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H/S HOLLY & SMITH ARCHITECTS

H/S Project No.: 13062

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SECTION 22 0500 - VALVES, STRAINERS, UNIONS AND FITTINGS

PART 1 – GENERAL

1.1 SUMMARY

The work under this heading includes the furnishing and installing of all required appurtenances incidental to the piping systems as indicated on the drawings. Refer to BASIC MATERIALS AND METHODS SECTION which shall apply to all work in this Section.

1.2 QUALITY ASSURANCE

A. Manufacturer: Provide valves and accessories for work in this Section produced, meeting the requirements specified. Approved manufacturers:

Victaulic	Gruvlok
Perfection	Crane
NIBCO	Hammond
Apollo	American Valve
B&G	Griswold
Flow Design	

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide factory-fabricated valves for use in service indicted. Provide valves of types and pressure ratings indicated; provide proper selection to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is installer's option. Valves shall be of same make for all these services.

B. Valves shall comply with the following:

Gate - cast iron - MSS SP-70
Gate - bronze - MSS SP-80
Globe - cast iron -MSS SP-85
Globe - bronze - MSS SP-80
Ball - MSS SP-110
Butterfly - MSS SP-67
Check - cast iron - MSS SP-71
Check - bronze - MSS SP-80

C. Gate valves shall be equipped with packing suitable for intended service. (Under no circumstances is asbestos acceptable.) Valves shall be designed so back seating protects packing and stem threads from media when valve is fully opened, and equipped with gland follower. Guides for disc on rising stem valves shall be machined for accurate fit.

D. Globe valves shall be equipped with packing suitable for intended service. (Under no circumstances is asbestos acceptable.) Globe valves shall be designed so back seating protects packing and stem threads from media when valve is fully opened, and equipped with gland follower.

E. Ball valves shall have FULL port opening blow out proof stem: hard chrome plated forged brass ball, rated not less than 600# W.O.G. for sizes 3” or smaller.

F. Provide gear operators on butterfly valves 8" and larger. Valve bodies shall have extended necks to provide for 2-1/4" insulation.

G. Provide valves with features indicated and where not otherwise indicated, provide proper valve features as outlined in this specification. Comply with ANSI B31.1.

H. Valve flanges shall comply to ANSI B16.1 (cast iron), ANSI B16.5(steel), ANSI B16.24 (bronze). Steel flanges shall be Class 150.

I. Threaded valve ends shall comply with ANSI B2.1.

J. Butt-Weld valve ends shall comply with ANSI B16.25.

K. Solder Joint valve ends shall comply with ANSI B16.18.

L. Flangeless valve bodies shall be manufactured to fit between flanges and shall comply with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).

M. Fabricate pressure-containing components of valves, including stems and seats from brass or bronze materials, of standard alloy recognized in valve manufacturing that resist de-zincification.

N. Design seat of valve with removable disc, and assemble valve so disc can be replaced when worn.

O. Butterfly valves shall be designed for flow regulation, and manufactured to be tight in closed position. Test pressures in accordance with MSS SP-67 as follows: Seat 2-12" 220psi. No leakage shall be permitted under test.

P. Check valves at pump discharge shall include spring return.

2.2 GATE VALVE FOR COPPER PIPING

A. Flanged Ends 2-1/2" and Larger: Class 125, iron body, bronze mounted, bolted bonnet, rising stem, OS&Y, solid wedge. Provide dielectric gasket and bolt isolators.

B. Solder Ends 2" and Smaller: Class 125, bronze body, screwed bonnet, rising stem, solid wedge. (Non-rising stem gate valves may be used where headroom prevents full extension of rising stems.)

2.3 BALL VALVES

A. Threaded Ends 3" and Smaller: 600# W.O.G., forged brass two piece body, hard chrome plated forged brass ball, blow-out proof stem.

B. Soldered Ends 2" and Smaller: 600# W.O.G., forged brass two piece body, hard chrome plated forged brass ball, true adjustable packing nut ("O"-ring only type stem seal not acceptable), blow-out proof stem.

C. Flanged Ends 2-1/2” and larger: Class 150, flanged ends, carbon steel body with 316 s.s. trim, uni-body design, full port, blowout proof s.s. stem and ball, telfon seat.

2.4 UNIONS IN COPPER LINES

Cast Bronze Unions.

2.5 UNIONS IN BLACK STEEL, WROUGHT IRON OR GALVANIZED STEEL PIPING

Ground joint malleable iron galvanized Class 300 for 2" nominal pipe sizes or below. For pipe sizes 2-1/2" and larger use forged steel welding flanges (Galvanized for galvanized piping).

2.6 UNIONS IN CONNECTION BETWEEN COPPER AND STEEL OR IRON PIPING

Provide bronze valves or dielectric waterways.

2.7 GAGE COCK

Crane No. 744, or Weiss TC-14, all bronze.

2.8 AIR VENT

Automatic air vents where indicated on drawings shall be Bell & Gossett No. 7, or Taco 417, with copper discharge line piped to closet floor drain.

2.9 MANUAL AIR VENTS

Where installed shall be Crane No. 744, or Weiss TC-14, with 1/4" tap into line to be vented.

2.10 GAUGES

Furnish and install where shown on the plans or where good practice required, pressure gauges with 4-1/2 glass dial face, corrosion resistant stainless steel case and ring, balanced adjustable black pointer guaranteed accurate to 1% of range, easy read dial - white background with bold black numerals and graduations, 270 degree ARG, 1/4" N.P.T. bottom connection.

2.11 THERMOMETERS

Shall be Adjustable Angle type with 9" case, lens front reading mercury tube, with angle satin finish aluminum scales, bold black numerals, bold scale graduations, thick glass windows, and die cast aluminum case with baked bronze finish. Thermometer shall rotate 180 degrees and stem swivels 180 degrees in 10 degree increments separable wells to suit insulation. For chilled water 20 degrees to 120 degrees. For hot water 30 degrees to 240 degrees.

PART 3 - EXECUTION

3.1 WORKMANSHIP AND INCIDENTAL ITEMS

A. All valves shall be installed so as to be easily accessible for cleaning, inspection, maintenance, and operation.

B. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward for horizontal plane unless unavoidable. Provide chain operators on all valves over 6' above floor in mechanical rooms.

C. Except as otherwise indicated, install valves with the following ends or types of pipe/tube connections:

Tube Size 2" and smaller - Soldered-joint valves
Pipe Size 2" and smaller - Threaded valves
Pipe Size 2-1/2" and larger - Flanged end valves

D. Install swing check valves in horizontal position, unless otherwise shown on drawings, with hinge pin horizontally perpendicular to centerline of pipe. Install for proper direction of flow.

E. Provide access panels at all concealed valves.

F. Major control and sectionalizing valves throughout building shall be identified by means of a brass valve tag bracketed to valve handle. Contractor shall prepare schedule of such identifying plates and frame under glass for installation in main equipment room.

G. All welded piping to be welded by certified welders skilled in the work to be done.

H. No piping of dissimilar metals placed in contact or in close proximity with each other. Provide bronze valves wherever piping of dissimilar metals is joined.

I. Run all piping concealed unless specifically noted otherwise, making all necessary offsets, turns, etc., necessary to conceal piping from view.

J. Provide all necessary steel frame supports, anchor bolts, sleeves, etc., required for safe support of equipment and piping installed under this contract. The Mechanical Contractor shall be completely responsible for the accurate position and dimensions of all foundations and support items.

END OF SECTION 22 0500

SECTION 22 0700 - PIPING AND EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Provide a complete system of insulation, as herein specified, for both inside and outside of building.

B. The General Provisions of the Contract including General and Supplementary Conditions and General Requirements apply to the work specified in this Section.

C. Refer to Section BASIC MATERIALS AND METHODS, which is applicable to this Section.

D. Insulation shall include insulating materials, their applications, finish, bands, tie wire and weather protection for all piping, fittings, valves, and equipment as indicated and specified herein.

1.2 GENERAL

A. All insulation shall be applied in a workmanlike manner by skilled workmen regularly engaged in this type of work.

B. All pipe insulation shall have COMPOSITE flame and smoke hazard ratings as tested in accordance with standard testing methods (NFPA) 255 and UL 723).

C. Composite ratings shall not exceed: flame spread 25, smoke developed 50.

D. Accessories such as adhesive, mastic, cement, tapes and cloth shall have the same component ratings as listed above.

E. THE INSULATION CONTRACTOR SHALL CERTIFY IN WRITING, PRIOR TO INSTALLATION, THAT ALL PRODUCTS TO BE USED WILL MEET THE ABOVE CRITERIA.

1.3 QUALITY ASSURANCE

A. Manufacturer: Provide insulation and accessories for work in this Section produced, meeting the requirements specified. Approved manufacturers:

Johns-Manville	Knauf
Owens-Corning	Aeroflex
Armacell	RBX

PART 2 - PRODUCTS

2.1 AIR CONDITIONING DRAINS AND REFRIGERANT PIPING

A. Insulate **all** air conditioning condensate drains and refrigerant pipe, fittings, flanges and valves with flexible foamed plastic tubing insulation, J-M Aerotube 11, Rubatex, or approved equal. Thickness to be 3/4 inch.

B. Insulate all horizontal waste piping (new or existing) above ground that receives A/C condensate from drain to vertical stack. Also insulate the "P" trap of those drains. Insulation shall be same as specified for above ground domestic cold water piping, fitting flanges and valves except thickness shall be 1/2 inch for all pipe sizes.

2.2 DUCT INSULATION

A. DUCT SIZES SHOWN ON DRAWINGS ARE FREE AREA SIZES. See Section 233000 for insulation and duct material and type required for each application. Insulation shall be as per the following:

B. Lined Duct system – No lined duct permitted.

C. Exterior Duct Wrap - Exterior insulation duct wrap shall be 2” thick .75 PCF fiberglass wrap with F.S.K. jacket.

2.3 DOMESTIC HOT AND COLD WATER PIPING ABOVE GROUND

A. Insulate all new above ground hot & cold water pipe with glass fiber pipe insulation with factory applied white all service jacket, with self-sealing lap (ASJ-SSL).

B. Insulate fittings, flanges and valves with performed insulation with PVC premolded one-piece fitting covers, with fiberglass inserts. Premolded or shop fabricated Glass Fiber covers may be used in lieu of above at the Contractor’s option. Optional covers to be given a smoothing coat of finishing cement in exposed areas and vapor sealed in all areas with vapor barrier mastic coating reinforced with white glass fabric.

C. Insulation thickness for all cold water piping to be ½ inch.

D. All new domestic hot water and hot water circulating piping shall be insulated in accordance with the Schedule below.

	PIPE DIAMETER	INSULATION THICKNESS
All mains, branches and other piping	1-1/4” and less	1/2”
	1-1/2” to 4”	1”

E. Provide an isolating vapor seal between pipe insulation jacket and pipe at butt joints of insulation at fittings, flanges, valves, hangers and at 21 foot intervals on continuous runs.

F. Adhere longitudinal laps and butt strips of jacket with factory applied pressure sensitive tape system.

2.4 HEAT TRACING OF EXTERIOR PIPING

Exterior above ground domestic water and fire water piping shall be provided with heat tracing to ensure protect against freezing. The heat trace cable shall be applied, the piping insulated as specified for domestic cold water systems above and the exterior shall have an aluminum jacket for protection. The heat trace cable shall be Raychem XL-Trace or equal, 5 watt per foot, 120 volt system designed and installed in accordance with manufacturer’s recommendations. The heat

trace system shall consist of the power distribution panel, electronic controller, ambient RTD, heat trace cable, tee kits, end seal kits, power connection kits, splice kits, cross kits, etc. The electronic controller shall be Raychem C910 or equal. The electronic controller shall have an output for fire alarm system monitoring when fire protection piping is heat traced.

2.5 ROOF DRAINS

Insulate the body of all new and existing roof drains and the roof drain piping and fittings from the drain through all horizontal runs to the connection with the vertical leader as specified for domestic cold water pipe, fittings, flanges and valves; thickness to be ½ inch for all pipe sizes. At Contractor's option 1-1/2" thick flexible fiberglass insulation with vapor barrier may be used in lieu of rigid fiberglass. Insulation shall be same type as specified for exterior duct wrap. All joints shall be sealed with pressure sensitive tape.

PART 3 - EXECUTION

3.1 WORKMANSHIP AND INSTALLATION

A. All insulation shall be applied per manufacturer's specifications and installation requirements.

B. Insulation shall be applied over clean dry surfaces after all test have been performed and approved.

C. Methods of application and other details not specified herein shall be in accordance with manufacturer's recommendations, which shall constitute minimum standards.

D. Sheet Metal Saddles - 10" long shall be provided on all hangers supporting insulated lines. They shall be fabricated to conform with the outside diameter of the pipe covering and shall be fabricated from 22 gauge sheet iron for pipe through 2-1/2" 20 gauge sheet iron for pipes through 8" and 16 gauge for all pipes over 8".

E. A rigid insulation material shall be used at each pipe hanger as an insert and the pipe covering shall pass full thickness through the hangers.

F. On all outdoor piping insulation above ground, provide aluminum jacket 0.016 inch thick with longitudinal z-joint secured with preformed 2" wide butt strips, as manufactured by KNAUF, MANVILLE or approved equal. Provide preformed aluminum fitting cover on all fittings. Exterior refrigerant piping shall be covered with 20 mil grey PVC jacket.

END OF SECTION 22 0700

SECTION 22 1100 - PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to the work specified in this Section.

1.2 DESCRIPTION OF WORK

A. Furnish and install new fixtures, waste, vent, storm drain, cold water and hot water piping shown on plans.

B. Connections of all equipment and fixtures with accessory fittings, shut-off valves, trimmings, traps, structural supports, insulation, etc., as herein specified and/or as shown on drawings.

C. Refer to SECTION 23 0500 which is applicable to this Section.

D. Include (but not necessarily limited to) the following items of mechanical equipment, fixtures and materials installed and in a first class operating condition:

1. All labor, materials, equipment, accessories, and miscellaneous items required to provide a complete plumbing system. Provide adequate supervision at all times during the progress of the work.
2. All plumbing piping and hangers for same as specified herein and where shown on the Architectural and/or mechanical drawings.
3. New water service and connection to water distribution.
4. New sewer and storm drain services, with connections to service mains and piping distribution.
5. Hose bibbs.
6. Floor and miscellaneous drains.
7. All sewer, waste and vent piping and all cleanouts necessary for a complete operation installation as shown on mechanical drawings, or as required by the State and Local Sanitary Codes.
8. Temporary water, sanitary, etc., facilities during construction period.

1.3 QUALITY ASSURANCE

A. Manufacturer: Provide plumbing fixtures and accessories for work in this Section produced, meeting the requirements specified. Approved manufacturers:

American Standard	Just
Kohler	Kind Red
Crane	Church
Toto	Bemic
Bradley	Centoco
Acorn	Wade
Symmons	Watts
Wiloboughy	J.R. Smith
Riat	Sloan
Zurn	Delaney
Mustee	Chicago
Elkay	T&S Brass

Haws	Zoiler
Weil	Goulds
B&G	Grundfos
Taco	Charlotte Pipe
NIBCO	Harvel
Lewis Pipe	Canariis
AB &I	Tyler
US Plastics	Lochinvar
AO Smith	Rheem
Bradford White	Laars
Kimax	Spears
Enfield	Orion

B. Soldering processes shall conform to ASME B31.3 Process Piping and Copper Development Association recommended practices.

PART 2 - PRODUCTS

2.1 SANITARY SEWER

A. Cleanouts in sanitary lines, both inside and outside at building, cast-iron body caulking ferrules with brass thread flanged plugs.

B. Cleanout covers located in floors for sewer lines inside of building, with satin brass scoriated tops and covers.

C. Cleanouts shall be installed in each change of direction of sewer lines where more than a 45 degree angle turn is made. Cleanouts shall be provided within 18” of each sanitary tee.

D. Cleanouts on underground lines shall be brought to a cast-iron cleanout box, with service marking, 1/2" thick flanged type and loose cover. Provide 12" X 4" thick concrete slab around cover and frame.

E. Size and distance between cleanouts shall be required by local authorities and/or as indicated on drawings.

F. All floor drains shall be provided with trap primers and ½” trap primer line.

G. All soil, waste and vent piping shall be solid core, pressure rated schedule 40 PVC with solvent weld fittings (except for kitchen grease waste). Pipe and fittings shall conform with ASTM D 2665.

2.2 DOMESTIC WATER

A. Ball valves shall be provided where indicated on drawings and shall be designed for a minimum water working pressure of not less than one hundred fifty (150) pounds per square inch. Each underground valve shall be protected by a cast-iron valve box with minimum thickness of 3/16 inch. The cover shall have the word "WATER" cast in the metal.

B. Hot and cold water piping inside the building shall be polypropylene made in a 3-layer extrusion process and shall conform to ASTM F 2389 requirements. The hot water piping shall contain a fiber layer to restrict thermal expansion. The valves and pipe fitting shall be polypropylene with fusion welded joints.

Piping in the pump room and within 10' of water heaters shall be hard drawn seamless copper tubing, type "L" with wrought copper sweat fittings and lead free silver solder.

No piping joints shall be allowed under the building slab. Underground piping shall be SDR 7.4 or heavier.

Piping exposed to sunlight shall have UV inhibitor.

At Contractor's option, hard drawn seamless copper tubing, type "L" with wrought copper fittings and lead free silver solder may be used.

C. All piping, fittings, solder and flux used in conjunction with the potable water systems shall be lead free. The term "lead free" shall be as defined in the Safe Drinking Water Act Amendment of 1986 (P.L. 99-339).

2.3 STORM DRAIN SYSTEM

A. All storm drain piping inside the building, under slab, out to the connections at the service main shall be as follows.

1. Above ground and underground shall be schedule 40 PVC as specified for sanitary sewer above ground.
2. Cleanouts shall be as specified for sanitary sewer, except covers shall have the word "Drain" cast in them.

2.4 FIXTURES

A. Furnish, install and/or connect all plumbing fixtures indicated on drawings or as herein specified. Refer to Mechanical as well as Architectural Drawings for location and number of fixtures required. If any fixtures shown on Architectural Plans but not on Mechanical Plans, or vice versa, these fixtures shall be furnished, installed and connected the same as if indicated on all drawings. See Architectural Drawings for specific fixtures required. Where a specific manufacturer's name and catalog number is used to indicate the type and quality required, it shall be assumed that other manufacturer's products may be used, where they are equal and approved by the Architect as stipulated elsewhere herein.

B. Each plumbing fixture shall be fitted with all necessary and proper fittings, trim and operating devices and shall be left in perfect operating condition. The finish of all traps, wall escutcheons, and exposed metal work in connection with fixtures, trimmings and operating devices shall be chromium plated.

C. Before setting any fixtures or rough-in for fixtures, obtain the exact mounting height, as desired, from the Architect.

D. Equipment shown on drawings to be furnished under other sections shall be roughed-in, installed and connected by this Contractor under this Section. This Contractor shall furnish and install all necessary valves, piping, fittings and waste traps, etc., not provided with said equipment but as required for proper operation and installation. Obtain rough-in dimensions before installing any piping.

E. Plumbing fixtures shall be as follows:

WATER CLOSET (MARK P-1)

Floor mounted; china; elongated rim; top spud; low consumption; open front white seat less cover; manual flush with screwdriver stop and back flow vacuum breaker.

Fixture - Kohler Model K-4350
Flush Valve – Sloan Royal 111-1.28

WATER CLOSET (MARK P-1A)
Floor mounted; china; elongated rim; top spud; low consumption; handicap use, ADA compliant; open front white seat less cover; manual flush valve with screwdriver stop and back flow vacuum breaker.

Fixture – Kohler Model K-4405
Flush Valve – Sloan Royal 111-1.28

LAVATORY (MARK P-2)
Wall hung; china; mount for handicap use, ADA compliant; concealed support arms; grid strainer with 1-1/2" tailpiece; 1-1/2" c.p. "P" trap with offset waste to wall; Battery sensor faucet with thermostatic mixing valve, 3/8" flexible metal c.p. risers with wheel handle stops; provide all piping from supplies to fixture. Provide ADA Lav Shield to encapsulate all piping and valves.

Fixture – Kohler Model K-2084 – color white, 21" x 18"
Faucet – Sloan EFX-250.50

LAVATORY (MARK P-2A)
Undermount lavatory, ADA compliant; grid strainer with 1-1/2" tailpiece; 1-1/2" c.p. "P" trap with offset waste to wall; Battery sensor faucet with thermostatic mixing valve, 3/8" flexible metal c.p. risers with wheel handle stops; provide all piping from supplies to fixture. Provide Trap Wrap insulation to encapsulate all piping and valves.

Fixture – Kohler Model K-2084 – color white, 21" x 18"
Faucet – Sloan EFX-250.50 (Provide mixing valve per Plumbing drawings)

URINAL (MARK P-3)
ADA Wall hung; china; top spud; low consumption; wall hanger; manual flush valve with vacuum breaker and screwdriver stop. Mount at ADA height.

Fixture – Kohler Model K-4991-ET-0
Flush Valve – Sloan Model Royal-186
Carrier – Jay R Smith 0636

SINK (MARK P-4)
Stainless Steel ADA; two compartment; countertop; self-rimming; 6" deep bowl; 18 ga. type 304 s.s.; 3/8" flexible supplies with wheel handle stops; two stopper strainers; continuous waste; 1-1/2" c.p. "P" trap with waste to wall. See plans where offset piping and waste are required. Insulate waste and water piping under fixture with closed cell insulation, as manufactured by Truebro or approved equal.

Fixture – Elkay Model ECTSRAD3322BG
Faucet – Elkay Model K-7505
Continuous Waste – Elkay Model LK-53
Stopper – Elkay Model LK-35

SERVICE SINK (MARK P-5)

Molded plastic floor mop sink; 12" high sides; 24" X 24" X 10"; faucet with integral stops; wall brace and vacuum breaker; hose and hose bracket; stainless steel strainer and 3" deep seal "P" trap.

Fixture – Fiat Model MSB 2424
Faucet – Fiat Model #830-AA
Hose – Fiat Model #832-AA

DRINKING FOUNTAIN (MARK P-6)
Wall mounted; electric fountain; bi-level ADA compliant with bottle filling station, stainless steel; 120V; 1-1/2" "P" trap; 3/8" c.p. metal supply with wheel handle stop; 7.5 GPH to 50 degree F at 90 degree F ambient.

Fixture – Elkay Model LZWS-LRP

SINK (MARK P-7)
Single bowl; 304 stainless steel; countertop; under mount; 18 gauge; 14" X 14" X 6"; strainer with 1-1/2" tailpiece; 1-1/2" c.p. "P" trap with waste to wall; single lever swing spout faucet; 3/8" flexible supplies with wheel handle stops.

