for Water Content of Soil and Rock in Place by Nuclear Methods
E329	Standard Specifications for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

MAWSS Standard Specifications, (Section 12 - Sanitary Sewers)

QUALITY ASSURANCE

The Contractor shall conduct sampling, testing, and analysis as required by this section and elsewhere in the Contract Documents either by retaining the services of an independent construction materials testing consultant or with internal certified testers. The materials testing personnel shall meet the requirements of ASTM E329.

The Contractor's construction materials testing personnel shall complete material testing as outlined in Table 31 23 16.13-1:

Material	Test Required	Test/Sample Frequency
I.E. Granular Fill	D2922 Standard Test Method for Density of Soil and Soil Aggregate in Place by Nuclear Methods	1 test / 500 lf trench
Bedding/Initial Cover	D2922 Standard Test Method for Density of Soil and Soil Aggregate in Place by Nuclear Methods	1 test / 500 lf trench
Backfill Material	D2922 Standard Test Method for Density of Soil and Soil Aggregate in Place by Nuclear Methods	1 test / 500 lf trench

Table 31 23 16.13-1

SUBMITTALS

Provide grainsize analysis for bedding and backfill materials.

Provide manufacturers product information for geotextile fabric.

Provide copies of all material field testing reports completed for the project to the OWNER'S Project Representative and the AE within 48 hours of completing the individual tests. Along with each individual test result, provide a running spreadsheet of all individual test results.

PERMITS/FEES

SECTION 31 23 16.13 - TRENCHING

Contractor shall be responsible for obtaining all permits necessary to complete trenching work. Contractor shall pay all fees associated with obtaining permits. These include, but are not limited to permits to work within right-of-way.

PART 2 – MATERIALS

GENERAL

Material requirements per MAWSS Standard Specifications, Section 12 (Sanitary Sewers)

PART 3 - EXECUTION

GENERAL

Execution requirements per MAWSS Standard Specifications, Section 12 (Sanitary Sewers)

GRADING

Grade areas disturbed during trench excavation and backfilling and adjacent areas as necessary to establish new grades shown on plans as soon as practicable after backfilling. If new grades are not shown on plans, grade areas to tie into the surrounding area without abrupt changes in elevations or slopes and provide drainage away from structures.

New grades are designed to produce desired configuration of site and do not represent a balance between cut and fill.

SECTION 31 23 16.13 - TRENCHING

Grades for earthwork shall not deviate more than 1 inch from plan elevations unless otherwise directed by OWNER'S Project Representative.

GRADING AROUND TREES

Limit excavation, fill or grading near trees or other vegetation to the extent possible. No excavation, trenching or backfilling shall occur within the fenced tree protection zone of existing trees without authorization from the OWNER'S Project Representative. If tree roots are encountered during trenching cut roots cleanly and squarely.

CLEAN UP

Remove excess bedding, backfill and spoil material from the site as soon as possible after backfilling is complete, but no later than 1 calendar day after backfilling is complete.

Thoroughly clean all drainage ways, roads, parking lots sidewalks and paved surfaces and remove and dispose all debris and mud.

END OF SECTION 31 23 16.13

SECTION 31 23 16.16 STRUCTURAL EXCAVATION FOR MINOR STRUCTURES BASED ON DFD MASTER SPECIFICATION DATED 09/01/2015

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to complete trenching for utilities and other work, as required in these specifications, on the drawings and as otherwise deemed necessary to complete the work. Included are the following topics:

PART 1 - GENERAL

Scope

Related Work

Reference Standards

Quality Assurance

PART 2 - MATERIALS

Granular Fill

Structural Fill

PART 3 - EXECUTION

Preparation

Dewatering

Excavation

Bearing Surface Approval

Construction of Foundations, Footings and Slabs Backfill and Compaction Restoration

RELATED WORK

(Note to the designer: The designer must determine if this work will impact other related work or Contractors and should revise these specifications accordingly to only include those Sections that apply to the project.)

Applicable provisions of Division 1 govern work under this Section.

Related work specified elsewhere:

Section 02 32 00 – Geo Technical Investigation

Section 02 41 13 – Demolition

Section 30 05 00 - Common Work Results For All Exterior Improvements

Section 31 20 00 – Earthmoving

Section 31 23 16.13 – Trenching

Section 31 23 19 - Dewatering

Section 31 25 00 – Erosion Control

Section 00 00 00 – (Section Title)

REFERENCE STANDARDS

(Note to the designer: The A/E shall discuss the quality assurance procedures with the DFD Project Manager. The A/E shall determine the frequency of the required tests based on the project specifics. Delete references from this section that are not applicable to the project.)

D422-63 Standard Test Method for Particle Size Analysis of Soils

- D4318 Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils
- D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³)
- D1140 Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing
- D1557 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³)
- D2922 Standard Test Methods for Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)
- D3017 Standard Test Method for Water Content of Soil and Rock In-Place by Nuclear Methods (Shallow Depth)
- D4253 Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
- D6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- D6913 Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
- E329 Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

QUALITY ASSURANCE

(Note to the designer: A/E to determine the type and frequency of quality assurance geotechnical testing required on each project. Provide listing of quality assurance testing requirements associated with trenching in this item. If Contractor is not responsible for testing, modify this section accordingly. If Contractor is required to complete testing, complete the table below and specify the type of tests required and the frequency of the testing. Materials, tests and frequency shown are provided as a starting point and should be modified as necessary based on scope of project.)

The Contractor's construction materials testing personnel shall complete material testing as outlined in Table 31 23 16.16 -1.

Material	Test Required	Test/Sample Frequency
Granular or Structural Backfill ⁽¹⁾	ASTM D422-63Standard Test Method for Particle Size Analysis of Soils	0 tests: 0-500 cy 1 test: 500-3000 cy
	ASTM D1140 Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75-µm) Sieve in Soils by Washing	"
Granular or Structural Backfill	ASTM D6938 Standard Test Methods for In- Place Density and Water Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)	0 tests: 0-500 cy 1 test: 500-3000 cy

Table 31 23 16.16 -1

1) Tests shall meet the requirements for gradation as listed in WisDOT Section 209.2 and 210.2.

PART 2 - MATERIALS

(Note to the designer: Edit material requirements as necessary to account for local variations in material availability. Comply with the substantive requirements of the materials described below.

GRANULAR FILL

Clean material meeting the requirements of "Grade 1" or "Grade 2" granular backfill as defined in WisDOT Section 209.2.1.

STRUCTURAL FILL

Clean material meeting the requirements of "Structure Backfill" as defined in WisDOT Section 210.2.1.

PART 3 - EXECUTION

PREPARATION

Review drawings and prepare work plan and schedule. Coordinate any necessary interruptions in utility service with DFD Project Representative, in accordance with other specification sections.

Contact Diggers Hotline. Locate and protect utilities, structures, pavement, trees, landscaping, benchmarks and other features in the work area.

Layout work according to drawings. Establish and transfer lines and grades as necessary to complete the work.

Remove topsoil from work area in accordance with Section 31 20 00 – Earthwork. Sawcut and remove pavement from work area in accordance with Section 02 41 13 – Demolition.

Support existing buildings, utilities and structures as necessary prior to beginning building excavation.

Grade area surrounding excavation to drain water away from excavation.

DEWATERING

Dewatering shall be completed in accordance with Section 31 23 19 – Dewatering.

EXCAVATION

(Note to the designer: Provide any site-specific requirements relative to limitations on the size of the excavation, protection requirements, etc... Also reference geotechnical reports for site-specific requirements relative to shoring, underpinning or piling associated with protecting existing structures.)

Excavate to elevations and dimensions necessary to complete construction. Excavations shall be sufficiently deep to provide for foundations, footings, slabs, and any required base material.

Do not excavate material from under the 45 degree bearing splay beneath existing foundations or footings.

Notify DFD Project Representative if correction of unauthorized excavation or overexcavation is necessary. Said excavations will be corrected based on recommendations of DFD Project Representative or DFD's geotechnical consultant. Contractor will be responsible for all costs associated with correcting these excavations, including fees charged by DFD's geotechnical consultant.

Segregate the various materials excavated. Reserve material meeting the requirements of backfill for the project location. Excavated material that does not meet the requirements of backfill, and excess excavated material, shall be removed from the site and disposed by the contractor unless directed otherwise by other specification sections or the DFD Project Representative.

Locate bedding, backfill and spoil piles in accordance with OSHA requirements, and so that it does not interfere with public travel, adjacent landowners or other construction activities.

BEARING SURFACE REVIEW

(Note to the designer: Reference geotechnical reports and provide any site-specific requirements relative to bearing soil requirements or modifications.)

Prior to over-excavating below the proposed bearing surface grade, or modifying bearing surface soil, contact DFD Project Representative to schedule inspection. Provide minimum of 24 hours confirmed notice.

Provide smooth soil surface at bearing surface grade, unless otherwise required by sitespecific geotechnical reports. Hand trim excavation, remove loose material, lumped subsoil, rock and boulders from the bearing surface.

Once the bearing surface grade is established, protect the soils from becoming saturated, frozen, or adversely altered. Do not allow soils from the sidewall of the excavation to spall and fall onto the bearing surface.

CONSTRUCTION OF FOUNDATIONS, FOOTINGS AND SLABS

Construct foundations, footings and slabs in accordance with the drawings and pertinent specification sections.

Do not allow excavation sidewall soils to spall into excavation.

Do not allow water to collect in excavation.

Protect base of excavation from freezing.

Install waterproofing and foundation drainage system in accordance with drawings.

BACKFILL AND COMPACTION

Remove all forms, bracing, staking and other construction materials from the excavation prior to initiating backfilling.

Excavation shall be reasonably free of water prior to beginning backfilling. Do not place material on frozen surfaces or use frozen material.

Backfill excavation using the material specified on Table 31 23 16.16 - 2, or as shown on the drawings.

Compact fill material as required by Table 31 23 16.16 - 2 for the given use.

Moisture condition backfill material as necessary to achieve density required for given use.

Place and compact material to minimize settlement and avoid damage to structures, pipes, utility lines and other features. Hand-place and compact material as necessary.

Place backfill simultaneously on both sides of structures.

Backfill trenches to elevations shown on the drawings; allow for placement of base course, pavements, and topsoil as required by the drawings and other Contract Documents. Where final restoration will be delayed, backfill excavation to existing grade to provide a safe, free-draining surface.

It the responsibility of the Contractor to provide all necessary compaction equipment and other grading equipment that may be required to obtain the specified density. Vibratory plate or tamping type walk behind compactors will be required whenever backfill is placed adjacent to structures, pipes, utility lines and other features.

Flooding or jetting of backfill material for compaction purposes is not allowed.

SECTION 31 23 16.16 – STRUCTURAL EXCAVATION FOR MINOR STRUCTURES

8 OF 10

(Note to the designer: Remove row and/or columns from table that are not applicable to the project.)

Table 31 23 16.16 -2

Location	Required Material	Maximum Compact ed Lift Thickness	Minimum Proctor Compaction	Minimum Relative Density (a)
Areas Beneath Footings, Floor Slabs, or Structures	Structural Fill	6''	95% Modified	70%
Footing, Foundation and Structure Backfill	Structural Fill	6''	95% Modified	70%
Areas within 10' of an Existing or Proposed Building or Structure Footing or Slab	Granular Fill	8"	90% Modified	60%
Areas Beneath Existing or Proposed Pavement (Roads, Drives, Walks)	Granular Fill	8"	90% Modified	60%
Turf Areas	Earth Fill	12"	85 % Modified	50%

a) Minimum relative density as determined by ASTM D-4253-00 for coarse-grained soils with less than 15% by mass passing the No. 200 sieve. Applicable only when minimum proctor compaction cannot be achieved.

RESTORATION

Restore structure excavation to proposed grades and surfaces as soon as practicable after backfilling.

Remove excess backfill and spoil material from the site as soon as possible after backfilling is complete, but no later than 2 calendar days after backfilling is complete.

SECTION 31 23 16.16 – STRUCTURAL EXCAVATION FOR MINOR STRUCTURES

Thoroughly clean all drainage ways, roads, parking lots sidewalks and paved surfaces and remove and dispose all debris and mud.

END OF SECTION 31 23 16.16

SECTION 31 23 33 TRENCHING AND BACKFILLING STRUCTURE EXCAVATION AND BACKFILL FOR DRAINAGE AND MINOR STRUCTURES

PART 1- GENERAL

GENERAL

The work under this Section shall consist of the removal and disposal of all excavated materials of any nature required for the construction of all box type culverts (including bridge type), pipe culverts (including pipe arches), storm drains, and other minor structures in accordance with these Specifications and to reasonably close conformity with the lines and grades shown on the plans or designated by the Engineer.

This Section shall further include backfilling of structure foundations with suitable material in accordance with plan details or as directed.

CLASSIFICATION OF MATERIALS

1. Excavation.

All excavation for structures below natural ground or the designated subgrade, whichever is lower, or the elevation designated by the Engineer will be classified as Structure Excavation and shall include all materials encountered regardless of their nature, exclusive of water or other liquids which will not be classified as excavated material, necessary for the proper construction of the structure.

Excavation for ditches at the inlet and outlet ends of drainage structures and any other ditches indicated on the plans shall be constructed under "Roadway and Drainage Excavation" items.

2. Backfill.

a) Foundation Backfill.

Special selected material ordered placed under a structure to provide a suitable foundation for the structure shall be classified as Foundation Backfill.

b) General Backfill.

Material used for ordinary backfill shall include special material for areas immediately adjacent to weepholes and a drainage belt for large masonry structures.

MATERIAL

a) Foundation Backfill.

Foundation Backfill is a special selected material suitable (approved free-draining commercial or local material) for use as foundation for the structure.

CONSTRUCTION REQUIREMENTS.

b) General Backfill.

Material used for general backfill shall be a compactible soil of acceptable quality except that material for areas immediately adjacent to weepholes shall be free draining material conforming to the following:

 Local material shall have a permeability coefficient of at least 0.1 mm/sec., measured by the AASHTO T 215 constant head permeameter, with 90% passing the 3/4 inch {19.0 mm} sieve and a maximum of 10% passing the Number 8 {2.36 mm} sieve.

- 2. Commercial material shall be aggregates meeting the requirements of ALDOT #467 or ALDOT #57.
- 3. Other commercial aggregates will be considered and can be used if approved by the Materials and Tests Engineer.

CONSTRUCTION REQUIREMENTS.

a) General.

Foundation excavation shall be of the size and depth conforming to the outline for the structure shown on the plans or established by the Engineer. Unsuitable foundation material below the normal design elevation shall be removed as directed by the Engineer and paid for as Structure Excavation.

Where rock, gravelly soil, hard pan, or other unyielding material is encountered, it shall be removed as ordered by the Engineer for a depth of at least 12 inches {300 mm} below the designated grade. This extra depth of excavation shall be backfilled with suitable, approved material measured and paid for as foundation backfill.

Attention is directed to the special requirements for placement of pipe culverts in embankment areas noted in the plans.

b) Excavation.

Choice of equipment to perform the excavation within the limits of the lines and grades noted in this Section or directed shall, in general, be that of the Contractor provided such produces the desired results without injuring any adjacent or adjoining work.

Special care shall be taken not to disturb or loosen foundation material below designated foundation limits.

Unless otherwise indicated in the plans or directed by the Engineer, all sheeting and bracing used in making structure excavation shall be removed by the Contractor following the completion of the work.

c) Backfilling

1. Foundation Backfill.

Foundation backfill shall be deposited uniformly for the full width of the excavation in horizontal layers not to exceed 6 inches {150 mm} in thickness with each layer compacted as directed by the Engineer.

2. General Backfill.

General backfilling consisting of all backfill except foundation backfill shall be performed in accordance with the requirements of Section 210 and Section 530 with particular attention directed to the requirements for protecting structures.

No backfill shall be placed against a newly constructed masonry or concrete structure for a period of 10 days unless authorized by the Engineer.

Large masonry or concrete structures such as box culverts and retaining walls, etc. shall have a deposit (belt), not less than 1 foot {300 mm} wide and 1 foot {300 mm} deep, of approved local or commercial free draining material placed full length along the back face of the vertical walls at the line of weepholes. This material must conform to the requirements specified under Sub article 214.02(b).

Small structures such as inlets, etc. and top slabs of culverts having weepholes shall have approximately 1 cubic foot {0.03 m³} of approved commercial free draining material, as specified in Subarticle 214.02(b), placed at each weephole.
Placing of the material at weepholes shall be done in such a manner as to provide maximum depth of filtering effect.

Prior to the placing of any free draining material, each weephole shall be protected by rough stones, a grooved concrete block, or hardware cloth to permit seepage yet prohibit loss of material through the weephole.

METHOD OF MEASUREMENT

No direct payment will be made for the operation, or the special material noted above for treatment of weepholes.

1) Structure Excavation.

a) Quantity of Excavation.

The quantity of excavation will be the number of cubic yards {cubic meters}, measured in its original position, that is excavated in accordance with the details shown on the plans and the following limitations.

b) Masonry Structures other than Culverts.

For masonry structures other than culverts, measurement will be made of material removed from the area bounded by vertical planes 1 foot {300 mm} outside of the neat lines of the foundation or footing plan and parallel thereto, and to the elevations shown on the plans or directed by the Engineer to provide installation on a suitable foundation. No measurement or payment will be made for material excavated outside these limits.

c) Excavation for Culverts.

For box, arch, and pipe culverts with wing walls or headwalls or other minor structures including storm sewers, measurement will be made of the material removed in accordance with the following:

- The excavation shall be considered to be a trench with vertical sidewalls. No separate measurement for minor structures (inlets, junction boxes, catch basins, manholes, etc.) other than noted below, such being considered incidental to work.
- The length of the excavation shall be the actual length of the structure (including inlets, junction boxes, etc.) measured along the flowline plus 1 foot {300 mm} at each end. When headwalls or wing walls are used, the length shall be the average net length of the structure, tip to tip of wings.
- The width of the excavation shall, in the case of pipe structures, be considered the inside diameter of the pipe plus 3 feet {1 m}. For box culverts, the width shall be the outside width of the barrels plus 4 feet {1.2 m}. On all culvert structures, no allowance will be made for wing flares or toe walls.
- d) Depth of Excavation.