Fixture – Elkay Model ELUH12LV
Faucet – Elkay Model LK7921SSS
Drain Fitting – Elkay LK174

HOSE BIBB (MARK HB)
3/4" rough brass, loose key sill cock with vacuum breaker, Smith 5609.QT or Mifab MHY-16. Use for all interior hose bibs.

HOSE BIBB (MARK HB-1)
Wall hydrant J. R. Smith 5509.QT cast box with cover, bronze finish, loose key with vacuum breaker. Use for all exterior hose bibs.

FLOOR DRAIN (MARK FD)
J. R. Smith 2005-B, cast-iron - See plans for sizes. Nickel brass square strainers in toilet rooms and finished areas. All floor drains shall have 4" deep seal traps and trap primer connections.

FLOOR DRAIN (MARK FD-1)
J.R. Smith No 2010-F37 cast iron body and flashing collar with extended rim nikaloy strainer, install with rim flush with floor. All floor drains shall have 4" deep seal traps, sediment bucket hinged grate and trap primer connections. Use in all mechanical rooms.

TRAP PRIMER (MARK TP)
Automatic water metering type, Precision Plumbing Products Model PR-500, with SS-8 supply tube and DU distribution unit to serve drains as shown on drawings. Install per manufacturers recommendations and provide wall access panel for periodic inspection.

ROOF DRAIN (MARK RD)
Cast iron drain with sump, flashing clamp, gravel stop and 16" diameter low profile dome. J. R. Smith Model 1010, see drawings for sizes.

ICE MACHINE BOX (MARK IM)
Metal recessed wall box with ¼ turn ball valve and cold water connection.

2.5 VALVES, STRAINERS, UNIONS AND FITTINGS

A. General - All material shall be new, of the best quality with same brand or manufacturer for all similar installations. SEE SECTION 220500 for type and manufacturer.

2.6 WATER HAMMER ARRESTORS

A. Provide arrestors as marked A.C. (air chambers) where shown on the drawings and/or as necessary to prevent water hammer in the cold water and hot water piping based on actual piping arrangement on the job. At a minimum water hammer arrestors shall be provided at each fixture group. Branch lines over 20' shall be provided with 2 water hammer arrestors. Size and install water hammer arrestors as per manufacturer's recommendations for the installed plumbing fixture units on each branch.

B. Install fluid water hammer arrestors in compliance with ASSE Standard 1010.

C. Each unit shall be constructed with a single moving part. The barrel shall be fabricated of Type "K" hard drawn copper, with the cap fabricated from standard wrought copper fittings attached to the barrel with lead free solder. The piston shall be machined from brass and equipped with rubber "O" rings.

2.7 WATER HEATERS

For sizes and requirements of all water heaters see schedules and details on the drawings. All storage tank type water heaters shall have brass drain valves and ASME T&P relief valve. The water heaters shall be piped and installed per manufacturer's recommendations.

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. All piping, waste and stacks shall be run concealed underground, in ceiling spaces, walls or in chases provided. The entire installation must present an appearance truly in keeping with the best practice and indicative of skill and neatness. In areas of exposed ceilings piping shall be grouped together and run on common pipe hangers with piping run parallel to building lines.

B. All material shall be installed in a neat and workmanlike manner by competent specialists for each sub-trade. The installation of any materials and equipment not meeting these standards may be condemned by the Architect and shall be removed and re-installed at no additional cost to the Owner. Contractor is responsible for the safety and good condition of the materials installed until final acceptance by the Owner.

3.2 INSTALLATION

A. Pipe shall be laid to the grades and alignment indicated on the drawings. Each pipe shall be laid line to line and grade and in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets of the flow line. The interior of the pipe shall be cleaned of all dirt and superfluous materials of every description. Trenches shall be kept free from water until the pipe joining material has set and pipe shall not be laid when the conditions of the trench or the weather is unsuitable for such work. At times when the work is

not in progress, open ends of pipe and fittings shall be securely closed, so that no trench water, earth or other substance will enter the pipe or fittings. Minimum compacted pipe coverage shall be 2'-0", or as indicated on drawings.

B. Where the location of the sewer is not clearly defined by dimensions on the drawings, the sewer shall not be run closer horizontally than 6'-0" to water supply main except that the bottom of the water pipe will be at least twelve (12") inches above the top of the sewer pipe, both pipes may be lain in the same trench. Where sewer mains cross above water services the sewer piping for a distance of ten (10') feet each side of the crossing shall be cast-iron without any joint closer horizontally than three (3') feet to the crossing.

3.3 SANITARY SEWER PIPING

A. New piping shall be a complete system to waste and vent lines from all fixtures.

B. All waste lines shall be installed on a continuous waste and vent system as required by codes and/or regulations.

C. All piping shall be installed straight and true and sized as indicated on drawings.

D. All changes in direction shall be made by the use of 45 degree wyes, double wyes, long sweep quarter bend or 1/8 bends, except that single sanitary tees may be used on vertical stacks. Tees and crosses may be used in vent pipes.

E. Cleanouts easily accessible shall provide at the foot of each vertical waste or soil stack. Cleanouts shall be of nominal size as the pipes up to four (4") inches and not less than four (4") inches for larger pipes. The distance between cleanouts in horizontal lines shall not exceed those distances required by local authorities or 50’, whether indicated or not. Cleanouts shall be installed at the bottom of vertical risers and as the sewer exits the building.

F. All cleanouts installed so as to be easily accessible, and all outside cleanouts installed flush with finished grade.

G. Horizontal soil or waste lines shall be run at uniform grade of not less than 1/4" per foot. Horizontal lines shall be supported or anchored at intervals specified in BASIC MATERIALS AND METHODS. All stacks shall be supported at their base and every floor to the roof line and pipes shall be rigidly secured.

H. Every fixture trap shall be protected against siphonage and back pressure and air circulation assured by means of a soil or waste stack vent, a continuous waste or soil vent, a loop or circuit vent.

H. No vents shall be less than 2" in diameter and no case shall branch or main vent have a diameter less than half that of the soil or waste pipe served, or as required by local code.

3.4 HOT WATER AND COLD WATER SYSTEMS

A. This installation comprises a complete and operating system of hot and cold water distribution and connection to each and every fixture and appliance requiring this service and/or as indicated on drawings.

B. All ends of tubing shall be square cut and burrs removed before assembling. Joints shall be thoroughly cleaned with sandpaper or emery cloth before applying the flux.

C. All water supply piping, fittings, and fixtures shall be protected against water hammer shock, or surge pressure, by adequate air chambers.

D. Each riser battery shall be valved in an accessible location.

E. No hot water piping shall be run closer than six (6") inches from cold water pipes.

F. Distribution and sizes shall be as indicated on drawings.

G. Pitch all piping to low points to allow for system drainage.

3.5 STORM DRAIN SYSTEM

A. All horizontal storm drain pipe shall be run at uniform grade of not less than 1/4" per foot. If a lesser slope is required because of on job conditions, contractor shall obtain permission before making the change.

B. Horizontal lines inside and under the building shall be supported or anchored at intervals as specified in Section 230500.

C. Connect storm drain piping to site drainage piping and run to service main as shown on drawings.

D. Make all arrangements with Local Authority for the inspection of the new storm drain system and pay all assessed costs and fees.

3.6 MISCELLANEOUS ITEMS OF WORK

A. Contractor shall be responsible for securing all information and data for connection to all utilities and pay all costs including meter fees and connection fees.

B. Contractor shall provide temporary water and sewerage on site for use during construction period as required.

C. All valves shall be installed so as to be easily accessible for cleaning, inspection maintenance, and operation.

D. Provide access panels at all concealed valves.

E. All welded piping to be welded by Certified welders skilled in the work to be done.

F. No piping of dissimilar metals placed in contact or in close proximity with each other. Provide bronze valves wherever piping of dissimilar metals is jointed.

G. Provide all necessary steel frames supports, anchor bolts, sleeves, etc., required for safe support of equipment and piping installed under this contract. The Mechanical Contractor shall be completely responsible for the accurate position and dimensions of all foundations and support times.

END OF SECTION 22 1100

SECTION 23 0500 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to the work specified in this Section.

B. Separation of specifications into sections is for convenience only and is not intended to establish limits of work or liability. The following are the Sections that will apply to this project.

23 05 00 - Basic Materials and Methods
22 07 00 - Piping and Equipment Insulation
22 11 00 - Plumbing
21 13 00 - Fire Suppression System
23 30 00 - Heating, Ventilation and Air Conditioning
23 25 00 – Water Treatment for HVAC Systems
23 05 93 - Testing, Adjusting, and Balancing of Air and Hydronic Systems
22 05 00 - Valves, Strainers, Unions and Fittings
23 09 00 - Building Temperature Control and Energy Management System

1.2 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the Contract Documents.

1.3 DEFINITIONS

D. These definitions are included to clarify the direction and intention of these Specifications. For further clarification, contact the Architect/Engineer.

1. Concealed / Exposed: "Concealed" areas are those areas that cannot be seen by the building occupants. "Exposed" areas are all areas, which are exposed to view by the building occupants, including under counters, inside cabinets and closets, plus all mechanical rooms. “Exterior” areas are those that are outside the building exterior envelope and exposed to the outdoors.

2. Furnish: The term "furnish" is used to mean "supply and deliver to the Project Site, ready for unloading, unpacking, assembly, installation, and similar operations.

3. Install: The term "install" is used to describe operations at Project Site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

4. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use.

1.4 DESCRIPTION OF WORK

A. The work to be done under this heading includes the furnishing of labor, materials, equipment, and service necessary for and reasonably incidental to the proper completion of all mechanical work as shown on the drawings and herein specified.

B. Visit and examine the job site, and with all authorities concerned in order to become familiar with all existing conditions pertinent to the work to be performed thereon. No additional compensation will be allowed for failure to be so informed.

C. Materials and equipment shall be new, except where otherwise indicated, of the best quality, with same brand of manufacturer for all similar material. All equipment shall be installed in accordance with manufacturer's requirements. Equipment with electrical components shall be laboratory tested.

D. All work shall be performed in a neat and workmanlike manner, and in accordance with all codes, standards, and requirements of the industry. All workers shall be trained in the tasks they perform. Training shall be by an industry accepted trade school.

E. In general, provide the installation of plumbing, and HVAC systems complete with all piping, fittings, fixtures, equipment, etc.

F. Regardless of titles and subdivisions herein employed, consider these specifications as one complete document with General Section applying to all other sections. All bidders are cautioned to read entire specifications and to thoroughly familiarize themselves with all requirements thereof.

G. Check all specifications and all drawings and bring to attention any conflicts or variations as shown as noted.

H. Specifications and accompanying drawings apply to all contracts or sub-contracts entered into for supplying material or labor for construction of work specified herein and shown on drawings.

I. Protect Owner and his agents including Construction Manager, Architect and/or Engineer from any and all damages and expense arising from fulfillment of contract and at completion of work repair all damages done.

J. For any points which are not clear, or for items and/or details which the Contractor feels are in need of clarification, consult the Architect before submission of a proposal.

K. The drawings and the specifications are complementary and what is shown and/or called for on one shall be furnished and installed the same as if shown and/or called for in the other.

L. In case of discrepancies and/or ambiguities in the drawings and/or in the specifications, the Architect shall be consulted prior to submission of a proposal. Failure to do so on the part of the successful bidder shall be construed as explicit agreement on his part to abide by the Architect's decision in such matters.

M. The word "provide" as used in these Specifications and on the Drawings shall be termed to mean "furnish and install".

N. Contractor shall include in base bid the connection of all sewer, storm drain and water piping to mains as shown on the drawings. Contractor shall include all material and all costs for complete installation.

O. If the Contractor notices during the bidding any items of the contract documents which will violate any applicable code, these items shall be brought to the attention of the Architect before the bid date. Failure to bring these items to the attention of the Architect shall be construed as explicit agreement that the Contractor has included in his bid price any and all modifications necessary to complete the project in accordance with all applicable codes.

1.5 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. All exposed uninsulated piping, ductwork and other equipment requiring painting will be painted under PAINTING SECTION. Leave all these surfaces clean of oil, dirt, plaster, etc., ready for painting section's work.

B. Power wiring for all equipment shall be done under ELECTRICAL SECTION.

C. Provide approved wiring diagrams to the Electrical Contractor showing interlocking of all equipment and controls, assisting in all wiring problems affecting his equipment, checking and verifying that same is wired correctly under the Electrical Section for proper operating of all mechanical items.

D. Furnish under this section all heating, air conditioning, ventilating and other mechanical systems controls, starters, firestats, relays, and related equipment.

E. Openings for all access doors, relief and return air grilles, etc., shall be provided under the respective trade sections.

F. Curbs, flashings, etc., for exhaust fans, vents, etc., shall be provided under the respective sections.

G. All HVAC control wiring shall be furnished and installed by Building, Automation and Temperature Control Contractor.

H. Piping and ductwork penetrations through fire rated partitions/floors shall be fire sealed in accordance with the UL fire resistance directory. See Sealant Specification for materials. The integrity of the fire rating, as indicated on the architectural drawings, shall be maintained.

1.6 QUALITY ASSURANCE

A. The Contractor bidding on this portion of the work must be fully experienced in installations of equal size, complexity, and quality, and must be licensed to perform such work as required by the Louisiana State Legislature, R.S.37:2152-2163.

B. In bidding he acknowledges that he fully understands the scope of work and design, and has the ability for the contract price to assemble and install the equipment, piping and ductwork shown or specified, so as to mold same into a satisfactory workable system and arrangement. Contractor shall be trained by the proposed manufacturer for the installation of the equipment. No work shall begin until the Contractor has adequate training and understanding of the equipment.

C. Contractor shall recognize that a fault or error in his work remains his responsibility regardless of whether such difficulty was discovered after the work had progressed, and shall make corrections at no cost to the Owner.

D. Adequate and competent constant supervision shall be provided by Contractor to assure that work is done in accordance with good standard practice and workmanship and with intent of drawings and specifications. Contractor shall recognize that amount of information and detail could be provided to contract documents is limitless and could extend into every minute detail and sequence of operations, to a point where only workmen would be required, without drawing on ability, experience and ingenuity of the Contractor.

E. All work shall be installed in strict accordance, with all existing local and state codes and ordinances, with National Board of Fire Underwriters

F. This Contractor shall secure all permits and inspections and shall pay all fees and taxes and shall provide Owner with certificates of approval from agencies having jurisdiction over various phases of work.

G. Contractor shall maintain and service all equipment until time of acceptance by Owner. Contractor shall include all required service access in the installation as required by the manufacturer and governing codes.

H. Prior to starting any work, the Contractor shall submit a quality assurance plan for approval by the Architect. In the quality assurance plan, the Contractor shall provide the following information:

1. List of all sub-contractors and equipment suppliers.
2. List of all foreman and job superintendents including job experience for all trades.
3. Construction time schedule demonstrating coordination with other trades and showing detailed time lines for test and balance and commissioning being completed prior to final punch list inspection.

I. Fire Suppression, Plumbing and HVAC systems shall be coordinated with other systems and trades to include but not be limited to: Electrical systems, fire alarm, security systems, telephone and data systems.

J. Verification of Dimensions: The Contractor shall be responsible for the coordination and proper relation of Contractor's Work to the building structure and to the Work of all trades. The Contractor shall visit the premises and become thoroughly familiar with all details of the Work and working conditions, to verify all dimensions in the field, and to advise the Architect/Engineer of any discrepancy before performing any Work. Adjustments to the Work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner or the Architect/Engineer.

K. All dimensional information related to new structures shall be taken from the appropriate Drawings. All dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the Site.

L. The Drawings are subject to the requirements of Reference Standards, structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of Work. Work shall be organized and laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. All exposed Work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

M. When the Drawings do not give exact details as to the elevation of pipe and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with proper grades for the functioning of the system involved. Piping and duct systems are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas.

N. Where core drilling of floor or wall penetrations is required, Work shall be performed in accordance with Division 03 Specifications. Where applicable Division 03 Specifications are not included in the Project, core drilling shall be in accordance with generally accepted standards, and be performed by licensed personnel where applicable.

O. Certify in writing that neither the Contractor nor any of Contractor's subcontractors or suppliers will supply any materials that contain any asbestos in any form for this Project.

1.7 SUBMITTALS

A. Shop Drawings and Submittal Data required:

1. Submit to the Architect for review, complete descriptive information and dimensional data on all items of equipment, materials and accessories, including duct, piping, equipment and sprinkler layouts. Piecemeal submissions shall not be approved. Written approval thereof must be obtained before ordering or installation. The following shall be submitted:

Ductwork layout	Diffusers, grilles & registers
Piping layout	Equipment room layout
Plumbing layout	VRF heat pump systems
Plumbing fixtures	Controls
Water heaters	Coordination Drawings
Plumbing materials	Valves, strainers, unions & fittings
Ductwork accessories	Exhaust fans

2. Shop drawings and submittal data shall be considered to be instruments of service only and submitted for the sole purpose of convenience to the Contractor to assist him in the performance of the contract. The Architect's review of the shop drawings and submittal data shall not supersede these specifications, the accompanying drawings, or the contract terms, unless specifically covered by a properly executed change order, and then only to the extent specifically and explicitly stipulated therein.

3. Submit in accordance with requirements of Architectural Sections, Division 1.

P. Ductwork shop drawings shall be at a minimum ¼" scale. Duct shop drawings shall show the following:

Q. All structural members larger than 4".
R. All hydronic piping 2" or larger.
S. All conduit 2" or larger
T. All duct fittings, take-offs, volume dampers, control devices and fire dampers.
U. All grilles, louvers, registers and diffusers.
V. Duct dimensions and insulation methods.

W. Duct dimensioned from structural beams and columns.
X. Architectural ceiling heights, furrings, chases, etc.
Y. Cross-sections in areas of congestion or conflict.
Z. Installation details for all duct and related equipment.
AA. Lights, speakers, smoke detectors and other ceiling mounted devices.
BB. All plumbing piping 2" and larger.

CC. All layout shop drawings shall be submitted in AutoCad and hardcopy. Layout drawings shall be dimensioned and coordinated with other trades.

DD. Coordination drawings shall include all items indicated above for the ductwork shop drawings and the following:

EE. All plumbing piping.
FF. All structural members.
GG. Al electrical conduit.
HH. All hydronic piping.
II. All sprinkler system piping and sprinkler heads.

JJ. No work shall begin until coordination and ductwork shop drawings are approved by Engineer.

B. After completion of project Contractor shall turn over to the Architect complete operating and maintenance instructions including listing of supply and repair items and locations of places to purchase same. Comply with requirements of Division 1 Sections.

C. Substitutions:

1. All material, equipment, methods, and accessories entering into the work under this section of contract are subject to approval or disapproval of the Owner. Approval of any manufacturer, material, or product shall not constitute a waiver of Owner's right to demand full compliance with contract requirements, including shape, size, quality and performance.

2. Equality of materials is that established by opinion of Owner. Decision of Owner is final.

3. Whenever a material or article of equipment is specified by use of a proprietary name, or by naming the manufacturer or vendor, any material or article which will perform adequately the duties imposed by the design will be considered for substitution, providing it is of equal substance, and function, meets specifications, and is aesthetically acceptable to the Owner. Refer to Division 1 Sections for approval procedures.

4. Literature, technical data, etc., includes complete data and samples if necessary, with submissions for substitutions. Burden of proof that material offered for substitution is equal, or superior, in construction and efficiency to that named, rests on Contractor, and unless proof is satisfactory to Architect, substitution will not be approved. Contractor shall note any deviations from specified equipment with the substituted submittal. Failure to note deviations will result in rejection of substituted equipment and materials.

D. See Architectural Specifications for "As-Built" requirements.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All equipment, ductwork, and materials shall be delivered to the Project Site clean and sealed for protection.

B. Take particular care not to damage the existing construction in performing Work. All finished floors, step treads and finished surfaces shall be covered to prevent any damage by workers or their tools and equipment during the construction of the Project.

C. Equipment and materials shall be protected from rust and dust/debris both before and after installation. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these Specifications.

D. All material affected by weather shall be covered and protected to keep the material free from damage while material is being transported to the Site and while stored at the Project Site.

E. During the execution of the Work, open ends of all piping and conduit, and all openings in equipment shall be closed when Work is not in progress, and shall be capped and sealed prior to completion of final connections, so as to prevent the entrance of foreign matter.

F. All equipment shall be protected during the execution of the Work. All ductwork and equipment shall be sealed with heavy plastic and tape to prevent build-up of dust and debris.

G. All ductwork and air handling equipment shall be wiped down with a damp cloth immediately before installation to ensure complete removal of accumulated dusts and foreign matter.

H. All plumbing fixtures shall be protected and covered to prohibit usage. All drains shall be covered until placed in service to prevent the entrance of foreign matter.

1.9 JOB CONDITIONS

A. Accompanying drawings, including plans, details, diagrams, notes, etc., are shown to limit and explain structural conditions, construction requirements, sizes, capacities and method of installation and erection. Structural and other conditions may require certain modifications and adjustments from conditions shown. Such deviations are permissible; however, specific sizes capacities and requirements affecting the satisfactory performance and operation of the installation shall remain unchanged. Make allowance for normal job conditions and interferences.

B. Whenever it becomes necessary to shift ducts or pipes or to change shape of ducts, such changes shall be referred to Architect for approval.

C. Ask for details whenever uncertain about method of installation. Lack of details not requested shall not excuse improper installation and correction shall be responsibility of Contractor. Contractor shall consult manufacturer for details specific to their items of equipment.

D. Furnish detailed duct layout and equipment room shop drawings based on field measurements and actual job conditions.

E. Schedule and perform all mechanical work to avoid delays to the Contractor and other trades.

F. All piping, cleanouts and covers, and other mechanical items in way of construction or remodeling, shall be rerouted, relocated or otherwise adjusted to work out with such construction or changes shown or specified in any or all of various sections of specifications. Unknown piping that is encountered will be referred immediately to Architect for method of disposition before continuation of work.

G. The Contractor shall review the architectural drawings to become familiar with the phasing of construction required for this project.

1.10 GUARANTEE AND SERVICE

A. Guarantee all equipment, materials, and workmanship for a period of one (1) year following date of acceptance unless noted otherwise.

B. During the period of guarantee any defects in equipment, materials, or workmanship shall be promptly corrected without cost to the Owner.

C. Guarantee includes equipment capacity and performance ratings specified without excessive noise levels. Any deficiencies in equipment capacity specified shall be promptly corrected.

D. Guarantee does not include maintenance items.

PART 2 – PRODUCTS

GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. All equipment installed shall have local representation, local factory authorized service, and a local stock of repair parts.

C. Responsibility for furnishing proper equipment and/or material and ensuring that equipment and/or material is installed as intended by the manufacturer, rests entirely upon the Contractor. Contractor shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

D. All materials, unless otherwise specified, shall be new, free from all defects, suitable for the intended use and of the best quality of their respective kinds. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of Work involved. All Work shall be executed by mechanics skilled in their respective trades, and the installations shall provide a neat, precise appearance. Materials and/or equipment damaged in shipment or otherwise damaged prior to installation shall not be repaired at the job Site but shall be replaced with new materials and/or equipment.

E. Materials and equipment manufactured domestically are preferred when possible. Materials and equipment that are not available from a domestic manufacturer may be by a non-domestic manufacturer provided they fully comply with Contract Documents.

F. Prevention of Rust: Standard factory finish will be acceptable on equipment specified by model number; otherwise, surfaces of ferrous metal shall be given a rust inhibiting coating.

2.1 ACCESS PANELS

A. Provide all access panels necessary for proper access to valves, traps, fixture connections, dampers, VAV boxes, control devices or other items installed under this contract. Coordinate access with manufacturer’s recommendations.

B. Panels to be Milcor, Type M, or KARP Model D3C-214M hinged with screwdriver lock or as indicated on drawings for special locations, minimum size 12” x 12” or larger as required for proper access. Minimum size for VAV box access is 24” x 24”.

C. Exact locations for panels to be directed by Architect. Provide number of access panels required for proper access.

2.2 TOOLS AND SCAFFOLDING

Furnish all tools, equipment, scaffolding and other facilities required to properly and expeditiously perform the work.

2.3 SIPHON PREVENTORS

Furnish and install on all equipment and fixtures requiring same, backflow preventors or vacuum breakers of a type approved by the IPC and DHH. Water connections to fixtures and equipment shall be made in such a way as to prevent back siphonage when the water supply is out or the pressure drops. Provide reduced pressure type back flow preventors where indicated on drawings. They shall be Watts series 900 or Febco Series 825, size as indicated on drawings.

2.4 SLEEVES AND THIMBLES

A. Pipe sleeves - wrought iron or cast iron of sufficient size for piping and installation to be installed in floors, walls below grade, and grade beams where piping passes through.

B. Thimbles above grade - heavy galvanized steel of proper size to allow freedom of piping and insulation, set in floor or roof slab as work progresses, also to be installed in wall and partitions where piping passes through.

C. Thimbles below grade - same as pipe sleeves above.

D. Sleeves through floors extend 1" above finished floor. Caulk around and seal all piping in chases and piping passing through floor slab.

E. Provide sleeve seals and shields for all pipe penetrations of ground floor slab.

F. Provide UL listed fire-stopping in all pipe penetrations of rated floors and walls, see Architectural Specifications for Requirements.

G. Provide escutcheons for all exposed piping penetrating walls, ceilings or floors.

2.5 BUCKS, GROUNDS AND CHASES

A. Be responsible for proper location and sizes or for any errors or omission in placing same.

B. Failure to inform the General Contractor promptly of such requirements shall not relieve the Mechanical installer of the responsibility for providing a complete mechanical system.

2.6 HANGERS

A. Horizontal piping above grade without hubs shall be rigidly supported. Distance between pipe supports:

1. 1/2" pipe	6'-0" maximum
2. 3/4" pipe	7'-0" maximum
3. 1" pipe	8'-0" maximum
4. 1 1/4" pipe	9'-0" maximum
5. 1 1/2" pipe and over	10'-0" maximum

B. Hangers shall be similar to "Split Ring" type.

C. Metal strap or wire will not be acceptable.

D. For two or more systems of piping run parallel and with same grade trapeze hangers may be used.

E. Use #22 gauge galvanized sheet steel saddles, minimum 18” long between the pipe covering and each pipe hanger on all insulated lines. Saddles shall extend along pipe runs and at least half way up piping on each side.

F. All above grade horizontal sewer drain, vent, waste and similar piping shall be hung at every hub using the same type hangers as specified for other piping.

G. All underground piping under building shall be hung from slab with stainless steel hangers. See detail on drawings.

H. Rods supporting pipe hangers shall have the following dimensions:

½” to 2” pipe	3/8” rod
2-1/2” to 3” pipe	½” rod
4” to 5” pipe	5/8” rod
6” pipe	¾” rod
8” through 12”	7/8” rod

Rods for trapeze hangers shall be a minimum of 3/8” and shall have the equivalent cross section, listed above, per pipe supported.

2.7 PAINTING AND IDENTIFICATION

A. Equipment, including pumps, motors, and similar factory fabricated and assembled units shall be furnished with factory applied protective prime coat paint of finished baked enamel. Equipment surfaces damaged during course of construction or shipment shall be refinished by the Mechanical Contractor.

B. Uncoated black ferrous piping and fittings shall be cleaned under this section and painted with one coat of enamel paint under PAINTING SECTION. Color of piping shall be selected by Architect. Hangers and supports shall be coated by dipping or brush painting with one coat of asphalt varnish. Steel frame equipment supports shall be cleaned and painted with one coat of aluminum paint.

C. Detached motor controllers, disconnects, etc., shall be identified with metal or plastic plates with etched letters to completely identify service of electrical equipment.

D. Major control and sectionalizing valves shall be identified by means of etched brass plates bracketed to valve handle. Contractor shall prepare schedule of such identifying plates for Architect's approval.

E. Exposed ductwork shall be cleaned under this Section and painted under Painting Section.

F. Provide ceiling markers for all controllers, valves, fans or VAV boxes located above the ceiling. The ceiling markers shall be ½" diameter dots colored to represent the system for valves. Provide equipment labels with ½" high black lettered text for all controllers, VAV boxes and fans.

G. Duct systems shall be labeled with printed plastic contact-type permanent adhesive labels.

H. All chilled water piping and domestic water piping shall be labelled. The label shall designate the piping system and direction of flow.

2.8 NAMEPLATES

G. Each major component of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Inspection.

H. Nameplates shall be black laminated rigid phenolic with white core. Nameplate minimum size shall be 1 inch high by 3 inches long with 3/16-inch-high engraved white letters.

I. Nameplate Fasteners: Fasten nameplates to the front of equipment only by means of stainless steel self-tapping screws. Stick-ons or adhesives will not be allowed unless the NEMA enclosure rating is compromised, then only epoxy adhesive shall be used to attach nameplates.

J. Nameplate Information: In general, the following information is to be provided for the types of electrical components or enclosures supplied with equipment.

1. Individual Starters, Contactors, Disconnect Switches, and Similar Equipment: Identify the device, and voltage characteristics source and load served.

2.9 WALL, FLOOR AND CEILING PLATES (ESCUTCHEONS)

A. Except as otherwise noted, provide stainless steel or chrome plated brass floor and ceiling plates around all pipes, ducts, conduits, etc., passing exposed through walls, floors or ceilings, in any spaces except underfloor and plenum spaces.

B. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines that are insulated and positively secured to such pipe or insulation.

C. For finished ceiling installation, secure escutcheons to ceiling with escutcheon fasteners.

D. Plates will not be required for piping where pipe sleeves extend ¾-inch or more above finished floor.

E. Round and rectangular ducts shall have closure plates (not chrome plated) made to fit accurately at all floor, wall and ceiling penetrations.

PART 3 - EXECUTION

3.1 PREPARATION

F. Cooperate with trades of adjacent, related or affected materials or operations, and with trades performing continuations of this Work in order to effect timely and accurate placing of Work and to coordinate, in proper and correct sequence, the Work of such trades.

G. The size of equipment indicated on the Drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine that the equipment proposed will fit in the space. Fabrication Drawings shall be prepared when required by the Architect/Engineer or Owner to indicate a suitable arrangement.

H. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.

I. Space Requirements:

1. Consider space limitations imposed by contiguous Work in location of equipment and material. Do not provide equipment or material which is not suitable in this respect.

2. Make changes in material and equipment locations of up to five (5) feet, to allow for field conditions prior to actual installation, and as directed by the Architect/Engineer at no additional cost to the Owner.

J. Contractor shall note that the electrical design and Drawings are based on the equipment scheduled and indicated on the Drawings. Should any equipment be provided requiring changes to the electrical design, the required electrical changes shall be made at no cost to the Owner.

K. Connections for equipment other than Divisions 21, 22, 23:

1. Rough-in and provide all gas, air, water, steam, sewer, etc. connections to all fixtures, equipment, machinery, etc., furnished by the Owner and/or other trades in accordance with detailed rough-in Drawings provided by the equipment suppliers, by actual measurements of the equipment connections, or as detailed.

2. After the equipment is set in place, make all final connections and provide all required pipe, fittings, valves, traps, etc.

3. Provide all backflow preventers and air gap fittings required, using approved devices. In each service line connected to an item of equipment or piece of machinery, provide a shutoff valve. On each drain not provided with a trap, provide a suitable trap.

4. Provide all ductwork, transition pieces, etc., required for a complete installation of vent hoods, fume hoods, etc.

3.2 INSTALLATION

L. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

M. All installation shall be in accordance with manufacturer’s published recommendations.

N. Piping may be run exposed in rooms typically without ceilings such as mechanical rooms, janitor's closets, tight against pan soffits in exposed "tee" structures, or storage spaces, but only where necessary. Shutoff and isolation valves shall be easily accessible.

O. All pipe, conduits, etc., shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All ducts, pipes and conduits run exposed in machinery and equipment rooms shall be installed parallel to the building lines, except that piping shall be sloped to obtain the proper pitch. Piping and ducts run in furred ceilings, etc., shall be similarly installed, except as otherwise shown. All pipe openings shall be kept closed until the systems are closed with final connections.

P. Prior to the installation of any ceiling material, gypsum, plaster or acoustical board, the Contractor shall notify Owner's Project Manager so that arrangement can be made for an inspection of the above-ceiling area about to be "sealed" off. The Contractor shall provide written notification to the Owner at least five (5) calendar days prior to the inspection.

Q. Precedence of Materials:

1. The Specifications determine the nature and setting of materials and equipment. The Drawings establish quantities, dimensions and details.

2. If interference is encountered, the following installation precedence of materials shall guide the Contractor to determine which trade shall be given the "Right of Way":

a. Building lines

b. Structural members

c. Structural support frames supporting ceiling equipment

d. Soil and drain piping

e. Vent piping

f. Supply, return and outside air ductwork

g. Exhaust ductwork

h. HVAC water and steam piping

i. Condensate piping

j. Fire protection piping

k. Natural gas piping

l. Medical/Laboratory gases

m. Domestic water (cold and hot, softened, treated)

n. Refrigerant piping

o. Electrical conduit

3. Coordinate fire suppression, plumbing and HVAC systems with transport systems as required to maintain transport system right-of-way.

3.3 EXCAVATION, TRENCHING AND BACKFILL

A. The Contractor shall perform all excavation of every description and of whatever substances encountered to the depths indicated on the drawings. During excavation material suitable for backfill shall be piled in an orderly manner a sufficient distance from the banks of the trench

to avoid overloading and to prevent slides or cave-ins. All material not suitable for backfilling shall be removed completely from job site. Such shoring shall be done as hereinafter specified.

B. Trenches shall be of necessary width for the proper laying of the pipe and the banks shall be as nearly vertical as practicable. The bottom of the trenches shall be accurately graded to provide uniform bearing and support. Bottom of trenches shall have 6" layer of compacted limestone aggregate. Care shall be taken to provide uniform bearing and support.

C. Bell holes and depressions for joints shall be dug after compaction and grading in order that the pipe will be supported along its entire length. Whenever wet or otherwise unstable soil that is incapable of receiving the bottom preparation and support piping, as determined by the Engineer, is encountered, such soil shall be removed to the depth required and the trench backfilled to the proper grade with river sand.

D. All shoring required to perform and protect the excavation, and as required for the safety of employees, shall be installed. The sides of the trenches, four (4') feet or less shall be protected as required. For trenches more than four (4') feet in depth, the sides shall be secured by the use of continuous sheet piling and shall be not less than two (2") inches in thickness. Meet the minimum requirements of OSHA for trench shoring not described above.

E. The trenches shall not be backfilled until all required pressure tests are performed and until the certificates of inspection from the proper authorities are obtained by the Contractor. The trenches shall be carefully backfilled with the excavated materials approved for backfilling consisting of earth, loam, sandy clay, sand and gravel, or other approved materials free from large clods of earth or stone, deposited in six (6") inch layers and thoroughly and carefully rammed until the pipe has a cover of not less than two (2') feet. The remainder of the backfill material shall then be thrown into the trench in one (1') foot layers and tamped. Any trench improperly backfilled, or where settlement occurs, shall be reopened to the depth required for proper compaction, then refilled and compacted, with the surface restored to the required grade and compaction, mounded over, and smoothed off. Sidewalks, drives and streets broken up by this work shall be repaired and returned to original condition.

3.4 FLASHING AND COUNTERFLASHING

All pipes and ducts that pass through roof and walls shall run so as not to interfere with the structural system and to permit proper application of base and counterflashing. All plumbing vents are to be finished with 2-1/2 pound sheet lead turned down into pipe. Other pipes to be provided with suitable curbs and flashed to roof or walls as indicated. Flues shall be properly flashed and counterflashed with approved type jacks. Roof drains shall have 2-1/2 pound lead sheet base secured to drain clamp and extending minimum of 2'-0" in all directions.

3.5 CLEANING, STERILIZING AND PIPING

A. When all work has been finally tested, Contractor shall clean all fixtures, pipes and exposed work.

B. All pipes shall be free from all obstructions.

C. All plated and other finished products shall be thoroughly cleaned and polished.

D. New water piping shall be sterilized as required by State Sanitary Code. Provide detailed reports describing sterilization method and duration for each piping section.

E. All piping shall be installed so that it may expand and contract freely without damages to equipment, other work, or injury to piping system. All necessary swing joints, expansion joints, or offsets to protect piping, etc., shall be installed whether indicated or not. Piping shall be graded to allow for system drainage.

F. Stainless steel or chromium plated floor, wall and ceiling plates shall be furnished on all exposed piping passing through floor, walls, or ceilings. Plates shall be secured in place with round head screws or toggle bolts of proper size and type for adjacent construction.

G. All piping shall be installed and sized as indicated on plans and be of equivalent materials to piping as hereinafter specified.

I. All piping shall be installed with runs arranged parallels or perpendicular to walls and ceilings with symmetrical and equal spacing between parallel pipes. Offsets shall be made using factory fittings, bending of piping shall not be accepted.

I. Notify Engineer a minimum 72 hours prior to enclosing piping in concealed spaces so that piping may be inspected.

3.6 TESTING

R. When any piece of mechanical equipment is operable and it is to the advantage of the Contractor to operate the equipment, Contractor may do so, provided that Contractor properly supervises the operation, and has the Owner's written permission to do so. The warranty period shall, however, not commence until such time as the equipment is operated for the beneficial use of the Owner, or date of Substantial Completion, whichever occurs first.

S. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install clean filter media, properly adjust, and complete all deficiency list items before final acceptance by the Owner. The date of acceptance and performance certification will be the same date.

T. Before the Work is accepted, an authorized representative of the manufacturer of the installed materials and/or equipment shall personally inspect the installation and operation of manufacturer's materials and/or equipment to determine that materials and/or equipment are properly installed and in proper operating order. The qualifications of the manufacturer's representative shall be appropriate to the technical requirements of the installation. The qualifications of the manufacturer's representative shall be submitted to the Owner for approval. The decision of the Owner concerning the appropriateness of the manufacturer's representative shall be final. Testing and checking shall be accomplished during the course of the Work where required by Work being concealed, and at the completion of the Work. In addition, the Contractor shall submit to the Architect/Engineer a signed statement from each manufacturer's representative certifying as follows: **"I certify that the materials and/or equipment listed below have been personally inspected by the undersigned authorized manufacturer's representative and is properly installed and operating in accordance with the manufacturer's recommendations."**

U. Check inspections shall include piping, equipment, heating, air conditioning, insulation, ventilating equipment, controls, mechanical equipment and such other items hereinafter specified or specifically designated by the Architect/Engineer.

V. The Contractor shall execute, at no additional cost to the Owner, any tests required by the Owner or the National Fire Protection Association, ASTM, etc. Standards listed. The Contractor shall provide all equipment, materials and labor for making such tests. The Owner will pay reasonable amounts of fuel and electrical energy costs for system tests. Fuel and electrical energy costs for system adjustment and tests, which follow Substantial Completion by the Owner, will be borne by the Owner.

W. Notify the Owner's Project Manager and the Architect/Engineer in writing at least seven (7) calendar days prior to each test and prior to other Specification requirements requiring Owner and Architect/Engineer to observe and/or approve tests.

X. All tests shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel performing, observing and inspecting, description of the test and extent of system tested, test conditions, test results, specified results an other pertinent data. Data shall be delivered to the Architect/Engineer as specified under "Requirements for Final Acceptance." The Contractor or Contractor's authorized job superintendent shall legibly sign all Test Log entries.

Y. Refer to Commissioning Specification Sections for additional Start-up, prefunctional and operational checkout, and for functional performance test procedures.

3.7 TESTING AND INSTRUCTION

A. Piping shall be tested to pressure hereinafter specified. Where pressures are not mentioned, it shall be understood that testing to 1-1/2 times service conditions, before insulation is applied, will be acceptable. All tests shall be held for a minimum of 24 hours before inspection. Test pressures shall not exceed the rated working pressure of any system component.

B. Furnish all necessary gauges, pumps, test plugs, and temporary connections and shall test sections of the building as work progresses.

C. All new underground sewerage, waste and storm drainage piping shall be plugged at outlets and tested hydrostatically to 10 psi before being covered. Notify Engineer a minimum 72 hours prior to any backfill of underground piping so that piping may be inspected. Failure to notify Engineer prior to backfill will constitute a rejection of the underground piping installation. All other drainage piping, vent and waste risers shall be plugged and tested by filling with water from top to bottom of each floor prior to being connected to fixtures. Tests shall be held a minimum of 24 hours.

D. All new cold and hot water supply piping shall be tested hydrostatically to 125 pounds per square inch before application of insulation. Test shall be held a minimum of 24 hours.

E. All tests shall be made in the presence of the Architect or his representative. Where pipes or connections in new piping are found to leak, they shall be made tight and the tests repeated.

F. Make all necessary adjustments to controls, dampers, valves, etc., to obtain best operation first with empty building and later under actual conditions. A minimum of two job site visits required.

G. Thoroughly check the operation of each item of equipment and controls while testing, without waiting first for the Owner or Architect to complain about their operation. Verify that same are wired correctly and completely, notifying the proper parties for necessary corrections. Thoroughly instruct the Owner's representative in the operation and care of controls, individual equipment, and entire system. Provide training for each equipment item to include

recommended maintenance procedures, control adjustments and system installation specifics. The following is the minimum training period for each item of equipment:

Overall Plumbing System – 4 hours
Overall HVAC System – 8 hours

H. Provide Architect with six (6) copies of balance reports as hereinafter specified. See Section 23 05 93.

I. After adjustment period and before acceptance replace construction filters specified in 3.8 with specified type.

3.8 CUTTING AND PATCHING

Cooperate to the fullest extent with all other trades to reduce to a minimum the amount of cutting and patching of other work necessary for this installation. Do not cut or patch the work of other trades but arrange to provide cutting templates in time, or otherwise pay the respective other contractors for changing theirs, to accommodate this work. No cutting into any structural units likely to impair the strength shall be done without the approval of the Architect.

3.9 CLEAN UP

Remove debris, surplus and waste materials, oil, grease or stains resulting from the work performed and leave the premises in a broom clean condition AT THE END OF EACH WORKING DAY. All debris, surplus and waste material shall be removed completely from the job site.

3.10 OPERATION OF AIR-HANDLING UNITS DURING CONSTRUCTION

Contractor shall provide 4”-85% efficient filters for units with 1.0” ESP and greater or (sets of 2) MERV 12, 1” filters for units under 1.0” ESP for air-units operated during construction. In addition roll type filter media shall be provided on all return air grilles and unit openings. Contractor shall be responsible for changing media as required. The Contractor is to protect the air unit coils and keep air-unit and duct interior surfaces clean. All ductwork and air unit/fan openings shall be covered with plastic wrap during construction. If the Contractor fails to comply with the filtration requirements, the Contractor shall clean and/or replace the coils and duct system at his expense.

3.11 INSTALLATION OF VRF/VRV HEAT PUMP SYSTEMS

All VRF/VRV heat pump systems shall be installed in strict accordance with manufacturer’s installation requirements. **All contractor employees working on heat pump systems shall be trained by the heat pump system manufacturer in the operation, maintenance and installation of the system.** Contractor shall provide evidence of training prior to the start of heat pump installation work. Only trained workers shall be allowed to install heat pump system components, including refrigerant piping, controls, indoor units, outdoor units and branch boxes. If heat pump system items are installed by workers that do not have the proper training, all work by the untrained employees shall be removed and reinstall by trained employees at the Contractor’s expense.

END OF SECTION 23 0500

SECTION 23 0593 - TESTING AND BALANCING OF AIR SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Contractor shall furnish all labor, equipment and services necessary for and incidental to Air and Water Systems Testing and Balancing.

B. The Contractor shall procure the services of an independent testing and balancing agency. The Testing and Balancing Agency (TBA) specializes in testing and balancing of heating, ventilating, air-moving equipment, air-conditioning system and Hydronic systems. The Mechanical Contractor shall award the test and balance contract to the above agency as soon as possible after receipt of contract.

C. Testing and Balancing shall not begin until the systems have been completed and are in full working order.

D. Shop drawings must be provided to the TAB firm no later than 30 days after the final, approved shop drawings have been returned by the Architect to the Contractor.

E. Duct leakage testing shall be the responsibility of the TBA subcontractor.

F. Fire and smoke damper testing shall be done by the contractor and witnessed by the TAB firm.

G. The final and complete Test and Balance Report shall be submitted, for approval, not less than two weeks before a final inspection of the Project is requested by the General Contractor. Engineer approval of the final test and balance report is a pre-requisite for Substantial Completion. Failure to provide the Report shall be cause to delay the final inspection until the Report is Approved.

H. Contractor is cautioned that test and Balance Report shall include both Grille counts, and Supply, Return, Outside Air and Exhaust Duct Traverses so that duct leakage can be calculated.

I. The Contractor shall provide a guarantee that the AABC or NEEB will assist in completing the test and balance requirements in the event the TBA firm fails to comply with the Contract Documents.

1.2 REFERENCES

A. AABC – National Standards for Total System Balance.

B. NEBB – Procedural Standards for Testing, Adjusting, and Balancing.

1.3 SUBMITTALS

A. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

B. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.

C. Provide reports in soft cover, letter size, binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating, thermostat locations.

1.4 QUALITY ASSURANCE

Perform total system balance in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance or NEBB Standards – Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems or Testing Adjusting and Balancing Bureau (TABB)-National Standards for Environmental Systems Balance.