The depth of excavation will be as deep as required to install the structure on a suitable foundation to the flowline indicated. This depth shall then be measured in accordance with the following:

- i. Pipe with an inside diameter of 48 inches {1200 mm} or less shall be laid in a trench extending at least 1 foot {300 mm} above the elevation of the top of the pipe. The depth of excavation shall be measured from a point 1 foot {300 mm} above the top of the pipe, or from subgrade elevation in cut sections.
- ii. For box culverts and pipe larger than 48 inches {1200 mm} in diameter, cross sections of the original ground will be taken at major breaks in the ground line profile and at changes in the culvert barrel widths along the length of the culvert as defined in Item 2 above.
- e) Computation of the Volume of Excavation.

The average end area method shall be used in computing the volume and no measurement for payment will be made for material excavated outside of the limits noted above.

f) Excavation For Side Drainpipe.

No measurement or payment will be made for excavation for side drainpipe of any size or for side drain culverts unless so provided by plan details. The cost of such excavation

shall be included in the price bid for the items; however, pipe designated on the plans as storm sewer pipe will not be classified as side drain.

2) Foundation Backfill.

Foundation backfill will not be measured directly but the volume will be fixed at 150 percent of the volume of the excavation which it replaces that lies between the bottom of the structure and the bottom elevation of the trench ordered excavated. Where satisfactory structure foundation is provided by the normal process of removing and backfilling unsuitable material under fill areas, none of such backfill will be classified as foundation backfill.

BASIS OF PAYMENT.

a. Structure Excavation.

Payment will be made for the number of cubic yards {cubic meters}, measured as detailed above, at the contract unit price bid for Structure Excavation. Such payment shall be payment in full for furnishing all materials, equipment, tools, labor, pumping, bailing, draining, and all incidentals necessary to complete the work and shall include installation and removal of any cribs, cofferdams, shoring, sheeting, or other protection, the satisfactory disposal of any unsuitable material from the excavation, and the placement and compaction in backfill or embankment of the material excavated and suitable for such use.

b. Foundation Backfill.

Payment for the calculated cubic yards {cubic meters} of this material, determined as noted herein, will be made at the contract unit price bid which shall be full compensation of the item complete in place and includes furnishing of all material, placement, compaction and all equipment, tools, labor, and incidentals necessary to complete the work.

- c. Payment will be made under Item No.:
- 214-A Structure Excavation per cubic yard {cubic meter}
- 214-B Foundation Backfill, Local/Commercial per cubic yard {cubic meter}

END OF SECTION 31 23 33

SECTION 31 25 00 EROSION CONTROL

PART 1 - GENERAL

SCOPE

The work under this section consists of providing all work, materials, labor, equipment, and supervision necessary to provide and construct erosion control measures necessary to protect property and the environment. Included are the following topics:

Part 1 - GENERAL

Scope

Related Work

Reference Documents

Erosion Control Plan

Part 2 - MATERIALS

General

Temporary Ditch Barriers

Silt Fence

Erosion Mat

Staples

Riprap

Gabion Stone

Soil Stabilizers

Soil Tackifiers

Part 3 - EXECUTION

General Grading and Earthwork Drainage Tracking Control Maintenance

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related work specified elsewhere:

- Section 02 41 13 Demolition
- Section 30 05 00 Common Work Results For All Exterior Improvements
- Section 31 20 00 Earthmoving
- Section 31 22 16.15 Roadway Subgrade Preparation
- Section 31 23 16.13 Trenching
- Section 31 23 16.16 -- Structural Excavation for Minor Structures
- Section 31 23 19 Dewatering
- Section 32 92 20 Native Seeding

REFERENCE DOCUMENTS

Provide erosion control in accordance with the following references:

- Approved Product List, current version as published by ALDOT.
- Soil Erosion and Sediment Control Handbook, current version as published by ADEM.

Method of measurement and basis of payment sections in any referenced erosion control documents shall not apply to this contract.

EROSION CONTROL PLAN

The A/E has prepared an erosion control plan for the project. The Contractor will provide the A/E with submittals for materials used to implement the erosion control plan, as well as any modifications to the erosion control plan that are necessary due to the Contractor's means and methods of construction.

Contractor shall comply with all the requirements of the erosion control plan and the ADEM Construction General Permit. Contractor shall be responsible for completing all construction site inspection reports for the duration of the project and the Notice of Termination form required by ADEM.

PART 2 - MATERIALS

GENERAL

Erosion control products, including but not limited to, silt fence, wattles, and geotextile fabric, shall be listed on the ALDOT Approved Products List.

TEMPORARY DITCH BARRIERS

Rectangular bales of hay or straw, tightly bound with twine, not wire. Anchor stakes shall be "T" or "U" steel posts, or hardwood, 2-inches by 2-inches nominal. Rebar shall not be used for anchor bales.

Temporary ditch checks meeting the requirements of the ALDOT Approved Products List and installed per the manufacturer's instructions may be used in lieu of bales. Temporary ditch checks may also be classified as silt logs, silt logs, or wattles.

SILT FENCE

Fence fabric shall be in 3-foot-tall rolls, with 4' tall 2" x 2" nominal cross section hardwood posts spaced a maximum of 10' o.c.

RIPRAP

Riprap shall be the class specified in the plan and shall conform to ALDOT Standard Specifications, Section 610. If a class is not specified in the plan, medium riprap shall be used.

PART 3 - EXECUTION

GENERAL

Install erosion control measures as required by the erosion control plan and contract documents. Provide additional erosion control measures as dictated by Contractor's means and methods, or by differing site conditions. Notify OWNER'S Project Representative of additional erosion control features that are provided, but not shown on the plan.

Contractor shall provide all erosion control measures necessary to protect property and the environment. Perform all work in accordance with manufacturer's instruction where these specifications do not specify a higher requirement.

GRADING AND EARTHWORK

Install all temporary or permanent erosion control measures prior to any onsite grading or land disturbances.

Clear only those areas designated for the placement of improvements or earthwork before placement of the final cover. Perform stripping of vegetation, grading, excavation, or other land disturbing activities in a logical sequence and manner which will minimize erosion. If possible, schedule construction for times of the year when erosion hazards are minimal.

Do not clear the site of topsoil, trees, and other natural ground covers before the commencement of construction. Retain natural vegetation and protect until the final ground cover is placed.

Do not stockpile soil within 25 feet of any roadway, parking lot, paved area, or drainage structure or channel. Provide temporary stabilization and control measures (seeding, mulching, covering, erosion matting, barrier fencing) for the protection of disturbed areas and soil piles which will remain unfinished for a period of more than 14 consecutive calendar days.

Remove surplus excavation materials from the site immediately after rough grading. The disposal site for the surplus excavation materials shall also be subject to these erosion control requirements.

DRAINAGE

Minimize water runoff and retain or detain on-site whenever possible so as to promote settling of solids and groundwater recharge.

Convey drainage to the nearest adequate public facility. Do not discharge water in a manner that will cause erosion or sedimentation of the site or receiving facility.

Protect storm sewer inlets and catch basins in accordance with the erosion control plan, if provided. If not specified, protect inlets with straw bale barriers, silt fencing, filter basket, gabion stone weepers, or other equivalent methods approved by the A/E which provide the necessary erosion protection.

Divert roof drainage and runoff from all areas upslope of the site around areas to be disturbed or channel them through the site in a manner that will not cause erosion.

Minimize the pumping of sediments when dewatering. Discharge to a sedimentation basin or sedimentation vessel to reduce the discharge of sediments. Do not discharge water in a manner that will cause erosion or sedimentation of the site or receiving facility.

TRACKING CONTROL

Provide each entrance to the site with a stone tracking pad.

If necessary, provide a crushed aggregate paved parking area.

If applicable, wash water shall be discharged to sedimentation basins, sedimentation vessels, or other such control areas. Untreated wash water shall not be discharged to storm sewers or surface water bodies.

MAINTENANCE

Inspect all erosion control measures within 24 hours of the end of each rainfall event that exceeds 0.25" or daily during period of prolonged rainfall, or weekly during periods without rainfall. Immediately repair and/or replace any and all damaged, failed, or inadequate erosion control measures.

Maintain records of all inspections and any remedial actions taken.

Maintain stockpile stabilization measures as necessary after rainfall events and heavy winds. Replace tarps, re-seed, and reapply mulch, tackifiers and stabilizers as necessary.

Remove sediment from stormwater and erosion control structures, basins and vessels as necessary.

Repair or replace damaged inlet protection.

Replace or supplement stone tracking pads with additional stone when they become ineffective.

Remove any sediment reaching a public or private roadway, parking lot, sidewalk, or other paved. Do not remove tracked sediments by flushing. Completely remove any accumulations not requiring immediate attention at least once daily at the end of the workday.

Frequently dispose of all waste and unused construction materials in licensed solid waste or wastewater facilities. Do not bury, dump, or discharge, any garbage, debris, cleaning wastes, toxic materials, or hazardous materials on the site, on the land surface or in detention basins, or otherwise allow materials to be carried off the site by runoff onto adjacent lands or into receiving waters or storm sewer systems.

END OF SECTION 31 25 00

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SECTION 32 11 23.33 DENSE GRADED BASE

PART 1 - GENERAL

SCOPE

The work under this section consists of constructing a dense graded base using crushed stone or crushed gravel. The Contractor may also use crushed concrete, reclaimed asphaltic pavement, reprocessed material, or blended material. The work under this section shall provide a surface ready for constructing and supporting the Concrete or Asphalt Pavement.

PART 1 - GENERAL

Scope

Related Work

Reference Standards

Quality Assurance

Submittals

PART 2 - MATERIALS

Dense Graded Base

PART 3 - EXECUTION

Construction

Compaction

Cleanup

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related work specified elsewhere:

Section 03 30 00 – Cast In Place Concrete

Section 30 05 00 – Common Work Results For Exterior Work

Section 31 22 16.15 – Roadway Subgrade Preparation

Section 32 12 16.13 -- Hot Mix Asphalt Paving

Section 00 00 00 – (Section Title)

REFERENCE STANDARDS

American Society for Testing and Materials (ASTM):

D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods
E329	Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

Alabama Department of Transportation (ALDOT) Standard Specifications (2022), Section 301 (Soil, Soil Aggregate, and Aggregate Base and Subbases)

Alabama Department of Transportation (ALDOT) Standard Specifications (2022), Section 306 (Density Requirements for Compaction)

Alabama Department of Transportation (ALDOT) Standard Specifications (2022), Section 825 (Crushed Aggregate Base Materials)

SECTION 32 11 23.33 - DENSE GRADED BASE

QUALITY ASSURANCE

The Contractor shall conduct sampling, testing, and analysis as required by this section and elsewhere in the Contract Documents either by retaining the services of an independent construction materials testing consultant or with internal certified testers. The materials testing personnel shall meet the requirements of ASTM E329.

The Contractor's construction materials testing personnel shall complete material testing as outlined in Table 32 11 23.33-1.

Material	Test Required	Test/Sample
		Frequency
Dense Graded	ASTM D1557 Standard Test Methods for Laboratory	1 test/500 CY
Base	Compaction Characteristics of Soil Using Modified Effort	placed
Dense Graded	ASTM D6938 Standard Test Method for In-Place	1 test/500 CY
Base	Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods	placed

Table 32 11 23.33 -1

SUBMITTALS

Provide copies of all material testing reports completed for the project within 48 hours of completing the individual tests. Along with each individual test result, provide a running spreadsheet of all individual test results.

PART 2 - MATERIALS

DENSE GRADED BASE

Material shall conform to ALDOT Section 825 dense graded base (Type B).

SECTION 32 11 23.33 – DENSE GRADED BASE

PART 3 - EXECUTION

CONSTRUCTION

Preparing the Foundation

Refer to Section 31 22 16.15 – Roadway Subgrade Preparation.

Placing Dense Graded Base Aggregate

Construct Dense Graded Base as specified in ALDOT Standard Specifications (2022) Section 301.

Construct the base to the width and section the drawings show. Shape, and compact the base surface to within 0.04 feet of the drawing elevation.

Ensure there is adequate moisture in the aggregate during placing, shaping, and compacting to prevent segregation and achieve adequate compaction. Moisture condition dense graded base as necessary to achieve required density as determined by ASTM D1557.

Excavation shall be reasonably free of water prior to placement of dense graded base. Do not place dense graded base on frozen surfaces or use frozen material.

Maintain the base until paving over it, or until the OWNER'S Project Representative accepts the work, if paving is not part of the contract.

COMPACTION

Compacting Dense Graded Base Aggregate

Compact Dense Graded Base as specified in ALDOT Standard Specifications (2022) Section 306.

If using a pneumatic roller, do not exceed a compacted thickness of 6 inches per layer. For the first layer placed over a loose sandy subgrade, the Contractor may, with A/E approval, increase the compacted layer thickness to 8 inches. If using a vibratory roller, do not exceed a compacted thickness of 8 inches per layer.

The material shall be compacted to meet the following:

•	Test Method to determine maximum density and moisture	ASTM D1557
•	Relative compaction relative to the optimum	95%
•	Moisture content relative to the optimum	-2% to +2%

The compacted material shall be tested for in-place field density in accordance with this Section, Part I, Quality Assurance.

CLEANUP

SECTION 32 11 23.33 - DENSE GRADED BASE

After the project is completed, thoroughly clean up all debris which may have accumulated during the placement of dense graded base and breaker run, if placed. All storm sewer manholes, inlets, and trench drains within the project area shall be inspected in the presence of the OWNER'S Project Representative and the A/E to confirm there is no accumulated debris. The Contractor shall ensure the manholes, inlets, and trench drains are free of water and debris prior to inspection by the parties noted above. Any accumulated debris in the manholes, inlets, and trench drains shall be removed and properly disposed of by the Contractor.

Replace or repair as required, all surfaces and/or landscape features damaged or disturbed under this item of work.

END OF SECTION 32 11 23.33

SECTION 32 12 16.13

HOT MIX ASPHALT PAVING

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to provide and construct the paving and surfacing as provided for in these specifications and on the drawings. Included are the following topics:

PART 1 - GENERAL

Scope

Related Work

Reference Documents

Quality Assurance

Submittals

PART 2 - MATERIALS

Hot Mix Asphalt (HMA) Pavement

Tack Coat

PART 3 - EXECUTION

Hot Mix Asphalt (HMA) Pavement

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related Work Specified Elsewhere:

Section 30 05 00 – Common Work Results for all Exterior Work

Section 31 22 16.15 – Roadway Subgrade Preparation

Section 32 11 23.33 - Dense Graded Base

REFERENCE DOCUMENTS

Alabama Department of Transportation (ALDOT) Standard Specifications (2022), Section 106.09 (Quality Control and Quality Assurance (QC/QA) Requirements for Hot Mix Asphalt (HMA) Pavement)

Alabama Department of Transportation (ALDOT) Standard Specifications (2022), Section 306 (Density Requirements for Compaction)

Alabama Department of Transportation (ALDOT) Standard Specifications (2022), Section 401 (Bituminous Surface Treatments)

Alabama Department of Transportation (ALDOT) Standard Specifications (2022), Section 405 (Tack Coat)

Alabama Department of Transportation (ALDOT) Standard Specifications (2022), Section 410 (Asphalt Pavements)

Alabama Department of Transportation (ALDOT) Standard Specifications (2022), Section 424 (Superpave Bituminous Concrete Base, Binder, and Wearing Surface Layers)

QUALITY ASSURANCE

The Contractor is to conduct sampling, testing, and analysis as required by this section and elsewhere in the Contract Documents by retaining the services of an independent construction materials testing firm acceptable to the Owner. Contractor must maintain a quality control program in accordance with ALDOT Standard Specifications (2022), Section 106 to ensure that the asphalt produced meets the specified mix design and plan requirements.

The Contractor's construction materials testing personnel must complete nondestructive nuclear density testing as outlined in Table 32 12 16.13-1. Test results shall be provided to A/E and OWNER'S Construction Representative within 24 hours of being completed. All densities shall meet the requirements outlined in ALDOT Standard Specifications (2022), Section 424

Layer	Test/Sample Frequency
Lower	3 random tests/5000 SF placed
Upper	1 random test/5000 SF placed

Table 32 12 16.13 - 1

If density is below specified amount, submit proposed corrective action to OWNER'S Project Representative. Corrective action may consist of removal and replacement of deficient pavement or reduced payment, as agreed to by the OWNER'S Project Representative.

SUBMITTALS

Provide HMA pavement mix design reports for all mix designs to be used on the project. All mix designs shall meet the requirements outlined in ALDOT Sections 410 and 424.

PART 2 - MATERIALS

HOT MIX ASPHALTIC (HMA) PAVEMENT

Provide HMA pavement thickness and type as indicated on the plan and conforming to the requirements of ALDOT Sections 410 and 424. Utilize the same material type throughout the paving operation unless noted elsewhere on the drawings. Ensure all asphaltic materials provided under this section conform to the requirements of ALDOT Section 401.

TACK COAT

Apply tack coat at a minimum rate of 0.05 gallons per square yard to the lower layer(s) of HMA pavement surface prior to placing upper layer(s) of HMA pavement, unless otherwise noted. The surface shall be clean and dry prior to tack coat application. Tack coat shall meet the requirements of ALDOT Section 405.

PART 3 - EXECUTION

HOT MIX ASPHALT (HMA) PAVEMENT

Complete all work under this section to ALDOT Section 410 and Section 424. Provide HMA layer thicknesses as shown on the drawings.

END OF SECTION 32 12 16.13

SECTION 32 13 13 — CONCRETE PAVING

<u>PART 1 — GENERAL</u>

1.1 <u>Related Documents</u>: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 <u>Summary</u>:

- A. Section Includes:
 - 1. Plaza
 - 2. Patios
 - 3. Crosswalk
- B. Related Sections:
 - 1. Section 033000 "Cast-in-Place Concrete" for general building applications of concrete.
 - 2. Section 031000 "Concrete Forming and Accessories
 - 3. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.3 Unit Prices:

- A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices".
- B. Unit prices apply to authorized work covered by quantity allowances.
- C. Unit prices apply to additions to and deletions from the Work as authorized by Change Orders.
- 1.4 <u>Definitions:</u>
 - A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.
 - B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.5 <u>Preinstallation Meetings:</u>

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to concrete paving, including but not limited to, the following:
 - a) Concrete mixture design.
 - b) Quality control of concrete materials and concrete paving construction practices.
 - 2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
 - a) Contractor's superintendent.
 - b) Independent testing agency responsible for concrete design mixtures.
 - c) Ready-mix concrete manufacturer.

- d) Concrete paving Subcontractor.
- e) Manufacturer's representative of stamped concrete paving system used for stamped detectable warnings.
- 1.8 <u>Action Submittals:</u>
 - A. Product Data: For each type of product indicated.
 - B. Sustainable Design Submittals: N/A
 - C. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.
 - D. Samples for Verification: For each type of product or exposed finish, prepared as Samples of size indicated below:
 - 1. Exposed Aggregate: 10-lb Sample of each mix.
 - E. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- 1.9 Informational Submittals:
 - A. Qualification Data: For qualified Installer of stamped detectable warnings ready-mix concrete manufacturer and testing agency.
 - B. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Fiber reinforcement.
 - 4. Admixtures.
 - 5. Curing compounds.
 - 6. Applied finish materials.
 - 7. Bonding agent or epoxy adhesive.
 - 8. Joint fillers.
 - C. Material Test Reports: For each of the following:
 - 1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
 - D. Field quality-control reports.
- 1.10 <u>Quality Assurance</u>:
 - A. Stamped Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.
 - B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 - Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
 - C. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
 - 2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Landscape Architect and not less than 96 inches by 96 inches. Include full-size detectable warning.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Landscape Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- 1.11 <u>Preconstruction Testing</u>:
 - A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.
- 1.12 Job Conditions:
 - A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
 - B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 - When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
 - C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 — PRODUCTS

- 2.1 General:
 - A. ACI Publications: Comply with ACI 301 unless otherwise indicated.
- 2.2 <u>Forms</u>:
 - A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 - 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
 - B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.
- 2.3 <u>Steel Reinforcement:</u>
 - A. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from galvanized-steel wire into flat sheets.
 - B. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.
 - C. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A, plain steel.
 - D. Reinforcing Bars: ASTM A615/A615M, Grade 60; deformed.
 - E. Galvanized Reinforcing Bars: ASTM A767/A767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A615/A615M, Grade 60 deformed bars.
 - F. Epoxy-Coated Reinforcing Bars: ASTM A775/A775M or ASTM A934/A934M; with ASTM A615/A615M, Grade 60 deformed bars.
 - G. Steel Bar Mats: ASTM A184/A184M; with ASTM A615/A615M, Grade 60 deformed bars; assembled with clips.
 - H. Plain-Steel Wire: ASTM A1064/A1064M, galvanized.
 - I. Deformed-Steel Wire: ASTM A1064/A1064M.
 - J. Epoxy-Coated-Steel Wire: ASTM A884/A884M, Class A; coated, plain.
 - K. Joint Dowel Bars: ASTM A615/A615M, Grade 60 plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A767/A767M, Class I coating. Cut bars true to length with ends square and free of burrs.
 - L. Epoxy-Coated, Joint Dowel Bars: ASTM A775/A775M; with ASTM A615/A615M, Grade 60 plain-steel bars.
 - M. Tie Bars: ASTM A615/A615M, Grade 60; deformed.
 - N. Hook Bolts: ASTM A307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

- O. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
- P. For epoxy-coated reinforcement, use epoxy-coated or other dielectricpolymer-coated wire bar supports.
- Q. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.
- R. Zinc Repair Material: ASTM A780/A780M.
- 2.4 <u>Concrete Materials:</u>
 - A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
 - 1. Portland Cement: ASTM C150/C150M, gray Portland cement Type I or Type II.
 - 2. Fly Ash: ASTM C618, Class C or Class F.
 - 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
 - B. Aggregates: All aggregates shall be furnished from ALDOT approved aggregate source whose producer is participating in a meeting the requirements of ALDOT 249.
 - C. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:
 - 1. Aggregate Sizes: 3/8 to 5/8 inch nominal.
 - 2. Aggregate Source, Shape, and Color as indicated on plans.
 - D. Air-Entraining Admixture: ASTM C260/C260M.
 - E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
 - 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 - 2. Retarding Admixture: ASTM C494/C494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
 - F. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
 - 1. Color: as indicated by manufacturer's designation, provided by one of the following:
 - a) ChemMasters
 - b) Davis Colors
 - c) Dayton Superior Corporation

- d) Elementis Pigments
- e) Hoover Color Corporation
- f) Lambert Corporation
- g) LANXESS Corporation
- h) QC Construction Products
- i) Scofield, L.M. Company
- j) Solomon Colors, Inc.
- k) Stampcrete International, Ltd.
- I) SureCrete Design Products
- 2. Color: Match Landscape Architect's sample
- G. Water: Potable and complying with ASTM C94/C94M
- 2.5 <u>Fiber Reinforcement:</u>
 - A. Synthetic Fiber: Monofilament polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C1116/C1116M, Type III, 1/2 to 1-1/2 inches long.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a) Monofilament Fibers:
 - (1) Axim Italcementi Group, Inc.; FIBRASOL II P.
 - (2) Euclid Chemical Company (The), an RPM company, Fiberstrand 100, Fiberstrand 150.
 - (3) Grace, W.R. & Co. Conn.; Grace MicroFiber.
 - (4) Metalcrete Industries; Polystrand 1000.
 - (5) QC Construction Products; QC FIBERS
 - b) Fibrillated Fibers:
 - (1) Axim Italcementi Group, Inc.; FIBRASOL F.
 - (2) Euclid Chemical Company (The), an RPM company; Fiberstrand F.
 - (3) Grace, W.R. & Co. Conn.; Grace Fibers
 - (4) Propex Concrete Systems Corp.; Fibermesh 300
 - B. Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C1116/C1116M, Type III, 1/2 to 1-1/2 inches long.
- 2.6 <u>Curing Materials:</u>
 - A. Absorptive Cover: AASHTO M 182, Class 4, burlap cloth.
 - B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlappolyethylene sheet.
 - C. Water: Potable.
 - D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Axim Italcementi Group, Inc.; Caltexol CIMFILM.
- b. BASF Construction Chemicals, LLC; Confilm.
- c. ChemMasters; Spray-Film.
- d. Conspec by Dayton Superior; Aquafilm.

- e. Dayton Superior Corporation; Sure Film (J-74).
- f. Edoco by Dayton Superior; BurkeFilm.
- g. Euclid Chemical Company (The), an RPM company; Eucobar.
- h. Kaufman Products, Inc.; VaporAid.
- i. Lambert Corporation; LAMBCO Skin.
- j. L&M Construction Chemicals, Inc.; E-CON.
- k. Meadows, W. R., Inc.; EVAPRE.
- I. Metalcrete Industries; Waterhold.
- m. Nox-Crete Products Group; MONOFILM.
- n. Sika Corporation, Inc.; SikaFilm.
- o. SpecChem, LLC; Spec Film.
- p. Symons by Dayton Superior; Finishing Aid.
- q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
- r. Unitex; PRO-FILM.
- s. Vexcon Chemicals Inc.; Certi-Vex EnvioAssist.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc.; A-H Curing Compound #2 DR WB.
 - b. ChemMasters; Safe-Cure Clear.
 - c. Conspec by Dayton Superior.
 - d. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
 - e. Edoco by Dayton Superior.
 - f. Euclid Chemical Company (The), an RPM company; Kurez W VOX.
 - g. Kaufman Products, Inc.; Thinfilm 420.
 - h. Lambert Corporation; AQUA KURE CLEAR.
 - i. L&M Construction Chemicals, Inc.; L&M CURE R.
 - j. Meadows, W. R., Inc.; 1100-CLEAR SERIES.
 - k. Nox-Crete Products Group; Resin Cure E.
 - I. SpecChem, LLC; PaveCure Rez.
 - m. Symons by Dayton Superior; Resi-Chem Clear.
 - n. Tamms Industries, Inc., Euclid Chemical Company (The); TAMMSCURE WB 30C.
 - o. TK Products, Division of Sierra Corporation.
 - p. Vexcon Chemicals Inc.; Certi-Vex Enviocure 100.
- F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 2, Class B, dissipating.

- 2.7 <u>Related Materials:</u>
 - A. Joint Fillers: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork in preformed strips.
 - B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
 - C. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
 - D. Epoxy-Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
 - E. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a) Anti-Hydro International, Inc.; A-H S-Q Hardener.
 - b) BASF Construction Chemicals, LLC; Mastercron.
 - c) ChemMasters; ConColor
 - d) Conspec by Dayton Superior; Conshake 600 Colortone
 - e) Dayton Superior Corporation; Quartz Tuff
 - f) Euclid Chemical Company (The), an RPM company; Surflex
 - g) Lambert Corporation; COLORHARD
 - h) L&M Construction Chemicals, Inc.; QUARTZPLATE FF.
 - i) Metalcrete Industries; Floor Quartz
 - j) Scofield, L.M. Company; LITHOCHROME Color Hardener
 - k) Southern Color N.A., Inc.; Mosaics Color Hardener
 - I) Stampcrete International, Ltd.; Color Hardener
 - m) Symons by Dayton Superior; Hard Top
 - 2. Color: Sample to be approved by Landscape Architect.
 - F. Pigmented Mineral Dry-Shake Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, non-fading mineral oxides interground with cement.
 - 1. Color: As selected by Landscape Architect from manufacturer's full range
 - G. Rock Salt: Sodium chloride crystals, kiln dried, coarse gradation with 100 percent passing 3/8-inch sieve and 85 percent retained on a No. 8 sieve.

2.8 <u>Stamped Detactable Warning Materials:</u>

A. Detectable Warning Stamp: Semirigid polyurethane mats with formed underside capable of imprinting detectable warning pattern on plastic concrete; perforated with a vent hole at each dome.

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

following:

a. Advanced Surfaces Inc.

- b. Matcrete Precision Stamped Concrete Tools.
- c. Southern Color N.A., Inc.
- d. Stampcrete International Ltd.
- e. Superior Decorative by Dayton Superior.
- 2. Size of Stamp: One piece, matching detectable warning area shown on Drawings.
- B. Liquid Release Agent: Manufacturer's standard, clear, evaporating formulation designed to facilitate release of stamp mats.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Advanced Surfaces Inc.; Liquid Release.
 - b. Matcrete Precision Stamped Concrete Tools; Liquid Release Agent.
 - c. Southern Color N.A., Inc.; SCC Clear Liquid Release.
 - d. Stampcrete International Ltd.; Stampcrete Liquid Release.
 - e. Superior Decorative by Dayton Superior; Pro Liquid Release.
- 2.9 Concrete Mixtures:
 - A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
 - 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.
 - B. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash or Pozzolan: 25 percent.
 - 2. Slag Cement: 50 percent.
 - 3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
 - C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 1. Air Content: 3-5 percent.
 - D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
 - E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture in concrete as required for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

- F. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate.
- G. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.
- H. Concrete Mixtures: Normal-weight concrete.
 - 1. Compressive Strength (28 Days): 3500 psi min.
 - 2. Maximum W/C Ratio at Point of Placement: 0.50.
 - 3. Slump Limit: 4 inches plus or minus 1 inch.
- 2.10 <u>Concrete Mixing:</u>
 - A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M and ASTM C1116/C1116M. Furnish batch certificates for each batch discharged and used in the Work.
 - When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
 - B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 — EXECUTION

- 3.1 <u>Examination</u>:
 - A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
 - B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
 - 1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
 - 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 "Earth Moving."
 - C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 <u>Preparation</u>:

- A. Remove loose material from compacted subbase surface immediately before placing concrete.
- 3.3 Edge Forms and Screed Construction:
 - A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
 - B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.
- 3.4 <u>Steel Reinforcement Installation:</u>
 - A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 - B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
 - C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
 - D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
 - E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinccoated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.
 - F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963/D3963M.
 - G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 Joints:

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Provide tie bars at sides of paving strips where indicated.

- 3. Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
- 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of 30 feet unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 - 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes.
 - a) Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
 - 2. Sawed Joints: Not allowed.
 - 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes.
- 3.6 <u>Concrete Placement:</u>
 - A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
 - B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
 - C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an opentextured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
- L. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.
- 3.7 <u>Float Finishing:</u>
 - A. General: Do not add water to concrete surfaces during finishing operations.
 - B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 - 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
 - 2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.
 - 3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.
- 3.8 <u>Special Finishes:</u>

- A. Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in paving surface as follows:
 - 1. Immediately after float finishing, spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
 - 2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
 - 3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
 - 4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.
- B. Seeded Exposed-Aggregate Finish: Immediately after initial floating, spread a single layer of aggregate uniformly on paving surface. Tamp aggregate into plastic concrete and float finish to entirely embed aggregate with mortar cover of 1/16 inch.
 - 1. Spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
 - 2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove sheeting when ready to continue finishing operations.
 - 3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
 - 4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.
- C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on paving surface according to manufacturer's written instructions and as follows:
 - 1. Uniformly spread per manufacturers recommendations of dampened, slip-resistive aggregate over paving surface in two applications. Tamp aggregate flush with surface using a steel trowel, but do not force below surface.
 - Uniformly distribute approximately two-thirds of slip-resistive aggregate over paving surface with mechanical spreader, allow to absorb moisture, and embed by power floating. Follow power floating with a second slipresistive aggregate application, uniformly distributing remainder of material at right angles to first application to ensure uniform coverage and embed by power floating.
 - 3. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
 - 4. After curing, lightly work surface with a steel-wire brush or abrasive stone and water to expose nonslip aggregate.
- D. Rock-Salt Finish: After initial brooming, uniformly spread rock salt over paving surface at the rate of 5 lb/100 sq. ft..
 - 1. Embed rock salt into plastic concrete with magnesium float.
 - 2. Cover paving surface with 1-mil thick polyethylene sheet and remove sheet when concrete has hardened, and seven-day curing period has elapsed.
 - 3. After seven-day curing period, saturate concrete with water and broomsweep surface to dissolve remaining rock salt, thereby leaving pits and holes.
- E. Pigmented Mineral Dry-Shake Hardener Finish: After initial floating, apply dryshake materials to paving surface according to manufacturer's written instructions and as follows:
 - 1. Uniformly spread dry-shake hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer to match paving color required.
 - 2. Uniformly distribute approximately two-thirds of dry-shake hardener over the concrete surface with mechanical spreader; allow hardener to absorb moisture and embed it by power floating. Follow power floating with a second application of pigmented mineral dry-shake hardener, uniformly distributing remainder of material at right angles to first application to ensure uniform color, and embed hardener by final power floating.
 - 3. After final power floating, apply a hand-troweled finish followed by a broom finish.
 - 4. Cure concrete with curing compound recommended by dry-shake hardener manufacturer. Apply curing compound immediately after final finishing.
- 3.9 <u>Detectable Warning Installation:</u>
 - A. Blockouts; Form blockouts in concrete installation of detectable paving units specified in Section 32 17 26 "Tactile Warning Surfacing".
 - 1. Tolerance for Opening Size: Plus 1/4 inch, no minus.
- 3.10 Concrete Protection and Curing:
 - A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
 - B. Comply with ACI 306.1 for cold-weather protection.
 - C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
 - D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
 - E. Curing Methods: Cure concrete by moisture curing as follows:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

- a) Water.
- b) Continuous water-fog spray.
- c) Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
- F. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moistureretaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.
- G. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.
- 3.11 <u>Paving Tolerances:</u>
 - A. Comply with tolerances in ACI 117 and as follows:
 - 1. Elevation: 1/4 inch.
 - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 - 3. Surface: Gap below 10-feet long; unleveled straightedge not to exceed 1/4 inch.
 - 4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
 - 5. Lateral Alignment and Spacing of Dowels: 1 inch.
 - 6. Vertical Alignment of Dowels: 1/4 inch.
 - 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
 - 8. Joint Spacing: 3 inches.
 - 9. Contraction Joint Depth: Plus 1/4 inch, no minus.
 - 10. Joint Width: Plus 1/8 inch, no minus.
- 3.12 Field Quality Control:
 - A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 - B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain at least one composite sample for each 5000 sq. ft. or fraction thereof of each concrete mixture placed each day.
 - a) When frequency of testing will provide fewer than five compressivestrength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

- 3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
- 4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
- 5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
- 6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.
 - a) A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Landscape Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Landscape Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Landscape Architect.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.
- 3.13 <u>Repair and Protection:</u>
 - A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Landscape Architect.
 - B. Drill test cores, where directed by Landscape Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in

satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 13 13

SECTION 32 13 73 — CONCRETE PAVING JOINT SEALANTS

<u>PART 1 — GENERAL</u>

- 1.1 <u>Related Documents</u>:
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2 <u>Summary:</u>
 - A. Section Includes:
 - 1. Cold-applied joint sealants.
 - 2. Hot-applied joint sealants.
 - 3. Cold-applied, fuel-resistant joint sealants.
 - 4. Hot-applied, fuel-resistant joint sealants.
 - 5. Joint-sealant backer materials.
 - 6. Primers.
- 1.3 <u>Preinstallation Meetings:</u>
 - A. Preinstallation Conference: Conduct conference at Project site.
- 1.4 <u>Action Submittals:</u>
 - A. Product Data: For each type of product.
 - B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
 - C. Paving-Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.
- 1.5 Informational Submittals:
 - A. Qualification Data: For testing agency.
 - B. Product Certifications: For each type of joint sealant and accessory.
- 1.6 <u>Quality Assurance:</u>
 - A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - B. Product Testing: Test joint sealants using a qualified testing agency.
- 1.7 <u>Field Conditions:</u>
 - A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.

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- 2. When joint substrates are wet.
- 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
- 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 — PRODUCTS

- 2.1 <u>Materials, General:</u>
 - A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- 2.2 <u>Cold-Applied Joint Sealants:</u>
 - A. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D5893/D5893M, Type NS.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Crafco Inc., an ERGON company; RoadSaver Silicone.
 - b. Dow Corning Corporation; 888.
 - c. Pecora Corporation; 301 NS.
 - B. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D5893/D5893M, Type SL.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Crafco Inc., an ERGON company; RoadSaver Silicone SL.
 - b. Dow Corning Corporation; 890-SL.
 - c. Pecora Corporation; 300 SL.
- 2.3 <u>Hot-Applied Joint Sealants:</u>
 - A. Hot-Applied, Single-Component Joint Sealant: ASTM D6690, Type I, II, or III
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Meadows, W. R., Inc.; Sealtight Hi-Spec.
 - b. Right Pointe; D-3405 Hot Applied Sealant.
- 2.4 <u>Cold-Applied, Fuel-Resistant Joint Sealants:</u>
 - A. General: Provide joint-sealant backer materials that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
 - B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

- 2.5 <u>Hot-Applied, Fuel-Resistant Joint Sealants:</u>
 - A. Hot-Applied, Fuel-Resistant, Single-Component Joint Sealants: ASTM D7116, Type I or Type II.
 - B. Hot-Applied, Fuel-Resistant, Single-Component Joint Sealants: ASTM D7116, Type III.
- 2.6 Joint-Sealant Backer Materials:
 - A. Joint-Sealant Backer Materials: Non-staining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.
 - B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
 - C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
 - D. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.
- 2.7 <u>Primers:</u>
 - A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 — EXECUTION

- 3.1 <u>Examination</u>:
 - A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
 - B. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.2 <u>Preparation:</u>
 - A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction jointsealant-substrate tests or prior experience. Apply primer to comply with jointsealant manufacturer's written instructions. Confine primers to areas of jointsealant bond; do not allow spillage or migration onto adjoining surfaces.