1.5 QUALIFICATIONS

TBA shall be a Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum three years experience.

PART 2 - PRODUCTS

2.1 ADJUSTMENT DEVICES

Replacement of adjustable pulleys, additional balancing dampers, additional fan belts, pressure taps and fitting, hydronic balancing valves and any other devices or equipment required to effect proper testing, adjusting and balancing shall be provided shall be provided by the Contractor at no additional cost to the Owner.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.

9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.

B. Beginning of work means acceptance of existing HVAC conditions.

3.2 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.

B. Air Outlets and Inlets; Adjust total to within plus 5 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 5 percent of design.

3.3 ADJUSTING – GENERAL

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark setting of valves, dampers, and other adjustment devices allowing setting to be restored. Set and lock memory stops. Balance with VFD's in lieu of valves or dampers when applicable.

C. After adjustment, take measurement to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

E. At the time of final inspection the TAB agency may be required to recheck, in the presence of the Owner's Representative, specific and random selections of data, air quantities, and air motion recorded in the certified report. Points and areas for recheck shall be selected by the Architect. Measurements and test procedures shall be the same as approved for the initial work for the certified report. Selections for recheck, specific plus random, shall not exceed 10% of the total number tabulated in the report.

F. Within 90 days of completing the test and balance, the TAB contractor shall perform an additional test for all pumps and air units to verify operating conditions are being maintained.

3.4 AIR SYSTEMS PROCEDURE (MINIMUM REQUIREMENTS)

A. Test and adjust fan RPM to design requirements.

B. Test and record motor full load nameplate rating and actual ampere draw.

C. Test and record system static pressures, fan suction and discharge.

D. Adjust all main supply and return air duct to proper design CFM.

E. Test and adjust each diffuser, grille and register (new and existing as indicated on drawings). Reading and tests of diffusers, grilles and registers shall include design velocity (FPM) and as adjusted velocity, design CFM and adjusted CFM.

F. Test and record outside, mixed air and discharge temperatures (D.B. for heating cycle, D.B. and W.B. for cooling cycle).

G. In coordination with the ATC contractor, set adjustments of automatically operated dampers to operate as specified, indicated and/or noted.

H. Test and adjust air handling and distribution systems to provide required or design supply, return, outside and exhaust air quantities.

I. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

J. Measure air quantities at air inlets and outlets.

K. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

L. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

M. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

N. Provide system schematic with required and actual air quantities recorded at each outlet or inlet

O. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

P. Adjust outside air automatic dampers, outside air, return air and exhaust dampers for design conditions.

Q. Measure temperature conditions across air, return air, and exhaust dampers to check leakage.

R. Where modulating dampers are provided, take measurement and balance at extreme conditions.

S. Measure and record pressure differentials between designated spaces.

3.6 REQUIRED REPORTS TO BE SUBMITTED

The following reports shall be submitted, as a minimum, with a complete Title Page, Summary, and Instrument List. All data and nomenclature shall be provided, as required by AABC and/or NEBB Procedure manuals, for each device tested and balanced.

1. Electric Motors.
2. V-Belt Motors.
3. Heating Coils Data.
4. Air Moving Equipment.
5. Exhaust Air Data.
6. Duct Traverses.
7. Air Distribution Test Sheets.

3.7 COMMISSIONING

A. Balancing Agency shall coordinate with the Mechanical Contractor the Commissioning requirements as here-in-before specified.

B. Contractor is cautioned that the Owner, thru the Architect, reserves the right to check and verify any and all points and readings of the Test and Balance report. If 15% or more of the points do not agree with the report, then the Contractor shall re-test and re-balance the entire project and submit a complete new Report. If 15% or more of this new Data is independently verified and still does not agree with the Contractor's new Report, then the Owner has the right to hire an Independent Test and Balance Contractor and the Original Contractor shall be held responsible to pay these costs.

C. All TAB deficiencies shall be corrected when found. Any deficiencies that are (for whatever reason) not corrected immediately shall be shown in the TAB report and listed on a summary sheet in the front of the TAB report. The TAB report must be completed and accepted by the Mechanical Engineer before the project is accepted and all items on the summary sheet shall become punch list items with dollar values assigned to them.

END OF SECTION 23 0593

SECTION 23 3000 - HEATING, VENTILATION AND AIR CONDITIONING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to the work specified in this Section.

B. Refer to Basic Materials and Methods Section 23 0500 which shall apply to work in this Section.

1.2 DESCRIPTION OF WORK

A. The work to be done under this Section includes the furnishing of all labor, tools, materials, equipment and services necessary for and reasonable incidental to the installation of complete air conditioning and heating and ventilation equipment as shown on plans and herein specified, excepting only work and/or materials indicated as being done and/or furnished under other sections.

B. Contractor shall refer to other Sections of the Specifications which may be applicable to or associated with this Section.

1.3 RELATED WORK SPECIFIED IN OTHER SECTION

A. Electrical Section will provide all power wiring including furnishing and installing of disconnect switches where specified. Control wiring for air conditioning equipment shall be provided by Building Automation and Temperature Control Contractor.

B. Other Sections will provide and install structural supports for equipment. These supports must be checked and coordinated by this Section so that they suit the equipment which is to be supported.

C. Other Sections will provide all platforms slabs, lintels and curbs, as directed by this Section, to accommodate the mechanical equipment.

D. Mechanical Contractor shall provide starters for motors furnished under this Section.

1.4 QUALITY ASSURANCE

A. These specifications with accompanying drawings, require complete apparatus, fully erected and in successful operating condition. Perform all work in best, most substantial manner.

B. All equipment furnished and installed under this Section shall be U.L. or E.T.L. approved and labeled where applicable.

C. All unfired pressure vessels furnished under this Section shall be ASME and National Board stamped.

D. All manufacturers products shall comply with the requirements of this Section.

E. Employ qualified sheet metal workers in accordance with SMACNA Duct Construction Standards.

F. Qualify welding/brazing process and welder/brazer performance in accordance with AWS B2.2, Standard for Brazing Procedure and Performance Qualification, or ASME Boiler and Pressure Vessel Code, Section IX (See 23 0500). Provide copy of certification for welding and brazing processes.

G. Soldering processes shall conform to ASME B 31.3, Process Piping and Copper Development Association recommended practices.

H. Manufacturer: Provide equipment and accessories for work in this Section produced, meeting the requirements specified. Approved manufacturers:

1.5 SUBMITTALS

A. Contractor, before beginning work, shall submit dimensional shop drawings (in accordance with requirements of Division 1), for approval, for all duct systems. Contractor is responsible to coordinate all plumbing, piping, sprinkler, ductwork and electrical to avoid all conflicts. Conflicts encountered after work has started will be corrected at Contractor's expense.

B. Where the equipment installed is of a different configuration and/or size than that shown on the drawings, Contractor shall assume all responsibility to conform with the intent of the contract documents. The Architect shall be advised of any changes and deviations for his approval. The same shall be true for any field modification required because of "on job" construction conditions.

PART 2 - PRODUCTS

2.1 HVAC DUCTWORK

A. Provide and install a complete system of ductwork as herein specified to include, but not limit to supply, return, exhaust and fresh air with grilles, registers, diffusers and appurtenance to provide a complete functional and operational system. Duct sizes shown on drawings are free area dimensions. Design shall be as described in the latest edition of SMACNA manuals and as per the following:

1. Galvanized sheet metal shall be lock form quality per ASTM A653 with a G90 zinc coating.

2. Outside air and exhaust air ducts shall be galvanized sheetmetal with air-tight seams and as per applicable sections of SMACNA manuals for low velocity ducts. Insulate outside air and exhaust air ducts with external wrap as per SECTION 22 0700.

3. Supply and return ducts for low pressure system and, low velocity systems shall be galvanized sheetmetal with airtight seams and as per applicable section of SMACNA manuals for low velocity ducts. All ducts shall be insulated with 2" exterior wrap as per Section 22 0700. Internally line the first 5’ of supply and return for sound attenuation.

4. Rectangular ductwork for medium pressure, high velocity systems shall be galvanized sheetmetal with airtight seams and as per applicable section of SMACNA manuals for high velocity ductwork. Insulate with 2" exterior duct wrap as per Section 22 0700. Internally line the first 5’ of supply and return for sound attenuation.

5. Round rigid ductwork shall be all round single wall spiral pipe and fittings, galvanized steel, as per applicable sections of SMACNA manuals for high velocity duct. Insulate with 2" exterior duct wrap as per Section 22 0700. Seal all seams, joints and wall penetrations with hardcast as herein specified.

6. All ducts shall be sealed per SMACNA Seal Class A. All joints, longitudinal seams and wall penetrations of all supply, return outside air and exhaust ducts shall be sealed with an elastomeric tape which shall consist of a pressure sensitive layer of modified butyl rubber sealer laminated to a foil backing material which shall conform to surface variations and irregular areas and shall not harden crack or peel. The sealant shall be waterproof and shall be a minimum of 15 mils thick. All ductwork shall be cleaned and prepared and sealant shall be applied strictly in accordance with manufacturer's instructions and recommendations. Sealant shall be Hardcast FG-1402, Suretape #653 or approved equal, at Contractor's option flanged gasketed duct system may be used for POSITIVE PRESSURE SYSTEM ONLY.

7. Flexible round duct where indicated on plans shall be listed by Underwriters' Laboratories, Inc., under UL-181 standards as Class I flexible Air Duct Material complying with NFPA Standards 90A. Ducts shall be rated on maximum pressure of 6 inches WG positive and 2 inches WG negative. The duct shall be factory fabricated assembly composed of: an inner duct of woven and coated fiberglass providing an air seal and bonded permanently to corrosion resistant coated steel wire helix: a 2" thick fiberglass insulating blanket and low permeably outer vapor barrier of fiberglass reinforced metalized film laminate. Pressure drop not to exceed .15" SP at 500 Fpm through 6" or larger duct. Maximum length of flexible duct shall not exceed 8'-0". Connect flexible round duct with ½" wide nylon positive locking nylon straps on inner duct and outer duct.

8. Splitter dampers shall be installed where branches take off of main trunk ductwork, where ducts divide or where shown on the drawings. Splitters shall be fitted with nickel plated damper regulators in finished areas. Splitters shall be factory fabricated in accordance with SMACNA Duct Construction Standards.

B. Flexible connections shall be provided between each fan unit and ductwork on supply side and also on return side. Material shall be flexible fire-resistive material, minimum 4" wide, UL listed, with no metal to metal contact. Flexible connection shall not be used on kitchen exhaust.

C. Duct supports for rectangular ducts shall be a minimum 1" X 18 gauge galvanized steel bands. Hanger bands shall be bent under lower corners and secured with self-tapping screws at corners and six (6") inch intervals up the sides. Distance between hangers shall be as recommended by SMACNA manual for low and medium ductwork. Ductwork shall be rigidly supported to prevent vibration. Duct attachments to structure, lower hanger attachments, ducts traps and rods and trapeze angles shall be in accordance with SMACNA Low Pressure and High Pressure Duct Standards.

D. Where the ducts pass through walls, draft stops or partitions, the space shall be packed with non-combustible materials, filling all voids around duct.

E. Fire dampers with fusible links shall be installed at all points in ductwork where indicated on drawings, and/or as required by NFPA, 90-A, AND MECHANICAL CODE OF THE IBC.

F. Provide radius elbows unless space prohibitive. Rectangular radius elbows shall be factory fabricated with a centerline radius of not less than the width of the duct. Round duct elbows shall have a minimum center line radius of 1-1/2 times the diameter of the duct and shall be smooth where possible. Provide square elbows where space prohibits the use of radius

elbows. Square elbows shall be factory fabricated with double thickness airfoil turning vanes pre-assembled and securely attached to runners.

G. In general, vertical risers and other duct runs, where the method of support specified above is not applicable, or not specifically detailed on drawings, shall be supported by substantial angle brackets designed to meet field conditions, installed to allow for duct expansion and approved by Architect.

H. Provide exposed operators for operation of dampers and splitters in inaccessible ceilings, operators shall be chrome plated.

I. Maximum duct leakage shall be +/- 5%, SMACNA Seal Class A. Ductwork between VAV box and air-handling unit shall be designed for 4.0" static pressure. Ductwork between VAV box and diffuser or in constant volume systems shall be designed for 1.0" static pressure. Outside air, return air and exhaust air systems shall be designed for 1.0" static pressure. Construct ductwork in accordance with SMACNA Duct Construction Standards for the specified pressure class.

J. Install Automatic dampers, airflow stations and other duct mounted devices required by Section 23 0900.

K. Smoke dampers shall be UL 555S/UL555 ultra low leakage combination fire/smoke damper with integral 24V actuator. Dampers shall be automatic reset type. Control and power wiring by Fire Alarm Contractor.

L. Dimensions of ductwork, shown on plans, are free area dimensions.

M. Provide opposed blade volume dampers with 2" standoff for all diffuser taps, main outside and return air at AHU's.

2.2 DIFFUSERS, GRILLES, REGISTERS

A. All sizes shall be as indicated on drawings. Provide a quantity of 5 additional diffusers and return grilles for each size and type indicated in the schedule. Special application grilles and diffusers shall not be not included.

B. All outlets shall be balanced to obtain specific air quantities free of all objectionable draft and noises.

C. Diffusers, grilles and registers shall be of normal commercial grade as indicated on Schedule on drawings. Refer to Architectural reflected ceiling plan for exact location.

D. Insulate the back of all diffusers, grates and registers with ¾" closed cell foam or manufacturer supplied insulation.

2.3 FIRE DAMPERS

Fire dampers shall be solid sheet curtain type, dynamic closure type corrosion resistant galvanized steel construction. Dampers mounted in the horizontal position shall be closed by a stainless steel negate spring. Damper to be easily reset through standard access panel for required periodic maintenance. Access panels are required for access to all fire dampers, minimum size 12 X 12 inches. Dampers shall be 100% out of air stream. Provide fusible links rated at 160 degrees F.

2.4 ACCESS DOORS

Access doors shall be installed in ductwork wherever required for ready access to any operating part. Doors shall not be smaller than 12 X 12 inches, with brass hinge and sash type fasteners. Ducts 30” or larger shall be supplied with minimum 18 X 18 inch access doors. Doors shall be double wall insulated type, hinged with sash locks and gaskets.

2.5 PIPING AND PIPING IDENTIFICATION

All piping at each piece of equipment shall be stencil to show the service and direction of flow. Stencils shall be black on a white background with letters one (1") inch high spaced at approximately forty-eight (48") inches apart by equipment or 10 foot intervals along piping runs.. Pressure-sensitive pipe markers ANSI Standard A 13.1 may be used in lieu of stenciling.

2.6 EXHAUST FANS AND OUTSIDE AIR INTAKES

A. Size and quantity shall be provided as indicated on drawings. Provide speed controller on all direct drive fans.

B. All roof exhaust fans and roof outside air intakes shall be provided with factory prefabricated curbs. Verify roof slope and provide sloped roof curb as required.

2.7 VIBRATION ISOLATION SYSTEMS

A. Work shall include furnishing, installing and testing all material required and hereinafter called for complete execution of the vibration isolation system. Isolation materials shall not be limited to compressors, convertors, air units, pumps, piping, duct work, fans, etc. All motor-connected equipment shall be considered a source of vibration and shall be isolated to prevent vibration and sound transmission. Isolation equipment, as manufactured by Kinetics, Mason Industries or prior approval equal, shall be used. Specific reference to isolation under equipment headings is to provide additional information by which proper selection of the required isolation may be made. Equipment specification data showing physical size, bearing points, weights per point, rotating speeds and sound power levels generated shall be furnished by the respective equipment supplier to the vibration isolation supplier after equipment submittals have been approved.

B. All mechanical and sound isolation materials specified herein or shown on drawings shall be provided by a single manufacturer to assure singular responsibility for proper selection, application, installation and performance. Substitution for isolation material specified incorporating non-permanent materials, such as cork, rubber, wood pulp, or thermal fiberglass will not be acceptable. Should no specific material be called out for particular use, all mechanical vibration isolation shall be based upon Chapter 46, A.S.H.R.A.E. Guide-Table 45, "Guide for Selection of Vibration Isolators". Bases, mounts and hangers furnished shall have a nominal deflection equal to the minimum deflection as shown in this guide and shall be furnished on all motor driven equipment requiring isolation as well as piping and duct connected to same.

C. To assure stability, the spring element to be a large diameter laterally stable spring with load plate and have a lateral stiffness greater than 0.8 times the rated vertical stiffness and be designed to provide up to 50% overload capacity. Each base mount spring shall have a 1" isolation sound pad of elastomeric material.

D. Isolation shall be stable during starting and stopping of equipment without any transverse or eccentric movement that could damage or adversely affect the equipment or attachments. Isolation systems for floor or ceiling-mounted equipment shall have a maximum lateral motion under start up and shut down of 3/8". Motion in excess shall be corrected by restrained spring-type mounts. Isolators shall be selected for the lowest operating speed of the equipment isolated and shall be located to produce uniform loading and deflection even when equipment weight is not evenly distributed. Static deflection on grade up to 3/8" shall use nominal 1" deflection springs on isolation pads. Static deflection above grade shall use spring isolators with spring deflection based upon 2007 ASHRAE Handbook Deflection data. The static deflection of the isolation system shall be selected to avoid being in resonance with the disturbing frequency. All spring isolators shall have neoprene sound damping pads separating isolator from structure.

E. Submittals shall contain a complete schedule of all equipment to be isolated along with the type of isolator, loading per isolator, static deflection, spring diameters and maximum deflection. Should isolation installed fail to perform satisfactorily in preventing the transmission of vibration, the isolation shall be replaced without cost to owner and properly selected isolators shall be installed.

F. Chilled, fire and domestic water pump bases shall consist of a concrete slab cast into a prefabricated inertia base frame assembly designed and supplied by the isolation materials supplier such as CPF inertia base. Frames shall be welded steel channels with a depth greater than 8% of the longest span between isolators, a minimum of 6" thick or as indicated on the drawings, and shall include 1/2" steel re-enforcing rods on maximum 8" centers each way. Prelocated equipment anchor bolts shall be included. Spring isolator support brackets shall be welded at the corners of the perimeter channel frame with 1/2" reinforcing rods welded 1-1/2" above bottom of bracket running continuously in two directions between all isolator brackets. Inertia bases used to support horizontally split case pumps shall be wide enough to support pipe elbows and may be rectangular or "T" shaped at manufacturers option.

G. Vertically hung air handling units and fans shall be isolated with large diameter laterally stable steel spring in series with a molded neoprene insert, assembled into a stamped or welded hanger bracket with load transfer plates for both the spring and neoprene insert. Hangers to allow a support rod misalignment thru a 30 degree arc. Mason Model 30N or Kinetics Model SFH.

H. All piping over 1" in diameter and connected to motor-driven equipment shall be spring hung for a minimum of 3 hangers in each direction. The spring deflection for the hanger shall be the same as the spring deflection for the equipment isolated. Mason Model 30N or Kinetics Model SFH.

I. Duct Work - All supply duct work shall be hung on neoprene or spring hangers for a minimum of 3 hangers from air handling unit to prevent the transmission of duct vibration into the structure. Mason Model 30N or Model HD or Kinetics Model SFH or Model RH.

2.8 VRF HEAT PUMP SYSTEM (See plans for simultaneous and non-simultaneous systems)

SYSTEM DESCRIPTION

The VRF (Variable Refrigerant Flow) system shall be an LG Multi V Sync IV simultaneous cooling and heating heat pump. The simultaneous heating and cooling VRF system shall consist of an outdoor unit, high efficiency heat recovery units designed for minimum piping and maximum design flexibility, indoor units, and controls by the equipment manufacturer. Every indoor unit shall be independently capable of operating in either heating or cooling

mode regardless of the mode of other indoor units. The system shall be capable of changing mode of individual indoor units (cooling to heating or heating to cooling) within a maximum time of 5 minutes to ensure indoor temperature can be properly maintained.

Include wall mounted thermostats, system controllers, branch boxes and all control wiring for a complete system.

Also approved Trane/Samsung and Daikin; however, contractor shall include all costs and additional design as required for alternate systems including equipment, piping and electrical.

QUALITY ASSURANCE

A. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
B. All wiring shall be in accordance with the National Electrical Code (NEC).
C. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.

STORAGE AND HANDLING

A. All VRF equipment shall be stored protected from weather, extreme temperature, etc. as suggested by the manufacturer. All VRF equipment shall be moved, lifted, etc. as suggested by the manufacturer.

WARRANTY

VRF equipment and system including labor shall be warranted by the manufacturer for a period of five years from date of project final acceptance. The warranty shall be granted upon submission to the manufacturer and acceptance by the manufacturer of proper installation with documentation including:

1) Selection output and layout of the VRF system.
2) 60 minutes of operational history upon commissioning from the VRF service tool.
3) Completed commissioning report as per the VRF equipment manufacturer.

During this period, any part of the system failing to function properly due to faulty workmanship or material shall be repaired or replaced at the VRF equipment manufacturer's discretion.

The VRF system shall be installed by a licensed mechanical contractor trained by the VRF equipment manufacturer or certified manufacturer's agent.

Commissioning shall be performed by the manufacturer or certified manufacturer's agent.

SIMULTANEOUS HEATING AND COOLING OUTDOOR UNIT

A. General:
   1. The outdoor unit shall be used with VRF components of the same manufacturer consisting of the outdoor unit, high efficiency heat recovery units, indoor units, factory designed and supplied Y-branches, and controls.
   2. System components shall be of the same manufacturer or as recommended by the manufacturer of the VRF equipment.
   3. Unit control boards shall perform all functions required to effectively and efficiently operate the VRF system and communicate in a daisy chain configuration from outdoor unit to heat recovery and indoor units via RS485.
   4. The outdoor unit shall be completely factory assembled, piped and wired. Dual and triple frame outdoor units will be field piped with factory designed and supplied Y-branch kits to manifold them together into a single refrigerant circuit.
   5. Each outdoor unit shall be run tested at the factory.

6. The sum of connected nominal capacity of all indoor air handlers shall range from 50% to 130% of outdoor unit nominal capacity to ensure the VRF system will have sufficient capacity to handle the building space loads at peak design.
7. Outdoor unit shall have a tested sound rating no higher than 58 dB(A) per outdoor unit frame tested per KSA0701. The outdoor unit frame shall include three quiet/nighttime operation settings of 47, 44, and 41 dBA.
8. All refrigerant lines from the outdoor unit to the heat recovery unit and from the heat recovery unit to the indoor units shall be field insulated.
9. The outdoor unit shall have an accumulator.
10. The outdoor unit shall have a high pressure safety switch
11. The outdoor unit shall have over-current protection.
12. The outdoor unit shall use a brazed plate subcooling heat exchanger.
13. The outdoor unit shall have the ability to operate with an elevation difference of up to 328 feet above or below the indoor units.
14. The outdoor unit shall allow up to a total equivalent refrigerant piping length of 3280 feet.
15. The maximum length from outdoor unit to indoor unit shall be up to 656 feet without traps.
16. The outdoor unit shall be capable of operating in heating only mode down to -4°F and up to 61°F ambient wet bulb without additional low ambient controls.
17. The outdoor unit shall be capable of operating in cooling only mode down to 21°F and up to 110°F ambient dry bulb.
18. The outdoor unit shall be capable of operating in simultaneous heating and cooling mode down to 14°F and up to 86°F ambient dry bulb.
19. The outdoor unit shall have an oil separator for each compressor and controls to ensure sufficient oil supply is maintained for the compressor.
20. Shall use R410A refrigerant.
21. Each outdoor unit frame shall have a removable inspection panel no greater than 6 inches tall or 12 inches wide to allow access to service tool connection, DIP switches, auto addressing and error codes.

B. Frame:
1. Shall be constructed with galvanized steel, bonderized and be finished with powder coat baked enamel paint.

C. Compressor:
2. All 208/230V 3 phase outdoor unit frames shall be equipped with one hermetic digitally controlled inverter driven scroll compressor and one hermetic constant speed scroll compressor.
3. All 460V 3 phase outdoor unit frames greater than 80MBh nominal capacity shall be equipped with one hermetic digitally controlled inverter driven scroll compressor and one hermetic constant speed scroll compressor.
4. A crankcase heater shall be factory mounted on all compressors.
5. The outdoor unit compressor shall have an inverter to modulate capacity. The frequency of the inverter compressor shall be completely variable from 25 to 105Hz.
6. The compressor shall be equipped with an internal thermal overload.
7. The compressor shall be mounted to avoid the transmission of vibration.

D. Fan:
1. All outdoor unit frames shall be furnished with two direct drive, variable speed propeller type fans.
2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be variable speed with a maximum speed up to 950 rpm.
3. All fans shall be provided with a raised guard to limit contact with moving parts.
4. The outdoor unit shall have vertical discharge airflow.

E. Coil:
1. The outdoor coil shall be of nonferrous construction with louvered fins on copper tubing.
2. The coil fins shall have a factory applied corrosion resistant GoldFin™ material with hydrophilic coating.
3. The coil shall be protected with an integral metal guard.

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

F. Electrical:
1. The outdoor unit electrical power shall be 208V, 60 Hz, 3 phase.
2. The outdoor unit shall be capable of operation within voltage limits of +/- 10% rated voltage.
3. The outdoor unit shall be controlled by integral microprocessors.
4. The control circuit between the indoor units, heat recovery box and the outdoor unit shall be 24VDC completed using a 2-conductor, stranded, shielded cable for the RS485 daisy chain communication.

HEAT RECOVERY UNITS FOR SIMULTANEOUS HEATING AND COOLING SYSTEMS

A. General:
1. Heat recovery units shall be designed for use with VRF equipment of the same manufacturer.
2. Heat recovery units shall have factory installed control boards that interface to the VRF equipment controls system and shall perform all functions to effectively and efficiently control the simultaneous heating and cooling VRF system.
3. Heat recovery units shall be completely factory assembled, internally piped and wired.
4. Heat recovery units shall be run tested at the factory.
5. Heat recovery units shall be designed for indoor installation.
6. Shall use R410A refrigerant.
7. All refrigerant lines from the outdoor unit to the indoor units shall be field insulated.
8. Heat recovery units shall allow up to 2, 3, or 4 indoor units to be connected.
9. Y-branches between heat recovery units and indoor units shall not be allowed to ensure independent heating and cooling control of each indoor unit regardless of the mode of any other indoor unit connected to that heat recovery unit.
10. Heat recovery units shall be permitted to be piped in series or parallel to minimize material cost and labor.
11. The following piping shall be allowed.
    a. Series piping of up to 16 heat recovery units
    b. Indoor units up to 131 equivalent feet of piping length from the respective heat recovery unit
    c. Indoor units up to 295 equivalent feet of piping length from the first branch
    d. Indoor units shall not exceed 16 feet above or below the heat recovery unit
    e. Elevation difference between the highest and lowest elevation indoor unit shall not exceed 16 feet.
    f. Total indoor unit nominal capacity shall not exceed 160MBh in any series string of 1 to 16 heat recovery units.

B. Heat Recovery Unit Construction:
1. The heat recovery unit shall have 2, 3, or 4 ports which can individually accommodate up to one indoor unit not to exceed 48.1 MBh nominal capacity.
    i. Indoor units greater than 48.1 MBh nominal capacity shall utilize 2 neighboring heat recovery unit ports.
2. The heat recovery unit housing shall be galvanized steel.
3. Each heat recovery unit shall contain piping, valves and controls to divert refrigerant for optimum efficiency.
4. The unit shall house one double spiral tube-in-tube heat exchanger per port of the heat recovery unit.
5. Heat recovery units shall be internally insulated and not require installation of any condensate drain.

C. Refrigerant System
1. R410A refrigerant shall be required for all VRF equipment and components including indoor units, outdoor units, refrigerant piping, valves, Y-branches, heat recovery units, etc. as applicable.

D. Refrigerant valves:

1. Each port shall be circuited with two 2-position solenoid valves to control refrigerant flow path.
2. Isolation valves shall be field supplied and installed for ease of service to the heat recovery unit without evacuating the entire system refrigerant charge.
   A. Shall be designed for use with R410A

E. Electrical:
1. The heat recovery box electrical power shall be 208/230V, 1 phase, 60 Hz.
2. All units shall be capable of satisfactory operation within +/-10% of nominal voltage.
3. The heat recovery unit shall be controlled by integral microprocessors from the main control in the outdoor unit.
4. The control circuit between the indoor units, heat recovery box and the outdoor unit shall be 24VDC completed using a 2-conductor, stranded and shielded cable for the RS485 daisy chain communication.

HIGH STATIC CEILING-CONCEALED DUCTED INDOOR UNIT

A. General:
1. High static ceiling concealed duct indoor unit shall mount fully concealed within the ceiling.
2. Shall be designed for use with R410a refrigerant.
3. Shall be installed with heat pump or simultaneous heating and cooling heat pump VRF systems of the same manufacturer.
4. The indoor unit shall communicate with the outdoor unit via RS485 daisy chain communication.
5. Field installed ductwork shall not exceed the external static pressure limitation of the high static ducted indoor unit.

B. Indoor Unit:
1. The indoor unit shall be factory assembled, wired and run tested.
2. The indoor unit shall be factory wired and piped with its own electronic expansion device, control circuit board, fan and motor.
3. The indoor unit shall have
   a. self-diagnostic function
   b. auto restart function
4. Indoor unit refrigerant circuit shall be filled with a dry nitrogen gas charge from the factory.

C. Unit Cabinet:
1. The cabinet shall be ceiling-concealed and ducted.

D. Filter:

Return filter box with high-efficiency filter shall be field provided and installed not to exceed external static pressure limitation of the high static ducted indoor unit.

E. Fan:
1. The indoor unit fan shall be no more than one assembly with two Sirocco fans direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced.
3. Motor shall have permanently lubricated bearings.
4. In cooling mode, the indoor fan shall have the following settings; Low, Med, and High.
5. In heating mode, the indoor fan shall have the following settings; Low, Med, and High.

F. Coil:
1. The indoor unit coil shall be nonferrous with louvered fins on copper tubing for maximum efficiency.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. The coils shall be pressure tested at the factory.
4. A condensate drain pan shall be factory installed below the coil.
5. All refrigerant lines to the indoor units shall be field insulated.

G. Condensate Pump:
1. The unit shall include a factory installed condensate pump that will be able to raise drain

water 27 inches above the bottom of the indoor unit.

H. Electrical:
   1. The unit electrical power shall be 208/230 volts, 1-phase, 60 Hz.
   2. The indoor unit shall be capable of operation within voltage limits of +/-10% rated voltage.

I. Controls:
   1. Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over an RS485 daisy chain.
   2. Provide wall mounted humidistat for units designated on the drawings to control space humidity. Provide auxiliary electric heater control and IO module programmed for dehumidification cycle. Humidity setpoint shall be 50% RH. The unit shall energize cooling and modulate as required to maintain humidity setpoint. The electric reheat shall be staged to maintain room temperature during humidity control mode. Regular heating shall be accomplished via the unit heating cycle.

WALL-MOUNTED INDOOR UNIT

A. General:
   1. Wall-mounted indoor units shall protrude from the wall no more than 7 inches.
   2. Shall be designed for use with R410a refrigerant.
   3. Shall be installed with heat pump or simultaneous heating and cooling heat pump VRF systems of the same manufacturer.
   4. The indoor unit shall communicate with the outdoor unit via RS485 daisy chain communication.

B. Indoor Unit
   1. The indoor unit shall be factory assembled, wired and run tested.
   2. The indoor unit shall be factory wired and piped with its own electronic expansion device, control circuit board, fan and motor.
   3. The indoor unit shall have
      a. self-diagnostic function
      b. auto restart function
   4. Indoor unit refrigerant circuit shall be filled with a dry nitrogen gas charge from the factory.

C. Unit Cabinet:
   1. The unit casing shall have a pearl white finish.
   2. Multi directional refrigerant piping up to four (4) directions shall be standard.
   3. Multi directional drain piping up to two (2) directions shall be standard.
   4. The indoor unit shall attach to a separate back plate that secures the unit to the wall.
   5. Indoor unit casing shall have integral sensor to read wireless handheld remote controller as standard from the factory.

D. Filter:
   1. Return air shall be filtered with a factory supplied removable, washable filter.
   2. Shall be furnished as standard with a factory installed plasma filter with no additional external power supply required.

E. Fan:
   1. The indoor fan shall be an assembly with one cross flow fan direct driven by a single motor.
   2. The indoor fan shall be statically and dynamically balanced.
   3. Motor shall have permanently lubricated bearings.
   4. In cooling mode, the indoor fan shall have the following settings; Low, Med, High, Power Cool, and Auto.
   5. In heating mode, the indoor fan shall have the following settings; Low, Med, High, and Auto.
   6. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
   7. A manually adjustable guide vane shall be factory installed allowing the ability to control the direction of airflow from side to side for units 15MBh and below.

8. A motorized sweeping guide vane shall be factory installed allowing the ability to control the direction of airflow from side to side for units 18MBh and above.
9. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.

F. Coil:
1. The indoor unit coil shall be nonferrous with louvered fins on copper tubing for maximum efficiency.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. The coils shall be pressure tested at the factory.
4. A condensate drain pan shall be factory installed below the coil.
5. All refrigerant lines to the indoor units shall be field insulated.

G. Electrical:
1. The indoor unit electrical power shall be 208/230V, 1-phase, 60 Hz.
2. The indoor unit shall be capable of operation within voltage limits of +/-10% rated voltage.

H. Controls:
1. Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over an RS485 daisy chain.

Condensate Pump:
1. Provide Little Giant model EC-OP-K condensate pump kit for each wall mounted indoor unit. The pump kit shall contain the pump, pump concealing cover (color to match wall mounted unit) and mounting hardware. The pump shall be capable of 2 GPM @ 12' head and shall operate on 230V, 1-phase, 60 Hz power. Install unit below indoor unit per manufacturer's recommendations and wire to unit auxiliary contacts.

4-WAY CEILING CASSETTE INDOOR UNIT

A. General:
1. Four-way ceiling cassette indoor units shall recess into the ceiling and mount flush.
2. Shall be designed for use with R410a refrigerant.
3. Shall be installed with heat pump or simultaneous heating and cooling heat pump VRF systems of the same manufacturer.
4. The indoor unit shall communicate with the outdoor unit via RS485 daisy chain communication.
5. Shall be rigidly constructed using a decaweb base plate.
6. Provide outdoor air kit for units as indicated on the drawings.

B. Indoor Unit:
1. The indoor unit shall be factory assembled, wired and run tested.
2. The indoor unit shall be factory wired and piped with its own electronic expansion device, control circuit board, fan and motor.
3. The indoor unit shall have
    a. self-diagnostic function
    b. auto restart function
4. Indoor unit refrigerant circuit shall be filled with a dry nitrogen gas charge from the factory.

C. Unit Cabinet:
1. The four-way ceiling cassette cabinet shall be designed to recess into the ceiling.
2. The cabinet panel shall have provisions for a field installed, pressurized and filtered outside air intake.
3. Branch ducting shall be allowed from cabinet following manufacturer recommendations.

D. Grille:
1. Four-way grille shall be fixed to bottom of the cabinet and allow two, three or four-way air flow.
2. Grille vane angles shall be individually adjustable from the wired remote controller to customize the airflow pattern for the conditioned space.
3. The indoor unit vanes shall have 6 fixed positions

4. The indoor unit vanes shall be capable of automatically swinging the vanes up and down for uniform air distribution. Vanes shall also be capable of being stopped at any position during swing operation.
5. The indoor unit shall have a setting in the heating or cooling mode that shall cycle the vanes up and down to evenly heat or cool the space.
6. Four-way ceiling cassette grille shall have integral sensor to read wireless handheld remote controller as standard from the factory.

E. Filter:
1. Return air shall be filtered with a removable, washable filter.
2. Shall be furnished as standard with a factory installed plasma filter with no additional external power supply required.

F. Fan:
1. The indoor fan shall be an assembly with one turbo fan direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced.
3. Motor shall have permanently lubricated bearings.
4. In cooling mode, the indoor fan shall have the following settings; Super Low, Low, Med, High, Power Cool, and Auto.
5. In heating mode, the indoor fan shall have the following settings; Super Low, Low, Med, High, and Auto.
6. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
7. The indoor unit shall have DIP switches that can be set to provide optimum airflow based on ceiling height.

G. Coil:
1. The indoor unit coil shall be nonferrous with louvered fins on copper tubing for maximum efficiency.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. The coils shall be pressure tested at the factory.
4. A condensate drain pan shall be factory installed below the coil.
5. All refrigerant lines to the indoor units shall be field insulated.

H. Condensate Pump:
1. The unit shall include a factory installed condensate pump that will be able to raise drain water 27 inches above the ceiling cassette face.

I. Electrical:
1. The unit electrical power shall be 208/230 volts, 1-phase, 60 Hz.
2. The indoor unit shall be capable of operation within voltage limits of +/-10% rated voltage.

J. Controls:
1. Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over an RS485 daisy chain.

2.9 PIPING AND FITTINGS

A. Furnish and install all piping related to air conditioning systems including refrigerant piping, air conditioning condensation drains, and other miscellaneous piping.

B. All piping shall be installed parallel and square with building lines and shall be sloped to permit drainage, with suitable provision for drainage at all low points.

C. Piping shall be arranged to maintain headroom and keep passageways clear and where necessary shall be offset to maintain the required clearance and conform with the structural features of the building. Contractor shall determine in advance of construction locations for all piping sleeves, hangers, etc. No allowance will be made for extra due to inaccurate location of sleeves, piping or equipment.

D. All piping shall have provisions for expansion and contraction with anchorage at each point shown on the plans and/or as required.

E. Full length pipe shall be used where possible, short lengths and couplings will not be permitted. After cutting, all pipes shall be reamed out to full bore and before erection, all cutting and foreign matter shall be removed from the inside of pipes. Screwed joints shall be made tight without caulking or the use of lead or paint and no lubricant shall be used except flake granite and cylinder oil paste, or approved pipe compound applied to make threaded pipe.

F. Pipe sleeves shall be provided for the passage of all pipe through walls, floors and partitions.

G. All condensate drain piping shall be installed using ASTM B88 type "L" hard drawn copper with wrought copper sweat fittings. Changes in direction of piping shall be made with short turn tee pattern or 45 degree wye fittings with brass cleanout plug. Insulate drain piping, minimum drain on fan coil units – 3/4", air handling units – 1-1/4".

H. Refrigerant piping shall be type "ACR" hard drawn copper wrought copper sweat type fittings and silfos solder. Provide a catch-all liquid line strainer and a liquid line moisture indicator sight glass at each condensing unit. Strainer shall be installed in a three valve by-pass. Completely evacuate system before providing refrigerant operating charge as recommended by equipment manufacturer. Pipe sizes shall be as recommended by equipment manufacturer for installation shown. Insulate all piping per Section 220700.

2.10 LOUVERS

A. Fabrication:
1. Model: ELF6375DXH.
2. Performance Ratings: AMCA licensed.
3. Frame:
   a. Material: Extruded aluminum, Alloy 6063-T5.
   b. Wall Thickness: 0.125 inch (3.2 mm), nominal.
   c. Depth: 6 inches (152 mm).
   d. Downspouts and caulking surfaces.
4. Blades:
   a. Style: Drainable.
   b. Material: Extruded aluminum, Alloy 6063-T5.
   c. Wall Thickness: 0.125 inch (3.2 mm), nominal.
   d. Angle: 37.5 degrees.
   e. Centers: 5-29/32 inches (150 mm), nominal.
5. Insect Screen:
   a. Material: Aluminum.
   b. Frame: Removable, rewireable.
6. Gutters: Drain gutter in head frame and each blade.
7. Downspouts: Downspouts in jambs to drain water from louver for minimum water cascade from blade to blade.
8. Vertical Supports: Hidden vertical supports to allow continuous line appearance up to 120 inches (3,048 mm).
9. Sill: Steeply angled integral sill eliminating areas of standing or trapped moisture where mold or mildew may thrive and effect indoor air quality.
10. Assembly: Factory assemble louver components. All welded construction.

B. Performance Data:

1. Based on testing 48 inch x 48 inch (1,219 mm x 1,219 mm) size unit in accordance with AMCA 500.
2. Free Area: 57 percent, nominal.
3. Free Area Size: 9.08 square feet (0.84 m^2).
4. Maximum Recommended Air Flow Thru Free Area: 1,023 feet per minute (312 m/min).
5. Air Flow: 9,289 cubic feet per minute (263 m^3/min).
6. Maximum Pressure Drop: 0.15 inches w.g. (3.8 mm w.g.).
7. Water Penetration: Maximum of 0.01 ounces per square foot (3.1 g/m^2) of free area at an air flow of 1,023 feet per minute (312 m/min) free area velocity when tested for 15 minutes.

C Accessories
Provide Blank-Off Panels where duct attachment is smaller than louver: 1 inch (25 mm), aluminum skin, insulated core, factory installed with removable screws and neoprene gaskets.

D. Finish
Kynar 500 Fluoropolymer Coating:
1. Conform to AAMA 605.2.
2. Apply coating following cleaning and pretreatment.
3. Cleaning: AA-C12C42R1X.
4. Dry louvers before final finish application.
5. Total Dry Film Thickness: Approximately 1.2 mils (0.03 mm), when baked at 450 degrees F (232 degrees C) for 10 minutes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All equipment and controls shall be installed in accordance with manufacturer's recommendations. Installation, adjustments and starting shall be done under supervision of manufacturer's representative.

B. All ductwork and equipment shall be installed in a neat and workmanlike manner in accordance with the guidelines of NFPA 90-A, SMACNA and the best practice of the trade.

C. Provide manual firestats, set at 125 degrees F, in return inlets of all fans and blowers and all exhaust fans of 600 cfm and over.

D. This Contractor shall furnish and install any and all mechanical items which are required to complete the temperature controls which are to be provided under other sections of the specifications.

E. All piping as specified under this section shall be tested to the following pressures:

Refrigerant - 450 psi
Condensate drain - 10 psi

The method of application of tests and duration shall be as described in SECTION 23 0500. Maximum of 5% pressure loss during the duration will be acceptable.

F. Upon completion of the installation of all work and equipment the Contractor shall start all equipment and make all necessary tests and adjustments to place entire heating, ventilating and air conditioning systems in a satisfactory condition for continuous safe operation of facilities.

G. All filters shall be replaced after period of test and adjustment. See air unit schedule for filters types.

END OF SECTION 23 3000

SECTION 260010 – ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. General electrical requirements
2. Temporary wiring, lighting and power

B. These specifications are intended to provide for labor, materials, equipment, and services and of performing all operations required for the complete electrical system as specified herein and/or shown on the accompanying drawings.

1.3 SUBMITTALS

A. Refer to Division 1 for Submittal Requirements. The following paragraphs are an extension of Division 1.

B. Where names of manufacturers or catalog numbers are listed in the Specification and/or on the accompanying drawings it is to establish a standard for the type, general design and quality of the product required. Where “or approved equivalent” is indicated, other products similar in design and of equivalent quality and complying with the Drawings and Specifications will be considered for acceptance. See Division 1 Section “Product Substitutions”. “Similar in design” and “equivalent quality” will be determined by the architect, engineer and lighting consultants.

C. Any item not specified herein, but submitted as a substitute for the specified item, shall be submitted in accordance with Division 1 Section “Product Substitutions” and accompanied by manufacturer’s documentation stating/illustrating the following applicable information in addition to the specific information requested in other sections:

1. Dimensions/weight.
2. Electrical ratings-voltage, amperage, short circuit capability, etc.
3. Construction – gauge of steel/aluminum, paint finish/application method, color, NEMA type, etc.
4. Warranty.
5. Local manufacturer’s representative or nearest stocking distributor.
6. Length of time the product has been available to the public.
7. Specific deviations.

D. Shop Drawings: Listed below are shop drawings required for submittal

1. Panelboards
2. Lighting Fixtures & Lamps
3. Lighting Control System
4. TVSS
5. Cable Television System
6. Wiring Devices & Device Cover Plates
7. Safety and/or Disconnect Switches
8. Fuses
9. Raceways, Fittings, Floor Boxes, Surface Metal Raceway, Cable Tray
10. Wiring/Cables
11. Telecommunications System

E. Comments made on Shop Drawings during the review do not relieve the Contractor from compliance with requirements of the contract documents. Shop Drawings will be checked for general conformance with the design concept of the project and general compliance with the documents. Review of the Shop Drawings shall not relieve the Contractor from responsibility for conforming and correlating all quantities and dimensions, coordinating work with that of all other trades, and performing work in a safe and satisfactory manner. Review of Shop Drawings shall not permit any deviation from Drawings and Specifications. Shop Drawings must be accompanied by signed statement from Contractor, stating that he has reviewed the submittal and checked it for compliance.

F. CLOSEOUT DRAWINGS:

1. Operation and Maintenance Manuals:

   a. Prepare Operation and Maintenance Manuals in accordance with the requirements in Division 1, specification section 017830.

2. Record Drawings:

   a. Prepare Record Drawings in accordance with the requirements in Division 1.
   b. In addition to the requirements specified in Division 1, indicate the following installed conditions:
      1) Equipment locations (exposed and concealed), dimensioned from prominent building lines.
      2) Approved substitutions, Contract Modifications, and actual equipment and materials installed.
      3) Underground conduits both interior and exterior, drawn to scale and fully dimensioned.
      4) Grounding systems.
   c. Transmit record drawings to Architect.