- 3.3 Installation of Joint Sealants:
 - A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
 - B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.
 - C. Install joint-sealant backings to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of joint-sealant backings.
 - 2. Do not stretch, twist, puncture, or tear joint-sealant backings.
 - 3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
 - D. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:
 - 1. Place joint sealants so they fully contact joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
 - E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
 - 1. Remove excess joint sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.
- 3.4 <u>Cleaning and Protection:</u>
 - A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.
 - B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.
- 3.5 <u>Paving-Joint Sealant Schedule:</u>
 - A. Joint-Sealant Application: Joints within concrete paving.
 - 1. Joint Location:
 - a) Expansion and isolation joints in concrete paving.

- b) Contraction joints in concrete paving.
- c) Other joints as indicated.
- 2. Joint Sealant: Single-component, nonsag, silicone joint sealant] [Single-component, self-leveling, silicone joint sealan.
- 3. Joint-Sealant Color as indicated on drawings.
- B. Joint-Sealant Application: Joints within concrete paving and between concrete and asphalt paving.
 - 1. Joint Location:
 - a) Joints between concrete and asphalt paving.
 - b) Joints between concrete curbs and asphalt paving.
 - c) Other joints as indicated.
 - 2. Joint Sealant: Hot-applied, single-component joint sealant.
 - 3. Joint-Sealant Color: Manufacturer's standard.
- C. Joint-Sealant Application: Fuel-resistant joints within concrete paving.
 - 1. Joint Location:
 - a) Expansion and isolation joints in concrete paving.
 - b) Contraction joints in concrete paving.
 - c) Other joints as indicated.
- D. Joint Sealant: Fuel-resistant, single-component, pourable, modified-urethane, elastomeric joint sealant.
- E. Joint-Sealant Color: Manufacturer's standard.

END OF SECTION 32 13 73

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SECTION 321400 - UNIT PAVING

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. Brick pavers.
 - 2. Concrete pavers.
 - B. Related Requirements:
 - 1. Section 321313 "Concrete Paving" for concrete base under unit pavers.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. For materials other than water and aggregates.
 - 2. For the following:
 - a. Pavers.
 - b. Mortar and grout materials.
- B. Sustainable Design Submittals:
- C. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C136.
- D. Samples for Initial Selection: For each type of unit paver indicated and the following:
 - 1. Joint materials involving color selection.
 - 2. Precast concrete curbs.
- E. Samples for Verification: For full-size units of each type of unit paver indicated. Assemble no fewer than five Samples of each type of unit on suitable backing and grout joints. Include Samples of the following:
 - 1. Joint materials.
 - 2. Precast concrete curbs.
- F. Compatibility and Adhesion Test Reports: From latex-additive manufacturer for mortar and grout containing latex additives.
- 1.4 INFORMATIONAL SUBMITTALS
 - A. Qualification Data: For Installer.
 - B. for mortar and grout containing latex additives.
- 1.5 QUALITY ASSURANCE
 - A. Installer Qualifications: A qualified unit paving installer. Installer's field supervisor shall have Concrete Paver Installer Certification from the Interlocking Concrete Pavement Institute (ICPI) with the following designations:

- 1. Commercial Paver Technician Designation.
- B. Preconstruction Compatibility and Adhesion Testing: Submit to latex-additive manufacturer, for testing indicated below, samples of paving materials that will contact or affect mortar and grout that contain latex additives.
 - 1. Use manufacturer's standard test methods to determine whether mortar and grout materials will obtain optimum adhesion with, and will be nonstaining to, installed pavers and other materials constituting paver installation.
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.
 - B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
 - C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
 - D. Store liquids in tightly closed containers protected from freezing.
- 1.7 FIELD CONDITIONS
 - A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.
 - B. Weather Limitations for Mortar and Grout:
 - Cold-Weather Requirements: Protect unit paver work against freezing when ambient temperature is 40 deg F and falling. Heat materials to provide mortar and grout temperatures between 40 and 120 deg F. Provide the following protection for completed portions of work for 24 hours after installation when the mean daily air temperature is as indicated: below 40 deg F, cover with weather-resistant membrane; below 25 deg F, cover with insulating blankets; below 20 deg F, provide enclosure and temporary heat to maintain temperature above 32 deg F.
 - 2. Hot-Weather Requirements: Protect unit paver work when temperature and humidity conditions produce excessive evaporation of setting beds and grout. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F (38 deg C) and higher.

a. When ambient temperature exceeds 100 deg F (38 deg C), or when wind velocity exceeds 8 mph (13 km/h) and ambient temperature exceeds 90 deg F (32 deg C), set pavers within 1 minute of spreading setting-bed mortar.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS
 - A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.
- 2.2 CONCRETE PAVERS
 - A. Manufacturer: Tremron Pavers or approved equal.
 - 1. Face Size and Shape: 4" X 8" colored concrete paver.
 - 2. Thickness: 60 MM for light duty applications.
 - 3. Colors: Charcoal, Natural Grey, and White, see plans for pattern layout.
 - 4. Finish: Standard Finish.
 - 5. Surface Texture: Flat Top
- 2.3 CURBS AND EDGE RESTRAINTS
 - A. Job-Built Concrete Edge Restraints: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mixed concrete with minimum 28-day compressive strength of 3000 psi (20 MPa).
- 2.4 ACCESSORIES
 - A. Cork Joint Filler: Preformed strips complying with ASTM D1752, Type II.
 - B. Compressible Foam Filler: Preformed strips complying with ASTM D1056, Grade 2A1.
- 2.5 SETTING-BED MATERIALS
 - A. Sand: ASTM C144.
- 2.6 JOINT MATERIALS
 - A. Polymeric Jointing Sand: Techniseal HP Nextgel Polymeric Jointing Sand or approved equal.
 - B. Color: Ivory, or approved equal.

PART 3 - EXECUTION

- 3.1 EXAMINATION
 - A. Examine surfaces indicated to receive unit paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
 - B. Where unit paving is to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.
 - C. Proceed with installation only after unsatisfactory conditions have been corrected and waterproofing protection is in place.
- 3.2 PREPARATION
 - A. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.
 - B. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.
- 3.3 INSTALLATION, GENERAL
 - A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.
 - B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
 - C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
 - 1. For concrete pavers, a block splitter may be used.
 - D. Handle protective-coated brick pavers to prevent coated surfaces from contacting backs or edges of other units. If, despite these precautions, coating does contact bonding surfaces of brick, remove coating from bonding surfaces before setting brick.
 - E. Joint Pattern: As indicated on drawings.
 - F. Tolerances:
 - 1. Do not exceed 1/16-inch (1.6-mm) unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches (3 mm in 600 mm) and] 1/4 inch in 10 feet (6 mm in 3 m) from level, or indicated slope, for finished surface of paving.
 - G. Expansion and Control Joints:
 - 1. Provide for sealant-filled joints at locations and of widths indicated. Provide compressible foam filler as backing for sealant-filled joints. Install joint filler before setting pavers. Sealant materials and installation are specified in Section 079200 "Joint Sealants."
 - 2. Provide joint filler at locations and of widths indicated. Install joint filler before setting pavers. Make top of joint filler flush with top of pavers.

- H. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.
 - 1. Install job-built concrete edge restraints to comply with requirements in Section 033000 "Cast-in-Place Concrete."
- I. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation.
- J. Spaced Joint Widths: Provided per built in spacers.

END OF SECTION 321400

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SECTION 32 14 43

POROUS UNIT PAVING

(Formerly 32 12 43 Porous Flexible Paving)

Notes: This section covers Grasspave2 Porous Pavement System from Invisible Structures. The system provides vehicular and heavy load support over grass areas while protecting grass roots from harmful effects of traffic. The major components of the complete system are the Grasspave2 units, an engineered base course, Hydrogrow soil amendment/fertilizer, sand, and grass from seed, hydromulch, or sod. Consult Invisible Structures, Inc. for assistance in editing this section for the specific application.

PART 1- GENERAL

SECTION INCLUDES

A. Porous pavement system.

RELATED SECTIONS

Geotechnical Investigation

Earthmoving

Plants, Soil, Sod

Irrigation

REFERENCES

- A. ASTM F 1951-08 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.
- B. ASTM D 638-10 Standard Test Method for Tensile Properties of Plastics
- C. ASTM C 33 Standard Specification for Concrete Aggregates
- D. AASHTO M6 Standard Specification for Fine Aggregate for Hydraulic Cement Concrete

SYSTEM DESCRIPTION

- 1. The Grasspave2 porous pavement system provides vehicular and pedestrian load support for grass areas, while protecting grass roots from harmful effects of traffic.
- 2. Major Components of the Complete System
 - a. Grasspave2 units, assembled in rolls.
 - b. Engineered sand and gravel base course.
 - c. Hydrogrow soil amendment and fertilizer, supplied with Grasspave2.
 - d. Sand fill or USGA greens mix.
 - e. Selected grass from seed, hydroseeding/hydro-mulching, or sod.
 - f. Selected topsoil (only for seeded installation).
 - g. Mulch (needed only for seeded or hydroseeded installations).
- 3. The Grasspave2 grass paving units, sand, and base course work together to support imposed loading.
- 4. The Grasspave2 grass paving units, Hydrogrow, and sand fill contribute to vegetation support.

SUBMITTALS

- 1. Submit under provisions of Section 01 30 00.
- 2. Shop Drawings: Submit design detail showing proper cross-section.

- 3. Samples: Submit manufacturer's sample of Grasspave2 10" x 10" section of Grasspave2 material.
- 4. Installation Instructions: Manufacturer's printed installation instructions. Include methods for maintaining installed products.
- 5. Certificates:
 - a. Manufacturer signed certificate stating the product is made in the USA.
 - b. Submit Material Certificates for base course and sand (or USGA mix) fill materials
 - c. Product certificates signed by the manufacturer certifying material compliance of polyethylene used to make Grasspave2 units.
 - d. ISO Certificate certifying manufacturer's quality management system is currently registered to ISO 9001:2008 quality standards.
- 6. Manufacturer's Material Certification: Product manufacturers shall provide certification of compliance with all applicable testing procedures and related specifications upon written request. Request for certification shall be submitted by the purchasing agency no later than the date of order placement.
- 7. Manufacturer Quality Certification: ISO Certification certifying manufacturer's quality management system for its Grasspave2 system is currently registered to ISO 9001:2008 quality standards. Any alternate materials submitted shall provide a certification that their porous pavement system manufacturing process is part of an ISO program and a certification will be required specifically stating that their testing facility is certified and in accordance with ISO.

DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect Grasspave2 units/rolls from damage during delivery and store rolls upright, under tarp, to protect
- C. from sunlight, when time for delivery to installation exceeds one week.
- D. Store Hydrogrow in a dark and dry location
- E. Handling: Protect materials during handling and installation to prevent damage

MAINTENANCE SERVICE

Notes: Once healthy turf has been established, the cell wall structure will have minimal visibility when proper turf maintenance practices are followed.

- A. Installer responsible for maintenance of grass plants water/irrigation, fertilizing, mowing for one
- B. growing season. DO NOT AERATE. See Grasspave2 Maintenance Guide from Invisible Structures System to be maintained by Owner after one growing season.

PROJECT CONDITIONS

- A. Maintain environmental conditions within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Do not begin installation of porous pavements until all hard surface paving adjacent to porous pavement areas, including concrete walks and asphalt paving, is completed.
- C. Install turf when ambient air temperatures is at least 55 degrees F (13 degrees C).
- D. In cold weather, do not use frozen materials or materials mixed or coated with ice or frost, and do not build on frozen base or wet, saturated or muddy subgrade.
- E. Protect partially completed paving against damage from other construction traffic when work is in progress.
- F. Adequately water sod or grass seed to assure germination of seed and growth of root system.
- G. Grass coverage on the sand-filled Grasspave2 rings must be completed within one week: See Part 3 Execution.
- H. DO NOT DRIVE, PARK ON, or use Grasspave2 system for two or three mowing cycles until grass root system has matured (about 3 to 4 weeks for sod or 6 to 8 weeks for seeded areas). Any barricades constructed must still be accessible by emergency and fire equipment during and after installation.

LIMITED WARRANTY

- A. Invisible Structures, Inc. (ISI) warrants to its purchasers that all products furnished by ISI will be free from defects in material and/or workmanship.
- B. This warranty shall be extended for a period of five (5) years following the date of shipment by ISI.
- C. Providing a written claim is presented to ISI within the warranty period and after inspection by ISI showing the materials have failed under this warranty, all defective materials shall be refurnished under this warranty, at no charge, excluding reinstallation costs. This in lieu of all other warranties expressed or implied and is the sole warranty extended by ISI.
- D. Our liability under this warranty is limited to the refurnishing of materials and does not include any responsibility for incidental, consequential, or other damages of any nature.

PART 2 - PRODUCTS

MANUFACTURERS

A. Acceptable Manufacturer: Invisible Structures, Inc., which is located at: 3510 Himalaya Rd. Suite 200; Aurora, CO 80011; Tel: 303-233-8383; Web: www.invisiblestructures.com.

GRASSPAVE2

- A. Composition:
 - 1. Manufactured in the USA.
 - 2. High density polyethylene (HDPE): 100 percent recycled materials.
 - 3. Color: black
 - 4. Color Uniformity: Uniform color throughout all units rolls.

- 5. Carbon Black for ultraviolet light stabilization.
- 6. Hydrogrow soil amendment and fertilizer, provided by manufacturer with Grasspave2.
- B. Performance Properties:
 - 1. Maximum Loading Capability: 15,940 psi (2.29 million psf, 109,906 kPa) when filled with sand.
 - 2. Wheelchair Access testing for ADA Compliance: Passing ASTM F 1951-08.
 - 3. Wheelchair Access testing for ADA Compliance: Passing Rotational Penetrometer testing.
 - 4. Tensile strength, pull-apart testing: 458 lbf/in from ASTM D638 Modified.
 - 5. System Permeability (Grasspave2, sand, base course): 2.63 to 38.55 inches of water per hour.
 - 6. Effective Imperviousness (E.I.): 10%.
- C. Dimensions (individual units are assembled and distributed into rolls):
 - 1. Roll area: From 108 sq ft (10 sq m) to 538 sq ft (50 sq m), in 108 sq ft (10 sq m) increments
 - 2. Roll Widths: From 3.3 ft (1 m) to 8.2 ft (2.5 m), in 1.6 ft (0.5 m) increments.
 - 3. Roll Lengths: From 32.8 ft (10m) to 65.6 ft (20 m), in 3.3 ft (1 m) increments.
 - 4. Roll Weights: From 41 lbs (19kg) to 205 lbs (93kg), in 41 lbs (19 kg) increments.
 - 5. Unit Nominal Width by Length: 20 inches by 20 inches (0.5 m by 0.5 m) or 40 inches by 40 inches (1 m by 1 m).
 - 6. Nominal Depth: 1 inch (2.5 cm) for rolls and individual units.

- 7. Unit Weight: 18 oz (510 g) or 5 lbs. (2.27 kg).
- 8. Volume Solid: 8 percent.

SYSTEM MATERIALS

Notes: All measurements are subject to manufacturing tolerances, unless otherwise specified.

- A. Base Course: Sandy gravel material from local sources commonly used for road base construction (recycled materials such as crushed concrete or crushed asphalt are NOT acceptable).
 - 1. Conforming to the following sieve analysis and requirements:
 - a. 100 percent passing sieve size 1 inch (25 mm).
 - b. 80-100 percent passing sieve size 3/4 inch (19 mm).
 - c. 60-80 percent passing sieve size 3/8 inch (9 mm).
 - d. 40-60 percent passing sieve size #4.
 - e. 25-40 percent passing sieve size #10.
 - f. 5-25 percent passing sieve size #40.
 - g. 0-5 percent passing sieve size #200.
 - 2. Provide a base course material nearly neutral in pH (range from 6.5 to 7.2) to provide adequate root zone development for turf.
 - 3. Material may be either "pit run" or "crusher run." Avoid using clay based crusher run/pit run. Crusher run material will generally require coarse, well-draining sand conforming to AASHTO M6 to be added to mixture (20 to 30 percent by volume) to ensure long-term porosity.
 - 4. Alternative materials such as crushed shell, limerock, or crushed lava may be used for base course use, provided they are mixed with sharp sand (20 to 30 percent) to ensure long-term porosity, and are brought to proper compaction.

Without added sand, crushed shell and limerock set up like concrete and become impervious.

5. Alternative size and/or composition of base course materials should be submitted to Invisible Structures, Inc. (Manufacturer) for approval.

- B. Sand Fill for Rings and Spaces Between Rings: Clean sharp sand (washed concrete sand). Choose one of the following:
 - i. Coarse, well-draining sand, such as washed concrete sand conforming to AASHTO M6 or ASTM C-33.
 - ii. United States Golf Association (USGA) greens, section sand mix "The Root Zone Mixture."
- C. Turf Conditioner:
 - 1. Hydrogrow a proprietary soil amendment manufactured by Invisible Structures, Inc. and provided with Grasspave2.
 - 2. NO SUBSTITUTIONS.

Notes: Use grass species resistant to wear by traffic generally a Blue/Rye/Fescue mix used for athletic fields in northern climates, and Zoysia, Fescue, or Bermuda types in southern climates. Check with local sod and seed suppliers for preferred mixtures. Dedicated fire lanes can use same grass species used on surrounding turf. Parking applications require greatest wear-resistant species possible, generally available only by seed or hydroseeding/hydro-mulching.

- D. Grass
 - 1. Sod: Use 1/2" thick rolled sod from a reputable local grower. Species should be wear resistant, free from disease, and in excellent condition. Sod shall be grown in sand or sandy load soils only. Sod grown in soils of clay, silt, or high organic materials such as peat, will not be accepted.