1.4 QUALITY ASSURANCE

A. The electrical installation shall conform to the requirements of the latest edition of the National Electrical Code (NEC). Notify Architect of conflicts before installation.

B. Electrical material shall be built and tested in accordance with the applicable standards of the National Electrical Manufacturers' Association (NEMA), the American National Standards Institute (ANSI), the American Society for Testing and Materials (ASTM), and the Institute of Electrical and Electronic Engineers (IEEE).

C. All applicable sections of the following codes and standards (latest edition) shall also be followed:

1. NFPA, including but not limited to, NFPA 70 (NEC) and NFPA 101 (Life Safety Code).
2. ADA (Americans with Disabilities Act)
3. International Building Code (latest edition)
4. Applicable state and local codes/ordinances.
5. CBM – Certified Ballast Manufacturer.
6. IPCEA – Insulated Power Cable Engineers' Association.
7. FM – Factory Mutual.
8. ETL – Electrical Testing Laboratories.
9. IES – Illuminating Engineering Society.

D. Include all items of labor and materials required to comply with the above referenced codes and standards. Where quantities, sizes, or other requirements indicated on Drawings or herein specified are in excess of the requirements of the Standards and Codes, the Specifications or Drawings shall govern. Where a conflict exists the more restrictive shall be bid.

1.5 COORDINATION

A. Power Characteristics: For all items requiring power provided in sections of Division 2 through 33, the Contractor is to verify all electrical requirements, including voltages, ratings and any other electrical characteristics with actual equipment to be furnished and adjust work as required to provide proper electrical service to the particular item at no extra cost to owner. Notify the Architect before starting work if changes from the work shown on the drawings will be necessary.

B. Coordination of Options and Substitutions: Where contract documents permit selection from several product options, do not proceed with purchasing until coordination of interface requirements has been checked and satisfactorily established.

C. Raceways, Wiring, Safety/Disconnect Switches, etc. for Equipment by Others: Electrical service required for all equipment furnished under Mechanical Divisions, Electrical Divisions, or other Divisions of this Specification shall be furnished and connected as part of this work. It is part of the work of this Division to obtain correct roughing-in dimensions and requirements for this equipment and provide labor, materials, equipment and services for a complete installation.

D. For exposed electrical work, coordinate colors and finishes with the Architect. Determine in advance of purchase that equipment and materials proposed for installation will fit into the confines indicated, leaving adequate clearance as required by applicable codes, and for adjustment, repair, or replacement.

E. MECHANICAL WORK:

1. Coordinate electrical work with mechanical work for proper service to each item of equipment requiring electrical connection prior to rough-in. All mechanical equipment loads shall be verified by the electrical contractor prior to rough-in. Where mechanical equipment loads are different from scheduled loads on the drawings, the electrical contractor shall notify the architect/engineer prior to any work being installed. In cases where mechanical equipment substitutions are approved, and the equipment loads require changes to the electrical circuitry, the contractor is responsible for making all necessary changes at no additional cost.
2. Determine, with each mechanical equipment installer, the proper sequencing and location for disconnect switches and similar points of interface between mechanical and electrical work.
3. Except as otherwise indicated, final power connections are provided under this Division.
4. Except as otherwise indicated, control wiring, 50 volts and less, and associated raceway system shall be provided under Mechanical.
5. Control wiring, 120 volts and above, and associated raceway systems shall be provided under this Division. Extend 120 volt circuits in mechanical rooms for control power to mechanical control panels, UV lights, heat trace, and any other items requiring control power.
6. Except as otherwise indicated, magnetic starters (including variable speed drives) shall be furnished under Mechanical Divisions, and mounted and connected under this Division.
7. Overload elements in starters shall be selected according to actual motor nameplate full load current. Responsibility for this coordination shall lie with the Division under which the particular starter is furnished.
8. Except as otherwise indicated, power disconnect switches and single speed manual starting switches shall be furnished and installed under this Division. Where combination magnetic starters are provided as work of another Division, the associated disconnect switch will be furnished as work of that Division. Fuses shall be furnished and installed under this Division. Except as otherwise indicated, disconnect switches for control wiring shall be furnished and installed under Mechanical Division.
9. Duct detectors for air handling units shall be furnished and installed by the mechanical contractor, and connected to a 120V power source by the electrical contractor.

F. UTILITY COORDINATION:

1. Coordinate connections of electrical, telephone and cable TV systems with the local electrical, telephone and cable TV utility companies. Comply with requirements of governing regulations, franchised service companies and controlling agencies. Pay any charges for installation of their facilities.
2. Contact the utility company to schedule and arrange for their work to be done. Pay any utility company charges for the installation of their facilities, and make arrangements for final connection of the services. Service shall be installed, connected, and available for full use prior to completion or acceptance of the work.
3. Coordinate utility installation requirements and obtain all utility installation and construction details related to the utility service entrance facilities prior to the start of work.
4. Service layout and arrangement, as indicated on the drawings, shall be confirmed with the utility company prior to bid. Obtain utility company construction standards and details prior to bid. Any modifications required shall be included in the bid and made at no additional cost to the Project.

G. EQUIPMENT LAYOUT:

1. The physical location and arrangements of electrical equipment is shown on the plans and is to be used by the Contractor. Alternate arrangements due to field conditions or changes in physical size of the equipment proposed for the project are to be submitted to the Architect for review before any work is begun or equipment ordered. The alternate arrangement is to be presented in a 1/4 inch scaled drawing showing all equipment, including those of other contractors. Include shop drawing cut sheets and applicable information. Indicate on the drawing by dimension all required Code clearances, wiring distances and maintenance access requirements. Where equipment heights are required to be coordinated with architectural or other items, indicate revised heights.
2. Where the design intent of the installation is not certain, ask for clarification. Lack of details will not be an excuse for improper installation. Any such work must be corrected at no expense to the Owner.
3. Coordination Drawings: For locations where several elements of the work must be sequenced and positioned with precision in order to fit into the available space, prepare coordination drawings showing the actual physical dimensions (at accurate scale, minimum ¼") required for the installation. At a minimum, prepare coordination drawings for every electrical room and telecommunication room within the building, and for installation of raceways. Raceways shall be coordinated with other trades to avoid conflicts. Prepare and submit coordination drawings prior to purchase-fabrication-installation of any of the elements involved in the coordination.
4. Contractor shall be responsible to insure that equipment selected fits in spaces allocated, with provisions for maintenance and/or code required access and clearances.

H. DELIVERY, STORAGE AND HANDLING

1. The Contractor shall be responsible for receiving, unloading, storing, protecting from weather, theft, breakage, etc., all electrical equipment, and material either purchases by the Contractor or furnished by others. The Contractor shall remove such material from storage and transport it to the site of erection when required for construction. The Contractor shall protect his own tools in a like manner. Also, the Contractor shall protect all equipment from accidental damage due to operating and maintenance activities that will be in progress in the same area.
2. Storage Coordination: It is recognized that space at project for storage of materials and products is limited. Coordinate deliveries of electrical materials and products with scheduling and sequencing of work so that storage requirements at project are minimized. In general, do not deliver individual items of electrical equipment to project substantially ahead of time of installation.
3. At all times take precautions necessary to properly protect electrical equipment from damage. Failure to comply with the above to the Architect's satisfaction shall be sufficient cause for the rejection of the particular piece of apparatus in question.

1.6 PHASED CONSTRUCTION; SEQUENCING

A. Refer to Division-1 provisions for determination of how construction phasing and sequencing requirements may affect performance of electrical work.

1.7 ALTERNATES

A. There may be certain alternates involved in the construction. The Contractor is cautioned to be aware of and to provide appropriate adjustments for all alternates described in the specifications or on the drawings.

1.8 PERMITS, INSPECTIONS AND FEES

A. Permits: Obtain and pay for all necessary permits, inspections, connection charges, fees, insurance, bond, licenses, and comply with all governing laws, ordinances, rules and regulations including those of the National Fire Protection Association and all municipal, state or other authority having jurisdiction over the work. Include all fees for services in bid.

B. Certificates of Inspection: Upon completion and before the date of substantial completion of each designated Phase, furnish a certificate of inspection issued by the proper authorities to the effect that the installation is in full conformity with all local and state requirements.

1.9 WARRANTY

A. The Contractor shall guarantee the work installed by him for one year from the date of final acceptance of the project and shall furnish free of cost to the Owner materials and labor necessary to repair or replace defective items of workmanship. The Contractor shall guarantee all equipment to be of the quality and capacity specified.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials and equipment shall conform in all respects to the requirements set forth in these Specifications and the accompanying Drawings.

B. Provide products which are compatible with other products of the electrical work, and with other work requiring interface with the electrical work, including electrical connections and control devices. For exposed electrical work, coordinate colors and finishes with the Architect. Determine in advance of purchase that equipment and materials proposed for installation will fit into the confines indicated, leaving adequate clearance as required by applicable codes, and for adjustment, repair, or replacement. For concealed electrical work requiring access, provide access panel, complete with anchorages and hardware, of adequate size for intended access.

C. All electrical products on this project shall conform, unless otherwise specifically noted, to applicable standards of the National Electrical Manufacturer’s Association and shall be listed by the Underwriter’s Laboratories, Inc.

D. Where materials, equipment, apparatus, or other products are specified by manufacturer, brand name or type, or catalog number, such designation is to establish standards of desired quality and style and shall be the basis of the bid. Except where noted, it is implied that “or approved equal” follows all specified items.

E. Any bills of materials, conduit and wire schedules, etc., shall be used for identification, type, and reference. It shall be the responsibility of the Contractor to determine exact quantities and components required to effect a complete job in accordance with drawings and associated specifications.

F. Equipment shall be installed in strict accordance with manufacturer's instructions. Contractor shall obtain these instructions and they shall be considered a part of these specifications.

2.2 FOUNDATIONS AND SUPPORTS

A. Provide concrete bases, pads, anchor bolts, slab inserts, hanger channels, cradles, saddles, etc for installation of floor mounted equipment such as switchboards, transformers, generators, etc.

B. Unless indicated otherwise, concrete pads for floor mounted electrical equipment shall be 4 inch high, poured integral with the floor slab wherever practical. Where not practical, construct 4 inch high housekeeping pads, reinforced with #3 steel wire mesh 6 x 6 inches, fastened to structural slabs with ½" diameter bolts embedded in structural slabs with expansion bolts at all corners (inset 3 inches) and no further apart than 18 inches. Use 3000 psi minimum compressive strength. Finish tops of housekeeping pads smooth and level within 1 percent of span. Pads shall be extended at least 4" beyond the equipment outline on all four sides.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with all federal, state and local safety laws, ordinances and regulations relating to the building and public health and safety.

B. No work shall be concealed until approved by the local inspector and all local regulations are adhered to.

C. Electrical Drawings are diagrammatic except where dimensioned. Do not scale. Follow manufacturer's certified Shop Drawings for accuracy. Consult Architect in cases of doubt or conflict. Unless noted as fixed, dimensions are based on the product of one (1) manufacturer. Verify dimensions with certified Shop Drawings of the materials actually approved and purchased.

3.2 TEMPORARY WIRING, LIGHTING AND POWER AT THE SITE: Furnish and install provisions for temporary electrical service and construction light and power during the construction period conforming to all local code and State labor law requirements.

A. Arrange for temporary service with the Utility Company.

B. Furnish, install, and maintain all temporary service equipment as required until permanent service is installed and "alive", switch-over of temporary light system, for the building while under construction.

C. Furnish, install, and maintain temporary feeders to permanent mechanical equipment and existing distribution and power electrical panels requiring service before permanent feeders are ready for same.

D. Provide and and/or all relocations of temporary electric facilities as necessary to clear the permanent installations of all trades.

E. Provide temporary panels, wires, conduits, etc. as required, to keep in operation the different building areas during construction. No additional compensation shall be provided to the Contractor to provide electrical power to all existing lights, receptacles, devices, HVAC equipment, etc., to keep these said areas in operation during construction.

F. Provide all required lighting for stairways to meet the requirements of all authorities having jurisdiction.

G. Refer to the Project Schedule for sequencing of the work. All electrical related services to and within the limits of work phasing areas not currently under construction, shall be maintained in complete functional operation. All electrical related work in areas designated by the work phasing plan to be under construction shall be made complete and functionally operable prior to proceeding with any other phase of the work.

H. Remove all temporary electrical service equipment from the building when temporary services are no longer required.

3.3 INSPECTION AND PREPARATION

A. Substrate Examination: Installer of each element of electrical work shall examine condition of substrate to receive work, and conditions under which work will be performed, and shall make notification of conditions detrimental to completion of work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

B. Existing Facilities and Conditions: The Contractor shall visit the building sites to determine existing conditions and will be held responsible for allowing for these conditions in his bid. This area of work may have existing storm drainage, mechanical and electrical utilities, etc. located underground. It is part of this work for the Contractor to determine the scope and location of all existing utilities and the scope and location of all new utilities to be installed concurrent with this project and arrange his work around others. Damages to existing utilities by the contractor shall be corrected by him at no additional compensation. Contractor shall call 1-800-272-3020 per Louisiana statutes.

C. Large and Heavy Equipment: Where possible, prearrange for movement and positioning of large equipment into the building structure, so that enclosing walls and roofs will neither be delayed nor need to be removed. Otherwise, make notice of opening requirements to be maintained for subsequent entry of large equipment units.

3.4 CUTTING AND PATCHING

A. Structural Limitations: Do not cut structural framing, walls, floors, decks and other members which are load bearing, except with the written consent of the Architect. Authorization will be

granted only where there is no other reasonable method for completing electrical work, and where proposed cutting clearly does not materially weaken the structure.

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

C. Patching: Where patching is required to restore other work, because of cutting or other damage occurring during installation of electrical work, execute patching in manner recommended by original Installer. Original Installer, where patching of finishes existing prior to beginning of work, refers to those performing similar work in areas of new construction. Restore other work in every respect, including elimination of visual defects in exposed finishes, as judged by Architect.

D. Provide, properly located and sized, all required chases, shafts, openings, furred spaces, etc., required for the work or to conceal any of the work, in any part of the structure.

E. It is the responsibility of this Division to coordinate with other responsible Divisions for required cutting and patching.

3.5 ELECTRICAL INSTALLATION

A. Conform with arrangement indicated by contract documents, recognizing that portions of work are shown only in diagrammatic form.

B. These specifications and accompanying drawings are intended to describe complete workable systems of the various types. Items of materials, work, or equipment not mentioned, but normally necessary for the proper execution of this work, shall be provided as if specifically called for.

C. The drawings show approximate locations only of feeders, branch circuits, outlets, etc., except where specific routing or dimensions are indicated. The Architect reserves the right to make changes in locations indicated, before roughing-in, without additional cost to the Owner.

D. Because of the small scale of the drawings, it is not possible to indicate all of the offsets, fittings, pull/junction boxes and accessories required. Investigate the structural and finish conditions and arrange work accordingly, furnishing fittings, bends, junction boxes, pull boxes, access panels, and accessories required to meet such conditions.

E. Where coordination requirements conflict with individual system requirements, comply with the Architect's decision on resolution of conflict.

F. Sequence, coordinate, and integrate various elements of electrical work so that electrical system will perform as indicated and be in harmony with other work of building. Architect will not supervise coordination, which is exclusive responsibility of Contractor.

G. Arrange work to facilitate maintenance and repair or replacement of equipment. Locate services requiring maintenance on wiring devices and similar units in front of services requiring less maintenance. Connect equipment for ease of disconnecting, with minimum of interference

with other work. Locate operating and control equipment and devices for easy access. Maintain NEC code working clearances around all electrical equipment.

H. Install access panels where electrical work requiring access is concealed by finishes and similar work. Access panels utilized shall be approved by the Architect.

I. Integrate electrical work in ceiling plenums, including lighting fixtures, with ceiling finish, suspension, ductwork, air diffusers and other work, so that required performances of each will be achieved.

J. Where work is in close proximity to the work of other contractors, the Electrical Contractor shall review plans of other contractors and coordinate his work with theirs. The Electrical Contractor shall verify the location of lighting fixtures, beams, structural members, conduit, ductwork, pipes or other obstructions before beginning his work in the area. Notify the Architect where proper clearances do not occur or where the work of others would interfere with the safe and/or proper operation of this work. Give right-of-way in confined-service spaces to piping which must slope for drainage, and to larger HVAC ductwork and similar services which are less conformable than electrical services.

K. Fireproofing: Where conduit and/or cables penetrate fire-resistant/rated walls, partitions, ceilings, or floors, adequate fire seals using UL listed methods and products listed for the application to maintain the fire-resistance rating shall be provided and installed.

3.6 MOUNTING HEIGHTS

A. Unless otherwise noted on the drawings or required by the Architect, the following mounting heights shall apply. Heights are to center of device unless noted otherwise:

Toggle Switches	48”
Receptacles	18”
Devices above counter	6” above counter or 2” above backsplash
Devices above or adjacent to lavatories	42”
Telephone/Data Outlets	18”
Wall mounted telephone	52”
Cable TV Outlets	84”
Motor Control Equipment	5’-0”
Fire Alarm Manual Pull Stations	48”
Panelboards	6’-6” to top (not more than 5’-6” from top most operating handling to floor.)

B. Upon approval of the Architect, mounting heights may be adjusted to simplify cutting of concrete blocks in block walls or to facilitate furniture, base or cabinet arrangements. All mounting heights may be field adjusted by the Architect without any additional cost.

C. Coordinate mounting height of wiring devices above counters and/or benches and/or shelves and/or lavatories with architect prior to rough-in.

3.7 SERVICE CONTINUITY

A. At all times during the construction of the project, services (power, telephone, fire alarm, etc.) shall be maintained to all portions of the site except with prior written approval of interruptions. Any required interruptions of services (power, telephone, fire alarm, etc.) due to work being performed under this contract shall be scheduled in advance after consultation with the Architect and the Owner.

B. At least 14 days prior to the requirement of any interruption of services, the Contractor shall furnish to the Architect for approval a written plan for the work associated with the outage including a description of the installation and removal of temporary wiring and facilities necessary to be installed.

3.8 ACCESS TO ELECTRICAL WORK

A. Install access units in accordance with manufacturer's written instructions, in compliance with NEC, and with recognized industry practices.

B. Coordinate with other work, including substrate construction work, as necessary to interface installation of access units with other work.

C. Locate each removable access unit accurately in relation to electrical work requiring access.

D. Provide adequate temporary support or attachment to framing or formwork so that units will not be dislocated during construction of substrates.

E. Set frames accurately in position and securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces.

F. Adjust hardware and panels after installation for proper operation.

G. Remove and replace panels or frames which are warped, bowed, or damaged.

3.9 EXCAVATING FOR ELECTRICAL WORK

A. General: Do not excavate for electrical work until the work is ready to proceed without delay, so that total time lapse from excavation to completion of backfilling will be minimized.

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

C. Notify the Architect before beginning any and each excavation. At this time, exact locations of underground services to be installed shall be determined by inspection with the Owner and the Architect. Wherever other underground facilities are known to exist in the area of required excavations such facilities shall be located exactly by hand excavation by the Contractor. Should any minor relocation of new facilities be required before installation, the Contractor shall make the necessary relocation at no extra cost to the Owner.

D. Excavate trenches to depth indicated or required.

E. Excavate with vertical-sided excavations to greatest extent possible, except where otherwise indicated. Where necessary, provide sheeting and cross-bracing to sustain sides of excavations. Remove sheeting and cross-bracing during backfilling wherever such removal would not endanger the work or other property. Where not removed, cut sheeting off at sufficient distance below finished grade to not interfere with other work.

F. Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.

3.10 BACKFILLING

A. General: Except as otherwise indicated, backfill with properly qualified backfill materials.

B. Backfill to elevations matching adjacent grades, at time of completion of work or as required to provide patching of paved surfaces.

3.11 WORKMANSHIP

A. All workmanship shall be of the highest quality. Any work judged substandard by the Architect shall be redone at the Contractors expense. Install all materials and electrical components of the work in accordance with instructions of manufacturer following the best modern construction practices and conforming with the Contract Documents. Workmanship shall be first class, in both function and appearance, whether finally concealed or exposed and shall be performed by experienced workmen skilled in the type of work. As practicable, the lines of all components of the system shall be perpendicular or parallel to building lines. In general, workmanship shall conform to guidelines set forth in N.E.C.A. manuals.

3.12 FIELD QUALITY CONTROL

A. As a minimum, upon completion of installation of electrical connections, and after circuitry has been energized, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement.

3.13 CLEANING UP

A. Remove once per week and at the completion of the work all empty cartons, scrap wire, raceways, rubbish, etc., accumulated on the project as a result of work performed.

B. Remove all marks, stains, fingerprints, bugs, dust and other foreign material from all electrical components. Refinish damaged surfaces and restore original finish to the satisfaction of the Architect.

C. After final performance test run of each electrical system, clean system both externally and internally. Touch-up minor damage to factory-painted finishes; refinish work where damage is extensive.

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

3.14 SAFETY: It shall be the Contractor’s responsibility to do all things necessary in the pursuit of the installation or testing to provide safe conditions in which to work.

END OF SECTION 260010

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Senator Wire & Cable Company.
4. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Type THHN-THWN and XHHW.

D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN, single conductors in raceway.

B. Feeders: Type THHN-THWN, single conductors in raceway.

C. Branch Circuits: Type THHN-THWN, single conductors in raceway. MC cable shall be allowed in locations permitted in the NEC, and where the MC cable can be concealed in walls, millwork, or above ceilings.

D. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
    a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    b. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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: Grounding systems and equipment.

1.3 SUBMITTALS

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

B. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.2 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad (13 mil); 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

B. Concrete Encased Grounding Electrode: Electrically conductive rebar (not less than 1/2" diameter) or #4 AWG bare copper conductor of at least 20 foot length.

C. Metal Frame of Building: Metal frame that is connected to earth by hold down bolts.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

C. Grounding Bus: Install in telephone equipment rooms, and elsewhere as indicated.

1. Install bus on insulated spacers 2 inches (50 mm) minimum from wall, 96 inches above finished floor unless otherwise indicated.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors.
3. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

C. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

D. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. For telephone, alarm, voice and data, and other communication equipment, provide minimum No. 4 AWG (or size as otherwise indicated) insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch (6.3-by-100-by-300-mm) grounding bus.
3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

E. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Concrete Encased Grounding Electrode: Metallic components shall be encased in not less than 2” of concrete and shall be located horizontally within that portion of concrete foundation that is

in direct contact with earth. If multiple concrete encased electrodes are present at the site, it shall be permissible to bond only one to the grounding electrode system.

D. Metal Frame of Building: Connect the metal frame hold down bolts for structural steel columns to earth by connecting the hold down bolts to a concrete-encased electrode located in the support footing or foundation. The hold down bolts shall be connected to the concrete encased electrode by welding, steel tie wires or other approved means.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test

wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
b. Perform tests by fall-of-potential method according to IEEE 81.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 5 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
5. Substations, Pad-Mounted Equipment, and main facility grounding field electrode system: 5 ohms.
6. Manhole Grounds: 5 ohms.

E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.

3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
6. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways to these supports with two-bolt conduit clamps.

D. Single Raceway: Support single raceway with threaded rod secured to structure and conduit clamp.

E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm)

thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.

6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section.

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Division 09 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

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. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit; a Tyco International Ltd. Co.
3. Anamet Electrical, Inc.
4. Electri-Flex Company.
5. O-Z/Gedney; a brand of EGS Electrical Group.
6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
7. Republic Conduit.
8. Robroy Industries.
9. Southwire Company.
10. Thomas & Betts Corporation.
11. Western Tube and Conduit Corporation.
12. Wheatland Tube Company; a division of John Maneely Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. EMT: Comply with ANSI C80.3 and UL 797.

G. FMC: Comply with UL 1; zinc-coated steel.

H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

    a. Material: Steel or die cast.
    b. Type: compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.
6. Condux International, Inc.
7. Electri-Flex Company.
8. Kraloy.
9. Lamson & Sessions; Carlon Electrical Products.
10. Niedax-Kleinhuis USA, Inc.
11. RACO; a Hubbell company.
12. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. LFNC: Comply with UL 1660.

F. Rigid HDPE: Comply with UL 651A.

G. Continuous HDPE: Comply with UL 651B.

H. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.

I. RTRC: Comply with UL 1684A and NEMA TC 14.

J. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

K. Fittings for LFNC: Comply with UL 514B.

L. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

M. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.
2. Hoffman; a Pentair company.
3. Mono-Systems, Inc.
4. Square D; a brand of Schneider Electric.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect. Surface metal raceway shall include 4-3/4” nominal base, raceway cover, divider to separate power and low voltage conductors, fittings and seam clips for a complete installation.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Mono-Systems, Inc.
b. Panduit Corp.
c. Wiremold / Legrand.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Cooper Technologies Company; Cooper Crouse-Hinds.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. FSR Inc.
5. Hoffman; a Pentair company.
6. Hubbell Incorporated; Killark Division.
7. Kraloy.
8. Milbank Manufacturing Co.
9. Mono-Systems, Inc.
10. O-Z/Gedney; a brand of EGS Electrical Group.
11. RACO; a Hubbell Company.
12. Robroy Industries.
13. Spring City Electrical Manufacturing Company.
14. Thomas & Betts Corporation.
15. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Metal Floor Boxes:
1. Type: As indicated on drawings.
2. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. All floor boxes shall have flanged covers, and shall be provided with device mounting brackets and hardware for a complete installation.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

G. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep) minimum. Provide 3-1/2 inch deep boxes for wall box dimmers and other devices requiring additional space.

L. Gangable boxes are allowed.

M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

N. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. CDR Systems Corporation; Hubbell Power Systems.
d. NewBasis.
e. Oldcastle Precast, Inc.; Christy Concrete Products.
f. Synertech Moulded Products; a division of Oldcastle Precast, Inc.

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.

4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC.", “TELEPHONE”, “CATV” as required to describe the system.
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

2.7 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: Galvanized Rigid Steel Conduit.
2. Concealed Conduit, Aboveground: Galvanized Rigid Steel Conduit.
3. Underground Conduit: RNC, Type EPC-40-PVC direct buried. Conduit stub-ups shall be Galvanized Rigid Steel Conduit elbows.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed: EMT.

2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
4. Damp or Wet Locations: Galvanized Rigid Steel Conduit.
5. Boxes and Enclosures: NEMA 250, Type 1.

C. Minimum Raceway Size: 1/2-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use compression fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches (300 mm) of enclosures to which attached.

I. Raceways Embedded in Slabs:

1. Coordinate all conduit run in the slab with structural engineer prior to installation. Structural engineer may require larger conduits to be routed below structural slab.

2. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum10-foot (3-m) intervals.

3. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
4. Arrange raceways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.
5. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
6. Change from ENT to GRC before rising above floor.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Surface Raceways:

1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

W. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

BB. Locate boxes so that cover or plate will not span different building finishes.

CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

EE. Confirm floor box locations with architect prior to installation of slab. Set floor boxes level and flush with finished floor surface.

FF. Group neutral conductors with phase conductors within boxes.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
5. Underground Warning Tape: Comply with requirements in Division 26 Section "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Division 07 Section "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
1. Manufacturers: Subject to compliance with requirements,

a. Advance Products & Systems, Inc.
b. CALPICO, Inc.
c. Metraflex Company (The).
d. Pipeline Seal and Insulator, Inc.
e. Proco Products, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.4 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
2. Sealant shall have VOC content less than that established in SCAQMD Rule 1168.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.2 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

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. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's

wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

2.2 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

F. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.3 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Tag:

1. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 8 mils (0.2 mm).
3. Foil Core Thickness: 0.35 mil (0.00889 mm).
4. Weight: 34 lb/1000 sq. ft. (16.6 kg/100 sq. m).
5. 3-Inch (75-mm) Tensile According to ASTM D 882: 300 lbf (1334 N), and 12,500 psi (86.1 MPa).

2.4 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.

3. Nominal size, 10 by 14 inches (250 by 360 mm).

E. Warning label and sign shall include, but are not limited to, the following legends:
1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.5 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

2.6 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

D. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.7 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in

contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

J. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
1. Power.

B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
b. Colors for 208/120-V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.

c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

C. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

D. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

G. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

    a. Power transfer switches.
    b. Controls with external control power connections.

I. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.

K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
b. Enclosures and electrical cabinets.
c. Access doors and panels for concealed electrical items.
d. Enclosed switches.
e. Enclosed circuit breakers.
f. Enclosed controllers.
g. Variable-speed controllers.
h. Push-button stations.
i. Contactors.
j. Remote-controlled switches, dimmer modules, and control devices.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. Indoor occupancy sensors.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

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

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Floor plans with occupancy sensor layout. Layout shall be coordinated with light fixtures, mechanical diffusers, and other items on the reflected ceiling plan
2. Interconnection diagrams showing field-installed wiring.
3. Functional block diagrams.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

B. Sensor location indicated on drawings is approximate. Coordinate sensor location with manufacturer's recommendation. Do not locate ultrasonic type occupancy sensors within 6 feet of mechanical diffusers or ceiling fans.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Lutron
2. Leviton
3. Acuity Brands
4. Douglas Lighting Controls
5. Watt Stopper (The).

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, sensors shall turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes. Sensors shall be capable of manual or automatic ON operation, and set for manual ON, automatic OFF.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit or room lighting controller.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outlet box. Ceiling or wall mounted to suit application.
    b. Relay: Externally mounted through a ½-inch (13-mm) knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.
8. Finish and Coverplates: Lighting control devices and cover plates shall match color of wiring devices.

C. Sensors:

1. IR (Infrared) Type: Ceiling or wall mounted to suit application; detect occupancy by sensing a combination of heat and movement in area of coverage.
   a. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch high ceiling.
   b. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot high ceiling.
2. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
   a. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305mm) in either a horizontal or vertical manner at an approximate speed of 12 inches/s (305 mm/s).
   b. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch high ceiling.
   c. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot high ceiling in a corridor not wider than 14 feet.
3. Dual-Technology Type: Ceiling or wall mounted to suit application; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
   a. Sensitivity Adjustment: Separate for each sensing technology.
   b. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
   c. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch high ceiling.

D. Wall Switch Occupancy Sensors
1. PIR (Infrared) Type: Wall mount, detect occupancy by sensing a combination of heat and movement in area of coverage.
   a. Auto ON/Auto OFF or Manual On/Auto OFF operation.
   b. Impact resistant IR lens.
   c. Dual relay where sensor controls multiple loads.
   d. Dual 120/277 volt operation.
   e. 1000 square foot, 180 degree coverage.

E. Digital Time Switch: Wall mount, digital timer with LCD display and ON/OFF pushbutton. Timer programmable for 5, 10, 15, or 30 minutes or 1, 3, 6, 9, 12 hours. Provides flicker and/or beep warning at 2 and 1 minute intervals before a pending turn off. 120/277 volt operation.

F. Room Lighting Controllers: Room lighting controllers shall have the following features:
1. Plenum rated for mounting above accessible ceiling.
2. Line voltage (120/277 volt) relays and 0-10 volt dimming outputs as required.
3. Accept inputs such as occupancy sensors, low voltage switches, and daylight sensors.
4. Support energy saving manual ON, bi-level, tri-level and dimming control strategies.
5. On/Off/Dim button for each load
6. Zero crossing circuitry for each relay for reliability and increased product life.
7. Capable of Bacnet interface with building automation system.

G. Low Voltage Switch: Low voltage switches shall have the following features:
   1. Customizable buttons with LED status indicators. Switches shall be available in single and multiple button configurations to suit application.
   2. Active dim feature (raise/lower) to enable manual adjustment of any selected load.
   3. Communicates with room lighting controller or relay in lighting control panel with low voltage wiring to control load.
   4. Programmable scene presets.
   5. Switch shall fit in single gang box, and shall be capable of multi-way operation.
   6. Infrared transceiver for wireless configuration and control.
   7. Provide engraved legend for each button.

2.2 DIGITAL PHOTOCELL INPUT MODULE

A. Description: Photocell module shall be an accessory to the lighting control panel and allow the system to read ambient light levels for use in controlling exterior lights. Module shall be compatible with lighting control panel, and mounted within control panel. Module shall include exterior photocell with the following features:

   1. Light-Level Monitoring Range: 0 to 200 fc.
   2. 24 VDC from photocell module.
   3. Slew rate, one minute full scale response time.
   4. Mounting, 1/2" NPT x .69” threaded stem
   5. Housing, UV stabilized plastic

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 98 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

B. Follow manufacturer’s instructions for mounting locations of sensors. Do not locate near air diffusers, ceiling fans and other devices that may affect performance of the sensor.

3.2 WIRING INSTALLATION

A. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer’s written instruction.

B. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

C. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

3.4 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 DEMONSTRATION

A. Provide 4 hours of Owner training for Lighting and Lighting Controls. Engage a factory-authorized service representative for lighting control system.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

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. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.4 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NECA 407.

1.8 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) to plus 104 deg F (plus 40 deg C).
b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

1.9 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Surface-or flush mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Outdoor Locations: NEMA 250, Type 3R.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.

5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
6. Finishes:

    a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    b. Back Boxes: Galvanized steel. Same finish as panels and trim.

7. Directory Card: Inside panelboard door, mounted in transparent card holder.

B. Phase, Neutral, and Ground Buses:

1. Material: Copper.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.

C. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Main and Neutral Lugs: Mechanical type.
2. Ground Lugs and Bus-Configured Terminators: Mechanical type.
3. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
4. Provide lug sizes necessary to terminate feeders.

D. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

E. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NECA 407.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NECA 407.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

C. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

E. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. For flush mounted panels, stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

I. Comply with NECA 1.

J. Group neutral conductors with phase conductors within enclosure.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate consisting of two lines of text. Line 1 shall include panel name, and Line 2 shall include panel voltage and source. For example,

PANEL L1
120/208V FED FROM MDP

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

E. Provide label to indicated available fault current and date calculated.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    b. Instruments and Equipment:

        1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

C. Panelboards will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

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. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Snap switches and wall-box dimmers.
3. Pendant cord-connector devices.
4. Cord and plug sets.
5. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

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

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.7 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V: Comply with NEMA WD 1, NEMA WD 6 configurations 5-20R, and UL 498.

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

a. Hubbell HBL5362 series.
b. Leviton 5362 series.
c. Pass & Seymour PS5362 series.

B. Convenience Receptacles, 125V with USB chargers.

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

a. Hubbell
b. Leviton
c. Pass & Seymour

2.2 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include power on indicator light and ground fault indicator light or reset lockout device.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

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

    a. Pass & Seymour; 2095 series.
    b. Hubbell; GFR5362 series.

C. Weather-Resistant GFI Receptacles, 125V, 20A.

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

    a. Hubbell GFR5362TR series.
    b. Pass & Seymour 2095TRWR series.

2.3 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.4 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.5 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

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

    a. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
    b. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
    c. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

C. Pilot Light Switches, 20 A:

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

a. Cooper; 2221PL for 120 V and 277 V.
b. Hubbell; HPL1221PL for 120 V and 277 V.
c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
d. Pass & Seymour; PS20AC1-PLR for 120 V.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277 V, 20 A:

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

a. Pass & Seymour; PS372010KL (single pole) and PS372030KL (three way). Equal by Hubbell and Leviton.

2. Description: Operated by cam lock, with key removable in both positions.

E. Wall Box Dimmers
1. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
2. LED Dimmers: 120 or 277 V; ELV/Triac or 0-10 volt control as indicated on drawings, no flicker/strobing at low end. For 0-10 volt control, provide 0-10 volt control cable between dimmer and each dimmable light fixture. LED dimmer shall be compatible with LED fixture drivers.

2.6 WALL PLATES

A. Single and combination types to match corresponding wiring devices

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material:
a. Finished Spaces: Smooth nylon, 0.035 thick.
b. Unfinished Spaces: Galvanized Steel

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, thermoplastic with lockable “WHILE IN USE” cover.

2.7 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: solid brass with satin finish.

D. Power Receptacle: As indicated on drawings

E. Voice and Data Communication Outlet: As indicated on drawings

2.8 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices: White, unless otherwise selected by Architect, or unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

a. Cut back and pigtail, or replace all damaged conductors.
b. Straighten conductors that remain and remove corrosion and foreign matter.
c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles on bottom, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening. Device plates shall be installed with all four edges in contact with finished wall surfaces.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 CONNECTIONS

A. Properly ground all wiring devices.

3.3 FIELD QUALITY CONTROL

A. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

SECTION 262813 - FUSES

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. Cartridge fuses rated 600-V ac and less.

1.3 ACTION SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

   1. Ambient temperature adjustment information.
   2. Current-limitation curves for fuses with current-limiting characteristics.
   3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
   4. Coordination charts and tables and related data.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Comply with UL 248-11 for plug fuses.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance: Class L, time delay over 600A otherwise Class RK1, time delay.
2. Feeders: Class L, time delay over 600A otherwise Class RK1, time delay.

3. Motor Branch Circuits: Class RK1, time delay.
4. Other Branch Circuits: Class RK1, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Shunt trip switches.
4. Molded-case circuit breakers (MCCBs).
5. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70.

1.8 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.
5. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

I. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
    b. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges.

END OF SECTION 262816

SECTION 265100 - LIGHTING

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. Lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CCT: Correlated color temperature.

C. CRI: Color-rendering index.

D. HID: High-intensity discharge.

E. LER: Luminaire efficacy rating.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Ballast, including BF.
4. Energy-efficiency data.
5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.

6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

    a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
    b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

D. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

1.7 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.8 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
2. Warranty Period for Emergency Fluorescent Ballast and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. LED Luminaires: Provide luminaires complete with power supplies (drivers) and light sources. LED luminaires shall meet the minimum requirements in the following table

Luminaire Type	Minimum Luminaire Efficacy	Minimum CRI
LED troffer	90 LPW	80
LED downlight	50 LPW	80
LED track or accent	40 LPW	80
LED low bay/high bay	80 LPW	70
LED linear	80 LPW	80

B. LED Luminaires shall also meet the following minimum requirements:
1. Luminaires shall have 10 year manufacturer’s warranty
2. Luminaires shall have a minimum L70 lumen maintenance value of 50,000 hours as calculated by IES TM-21, with data obtained per IES LM-80 requirements.
3. Luminaire drive current value shall be identical to that provided by test data for luminaire in question.
4. Luminaires shall be tested to IES LM-79 and IES LM-80 standards.

C. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

D. Metal Parts: Free of burrs and sharp corners and edges.

E. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

G. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

   a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
   b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

H. Factory-Applied Labels: Comply with UL 1598. Include recommended drivers. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following characteristics:
   a. CCT and CRI for all luminaires.

2.2 LED DRIVERS

A. NEMA SSL, UL 8750. LED drivers shall be electronic, UL Class 1, constant-current type and comply with the following requirements,

1. Output power (watts) and luminous flux (lumens) as shown or indicated in lighting fixture schedule for each luminaire type
2. Power factor greater than or equal to 0.9 over the full dimming range when provided.
3. Current draw total harmonic distortion (THD) of less than 20 percent.
4. Class A sound rating
5. Operable input voltage of 120-277 volts at 60 hz, unless noted otherwise.
6. Minimum 10 year manufacturer's warranty.
7. Integral thermal protection that reduces or eliminates the output power if the case temperature exceeds a value detrimental to the driver.
8. UL listed for locations where the luminaire is installed.
9. Where required, dimmable using 0-10V control or control as indicated in lighting fixture schedule.

2.3 LED LIGHT SOURCES

A. Correlated Color Temperature as indicated in lighting fixture schedule.

B. CRI: minimum value of 80

C. RoHS compliant

D. Provide light source color consistency by utilizing a binning tolerance within a 4 step McAdam ellipse.

2.4 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

2.5 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm).

F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

E. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers. Coordinate length of suspension cable/stem and AC cord prior to ordering fixtures.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to emergency power and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.4 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

1. Adjust aimable luminaires in the presence of Architect.

END OF SECTION 265100

SECTION 271300 - TELECOMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Mounting Elements.
2. UTP Cabling.
3. Workstation Outlets.
4. Equipment Cabinets.
5. Patch Panels.
6. Backboards.
7. Identification Products.

1.3 DEFINITIONS

A. Backbone: A facility (e.g., pathway, cable, or conductors) between telecommunications rooms or floor distribution terminals, the entrance facilities, and the equipment rooms within or between buildings.

B. BICSI: Building Industry Consulting Service International.

C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

D. EMI: Electromagnetic Interference.

E. Horizontal Cabling: Cabling between and including the telecommunications outlet/connector and the horizontal cross-connect. Also the cabling between and including the building automation system outlet or the first mechanical terminations on the horizontal connection point and the horizontal cross-connect.

F. IDC: Insulation Displacement Connector.

G. LAN: Local Area Network.

H. RCDD: Registered Communications Distribution Designer.

I. UTP: Unshielded Twisted Pair.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.5 SUBMITTALS

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

B. Shop Drawings:

1. Include dimensioned plan and elevation views of telecommunications equipment rooms, labeling each individual component. Show equipment rack assemblies, method of field assembly, workspace requirements, and access for cable connections.
2. System Labeling Schedules: Copy of labeling schedules.
3. Overall system block diagram.

C. Qualification Data: For installer, testing agency and field inspector.

D. Source quality-control reports.

E. Field quality-control reports.

F. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff.

1. Installation Supervision: Installation shall be under the direct supervision of a Registered Technician or Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

B. Installation shall comply with UFC 3-580-01 Telecommunications Building Cabling Systems Planning and Design

C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

1. Testing Agency's Field Supervisor: Person currently certified by BICSI as an RCDD to supervise field quality-control testing.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

F. Grounding: Comply with ANSI-J-STD-607-A.

1.7 WARRANTY

A. Minimum three years for parts and labor on all cable and connectors.

1.8 COORDINATION

A. Coordinate layout and installation of voice and data communication cabling with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings.
3. Adjust arrangements and locations of distribution frames and cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum performance.

B. Expansion Capability: Unless otherwise indicated, provide spare fibers and conductor pairs in cables, positions in cross-connect and patch panels, and terminal strips to accommodate 10 percent future growth. This does not apply to horizontal cable from workstation outlet to terminal.

2.2 PATHWAYS

A. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

B. Cable Trays:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cablofil Inc.
   b. Cooper B-Line, Inc.
   c. Chatsworth
   d. Cope - Tyco/Allied Tube & Conduit.

2. Cable Tray Materials: Metal, suitable for indoors, and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch (0.012 mm) thick.

   a. Basket Cable Trays: Size as indicated on drawings. Wire mesh spacing shall not exceed 2 by 4 inches (50 by 100 mm).
   b. Cable Runway: made of 3/8" x 1-1/2" x .065" rectangular steel tubing. Size as indicated on drawings, and a rung spacing of **12 inches.**

3. Provide a minimum of 12" clearance above all cable trays for future access.

C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."

1. Outlet boxes shall be two-gang with single gang trim ring unless noted otherwise on drawings.

2.3 MOUNTING ELEMENTS

A. Backboards: Interior-grade, void free plywood, fire-retardant treated, ¾ by 48 by 96 inches.

B. Floor mounted distribution racks: Freestanding, modular steel units designed for telecommunications terminal support with four posts.

1. Width compatible with EIA 310 standard 19-inch panel mounting.
2. Finish: Baked-polyester powder coat.

C. Power Strips: For mounting in the rack, with 20-A ac, NEMA WD 6, Configuration 5-15R receptacles. Power strip to be cord connected with 15-foot line cord.

2.4 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that my be incorporated into the Work include, but are not limited to, the following:

1. Belden CDT Inc.; Electronics Division.
2. Berk-Tek; a Nexans company.
3. CommScop, Inc.
4. KRONE Incorporated.
5. Mohawk; a division of Belden CDT.
6. Superior Essex Inc.

B. General Description: 100-ohm, 4-pair UTP, covered with a thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 6.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444.

C. (Analog) Voice Backbone Copper Cable:

1. No. 24 AWG, 25 or 50 pair, Category 5e.
2. NFPA 70, type CMR complying with UL 1666.
3. Cable Jacket Color: Gray.

D. Horizontal Copper Cable:

1. No. 23 AWG, 4 pair, category 6.
2. NFPA 70, types CMG and CMP.
3. Cable Jacket Color: Blue (Data), Green (Cameras), Yellow (WAP).

2.5 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Dynacom Corporation.
2. Hubbell Premise Wiring.
3. KRONE Incorporated.
4. Leviton Voice & Data Division.
5. Nordex/CDT; a subsidiary of Cable Design Technologies.
6. Siemon Co. (The).
7. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables. Comply with TIA/EIA-568-B.2, meeting or exceeding cable performance.

1. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.

2. Label each port to match workstation labeling.

E. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

F. Patch Cords: Factory-made, four-pair cables in lengths as indicated on drawings; terminated with eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure category 6 performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall be color-coded to match system cable.
3. Provide a patch cord for each wired port.

2.6 COMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular (RJ45). Comply with TIA/EIA-568-B.1.

B. Workstation Outlets: Unless indicated otherwise, two-port connector assemblies mounted in two gang device box with single gang trim ring and faceplate.