PART 3 - EXECUTION

INSPECTION

- A. Examine subgrade and base course installed conditions. Do not start porous paving installation until unsatisfactory conditions are corrected. Check for improperly compacted trenches, debris, and improper gradients.
- B. For fire lane installations: prior to installing base course for turf paving, obtain approval of local fire authorities of sub-base.
- C. Start of installation constitutes acceptance of existing conditions and responsibility for satisfactory performance. If existing conditions are found unsatisfactory, contact Architect for resolution.

PREPARATION

Notes: Ensure that subbase materials are structurally adequate to receive designed base course, wearing course, and designed loads. Generally, excavation into undisturbed normal strength soils will require no additional modification. Fill soils and otherwise structurally weak soils may require modifications, such as geotextiles, geogrids, and/or compaction (not to exceed 90%). Ensure that grading and soil porosity of the subbase will provide adequate subsurface drainage.

- A. Subgrade Preparation:
 - 1. Prepare subgrade as specified in the project Geotechnical Report and the porous paving system manufacturer's instructions.
 - 2. Proper subgrade preparation will enable the Grasspave2 rolls/units to connect properly and remain level and stationary after installation.
 - 3. Excavate area allowing for unit thickness, the engineered base depth (where required), and 0.5 inch (1.25 cm) for depth of sod root zone or topsoil germination area (when applicable).
 - 4. Provide adequate drainage from excavated area if area has potential to collect water, when working with in-place soils that have poor permeability.

- 5. Ensure in-place soil is relatively dry and free from standing water.
- 6. Uniformly grade base.
- 7. Level and clear base of large objects, such as rocks and pieces of wood.
- B. Base Preparation:
 - 1. Install Base as specified in Section 32 10 00. Verify engineered base (if Required) is installed in accordance with porous paving system manufacturer's instructions.
 - 2. Coordinate base installation and preparation with subdrains specified in Section 33 46 00.
 - 3. If required, place a geotextile separation layer between the natural ground and the 'engineered base'.
 - 4. If required, install the specified sub-drain and outlet according to construction drawings.
 - 5. Coordinate base installation and preparation with irrigation and drip irrigation lines specified in Section 32 84 00.
 - 6. Place engineered base in lifts not to exceed 6 inches (150 mm), compacting each lift separately to 95 percent Modified Proctor.
 - 7. Leave 1 inch (2.5 cm) of depth below final grade for porous paver unit and sand fill and 0.5 inch (1.25 cm) for depth of sod root zone or topsoil germination area (when applicable).

ON-SITE MANUFACTURER'S FIELD REPRESENTATIVE

- A. A qualified Manufacturer's field representative shall be available for a preconstruction meeting via phone or in person and will provide installation videos, design details, installation instructions, and the technical specifications.
- B. The time for on-site observation shall be indicated in the Contract Documents and included in the base bid price.

HYDROGROW INSTALLATION

- A. Spread all Hydrogrow mix provided (spreader rate = 4.53 kg per 100 m2 (10 lbs per 1076 ft2) evenly over the surface of the base course with a hand-held, or wheeled, rotary spreader.
- B. The Hydrogrow mix should be placed immediately before installing the Grasspave2.

GRASSPAVE2 INSTALLATION

- A. Install the Grasspave2 units by placing units with rings facing up, and using snapfit connectors, pegs and holes, provided to maintain proper spacing and interlock the units. Units can be easily shaped with pruning shears or knife. Units placed on curves, slopes, and high traffic areas shall be anchored to the base course, using 40d common nails with fender washer, as required to secure units in place. Tops of rings shall be between 6 mm to 13 mm (0.25" to 0.5") below the surface of adjacent hard-surface pavements.
- B. Install sand in rings as they are laid in sections by "back-dumping" directly from a dump truck, or from buckets mounted on tractors, which then exit the site by driving over rings already filled with sand. The sand is then spread laterally from the pile using flat bottomed shovels and/or wide "asphalt rakes" to fill the rings. A stiff bristled broom should be used for final "finishing" of the sand. The sand must be "compacted" by using water from hose, irrigation heads, or rainfall, with the finish grade no less than the top of rings and no more than 6 mm (0.25") above top of rings.

INSTALLATION OF GRASS

A. Grass coverage on the sand-filled rings must be completed within one week. Sand must be re-installed and leveled and Grasspave2 checked for integrity if rings become exposed due to wind, rain, traffic, or other factors. (Choose one paragraph below to meet grass installation method desired.)

- Install thin sod directly over sand filled rings, filled no higher than the top of the rings. Sod strips should be placed with very tight joints. Sodded areas must be fertilized and kept moist during root establishment (minimum of 3 weeks). DO NOT DRIVE ON SYSTEM: Sodded areas must be protected from any traffic, other than emergency vehicles, for a period of 3 to 4 weeks, or until the root system has penetrated and established well below the Grasspave2 units.
- B. Adequately water sod to assure germination of seed and growth of root system.

PROTECTION

A. Sodded areas must be protected from any traffic, other than emergency vehicles, for a period of 3 to 4 weeks, or until the root system has penetrated below the Grasspave2 units.

FIELD QUALITY CONTROL

- A. Remove and replace segments of Grasspave2 units where three or more adjacent rings are broken or damaged, reinstalling as specified, so no evidence of replacement is apparent.
- B. Perform cleaning during the installation of work and upon completion of the work. Remove all excess materials, debris, and equipment from site. Repair any damage to adjacent materials and surfaces resulting from installation of this work.

MAINTENANCE

- A. Maintain grass in accordance with manufacturer's instructions and as specified in Section 32 92 00 Manufacturers of Turfs and Grasses.
- B. Lawn Care: Normal turf care procedures should be followed, including dethatching.

- C. DO NOT AERATE. Aerator will damage the Grasspave2 units. Aeration in not necessary in a sand root zone.
- D. When snow removal is required, keep a metal edged plow blade a minimum of ³/₄ inch (17 mm) above the surface during plowing operations to avoid causing damage to the Grasspave2 units, or
 - 1. Use a plow blade with a flexible rubber edge, or
 - 2. Use a plow blade with skids on the lower outside corners set so the plow blade does not come in contact with the units.

END OF SECTION 32 14 43

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SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 - GENERAL

SCOPE

The work under this section consists of providing all work, materials, labor, equipment, and supervision necessary to provide and install pavement markings as provided for in these specifications and on the drawings. Included are the following topics:

Part 1 - GENERAL

Scope Related Work Reference Documents Submittals

Part 2 - MATERIALS

Pavement Markings

Part 3 - EXECUTION

Pavement Markings

RELATED WORK

Applicable provisions of Division 01 govern work under this Section.

Related Work Specified Elsewhere:

Section 30 05 00 – Common Work Results For All Exterior Improvements

SECTION 32 17 23 – PAVEMENT MARKINGS

1 OF 4

REFERENCE DOCUMENTS

Alabama Department of Transportation (ALDOT) Standard Specifications, Section 701 (Traffic Stripe)

Alabama Department of Transportation (ALDOT) Standard Specifications, Section 703 (Traffic Control Markings and Legends)

SUBMITTALS

Submit the manufacturer specifications for each pavement marking. The submittal for each material shall include the following at a minimum:

- Pavement Marking Material and Manufacturer
- Color and Batch Number
- Date Manufactured (Material more than one year old will not be accepted)
- Manufacturer Name and Address.

PART 2 - MATERIALS

PAVEMENT MARKINGS

Furnish Class 2 (thermoplastic) pavement markings conforming to ALDOT Sections 701 and 703.

PART 3 - EXECUTION

SECTION 32 17 23 – PAVEMENT MARKINGS

PAVEMENT MARKINGS

Prepare surface to receive markings and install them in accordance with ALDOT Section 701 and 703.

Apply pavement markings at the locations and to the dimensions and colors as shown on the drawings. If not otherwise specified, marking lines shall be yellow and have a minimum width of 4 inches.

Apply pavement markings at a rate per the manufacturers recommended application rate based on the temperature and surface material.

END OF SECTION 32 17 23

SECTION 32 17 23 – PAVEMENT MARKINGS

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SECTION 32 17 23 - PAVEMENT MARKINGS

SECTION 32 92 00 — TURF AND GRASSES

<u>PART 1 — GENERAL</u>

1.1 <u>Related Documents</u>: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 <u>Summary</u>:

- A. Section Includes:
 - 1. Seeding
 - 2. Sodding
 - 3. Meadow grasses and wildflowers
 - 4. Erosion-control material(s)
- B. Related Sections:
 - 1. Division 31 Section "Site Clearing" for topsoil stripping and stockpiling.
 - 2. Division 31 Section "Earthwork" for excavation, filling and backfilling, and rough grading.
 - 3. Division 32 Section "Plants" for trees, shrubs, groundcovers, and other plants.

1.3 <u>Definitions:</u>

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- C. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- D. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- E. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" drawing designations for planting soils.
- F. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- 1.4 <u>Preinstallation Meetings:</u>
 - A. Preinstallation Conference: Conduct conference at project site.

- 1.5 Informational Submittals:
 - A. Qualification Data: For landscape Installer.
 - B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
 - 1. Certification of each seed mixture for turfgrass sod, identifying source, including name and telephone number of supplier.
 - C. Product Certificates: For fertilizers, from manufacturer.
 - D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.
 - E. Material Test Reports: For existing surface soil and imported topsoil.
 - F. Planting Schedule: Indicating anticipated planting dates for each type of planting.
 - G. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of lawns during a calendar year. Submit before expiration of required initial maintenance periods.
- 1.6 <u>Closeout Submittals:</u>
 - A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf and meadows during a calendar year. Submit before expiration of required maintenance periods.
- 1.7 <u>Quality Assurance</u>:
 - A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of exterior plants, and experienced on landscape work with budgets of \$2,000,000.00 or more. Submit a letter stating such experience.
 - B. Installer's Field Supervision: Require Installer to maintain an experienced fulltime supervisor on Project site when work is in progress.
 - C. Pesticide Applicator: State licensed, commercial.
 - D. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
 - 1. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
 - 2. Report suitability of topsoil for plant growth. State-recommended qualities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.
 - E. The following codes and standards shall be observed:
 - 1. The Alabama Department of Transportation (ALDOT) Standard Specifications for Highway Construction, current edition.
 - 2. State and Federal laws, including for disease and insect control.
 - 3. Requirements of authorities having jurisdiction.
- 1.8 <u>Workmanship</u>:
 - A. Install all plant materials neatly.
 - B. Make minor adjustments to layout as may be required and requested by Landscape Architect at no additional cost to the Owner.
 - C. Coordinate delivery of all plant material with time of installation to prevent any plant material from being stockpiled on site longer than 24 hours.
 - D. Deliver materials in such a manner as to not damage or decrease the health and vigor of the plant materials. Store materials away from detrimental elements. Coordinate with General Contractor to secure a safe staging area.
 - E. Handle, load, unload, and transport materials carefully to avoid damage.
 - F. Maintain and protect plant materials as necessary to insure health and vigor.
- 1.9 <u>Delivery, Storage, and Handling:</u>
 - A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.
 - B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.
 - C. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk materials with appropriate certificates.
 - D. Deliver freshly dug sod that was harvested no more than 24 hours before laying.
 - E. Deliver sod after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set sod in shade, protect from weather and mechanical damage, and keep moist.
- 1.10 Job Conditions:
 - A. Planting Restrictions: Plant during the following period. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
 - 1. October / Fall to March / Spring
 - B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed according to manufacturer's written instructions and warranty requirements.
 - C. Coordination with Lawns: Plant trees and shrubs after finish grades are established and before planting lawns, unless otherwise acceptable to Landscape Architect.
 - D. When planting trees and shrubs after lawns, protect lawn areas and promptly repair damage caused by planting operations.

E. Do not plant when ground is frozen, snow covered, muddy, or when air temperature is below 45 degrees Fahrenheit.

1.11 Warranty:

- A. Special Warranty: Installer's standard form in which Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a) Death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, abuse by Owner, or incidents that are beyond Contractor's control.
 - b) Structural failures including plantings falling or blowing over.
 - c) Faulty operation of tree stabilization, edgings, tree grates.
 - d) Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- B. Warranty Periods from Date of Substantial Completion:
 - 1. Trees and Shrubs: One year.
 - 2. Ground Cover and Perennials: One Year.
 - 3. Include the following remedial actions as a minimum:
 - a) Remove dead exterior plants immediately. Replace immediately unless required to plant in the succeeding planting season.
 - b) Replace exterior plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
 - c) A limit of one replacement of each exterior plant will be required except for losses or replacements due to failure to comply with requirements.
 - d) Provide extended warranty for replaced plant materials; warranty period equal to original warranty period.
- 1.12 Contractor's Periodic Inspection:
 - A. During guarantee period, Contractor shall make periodic inspections of the project to satisfy himself that maintenance by the Owner is adequate.
 - B. Any methods or products which he deems not normal or detrimental to good plant growth shall be reported to the Owner in writing.
 - C. Failure to inspect and report shall be interpreted as approval and the Contractor shall be held responsible for any and all replacements.
- 1.13 <u>Maintenance Service:</u>
 - A. Initial Lawn Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:
 - 1. Seeded Lawns: 30 days from date of Substantial Completion.
 - a) When initial maintenance period has not elapsed before end of planting season, or if lawn is not fully established, continue maintenance during next planting season.
 - 2. Sodded Lawns: 30 days from date of Substantial Completion.

- B. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.
 - 1. During guarantee period, Contractor shall make periodic inspections of the project to satisfy himself that maintenance by the Owner is adequate.
 - 2. Any methods or products which he deems not normal or detrimental to good plant growth shall be reported to the Owner in writing.
 - 3. Failure to inspect and report shall be interpreted as approval and the Contractor shall be held responsible for any and all replacements.

PART 2 — PRODUCTS

- 2.1 <u>General:</u>
 - A. Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems.
- 2.2 <u>Seed</u>:
 - A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.
 - B. Seed Species: State-certified seed of grass species.
 - C. Seed Species: Seed of grass species as flows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 (1/2) percent weed seed.
- 2.3 <u>Turfgrass Sod:</u>
 - A. Turfgrass Sod: Approved, complying with TPI's "Specifications for Turfgrass Sod Materials" in its "Guideline Specifications to Turfgrass Sodding". Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.
 - B. Turfgrass Species: As indicated on the Drawings.
- 2.4 <u>Meadow Grasses and Wildflowers:</u>
 - A. Wildflower Seed: Fresh, clean, and dry new seed, of mixed species from the following supplier: Roundstone Native Seed LLC

Roundstone Native Seed LLC 9764 Raider Hollow Road Upton, KY. 42784 Ph. 888-531-2353 www.roundstoneseed.com

- B. Species Mixes:
 - 1. Mix 204 Native Power Line Woody Suppression Mix
 - 2. Mix 111 Southern Short Grass Meadow Mix
 - 3. Mix 133 Southern Showy Retention Basin Mix
- C. See Carrier: Inert material, sharp clean sand or perlite, or as recommended by supplier.

2.5 <u>Topsoil:</u>

- A. Topsoil shall be fertile, friable, sandy loam and a natural surface soil obtained from well areas reviewed by Landscape Architect and possessing characteristics of representative soils in the project vicinity that produce heavy growths of crops, grass, or other vegetation.
- B. Topsoil shall be free of subsoil, brush, organic litter, or objectionable weeds, clay, clots, stumps, stones, roots or other material harmful to plant growths or hindrance to planting or maintenance operations. Should regenerative materials be present in the soil, Contractor shall eradicate and remove such growth, both surface and root, which may appear in the imported material within one year following acceptance of the work.
- C. Topsoil shall not be handled in a frozen muddy condition. The acidity range shall be between 5.0 and 7.0 inclusive. The mechanical analysis of the soil shall be as follows:

<u>Sieve Size</u>	<u>Percent Passing</u>
1 inch mesh	99 – 100 percent
1/4 inch mesh	97 - 99 percent
No. 100 mesh	40 - 60 percent
No. 200 mesh	20 - 40 percent

- D. Topsoil shall be spread by the Landscape Contractor in all beds. The Landscape Contractor will be responsible for fine grading. Topsoil, regardless of the source, shall meet all requirements of the paragraph above.
 - 1. Topsoil depth to be 6", or as indicated in the Drawings.
- E. Stockpiled material that does not meet the requirements may, at the option of the contractor, be improved by screening and the addition of organic matter and chemical admixtures.

2.6 <u>Planting Soil Mixture:</u>

- A. Provide soil mix amended as per laboratory recommendations. Basic planting soil mix consists of:
 - 1. 50% topsoil (as described above)
 - 2. 50% prepared additives (by volume as follows)
 - 3. 3 parts humus (forest peat) or "Nature's Helper" by Klum
 - 4. 1 part sterilized cow manure, commercial fertilizer and lime as recommended in soil analysis.
- 2.7 <u>Fertilizer</u>:
 - A. Deliver fertilizer, mixed as specified, in original unopened standard size bags showing weight, analysis and name of manufacturer. Containers shall bear

manufacturer's guaranteed statement of analysis, or manufacturer's certificate of compliance covering analysis shall be furnished to Owner. Store fertilizer in such a manner that it shall be kept dry.

B. Base percentages of nitrogen, phosphorus, and potash on laboratory test recommendations as approved by Owner. For bidding, assume 20 percent nitrogen, 10 percent phosphorus, and 5 percent potash by weight. At least 50 percent of total nitrogen shall contain no less than 3 percent water-insoluble nitrogen. At least 60 percent of nitrogen content shall be derived from super-phosphate containing not less than 18 percent phosphoric acid or bone meal containing 25-30 percent phosphoric acid and 2-3 percent nitrogen. Potash shall be derived from muriate of potash containing 55-60 percent potash.

2.8 <u>Lime:</u>

A. Lime shall be agricultural limestone containing not less than 90 percent calcium and magnesium carbonates. Lime must be ground to such a fineness that not less than 90 percent must pass No. 8 mesh and not less than 25 percent must pass No. 100 mesh. Moisture is not to exceed 10 percent.

2.9 <u>Planting Accessories:</u>

A. Selective Herbicides: EPA registered and approved, of type recommended by manufacturer for application.

2.10 <u>Mulches:</u>

- A. Straw Mulch: Provide air-dry, clean, mildew and seed-free, salt hay or threshold straw of wheat, rye, oats, or barley.
 - 1. Shredded Mulch: Class A hay or straw mulch for seeding per AHD Section 860.03.
- B. Peat Mulch: Peat moss; natural, shredded, or granulated, fine texture, with pH range of 4 to 6 and water-absorbing capacity of 1100 to 2000%.
- C. Fiber Mulch: Biodegradable dyed-wood cellulose-fiber mulch, nontoxic, free of plant growth or germination-inhibitors, with maximum moisture content of 15% and a pH range of 4.5 to 6.5..
- D. Asphalt Emulsion Tackifier: Asphalt emulsion, ASTM D 977, Grade SS-1, nontoxic and free of plant growth or germination-inhibitors.
- E. Non-asphalt Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application, nontoxic and free of plant growth germination-inhibitors.
- 2.11 Erosion-Control Materials:
 - A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconutfiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.
 - B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd. (0.5 kg/sq. m), with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.

- C. Erosion-Control Mats: Cellular, non-biodegradable slope-stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface. Include manufacturer's recommended anchorage system for slope conditions.
- D. Products: Subject to compliance with requirements, following or equal.
 - 1. Invisible Structures, Inc.; Slopetame
 - 2. Products Company; Geoweb.
 - 3. Tenax Corporation USA; Tenweb.

PART 3 — EXECUTION

- 3.1 Examination:
 - A. Examine areas to receive lawns and grass for compliance with requirements and conditions affecting installation and performance of the Work.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in the soil within a planting area.
 - 2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 3. Uniformly moisten excessively dry soil that is not workable or which is dusty.
 - B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Landscape Architect and replace with new planting soil.
 - C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 <u>Preparation:</u>

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, and existing exterior plants from damage caused by planting operations.
 - 1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
 - 2. Protect grade stakes set by others until directed to remove them.
- B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Before commencing planting operations, location of grass areas and beds and outlines of areas to be planted shall be marked out on the ground, by the Contractor for approval by the Landscape Architect. Contact the Landscape Architect a minimum of 48 business hours in advance of the anticipated review of the layout.
- D. Planting operations shall be during favorable weather in which conditions are neither extremely cold or hot not to point that the risk of loss is too great. The Contractor shall inform the Landscape Architect of high risks due to weather.

- 3.3 <u>Turf Area Preparation:</u>
 - A. Limit lawn subgrade preparation to areas to be planted.
 - B. Newly Graded Subgrades: Grade will be brought to a level of 4" below finished grade by the General Contractor. The landscape contractor will spread 4" of topsoil, fine grading all lawn areas to finish grade. All areas shall have smooth and continual grade between the existing and fixed controls such as walks and curbs. Roll, scarify, rake and level as necessary to obtain true, even and firm lawn surfaces. All finished grades shall meet approval of the Landscape Architect before sodded or seeding operations begin.
 - 1. Apply fertilizer directly to subgrade before loosening.
 - 2. Thoroughly blend planting soil mix off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.
 - a) Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
 - b) Mix lime with dry soil before mixing fertilizer.
 - 3. Spread planting soil mix to a depth of 4" but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
 - a) Spread approximately 1/2 the thickness of planting soil mix over loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil mix.
 - b) Reduce elevation of planting soil to allow for soil thickness of sod.
 - C. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
 - D. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
 - E. Before planting, restore areas if eroded or otherwise disturbed after finish grading.
 - F. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 Preparation for Erosion-Control Materials:

- A. Prepare area as specified in the drawings.
- B. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.
- C. Fill cells of erosion-control mat with planting soil and compact before planting.
- D. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.
- E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 <u>Areas to Receive Seed:</u>

- A. The Contractor will provide 4" topsoil and grade to finish grade all areas to receive seed, which will include all disturbed areas not receiving sod. The Landscape Contractor will be responsible for fine grading. This is to include debris removal and any grading required to bring the finished topsoil grade to the proper level for applying seed.
- B. Thoroughly till existing soil to a minimum depth of 4" by running tilling device two directions at right angles over the entire surface to be hydroseeded. Fine grade to achieve uniformity and drainage.
- C. Apply lime uniformly with a mechanical spreader to the entire area to be hydroseeded at the rate determined from the soil test.
- D. Work soil to a uniform grade so that all areas have positive drainage away from drives, buildings and landscaped areas.
- E. Remove all trash and stones exceeding 1" in diameter from area to a depth of 2' prior to hydroseeding.
- F. Protect seeded slopes exceeding 4:1 with erosion-control blankets installed and stapled per manufacturer's recommendations.
- G. Protect seeded slopes exceeding 6:1 with jute or coir-fiber erosion-control mesh installed and stapled per manufacturer's recommendations.
- H. Protect seeded areas with slopes less than 6:1 against erosion by spreading straw mulch. Spread uniformly at 2 tons per acre to form a continuous 1-1/2" blanket.
- I. Anchor straw mulch by spraying with asphalt-emulsion tackifier at rate of 10 to 13 gal. per 1000 sq ft.
- J. Protect seeded areas against heat and drying winds by applying peat mulch within 24 hours after seeding. Soak and scatter uniformly to 3/16" thick and roll to smooth surface.

3.6 <u>Seeding Requirements:</u>

- A. Seeding operations will be required to have a satisfactory stand of grass before acceptance. A satisfactory stand is defined as a cover of living grass of specified species, after true leaves are formed in which no gaps larger than five (5) inches square occur. Areas determined by the Landscape Architect to be solid rock will be exempt from this requirement.
- 3.7 <u>Seeding Operations:</u>
 - A. Hydraulic equipment for the application of seed mulch and seed shall be equipped with a power driven agitator which will keep the mixture uniform during applications. The equipment shall have sufficient force and capacity to apply a uniform application of the mixture to the seed limits. Caution shall be exercised adjacent to non-grassed areas to prevent over spray onto plant beds or paved areas.
 - B. Hydroseed mixture shall consist of:
 - 1. 30 lbs. Hydroseed mulch/1000 square feet or per manufacturers recommendations.
 - 2. Seed mix: As specified on the drawings.

- 3. Seed shall not be sown when winds exceed 10 miles per hour or at any time the ground is not in a suitable condition for seeding.
- 4. Inoculated seed shall be added to the hydroseed mix only immediately prior to hydroseeding operations.
- 5. Landscape maintenance during construction is to continue prior to acceptance of the project.
- 6. Use non-toxic green dying agent when hydroseeding, at manufacturers suggested rate.
- 3.8 <u>Removal of Existing Grass:</u>
 - A. The Landscape Contractor is to remove existing grass and weeds from all areas for planting and resodding as designated on the plans. The existing stands are to be removed to a maximum depth of 1" so as to not disturb existing tree roots where present in those areas.
 - B. Aerate with a tined tiller to break up the upper 3" lightly not to damage tree roots. Pick up solids for discarding and cut cleanly any roots damaged.
 - C. Spread a light layer of topsoil not more than 1" in depth over the aerated area and fine grade to meet acceptance by the Landscape Architect. Apply fertilizer and lime to these areas as specified previously under "Areas to receive Sod" or "Preparation of Planting Beds" whichever the case may be.

3.9 <u>Sodding:</u>

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
- C. Lay sod across angle of slopes exceeding 1:3.
- D. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.
- E. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.
- 3.10 Lawn Maintenance:
 - A. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn. Provide materials and installation the same as those used in the original installation.
 - 1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.

- B. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawn uniformly moist.
 - 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 - 2. Water lawn with fine spray at a minimum rate of 1 inch (25 mm) per week unless rainfall precipitation is adequate.
- C. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height
 - 1. Mow grass to a height of 2 inches.
- D. Lawn Postfertilization: Apply fertilizer after initial mowing and when grass is dry, as per manufacturer's standards.
- 3.11 <u>Satisfactory Turf:</u>
 - A. Lawn installations shall meet the following criteria as determined by Landscape Architect:
 - Satisfactory Seeded Lawn: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).
 - B. Satisfactory Sodded Turf: At the end of maintenance period, a healthy, wellrooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
 - C. Use specified materials to reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

3.12 <u>Meadow:</u>

- A. Sow seed per seed supplier's recommendation. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
 - 1. Before sowing, mix seed with seed carrier at a rate per the seed supplier's recommendation.
 - 2. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 - 3. Do not use wet seed or seed that is moldy or otherwise damaged.
- B. Sow seed at a total rate per the seed supplier's recommendation for the specific seed types indicated on the Drawings.
- C. Protect seeded areas from hot, dry weather or drying winds by applying methods recommended by the seed supplier.
- D. Water newly planted areas and keep moist until meadow is established.
- 3.13 <u>Meadow Maintenance:</u>
 - A. Maintain and establish meadow by watering, weeding, mowing, trimming, replanting, and performing other operations as required to establish a healthy,

viable meadow. Roll, regrade, and replant bare or eroded areas and remulch. Provide materials and installation the same as those used in the original installation.

- 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and meadow damaged or lost in areas of subsidence.
- 2. Apply treatments as required to keep meadow and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Install and maintain temporary piping, hoses, and meadow-watering equipment to convey water from sources and to keep meadow uniformly moist.
 - 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 - 2. Water meadow with a fine spray at a rate recommended by seed supplier.

3.14 <u>Pesticide Application:</u>

- A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.15 <u>Cleaning and Protection:</u>

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after lawn is established.
- C. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.
- D. Protect lawn from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- E. Secure equipment and material on site to prevent theft before, during, or following installation, until the Substantial Completion.
- F. The 30-day maintenance period following Substantial Completion will be considered a lump sum item to be addressed as an item included in the contract.
- G. Remove nondegradagle erosion-control measures after grass establishment period.

3.16 <u>Maintenance Period:</u>

- A. Summary:
 - 1. Begin maintenance at commencement of Work of this Section and continue until Substantial Completion, as part of Work of this Section.
 - 2. Continue maintenance for a Maintenance Period of thirty days after date of Substantial Completion.
 - 3. Provide labor, materials, equipment and means for proper maintenance of all materials and workmanship.
- B. Submit a written report and conduct joint inspection with Landscape Architect of maintenance program and procedures, at inspection for Substantial Completion.
- C. Maintain all plants in a growing, well formed, healthy condition by watering, fertilizing, pruning, weeding, spraying, wrapping, straightening, replacement or by other necessary maintenance operations.
- D. Watering:
 - 1. Advise Landscape Architect immediately in writing of recommended alterations due to weather or other conditions.
 - 2. Water landscaped areas not covered by automatic watering system as frequently as necessary to maintain proper moisture level, using the following schedule as a guide:
 - a) Twice a month during March, April, May.
 - b) Once a month during June, July, August, September.
 - c) No watering from October through February, except in drought conditions.
- E. Fertilizing: Apply four (4) times a year to trees, shrubs, ground cover, and sod as per manufacturer's recommended application rate.
- F. Replace annual plantings seasonally, or according to schedule in Drawings. Blooming plants shall be replaced as necessary throughout specified Maintenance Period to maintain blooming condition.
- G. Remove dead wood as it becomes evident. Remove living portions of plants only at the direction of Landscape Architect.
- H. Apply approved anti-desiccant to all evergreen trees during last two weeks in October (except pines).
- I. Weed and pest control:
 - 1. For each spraying combine approved insecticide and fungicide to provide maximum protection for all plant materials. Three sprays annually; in March, May, and August.
 - 2. Two applications (Spring and Fall) of chemical pre-emergent spray, approved. Two applications (during growing season) of chemical contact spray (Round-Up, by Monsanto, or approved equal). Two days per month (every two weeks) manual weeding (by hand) during the period from March 1 through September 30; remove all visible weeds.
- J. Fill in areas where soil subsides due to settling or other processes. Replace mulch lost due to subsidence.
- K. Keep planting areas neat and uniformly mulched to specified depth on a continuous basis. In addition to replacing and re-spreading mulch as

necessitated during the maintenance period, completely replenish mulch in all planting areas one time during the last month of the one-year Guarantee Period, or as Directed by the Landscape Architect.

L. Maintain plants in their stable upright position and at the proper grade by straightening and tightening staking and guying apparatus and as approved by the Landscape Architect.

3.17 Acceptance:

- A. Submit written requests for inspection for Substantial Completion to the Landscape Architect at least three calendar days prior to anticipated date of inspection and testing.
- B. Submit Record Drawings and Maintenance manuals to the Landscape Architect with written request for inspection.
- C. Review the "punch list" work jointly with the Owner and Landscape Architect for Substantial Completion of the Work.
- D. Upon completion of repairs and replacements found necessary at the time of review, the Owner and Landscape Architect will confirm the date of Substantial Completion and issue the written notice of Substantial Completion if all items on the punch list have been completed. If necessary, another punch list will be written to itemize and deficiencies still existing and will be attached to the written notice of substantial completion. The contractor shall complete all "punch list" items if possible within 30 days while continuing maintenance.
- 3.18 <u>Cleaning and Protection:</u>
 - A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
 - B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.
 - C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
 - D. After installation, and before substantial completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.19 Acceptance and Guarantee:

- A. Substantial Completion:
 - 1. Submit written requests for inspection for Substantial Completion to the Landscape Architect at least three calendar days prior to anticipated date of inspection and testing.
 - Substantial Completion cannot be granted and at the same time no further applications for payment shall be for more than 85% of the Contract until there has been a walk - thru for planting at which time a "punch list" will be written consisting of items to be addressed and corrected by the Contractor immediately. Depending on the extent of

work on the "punch list", the Landscape Architect will determine the job to be "substantially complete" or pending the completion of the "punch list".

- 3. Submit Record Drawings and Maintenance manuals to the Landscape Architect with written request for inspection.
- 4. Review the "punch list" work jointly with the Owner and Landscape Architect for Substantial Completion of the total (contract) work. (See "General Conditions" Article No. 9).
- 5. Upon completion of repairs and replacements found necessary at the time of review, the Owner and Landscape Architect will confirm the date of Substantial Completion and issue the written notice of Substantial Completion if all items on the punch list have been completed. If necessary, another punch list will be written to itemize and deficiencies still existing and will be attached to the written notice of substantial completion. The contractor shall complete all "punch list" items if possible within 30 days while continuing maintenance.
- 6. The date of Substantial Completion will constitute the beginning date of the One Year Guarantee. This date also constitutes the beginning of warranty responsibilities and acceptance by the Owner and Landscape Architect.
- 3.20 <u>Guarantee:</u>
 - A. All work, products, equipment and materials for one year, beginning at the Date of Substantial Completion as per the written notice of Substantial Completion.
 - B. Make good any damage, loss, destruction or failure. Repairs and replacements shall be done promptly and at no additional cost to the Owner.
 - C. Repair damage to grass, and other work as necessary.
 - 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 the time of replacement.
 - E. Guarantee applies to all unacceptable conditions or losses with exception of those due to acts of nature, vandalism or Owner neglect, as determined by Landscape Architect. Act of Nature include, but may not be limited to, high winds of hurricane or tornado force, sleet, hail, freezing rain, plants washed away in a 50 year or greater rain storm in the first month of installation, and extreme cold (as determined by Landscape Architect). Contractor agrees to replace losses due to Acts of Nature at 15% less than original contract price for the damaged Work.
- 3.21 Warranty:
 - A. Make good any damage, loss, destruction or failure. Repairs and replacements shall be done and at no additional cost to the Owner.
 - B. Repair damage to grade, plants, and other work as necessary.
 - C. 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 warranty period as specified above dating from the time of replacement.

- D. Warranty applies to all unacceptable conditions or losses with exception of those due to Acts of Nature, vandalism or Owner neglect, as determined by Landscape Architect.
 - 1. Acts of Nature include, but may not be limited to, high winds of hurricane or tornado force; sleet, hail, or freezing rain; plants washed away in a 50-year or greater rain storm in the first month of installation; and sudden extreme cold, subject to the judgment of the Landscape Architect.
 - 2. Contractor agrees to replace losses due to Acts of Nature at the original contract price, reduced by 15%, for the damaged portions of the Work.

END OF SECTION 32 92 00

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SECTION 32 93 00 — PLANTS

<u>PART 1 — GENERAL</u>

1.1 <u>Related Documents</u>: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 <u>Summary</u>:

- A. Section Includes:
 - 1. Trees
 - 2. Shrubs
 - 3. Ground Cover
 - 4. Plants
 - 5. Tree Stabilization
 - 6. Edgings
- B. Related Sections:
 - 1. Division 31 Section "Site Clearing" for protection of existing trees and plantings, topsoil stripping and stockpiling, and site clearing.
 - 2. Division 31 Section "Earthwork" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
 - 3. Division 32 Section "Turf and Grasses" for lawn and meadow planting.
 - 4. Division 33 Section "Subdrainage" for below-grade drainage of landscaped areas, paved areas, and wall perimeters.

1.3 Unit Prices:

- A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices".
- B. Unit prices apply to authorized work covered by quantity allowances.
- C. Unit prices apply to additions to and deletions from the Work as authorized by Change Orders.

1.4 Definitions:

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum laced as recommended by ANSI Z60.1.
- C. Balled and Potted Stock: Exterior plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of exterior plant required.

- D. Bare-Root Stock: Exterior plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of exterior plant required.
- E. Clump: Where three or more young trees were planted in a group and have grown together as a single tree having three or more main stems or trunks.
- F. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of exterior plant required.
- G. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted exterior plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of exterior plant.
- H. Finish Grade: Elevation of finished surface of planting soil.
- I. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- J. Multi-Stem: Where three or more main stems arise from the ground from a single root crown or at a point right above the root crown.
- K. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
- L. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.
- M. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- 1.5 <u>Coordination:</u>
 - A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
 - 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.
- 1.6 <u>Preinstallation Meetings:</u>
 - A. Preinstallation Conference: Conduct conference at project site.

1.7 <u>Submittals:</u>

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each of the following:
 - 1. Edging materials and accessories, of manufacturer's standard size, to verify color selected.
- C. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and

experience. Include project names, addresses, and year completed, and include names and addresses of owner's contact persons.

- D. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
 - 1. Manufacturer's certified analysis for standard products.
 - 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- E. Material Test Reports: For existing surface soil and imported topsoil.
- F. Planting Schedule: Indicating anticipated planting dates for exterior plants.
- G. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of exterior plants during a calendar year. Submit before expiration of required maintenance periods.
- 1.8 Quality Assurance:
 - A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of exterior plants, and experienced on landscape work with budgets of \$2,000,000.00 or more. Submit a letter stating such experience.
 - B. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
 - 1. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
 - 2. Report suitability of topsoil for plant growth. State-recommended qualities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.
 - C. Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."
 - D. Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches (150 mm) above the ground for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above the ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.
 - E. Observation: Landscape Architect may observe trees and shrubs either at place of growth or at site before planting for compliance with requirements for genus, species, variety, size, and quality. Landscape Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

- F. Notify Landscape Architect of sources of planting materials seven days in advance of delivery to site.
- G. The following codes and standards shall be observed:
 - 1. The Alabama Department of Transportation (ALDOT) Standard Specifications for Highway Construction, current edition.
 - 2. State and Federal laws, including for disease and insect control.
 - 3. Requirements of authorities having jurisdiction.
- 1.9 <u>Workmanship</u>:
 - A. Install all plant materials neatly.
 - B. Make minor adjustments to layout as may be required and requested by Landscape Architect at no additional cost to the Owner.
 - C. Coordinate delivery of all plant material with time of installation to prevent any plant material from being stockpiled on site longer than 24 hours.
 - D. Deliver materials in such manner as to not damage or decrease the health and vigor of the plant materials. Store materials away from detrimental elements. Coordinate with General Contractor to secure a safe staging area.
 - E. Handle, load, unload, and transport materials carefully to avoid damage.
 - F. Maintain and protect plant materials as necessary to insure health and vigor.
- 1.10 <u>Delivery, Storage, and Handling</u>:
 - A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.
 - B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk materials with appropriate certificates.
 - C. Deliver exterior plants freshly dug.
 - D. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
 - E. Do not prune trees and shrubs before delivery except as approved by Landscape Architect.
 - F. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage.
 - 1. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape.
 - 2. Provide protective covering of exterior plants during delivery.
 - 3. Do not drop exterior plants during delivery and handling.
 - 4. Handle planting stock by root ball.
 - G. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery,

set exterior plants and trees in shade, protect from weather and mechanical damage, and keep roots moist.

- 1. Heel-in bare-root stock. Soak roots that are in dry condition in water for two hours. Reject dried-out plants.
- 2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
- 3. Do not remove container-grown stock from containers before time of planting.
- 4. Water root systems of exterior plants stored on-site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.
- 1.11 Job Conditions:
 - A. Planting Restrictions: Plant during the following period. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
 - 1. October / Fall to March / Spring
 - B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed according to manufacturer's written instructions and warranty requirements.
 - C. Coordination with Lawns: Plant trees and shrubs after finish grades are established and before planting lawns, unless otherwise acceptable to Landscape Architect.
 - D. When planting trees and shrubs after lawns, protect lawn areas and promptly repair damage caused by planting operations.
 - E. Do not plant when ground is frozen, snow covered, muddy, or when air temperature is below 45 degrees Fahrenheit.
- 1.12 <u>Warranty:</u>
 - A. Special Warranty: Installer's standard form in which Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a) Death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, abuse by Owner, or incidents that are beyond Contractor's control.
 - b) Structural failures including plantings falling or blowing over.
 - c) Faulty operation of tree stabilization, edgings, tree grates.
 - d) Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - B. Warranty Periods from Date of Substantial Completion:
 - 1. Trees and Shrubs: One year.
 - 2. Ground Cover and Perennials: One Year.
 - 3. Include the following remedial actions as a minimum:
 - a) Remove dead exterior plants immediately. Replace immediately unless required to plant in the succeeding planting season.
 - b) Replace exterior plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.

- c) A limit of one replacement of each exterior plant will be required except for losses or replacements due to failure to comply with requirements.
- d) Provide extended warranty for replaced plant materials; warranty period equal to original warranty period.
- 1.13 Contractor's Periodic Inspection:
 - A. During guarantee period, Contractor shall make periodic inspections of the project to satisfy himself that maintenance by the Owner is adequate.
 - B. Any methods or products which he deems not normal or detrimental to good plant growth shall be reported to the Owner in writing.
 - C. Failure to inspect and report shall be interpreted as approval and the Contractor shall be held responsible for any and all replacements.
- 1.14 Maintenance Service:
 - A. Initial Maintenance Service for Trees and Shrubs: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below.
 - 1. Maintenance Period: 30 days from date of Substantial Completion.
 - B. Initial Maintenance Service for Ground Cover and Plants: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below.
 - 1. Maintenance Period: 30 days from date of Substantial Completion.

PART 2 — PRODUCTS

- 2.1 <u>General:</u>
 - A. Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legen indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
 - 1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than ³/₄" in diameter; or with stem girdling roots are unacceptable.
 - 2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for plant.
- E. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery.

2.2 <u>Trees</u>:

- A. All large deciduous shade trees and ornamental trees are to be field grown from rooted cuttings true to variety and not grafted material. No grafted material will be accepted for the initial installation or as guarantee replacement material.
- B. Balled and burlapped plant materials are to be wrapped with organic wrapping burlap only. Synthetic material will not be accepted. Remove all nursery loading straps once plant material is placed in the pit.
- 2.3 Orders for Plant Materials:
 - A. Submit to Landscape Architect within 30 days from date of contract is awarded to General contractor confirmed orders for material from approved growers (listed on plant schedule). Contractor is responsible for payment of deposits required by approved growers.
 - B. Alternate Growers Alternate growers will be considered by the Landscape Architect only if submitted prior to bidding. The Landscape Architect will select and tag 100% of plant materials from acceptable alternate growers. The contractor will be responsible for all expenses related to tagging trips to alternate growers including usual fees charged by the Landscape Architect. The Contractor should anticipate \$800.00 per day charge. The Contractor shall arrange for and provide transportation for the Landscape Architect. Contractor shall provide the Landscape Architect a minimum of three weeks advance notice. Contractor shall limit tagging trips to no more than two at a maximum of two days each. All tagging trips will be completed within 45 days from date contract is awarded to General Contractor.
 - C. Contractor will submit confirmed orders from acceptable alternate growers within ten days of tagging by the Landscape Architect. Contractor is responsible for payment of deposits required by acceptable alternate growers.

- 2.4 <u>Fertilizer</u>:
 - A. Deliver fertilizer, mixed as specified, in original unopened standard size bags showing weight, analysis and name of manufacturer. Containers shall bear manufacturer's guaranteed statement of analysis, or manufacturer's certificate of compliance covering analysis shall be furnished to Owner. Store fertilizer in such a manner that ti shall be kept dry.
 - B. Base percentages of nitrogen, phosphorus, and potash on laboratory test recommendations as approved by Owner. For bidding, assume 20 percent nitrogen, 10 percent phosphorus, and 5 percent potash by weight. At least 50 percent of total nitrogen shall contain no less than 3 percent water-insoluble nitrogen. At least 60 percent of nitrogen content shall be derived from super-phosphate containing not less than 18 percent phosphoric acid or bone meal containing 25-30 percent phosphoric acid and 2-3 percent nitrogen. Potash shall be derived from muriate of potash containing 55-60 percent potash.

2.5 <u>Peat Moss:</u>

- A. Peat moss shall be Michigan peat moss or approved equal in color and consistency.
- B. Peat moss shall be moss peat, finely shredded to pass ½-inch mesh and shall be no less than 90 percent organic material by weight, with ash content by ignition of no more than 10 percent.
- C. Material shall contain 35-66 percent moisture by weight, but shall have waterholding capacity of 150-200 percent.
- D. Material shall have pH value of 4 to 5.
- E. Material may be imported supplied in bales or domestic furnished in bulk. If furnished in bulk, material and its source must be acceptable to Owner.

2.6 <u>Lime:</u>

A. Lime shall be agricultural limestone containing not less than 90 percent calcium and magnesium carbonates. Lime must be ground to such a fineness that not less than 90 percent must pass No. 8 mesh and not less than 25 percent must pass No. 100 mesh. Moisture is not to exceed 10 percent.

2.7 <u>Mulches:</u>

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of the following:
 - 1. Fresh Pinestraw (all planting beds and tree pits).
 - a) Mulch shall be of sufficient character as not to be easily displaced by wind or water runoff.
 - b) Mulch shall be free of weeds, weed seed, deleterious materials, and foreign materials, or other compounds detrimental to plant life.
 - 2. Double hammered brown mulch (annuals and spreading groundcover mass plantings).

2.8 <u>Maintenance Period</u>:

A. Summary:

- 1. Begin maintenance at commencement of Work of this Section and continue until Substantial Completion, as part of Work of this Section.
- 2. Continue maintenance for a Maintenance Period of thirty days after date of Substantial Completion.
- 3. Provide labor, materials, equipment and means for proper maintenance of all materials and workmanship.
- B. Submit a written report and conduct joint inspection with Landscape Architect of maintenance program and procedures, at inspection for Substantial Completion.
- C. Maintain all plants in a growing, well formed, healthy condition by watering, fertilizing, pruning, weeding, spraying, wrapping, straightening, replacement or by other necessary maintenance operations.
- D. Watering:
 - 1. Advise Landscape Architect immediately in writing of recommended alterations due to weather or other conditions.
 - 2. Water landscaped areas not covered by automatic watering system as frequently as necessary to maintain proper moisture level, using the following schedule as a guide:
 - a) Twice a month during March, April, May.
 - b) Once a month during June, July, August, September.
 - c) No watering from October through February, except in drought conditions.
- E. Fertilizing: Apply four (4) times a year to trees, shrubs, ground cover, and sod as per manufacturer's recommended application rate.
- F. Replace annual plantings seasonally, or according to schedule in Drawings. Blooming plants shall be replaced as necessary throughout specified Maintenance Period to maintain blooming condition.
- G. Remove dead wood as it becomes evident. Remove living portions of plants only at the direction of Landscape Architect.
- H. Apply approved anti-desiccant to all evergreen trees during last two weeks in October (except pines).
- I. Weed and pest control:
 - 1. For each spraying combine approved insecticide and fungicide to provide maximum protection for all plant materials. Three sprays annually; in March, May, and August.
 - 2. Two applications (Spring and Fall) of chemical pre-emergent spray, approved. Two applications (during growing season) of chemical contact spray (Round-Up, by Monsanto, or approved equal). Two days per month (every two weeks) manual weeding (by hand) during the period from March 1 through September 30; remove all visible weeds.
- J. Fill in areas where soil subsides due to settling or other processes. Replace mulch lost due to subsidence.
- K. Keep planting areas neat and uniformly mulched to specified depth on a continuous basis. In addition to replacing and re-spreading mulch as necessitated during the maintenance period, completely replenish mulch in

all planting areas one time during the last month of the one-year Guarantee Period, or as Directed by the Landscape Architect.

- L. Maintain plants in their stable upright position and at the proper grade by straightening and tightening staking and guying apparatus and as approved by the Landscape Architect.
- M. Ground dolomitic limestone not less than 85% total carbonates and magnesium, ground so that 50% passes 100-mesh sieve and 90% 20-mesh sieve.
- 2.9 Plant Materials:
 - A. All plants shall conform to or surpass minimum quality standards as defined by the American Association of Nurserymen (AAN), current edition of American Standard for Nursery Stock, published by the AAN, Inc. and in addition, shall conform to sizes and descriptions in the plant list.
- 2.10 Certificates of Inspection for Plant Material:
 - A. All necessary inspection certificates shall be supplied to the Landscape Architect's representative for each shipment of plant material, as required by law. Certificates showing source of origin shall be filed with Landscape Architect prior to acceptance of the material.
- 2.11 Inspection:
 - A. All plant materials shall be subject to inspection and approval. The Landscape Architect reserves the right to reject any and all plants which fail to meet this specification at any point during the installation of the job. All rejected materials shall be promptly removed from the site by the Contractor at no additional cost to the owner.
- 2.12 Quality and Size:
 - A. All plant materials furnished shall be well branched, proportioned width to height, of normal habit, sound, healthy and vigorous in growth. The minimum acceptable sizes of plants shall be measured before pruning with branches in normal position and shall conform to measurements specified. Plants used where symmetry is required shall be matched as closely as possible. Plants shall meet all requirements as listed in the plant list.
- 2.13 Source of Plants:
 - A. Plants shall be field nursery, container grown or collected material subject to the requirements of the Specifications.
- 2.14 Field Tagged Plants:
 - A. All trees (except Pines) are to be located by the Contractor at one of the nurseries listed on the drawings or equal as approved by the Landscape Architect. The Contractor should anticipate accompanying the Landscape Architect on the tagging trips but is not required to do so. Nurseries of equal quality must be approved prior to bidding.

- 2.15 Insect, Pests, and Plant Diseases:
 - A. All plants shall be of healthy stock, free from disease, insects, eggs, larvae, and parasites of an objectionable or damaging nature.
- 2.16 <u>Substitutions:</u>
 - A. Substitution from the specified list will be accepted only when satisfactory evidence in writing is submitted to the Landscape Architect, showing that the plant specified is not available. Requests for approval of substitute material shall include common and botanical names and size of plant material.
 - B. Only those substitutions of at least equivalent size and having the essential characteristics similar to the originally specified material will be approved.
 - C. Acceptance or rejection of substitute plant material will be issued in writing by the Landscape Architect.
- 2.17 <u>Topsoil:</u>
 - A. Topsoil shall be fertile, friable, sandy loam and a natural surface soil obtained from well areas reviewed by Landscape Architect and possessing characteristics of representative soils in the project vicinity that produce heavy growths of crops, grass, or other vegetation.
 - B. Topsoil shall be free of subsoil, brush, organic litter, or objectionable weeds, clay, clots, stumps, stones, roots or other material harmful to plant growths or hindrance to planting or maintenance operations. Should regenerative materials be present in the soil, Contractor shall eradicate and remove such growth, both surface and root, which may appear in the imported material within one year following acceptance of the work.
 - C. Topsoil shall not be handled in a frozen muddy condition. The acidity range shall be between 5.0 and 7.0 inclusive. The mechanical analysis of the soil shall be as follows:

<u>Sieve Size</u>	Percent Passing
1 inch mesh	99 – 100 percent
1/4 inch mesh	97 - 99 percent
No. 100 mesh	40 - 60 percent
No. 200 mesh	20 - 40 percent

- D. Topsoil shall be spread by the Landscape Contractor in all beds. The Landscape Contractor will be responsible for fine grading. Topsoil, regardless of the source, shall meet all requirements of the paragraph above.
 1. Topsoil depth to be 6", or as indicated in the Drawings.
- E. Stockpiled material that does not meet the requirements may, at the option of the contractor, be improved by screening and the addition of organic matter and chemical admixtures.

2.18 Planting Soil Mixture:

- A. Provide soil mix amended as per laboratory recommendations. Basic planting soil mix consists of:
 - 50% topsoil (as described Above)

50% prepared additives (by volume as follows)

3 parts humus, forest peat, or "Nature's Helper" by Klum

1 part sterilized cow manure, commercial fertilizer, and lime as recommended in soil analysis

B. The components shall be thoroughly mixed to uniform consistency by hand or machine methods.

2.19 <u>Mulch:</u>

- A. Pine straw mulch shall be clean, fresh, free of noxious weed, seed, fire ants, Japanese beetles, and/or fringed beetles. On slopes, pine straw mulch shall be used.
- B. Organic Mulch: Organic mulch, free from deleterious materials and suitable as a top dressing of trees and shrubs.
- C. In addition to organic mulches, mineral or inorganic-stone mulches may be required. Some repetition of general descriptions occurs in this article and in "Organic Soil Amendments" Article. Indicate function and location of each material to suit Project.
- 2.20 Miscellaneous Products:
 - A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

PART 3 — EXECUTION

3.1 <u>Examination</u>:

- A. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance of the Work.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in the soil within a planting area.
 - 2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
 - 3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

- B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Landscape Architect and replace with new planting soil.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.2 <u>Preparation:</u>
 - A. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by planting operations.
 - B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
 - C. Before commencing planting operations, location of major plants and outlines of areas to be planted shall be marked out on the ground, by the Contractor for approval by the Landscape Architect. Contact the Landscape Architect a minimum of 48 business hours in advance of the anticipated review of the layout.
 - D. Lay out exterior plants at locations directed by Landscape Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.
 - E. Planting operations shall be during favorable weather in which conditions are neither extremely cold or hot not to point that the risk of loss is too great. The Contractor shall inform the Landscape Architect of high risks due to weather.
 - F. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
 - G. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.
- 3.3 <u>Tree Transportation</u>:
 - A. The Contractor shall be responsible not only for the safe transportation of the plants to the site but also their condition upon arrival. Trees with abrasions of the bark, sun scalds, fresh cuts, or breaks of limbs which have not completely callused will be rejected. Trees which have been damaged during transit will be replaced by the Contractor at no additional cost. All plant unit costs will reflect all above listed specifications.
- 3.4 <u>Tree Tags</u>:
 - A. All plants accepted at the nursery by the Landscape Architect shall be tagged with serialized self locking tags. Trees delivered to the site without these tags or with broken tags will be rejected. The tags shall remain on the trees until the Contractor has been given instructions by the Landscape Architect for removal.

- 3.5 <u>Planting Area Establishment:</u>
 - A. Grade will be brought to the level of the finished rough grade by the General Contractor. The Landscape Contractor will be responsible for spreading of topsoil and fine grading work. This is to include debris removal and any grading required to bring the landscaping finished grade to the proper level for planting trees, shrubs, and ground covers. Contractor shall grade for proper drainage.
 - B. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- 3.6 Drainage Test:
 - A. Test excavated plant pits to determine if sufficient drainage is present for proper plant survival.
 - B. Tree pits shall be filled with water. If percolation is less than 100% within a period of twelve hours, drill a 12" auger to a depth of 4' below the bottom of the pit. Retest the pit. In case drainage is still unsatisfactory, notify the Landscape Architect in writing of the condition before planting the trees. Contractor is fully responsible for the warranty of the trees. If the tree is on a slope provide a trench filled with stone and a 4" drain pipe to the point of nearest relief
 - C. Drainage Test for Plants and Ground Covers shall be spot tested to insure proper percolation.
- 3.7 <u>Tree and Shrub Planting:</u>
 - A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
 - B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
 - C. Balled and Burlapped and Container Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 2" above adjacent finished grades.
 - 1. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - 2. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 - 3. Continue backfilling process. Water again after placing and tamping final layer of soil.
 - D. All transplanted material is to be replanted the same day it is dug or properly heeled in and watered regularly to insure life.

- E. Circular plant pits with vertical sides shall be dug by hand or machine methods for planting and transplanting of trees and shrubs.
- F. Shrub pit diameter shall be a minimum of one foot greater than the spread of the root mass.
- G. Balled and container plants shall be placed firmly upon scarified subgrade and backfilled with planting soil mixture. Remove all wire, cords, and burlap from the top of root ball. Hand tamp carefully around and under ball to fill all voids. Water during back filling. Form saucer from planting soil mixture in order to retain water.
- H. Gently loosen outer roots of container grown plants to encourage outward growth.
- I. Fertilizer shall be thoroughly mixed and soaked into the top 2" of soil for all plant pits.
- J. Fill the area between the pits, if the individual pits are arranged in a group, to the required grade with pine bark mulch 3" deep. Plant beds shall be neatly edged and kept free of weeds until the work is accepted.
- K. Groundcover beds shall be scarified by hand or machine method to minimum depth of 8". Four inches of pine bark additive and 20 pounds per 1000 square feet of Milorganite fertilizer, or organic equal, shall be uniformly incorporated into the soil to the full 8" of minimum depth.
- L. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
- M. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
- N. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- 3.8 <u>Tree and Shrub Pruning:</u>
 - A. Prune, thin, and shape trees and shrubs according to standard professional horticultural and arboricultural practices. Prune trees to retain required height and spread. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured or dead branches from flowering trees and shrubs. Prune to retain natural character.
- 3.9 Groundcover and Plant Planting:
 - A. Set out and space ground cover and plants other than trees and shrubs as indicated on Drawings in even rows with triangular spacing.
 - B. Dig holes large enough to allow spreading of roots.
 - C. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.
 - D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
 - E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
 - F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.10 Planting Area Mulching:

A. Mulch backfilled surfaces of planting areas and other areas as indicated on Drawings.

3.11 Cleaning and Protection:

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.
- C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- D. Secure equipment and material on site to prevent theft before, during, or following installation, until the Substantial Completion.
- E. After installation and before Substantial Completion, remove nursery stakes, tie tape, wire, burlap, and other debris from plant material, planting areas, and the Project site.
 - 1. When directed by Landscape Architect, remove nursery tags and labels from plant material.
- F. At the time of Substantial Completion, verify that watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.12 Maintenance Period:

- A. Summary:
 - 1. Begin maintenance at commencement of Work of this Section and continue until Substantial Completion, as part of Work of this Section.
 - 2. Continue maintenance for a Maintenance Period of thirty days after date of Substantial Completion.
 - 3. Provide labor, materials, equipment and means for proper maintenance of all materials and workmanship.
- B. Submit a written report and conduct joint inspection with Landscape Architect of maintenance program and procedures, at inspection for Substantial Completion.
- C. Maintain all plants in a growing, well formed, healthy condition by watering, fertilizing, pruning, weeding, spraying, wrapping, straightening, replacement or by other necessary maintenance operations.
- D. Watering:
 - 1. Advise Landscape Architect immediately in writing of recommended alterations due to weather or other conditions.
 - 2. Water landscaped areas not covered by automatic watering system as frequently as necessary to maintain proper moisture level, using the following schedule as a guide:
 - a) Twice a month during March, April, May.
 - b) Once a month during June, July, August, September.

- c) No watering from October through February, except in drought conditions.
- E. Fertilizing: Apply four (4) times a year to trees, shrubs, ground cover, and sod as per manufacturer's recommended application rate.
- F. Replace annual plantings seasonally, or according to schedule in Drawings. Blooming plants shall be replaced as necessary throughout specified Maintenance Period to maintain blooming condition.
- G. Remove dead wood as it becomes evident. Remove living portions of plants only at the direction of Landscape Architect.
- H. Apply approved anti-desiccant to all evergreen trees during last two weeks in October (except pines).
- I. Weed and pest control:
 - 1. For each spraying combine approved insecticide and fungicide to provide maximum protection for all plant materials. Three sprays annually; in March, May, and August.
 - 2. Two applications (Spring and Fall) of chemical pre-emergent spray, approved. Two applications (during growing season) of chemical contact spray (Round-Up, by Monsanto, or approved equal). Two days per month (every two weeks) manual weeding (by hand) during the period from March 1 through September 30; remove all visible weeds.
- J. Fill in areas where soil subsides due to settling or other processes. Replace mulch lost due to subsidence.
- K. Keep planting areas neat and uniformly mulched to specified depth on a continuous basis. In addition to replacing and re-spreading mulch as necessitated during the maintenance period, completely replenish mulch in all planting areas one time during the last month of the one-year Guarantee Period, or as Directed by the Landscape Architect.
- L. Maintain plants in their stable upright position and at the proper grade by straightening and tightening staking and guying apparatus and as approved by the Landscape Architect.
- 3.13 <u>Repair and Replacement:</u>
 - A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Landscape Architect.
 - 1. Submit details of proposed pruning and repairs.
 - 2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
 - 3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Landscape Architect.
 - B. Remove and replace trees that are in an unhealthy condition or are damaged during construction operations that Landscape Architect determines are incapable of restoring to normal growth pattern.
 - 1. Provide new trees of the same caliper size, height, species, and growing condition as those being replaced.

3.14 Acceptance:

- A. Submit written requests for inspection for Substantial Completion to the Landscape Architect at least three calendar days prior to anticipated date of inspection and testing.
- B. Submit Record Drawings and Maintenance manuals to the Landscape Architect with written request for inspection.
- C. Review the "punch list" work jointly with the Owner and Landscape Architect for Substantial Completion of the Work.
- D. Upon completion of repairs and replacements found necessary at the time of review, the Owner and Landscape Architect will confirm the date of Substantial Completion and issue the written notice of Substantial Completion if all items on the punch list have been completed. If necessary, another punch list will be written to itemize and deficiencies still existing and will be attached to the written notice of substantial completion. The contractor shall complete all "punch list" items if possible within 30 days while continuing maintenance.

3.15 <u>Cleaning and Protection:</u>

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.
- C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- D. After installation, and before substantial completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.16 Warranty:

- A. Make good any damage, loss, destruction or failure. Repairs and replacements shall be done and at no additional cost to the Owner.
- B. Repair damage to grade, plants, and other work as necessary.
- C. 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 warranty period as specified above dating from the time of replacement.
- D. Warranty applies to all unacceptable conditions or losses with exception of those due to Acts of Nature, vandalism or Owner neglect, as determined by Landscape Architect.
 - 1. Acts of Nature include, but may not be limited to, high winds of hurricane or tornado force; sleet, hail, or freezing rain; plants washed away in a 50-year or greater rain storm in the first month of installation; and sudden extreme cold, subject to the judgment of the Landscape Architect.
 - 2. Contractor agrees to replace losses due to Acts of Nature at the original contract price, reduced by 15%, for the damaged portions of the Work.

END OF SECTION 32 93 00

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SECTION 33 11 00

WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to provide water distribution system components and other work, as required in these specifications, on the drawings and as otherwise deemed necessary to complete the work. The limits of the work, including the responsible party for testing purposes, shall be clearly defined on the Drawings. Included are the following topics:

PART 1 - General

Scope
Related Work
Reference Documents
Reference Standards
Submittals
Continuity of Existing Water Distribution System
Provisions for Future Work
As-Built Drawings

PART 2 - Materials

General

PART 3 - Execution

General

RELATED WORK

Applicable provisions of Division 1 govern work under this section.

Related work specified elsewhere:

- Section 02 32 00 Geo Technical Investigation
- Section 22 11 00 Facility Water Distribution
- Section 22 13 00 Facility Sanitary Sewerage
- Section 22 14 00 Facility Storm Drainage
- Section 30 05 00 Common Work Results for All Exterior Work
- Section 31 23 16.13 Trenching
- Section 31 25 00 Erosion Control

REFERENCE DOCUMENTS

The Mobile Area Water and Sewer System (MAWSS) Standard Specifications, Section 11 (Potable Water Utilities) shall govern the work.

REFERENCE STANDARDS

American Society for Testing and Materials (ASTM):

- B88 Standard Specifications for Seamless Copper Water Tube
- F477 Standard Specifications for Elastomeric Gaskets for Joining Plastic Pipe

SECTION 33 11 00 – WATER UTILITY DISTRIBUTION PIPING

CWA PROJECT NO. 2022-0	8 IRONDALE LIBRARY IRONDALE, ALABAMA
D3139	Standard Specifications for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
D3350	Standard Specifications for Polyethylene Plastic Pipe and Fittings Materials
American Water Works As	sociation (AWWA):
C502	Dry Barrel Fire Hydrants
C504	Rubber-Seated Butterfly Valves
C509	Resilient-Seated Gate Valves for Water Supply Service
C515	Reduced Wall, Resilient Seated Gate Valves for Water Supply Service
C550	Protective Epoxy Interior Coatings for Valves and Hydrants
C800	Underground Service Line Valves and Fittings
C900	Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings for Water Distribution (4"-12")
C905	Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings for Water Distribution (14"-48")
C906	Polyethylene Pressure Pipe, and Fabricated Fittings for Water Distribution (4"-63")
C104/ANSI A21.4	Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
C105/ANSI A21.5	Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
C111/ANSI A21.11	Standard for Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
C151/ANSI A21.51	Standard for Ductile Iron Pipe, Centrifugally Cast
C153/ANSI A21.53	Standard for Ductile Iron Compact Fittings

SUBMITTALS

Provide manufacturers product information (cut sheets) and O&M information for watermain materials including:

- Pipe
- Fittings
- Valves
- Hydrants
- Joint Restraint Materials

Provide copies of all pressure and electric continuity testing procedures and results for the project to the OWNER'S Project Representative and the AE within 48 hours of completing the individual tests.

Provide reports that document safe sample collection procedures and results.

CONTINUITY OF EXISTING WATER DISTRIBUTION SYSTEM

Provide a construction schedule to OWNER'S Project Representative, municipal water utility (if applicable) and local fire department (if applicable) for review and approval prior to starting construction. Schedule shall indicate the date and time of all required water supply interruptions.

Do not interrupt existing water supply without approval from OWNER'S Project Representative, municipal water utility, and local fire department.

Once approved, notify all distribution system users impacted by outages a minimum of 48 hours in advance of outage. Notification shall be provided in writing and describe the nature and duration of outages, and provide the name and number of Contractor's foreman or other contact.

PROVISIONS FOR FUTURE WORK

N/A

AS-BUILT DRAWINGS

Show the actual locations of watermain and services, valves and hydrants on drawings and show changes to proposed watermain size, alignment, or grades. Show the actual locations, sizes and types of underground utilities and other features encountered during construction.

PART 2 - MATERIALS

GENERAL

The Mobile Area Water and Sewer System Standard Specifications, Section 11 (Potable Water Utilities) shall govern the materials required in this work.

PART 3 - EXECUTION

GENERAL

The Mobile Area Water and Sewer System Standard Specifications, Section 11 (Potable Water Utilities) shall govern the execution of this work.

END OF SECTION 33 11 00

SECTION 33 11 00 – WATER UTILITY DISTRIBUTION PIPING THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 33 30 00

SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision

necessary to provide for the sanitary sewer work required in these specifications and on the drawings. The limits of

the work, including the responsible party for testing purposes, shall be clearly defined on the Drawings. Included

are the following topics:

PART 1 - GENERAL

Scope

Related Work

Reference Documents

Reference Standards

Submittals

Provisions for Future Work

As-Built Drawings

PART 2 - MATERIALS

General

PART 3 - EXECUTION

General

Diverting Sewage

RELATED WORK

Applicable provisions of Division 1 govern work under this section.

Related work specified elsewhere:

- Section 02 32 00 Geo Technical Investigation
- Section 22 11 00 Facility Water Distribution
- Section 22 13 00 Facility Sanitary Sewerage
- Section 22 14 00 Facility Storm Drainage
- Section 30 05 00 Common Work Results for All Exterior Work
- Section 31 23 16.13 Trenching
- Section 31 25 00 Erosion Control

REFERENCE DOCUMENTS

The Mobile Area Water and Sewer System (MAWSS) Standard Specifications, Section 12 (Sanitary Sewers) shall

govern the work.

REFERENCE STANDARDS

American Society for Testing and Materials (ASTM) International:

C425 Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings

SECTION 33 30 00 - SANITARY SEWERAGE UTILITIES

C700 Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated

D1784 Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

D2235 Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings

D2564 Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

D2680 Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping

D3034 Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

D3212 Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

D3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

D4673 Standard Classification System for Acrylonitrile-Butadiene-Styrene (ABS) Plastics and Alloys Molding and Extrusion Materials

F477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

SECTION 33 30 00 – SANITARY SEWERAGE UTILITIES

3 OF 6

F679 Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings

American Water Works Association (AWWA):

C104/ANSI A21.4 Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings

C151/ANSI A21.53 Standard for Ductile Iron Pipe, Centrifugally Cast

C153/A21.53 Standard for Ductile Iron Compact Fittings

SUBMITTALS

Provide manufacturer's product information (cut sheets), shop drawings and O&M information for sewer materials

including:

- Pipe
- Fittings
- Pre-Cast and Cast-in-Place Structures
- Castings and Covers

Provide reports documenting all required testing and televising. testing results for the project to the DFD Project

Representative and the AE within 48 hours of completing the individual tests.

PROVISIONS FOR FUTURE WORK

SECTION 33 30 00 – SANITARY SEWERAGE UTILITIES

N/A

AS-BUILT DRAWINGS

Show the actual locations of sanitary sewer pipes and service lines, manholes and cleanouts on drawings. Show

changes to proposed sanitary sewer pipe, alignment, or grades. Show the actual locations, sizes and types of

underground utilities and other features encountered during construction.

PART 2 - MATERIALS

GENERAL

Material Requirements for this work are governed by MAWSS Standard Specifications, Section 12.

PART 3 - EXECUTION

GENERAL

Execution of this work is governed by MAWSS Standard Specifications, Section 12.

END OF SECTION 33 30 00

SECTION 33 30 00 – SANITARY SEWERAGE UTILITIES

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SECTION 33 40 00

STORM DRAINAGE UTILITIES

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to provide for the storm drainage work required in these specifications and on the drawings. The limits of the work, including the responsible party for testing purposes, shall be clearly defined in the Drawings. Included are the following topics:

PART 1 - GENERAL

Scope Related Work Reference Documents Reference Standards

Submittals

Provisions for Future Work

As-Built Drawings

PART 2 - MATERIALS

Excavation and Backfill

Reinforced Concrete Pipe

Manhole and Junction Box Structures

Inlets and Catch Basins

Headwalls

PART 3 - EXECUTION

Excavation and Backfill Reinforced Concrete Pipe Manhole and Junction Box Structures Inlets and Catch Basins Headwalls

RELATED WORK

Applicable provisions of Division 1 govern work under this section.

Related work specified elsewhere:

Section 02 32 00 – Geo Technical Investigation

Section 22 11 00 – Facility Water Distribution

Section 22 13 00 – Facility Sanitary Sewerage

Section 22 14 00 – Facility Storm Drainage

Section 30 05 00 – Common Work Results for All Exterior Work

Section 31 23 16.13 - Trenching

Section 31 25 00 – Erosion Control

REFERENCE DOCUMENTS

Alabama Department of Transportation (ALDOT) 2022 Standard Specifications, Section 214 (Structure Excavation and Backfill for Drainage and Minor Structures

Alabama Department of Transportation (ALDOT) 2022 Standard Specifications, Section 533 (Storm Sewers)

SECTION 33 40 00 - STORM DRAINAGE UTILITIES

Alabama Department of Transportation (ALDOT) 2022 Standard Specifications, Section 619 (Pipe Culvert End Treatments)

Alabama Department of Transportation (ALDOT) 2022 Standard Specifications, Section 621 (Inlets, Junction Boxes, Manholes, and Miscellaneous Drainage Structures)

REFERENCE STANDARDS

American Society for Testing and Materials (ASTM):

C76 Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

C443 Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

SUBMITTALS

Provide manufacturer's product information (cut sheets), shop drawings and O&M information for storm drainage materials including:

- Pipe
- Fittings
- Pre-Cast and Cast-in-Place Structures
- Reinforcing steel for cast-in-place structures
- Concrete strength testing (28-day break) for cast-in-place structures
- Castings

Provide reports documenting all required testing and televising.

PROVISIONS FOR FUTURE WORK

N/A

AS-Built drawings

Show the actual locations of storm drainage facilities and service lines and structures on drawings. Show changes to proposed storm drainage facilities, alignment, or grades. Show the actual locations, sizes and types of underground utilities and other features encountered during construction.

PART 2 - MATERIALS

EXCAVATION AND BACKFILL

Alabama Department of Transportation (ALDOT) 2022 Standard Specifications, Section 214 (Structure Excavation and Backfill for Drainage and Minor Structures) will govern the materials required for this work.

REINFORCED CONCRETE PIPE

Alabama Department of Transportation (ALDOT) 2022 Standard Specifications, Section 533 (Storm Sewers)

will govern the materials required for this work.

MANHOLE AND JUNCTION BOX STRUCTURES

Alabama Department of Transportation (ALDOT) 2022 Standard Specifications, Section 621 (Inlets, Junction Boxes, Manholes, and Miscellaneous Drainage Structures) will govern the materials required for this work.

INLETS & CATCH BASINS

Alabama Department of Transportation (ALDOT) 2022 Standard Specifications, Section 621 (Inlets, Junction Boxes, Manholes, and Miscellaneous Drainage Structures) will govern the materials required for this work.

HEADWALLS

Alabama Department of Transportation (ALDOT) 2022 Standard Specifications, Section 619 (Pipe Culvert End Treatments) will govern the materials required for this work.

PART 3 - EXECUTION

EXCAVATION AND BACKFILL

Alabama Department of Transportation (ALDOT) 2022 Standard Specifications, Section 214 (Structure Excavation and Backfill for Drainage and Minor Structures) will govern the execution of this work.

reinforced concrete pipe

Alabama Department of Transportation (ALDOT) 2022 Standard Specifications, Section 533 (Storm Sewers)

will govern the execution of this work.

MANHOLE AND JUNCTION BOX STRUCTURES

Alabama Department of Transportation (ALDOT) 2022 Standard Specifications, Section 621 (Inlets, Junction Boxes, Manholes, and Miscellaneous Drainage Structures) will govern the execution of this work.

INLETS & CATCH BASINS

Alabama Department of Transportation (ALDOT) 2022 Standard Specifications, Section 621 (Inlets, Junction Boxes, Manholes, and Miscellaneous Drainage Structures) will govern the execution of this work.

HEADWALLS

Alabama Department of Transportation (ALDOT) 2022 Standard Specifications, Section 619 (Pipe Culvert End Treatments) will govern the execution of this work.

END OF SECTION 33 40 00

IRONDALE, ALABAMA

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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33 71 73 – ELECTRIC UTILITY SERVICE