1. Faceplate: Smooth nylon, 0.035" thick. Color to match wiring devices.
2. Mounting: Flush, unless otherwise indicated.
3. Legend: Label each jack using BISCI labeling guidelines.

2.7 CABLE TELEVISION SYSTEMS (CATV)

A. Provide a complete CATV system, including distribution amplifiers and splitters, coax cable and TV outlets. Engage the services of a CATV vendor to calculate system losses and properly select all components of the system to achieve a quality TV signal at each outlet over all channels.

B. The system shall meet the applicable requirements of TIA/EIA, BICSI and NFPA 70.

C. Coordinate incoming service with local service provider.

D. System shall include headend amplifier if required by service provider, splitters, combiners, line taps, cables, outlets and all other parts to provide a complete and usable system. The system must be designed to operate within the 5 to 1000 MHz bandwidth using 1000 MHz passive devices and a minimum of 750 MHz active devices. Each outlet must have a minimum signal level of 0 decibel millivolts and a maximum of 15 dBmV at 55 and 750 MHz.

E. Cable: Quad shield RG6 coax.

F. Connector: F connector

2.8 GROUNDING

A. Comply with ANSI-J-STD-607-A..

2.9 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP cables according to TIA/EIA-568-B.2.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

2.11 SURGE PROTECTION

A. Protect components from voltage surges originating external to equipment housing and entering through power, communication or control leads. There is to be two levels of protection as follows:

1. All incoming 120 volt circuits.
2. Protect communication and control, and low voltage power lines as they leave the control box and route to another separate building or to a device outside the building.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within equipment cabinets, and except in accessible ceiling spaces. Raceways shall be provided in walls, in spaces with exposed ceilings, and in unaccessible ceiling areas. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

2. Minimum 3/4” conduit for voice/data cabling.

B. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer’s limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.

B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

C. Install manufactured conduit sweeps and long-radius elbows whenever possible.

D. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard when entering room from overhead.
4. Extend conduits 3 inches above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

E. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

F. Prepare wall penetrations and verify the penetrations of fire rated walls are made using products labeled for use of wall penetrations.

G. Support cable runway every 5 feet.

3.4 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, “Cable Termination Practices.”
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer’s limitations on bending radii, but not less than radii specified in BICSI ITSIM, “Cabling Termination Practices” Chapter. Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. At communication outlets, install a loop in each cable within the box before making the final termination.

11. In the communications equipment room, install a 10-foot-long service loop on each end of cable.
12. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, “Pulling Cable.” Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than ½ inch from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.

F. Group connecting hardware for cables into separate logical fields.

G. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
    c. Electrical Equipment Rating More Than 5kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, 5kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.5 GROUNDING

A. Install grounding according to BICSI TDMM, “Grounding, Bonding, and Electrical Protection” Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar in each communications closet to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 4 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A.

B. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Furnish an electronic copy to the Owner of final comprehensive schedules for Project.

C. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

D. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

E. Communications Outlets: Identify wiring closet and termination/port number for each jack. Use hot, stamped or engraved machine printing with white-filled lettering on face of plate, durable wire markers or tags inside outlet boxes.

F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visually inspect UTP cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform test with a tester that complies with performance requirements in “Test Instruments (Normative)” Annex, complying with measurement accuracy specified in “Measurement Accuracy (Informative)” Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. UTP Performance Tests:

a. Test for each outlet. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:

1) Wire Map.
2) Length (physical vs. electrical, and length requirements).
3) Insertion loss.
4) Near-end crosstalk (NEXT) loss.
5) Power sum near-end crosstalk (PSNEXT) loss.
6) Equal-level far-end crosstalk (ELFEXT).
7) Power sum equal-level far-end crosstalk (PSELFEXT).
8) Return loss.
9) Propagation delay.
10) Delay skew.

5. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.

a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listed and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

B. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

C. Prepare test and inspection reports.

D. Remove and replace cabling where test results indicate that they do not comply with specified requirements. Retest and inspect replaced cabling to determine compliance with specifications.

END OF SECTION 271300

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stripping and stockpiling topsoil.
2. Removing above- and below-grade site improvements.
3. Disconnecting, capping or sealing site utilities.
4. Temporary erosion- and sedimentation-control measures.

1.2 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.3 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

C. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.

D. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 2 Section "Earthwork."

1. Obtain approved borrow soil material off-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways and comply with all requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.

B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

3.4 TOPSOIL STRIPPING

A. Strip topsoil to depth indicated on Drawings or if not indicated 24" in a manner to prevent intermingling with underlying subsoil or other waste materials as applicable in non-paved areas.

B. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

3.5 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION **311000**

SECTION 312000 - EARTH MOVING (SITE WORK)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for walks pavements turf and grasses andplants.
3. Excavating and backfilling for buildings and structures.
4. Subbase course for concrete walks pavements.
5. Excavating and backfilling trenches for utilities and pits for buried utility structures.

1.2 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.3 PREINSTALLATION MEETINGS

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

1.4 INFORMATIONAL SUBMITTALS

A. Material test reports.

1.5 FIELD CONDITIONS

A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.

B. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored to comply with local practice or requirements of authorities having jurisdiction.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored to comply with local practice or requirements of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.3 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 SUBGRADE INSPECTION

A. Proof-roll subgrade [below the building slabs and pavements] <Insert locations> with a pneumatic-tired dump truck to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.8 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

D. Trenches under Roadways: Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

E. Initial Backfill: Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Final Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

G. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.10 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

3.11 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D698:

1. Under steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.

4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.13 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.14 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Shape subbase course and base course to required crown elevations and cross-slope grades.
2. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
3. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.15 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.16 FIELD QUALITY CONTROL

A. Special Inspections: Contractor will engage a qualified special inspector to perform inspections:

B. Testing Agency: Contractor will engage a qualified geotechnical engineering testing agency approved by owner to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION **312000**

SECTION 31 21 00 – EARTH MOVING (BUILDING PAD)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Geotechnical Investigation by Ardaman & Associates, Inc., dated January 9, 2018. Geotechnical report may be obtained from Architect's office.

1.2 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for buildings.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for slabs-on-grade.
4. Excavating and backfilling for utility trenches.
5. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.

B. Related Sections include the following:

1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
2. Division 03 Section "Cast-in-Place Concrete".

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

D. Drainage Course: Course beneath the slab that minimizes upward capillary flow of pore water.

E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

F. Fill: Soil materials used to raise existing grades.

G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

H. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

I. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.
2. Test reports on borrow material.
3. Field density test reports.
4. One optimum moisture-maximum density curve for each type of soil encountered.

1.5 QUALITY ASSURANCE

A. Codes and Standards: Perform work in compliance with applicable requirements of governing authorities having jurisdiction.

B. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

C. Testing & Inspection Service: Owner will engage and pay for soil testing and inspection service for quality control testing during earthwork operations. Contractor shall pay for all retesting of failed tests.

1.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Existing Utilities: Locate existing underground utilities before performing earthwork. If utilities are to remain in place, provide protection from damage during earthwork operations.

C. Interuption of Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.
3. Contact utility-locator service for area where Project is located before excavating.

D. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soils: **Imported soil fill material used to raise the site grade should be a low plasticity sandy or lean clay (USCS Classification, CL), shall be free of roots, construction debris, organic matter or any other deleterious materials, have a maximum clay lump size less than two (2) inches and have a liquid limit of less than 40 and a plasticity index value between 12 and 22. If a fine-grained sandy clay soil is used for select fill, close moisture content control will be required to achieve the recommended degree of compaction.**

B. Unsatisfactory Soils: Soils other than satisfactory soils.

1. Unsatisfactory soils also include **satisfactory soils not maintained within 0 to +3 percentage points of the optimum moisture content at time of compaction as determined by the Standard Proctor test (ASTM D 698).**

C. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

D. Drainage Course: Provide a stone or sand drainage layer (per list below) at contractor's option beneath the concrete slab and vapor retarder.

1. A 4" thick layer number 8 washed gravel per ASTM C33, complying with the following gradation:

Sieve Size	Percent Passing
1/2"	100
3/8"	85 to 100
No. 4	10 to 30
No. 8	0 to 10
No. 16	0 to 5

2. A 4" thick layer of number 57 crushed and washed limestone per ASTM C33. complying with the following gradation:

Sieve Size	Percent Passing
1-1/2"	100
1"	95 to 100
1/2"	25 to 60
No. 4	0 to 10
No. 8	0 to 5

E. Refer to Geotechnical Investigation for additional information on fill material and on compaction requirements for fill material.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. In order to prepare the building and pavement areas for fill or for insitu soils to be used as a final subgrade, the site shall be stripped of all vegetation, soft or loose surface soils, obstructions and all deleterious materials. This includes any loose or water-softened surface materials.

1. When trees are removed, the entire root ball should be excavated such that the remaining roots measure 1 inch in diameter, or less.

2. Any holes left behind from this process shall be filled with controlled – compacted structural fill.

C. Additional information for preparation requirements of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface, and treatment or improvement are specified in Division 2 Section "Site Clearing." Also refer to Geotechnical Investigation for additional information on site work and subgrade preparations.

D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

E. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated materials as directed by Architect.

F. Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction (including all OSHA requirements). Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

B. Avoid opening excavations during inclement weather.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill. Alternatively, excavate the trench 6” deeper than the bottom of the pipe and provide 6” bedding course.
3. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.7 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Contact Architect and Engineer 48 hours prior to proof- rolling. A representative of the Architect or a representative of the Engineer of Record must be on site during proof-rolling operations.
2. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
3. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
4. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.8 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2000 psi, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

3.9 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.11 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Backfill trenches excavated under footings and within 18 inches of bottom of footings with a lean concrete fill to elevation of bottom of footings. Provide a lean concrete fill with a 28-day compressive strength of 2500 psi.

D. Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.

E. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

G. Place and compact final backfill of satisfactory soil to final subgrade elevation.

H. All utility trenches that penetrate the building shall be effectively sealed to restrict water intrusion and flow through trenches that could migrate below the building. An effective clay “trench plug” that extends at least five (5) feet out from the face of the building exterior shall be constructed at each utility trench which penetrates the building perimeter. The plug material shall be a clay satisfactory soil compacted at a water content at or above the soils optimum water content. The clay satisfactory soil shall be placed to completely surround the utility line and be compacted.

I. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.12 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under steps and ramps, use satisfactory soil material.
2. Under building slabs, use satisfactory soil material.
3. Under footings and foundations, use satisfactory soil material

C. Scarify each lift lightly to ensure proper bonding between lifts

D. Place soil fill on subgrades free of mud, frost, snow, or ice.

E. Extend edges of compacted structural fill 5 feet beyond edges of soil supporting structures prior to sloping.

3.13 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within **0 to +3 percentage points of the optimum moisture content at time of compaction as determined by the Standard Proctor test (ASTM D 698).**

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds the optimum moisture content allowance stated above and is too wet to compact to the specified dry unit weight.

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials only after the site has been proof-rolled.

B. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

C. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

D. Compact all satisfactory soil materials to at least **95 percent of the maximum dry density as determined by the Standard Proctor compaction test (ASTM D 698).** See Geotechnical Investigation for further information.

3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
3. Compact grading fill materials outside of building slab limits to at least **90 percent of the maximum dry density as determined by the Standard Proctor compaction test (ASTM D 698).** See Geotechnical Investigation for further information.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.16 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Provide a drainage course using granular material as defined in part 2 of this specification.

B. Place drainage course on subgrades free of mud, frost, snow, or ice.

C. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Place drainage course 6 inches or less in compacted thickness in a single layer.
2. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
3. Compact each layer of drainage course to a minimum relative density of 75 percent as per ASTM D4253.

3.17 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
2. Determine that fill material and maximum lift thickness comply with requirements.
3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

D. Testing agency will test compaction of soils in place according to ASTM D 1557, ASTM D 2167, ASTM D 2922, ASTM D 2937 and ASTM D 698, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than 3 tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 200 feet or less of wall length, but no fewer than 2 tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 400 feet or less of trench length, but no fewer than 2 tests.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.18 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect (or Engineer); reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off of Owner's property.

END OF SECTION 31 21 00

SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes construction dewatering.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 FIELD CONDITIONS

A. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide temporary grading to facilitate dewatering and control of surface water.

B. Protect and maintain temporary erosion and sedimentation controls, which are specified in Section 015000 "Temporary Facilities and Controls," Section 311000 "Site Clearing," during dewatering operations.

3.2 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

1. Space well points or wells at intervals required to provide sufficient dewatering.

2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

B. Place dewatering system into operation to lower water to specified levels before excavating below ground-water level.

C. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.3 OPERATION

A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

B. Operate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.

1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
3. Maintain piezometric water level a minimum of 24 inches below bottom of excavation.

C. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

3.4 FIELD QUALITY CONTROL

A. Survey-Work Benchmarks: Resurvey benchmarks regularly during dewatering and maintain an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

END OF SECTION 312319

SECTION 313116 - TERMITE CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
1. Soil treatment with termiticide.

1.2 1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include the EPA-Registered Label.
B. Product certificates.
C. Soil Treatment Application Report: Include the following:
1. Date and time of application.
2. Moisture content of soil before application.
3. Brand name and manufacturer of termiticide.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes, and rates of application used.
6. Areas of application.
7. Water source for application.

1.3 1.3 QUALITY ASSURANCE

A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located.

B. Regulatory Requirements: Formulate and apply termiticides according to the EPA-Registered Label.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 2.1 MANUFACTURERS

A. Available Manufacturers for NEW CONSTRUCTION: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Termiticides:
a. Dow AgroSciences LLC; Dursban TC.

b. b. FMC Corporation, Agricultural Products Group; Talstar, Prevail FT, Dragnet SFR.
c. c. Syngenta; Demon TC.

2.2 2.2 SOIL TREATMENT

A. Termiticide: Provide an EPA-registered termiticide complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

B. Soil Treatment Preparation: Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

3.2 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.

1. Slabs-on-Grade: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
2. Foundations: Adjacent soil including soil along the entire inside perimeter of foundation walls, along both sides of interior partition walls, around plumbing pipes and electric conduit penetrating the slab, and around interior column footers, piers, and chimney bases; also along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
3. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.

B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

D. Post warning signs in areas of application.

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

END OF SECTION **313116**

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes Concrete Paving.

1. Driveways.
2. Roadways.
3. Parking lots.
4. Curbs and gutters.
5. Walks.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of product, ingredient, or admixture requiring color selection.

C. 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.

1.3 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

1.4 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, fabricated from as-drawn steel wire into flat sheets.

B. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.

C. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

D. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.

E. 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.

2.3 CONCRETE MATERIALS

A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150/C 150M, gray or white portland cement Type I/II.

B. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 4M, uniformly graded. Provide aggregates from a single source.

C. Air-Entraining Admixture: ASTM C 260/C 260M.

D. 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.

E. Color Pigment: ASTM C 979/C 979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

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

a. Alabama Pigments Company, LLC.
b. BASF Corp. - Construction Chemicals.
c. Bon Tool Co.
d. Brickform; a division of Solomon Colors.
e. Butterfield Color.
f. Davis Colors.
g. Decosup Inc.
h. Dynamic Color Solutions, Inc.
i. Euclid Chemical Company (The); an RPM company.
j. Hoover Color Corporation.
k. Lambert Corporation.
l. LANXESS Corporation.
m. Matcrete Inc.

n. NewLook International, Inc.
o. Proline Concrete Tools, Inc.
p. QC Construction Products.
q. Rockwood Pigments NA, Inc.
r. Scofield, L. M. Company.
s. Solomon Colors, Inc.
t. Southern Color N.A., Inc.; a division of Rockwood Pigments.
u. Specialty Concrete Products, Inc.
v. Stampcrete International, Ltd.
w. SureCrete Design Products.

2. Color: As selected by Architect from manufacturer's full range.

F. Water: Potable and complying with ASTM C 94/C 94M.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry or cotton mats.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

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

a. BASF Corp. - Construction Chemicals.
b. Bon Tool Co.
c. Brickform; a division of Solomon Colors.
d. ChemMasters, Inc.
e. Dayton Superior.
f. Euclid Chemical Company (The); an RPM company.
g. Kaufman Products, Inc.
h. L&M Construction Chemicals, Inc.
i. Lambert Corporation.
j. Metalcrete Industries.
k. Nox-Crete Products Group.
l. Sika Corporation.
m. SpecChem, LLC.
n. TK Products.
o. Vexcon Chemicals Inc.
p. W. R. Meadows, Inc.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

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

a. Anti-Hydro International, Inc.

b. ChemMasters, Inc.
c. Dayton Superior.
d. Euclid Chemical Company (The); an RPM company.
e. Kaufman Products, Inc.
f. L&M Construction Chemicals, Inc.
g. Lambert Corporation.
h. Nox-Crete Products Group.
i. Right Pointe.
j. SpecChem, LLC.
k. TK Products.
l. Unitex by Dayton Superior.
m. Vexcon Chemicals Inc.
n. W. R. Meadows, Inc.

F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

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

a. Anti-Hydro International, Inc.
b. ChemMasters, Inc.
c. Dayton Superior.
d. Euclid Chemical Company (The); an RPM company.
e. Kaufman Products, Inc.
f. L&M Construction Chemicals, Inc.
g. Lambert Corporation.
h. SpecChem, LLC.
i. Vexcon Chemicals Inc.
j. W. R. Meadows, Inc.

2.5 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber 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.

2.6 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.

B. 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: 5-1/2 percent plus or minus 1-1/2 percent.

C. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

D. Concrete Mixtures: Normal-weight concrete.

1. Compressive Strength (28 Days): 4000 psi.
2. Maximum W/C Ratio at Point of Placement: 0.45.
3. Slump Limit: 5 inches, plus or minus 1 inch.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

3.2 PREPARATION

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 STEEL REINFORCEMENT INSTALLATION

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

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.

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.

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.

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:

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 3/8-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. 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.

B. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

C. 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.

D. Screed paving surface with a straightedge and strike off.

E. Commence initial floating using bull floats or darbies to impart an open-textured 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.

3.7 FLOAT FINISHING

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.

C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on paving surface according to manufacturer's written instructions.

1. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.

2. After curing, lightly work surface with a steel-wire brush or abrasive stone and water to expose nonslip aggregate.

3.8 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. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture-retaining-cover curing, curing compound or a combination of these.

3.9 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-feet-long; unleveled straightedge not to exceed 1/2 inch.
4. Joint Spacing: 3 inches.
5. Contraction Joint Depth: Plus 1/4 inch, no minus.
6. Joint Width: Plus 1/8 inch, no minus.

3.10 REPAIR AND PROTECTION

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 Architect.

B. 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.

C. 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 321313

SECTION 321400 - UNIT PAVERS

1.1 GENERAL

A. SUMMARY

B. Section Includes:
1. Concrete pavers set in aggregate setting beds.
2. Detectable warring 4x8 ADA Compliant Paver.

C. SUBMITTALS

1. Product Data: For materials other than water and aggregates.

D. PROJECT CONDITIONS

1. Cold-Weather Protection: Do not use frozen materials or build on frozen subgrade or setting beds.

1.2 PRODUCTS

A. CONCRETE PAVERS

1. Concrete Pavers: Solid interlocking paving units complying with ASTM C 936, made from normal-weight aggregates.

1.3 Manufacturers: Subject to compliance with requirements.

A. Pave Stone

B. Approved manufacture.

1.4 Thickness: 2-3/8 inches

1.5 Face Size and Shape: 4-by-8-inch rectangle or as indicated by the Architect.

1.6 Color: As selected by Architect from manufacturer's full range

A. AGGREGATE SETTING-BED MATERIALS

1. Graded Aggregate for Base: Sound, crushed stone or gravel complying with ASTM D 2940, base material.
2. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate.
3. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16sieve and no more than 10 percent passing No. 200sieve.

4. Drainage Geotextile: Nonwoven needle-punched geotextile fabric, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1.7 Apparent Opening Size: No. 40**sieve, maximum; ASTM D 4751.**

1.8 Permittivity: 0.5 per second, minimum; ASTM D 4491.

A. Herbicide: Commercial chemical for weed control, registered with the EPA. Provide in granular, liquid, or wettable powder form.

1.9 EXECUTION

A. INSTALLATION, GENERAL

1. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
2. Cut unit pavers with motor-driven masonry saw equipment to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible.

1.10 For concrete pavers, a block splitter may be used.

A. Joint Pattern: As indicated by the Architect

B. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.

C. AGGREGATE SETTING-BED APPLICATIONS

1. Compact soil subgrade uniformly to at least 95 percent of ASTM D 698 laboratory density.
2. Place aggregate base, compact by tamping with plate vibrator, and screed to depth indicated.
3. Place drainage geotextile over compacted base course, overlapping ends and edges at least 12 inches.
4. Place leveling course and screed to a thickness of 1 to 1-1/2 inches, taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.
5. Treat leveling course with herbicide to inhibit growth of grass and weeds.
6. Set pavers with a minimum joint width of 1/16 inchand a maximum of 1/8 inch, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 3/8 inchwith pieces cut to fit from full-size unit pavers.
7. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

END OF SECTION **321400**

SECTION 321413 – Concrete Unit Pavers- sand set on concrete base

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Concrete paver units.
2. Bedding and joint sand.
3. Geotextiles.
4. Edge restraints.
5. Cleaners and Sealers

1.2 REFERENCES

A. American Society of Testing and Materials (ASTM):

1. C 33, Specification for Concrete Aggregates.
2. C 136, Method for Sieve Analysis for Fine and Coarse Aggregate.
3. C 140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
4. C 144, Standard Specification for Aggregate for Masonry Mortar.
5. C 936, Specification for Solid Interlocking Concrete Paving Units.
6. C 979, Standard Specification for Pigments for Integrally Colored Concrete.
7. C 1645, Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units.

B. Interlocking Concrete Pavement Institute (ICPI)

1. ICPI Tech Spec Technical Bulletins

a. SUBMITTALS

C. In accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

D. Manufacturer’s drawings and details: Indicate perimeter conditions, relationship to adjoining materials and assemblies, expansion and control joints, concrete paver layout, patterns, color arrangement, installation and setting details.

E. Sieve analysis per ASTM C 136 for grading of bedding and joint sand.

F. Bedding sand durability test results.

G. Concrete pavers:

1. Four representative full-size samples of each paver type, thickness, color, finish that indicate the range of color variation and texture expected in the finished installation. Color(s) selected by Architect from manufacturer’s full range available colors.
2. Accepted samples become the standard of acceptance for the work.

3. Test results from an independent testing laboratory for compliance of paving unit requirements to ASTM C 936.
4. Manufacturer's catalog product data, installation instructions, and material safety data sheets for the safe handling of the specified materials and products.

H. Paver Installation Subcontractor:

1. A copy of Subcontractor’s current certificate from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program.
2. Job references from projects of a similar size and complexity. Provide Owner/Client/General Contractor names, postal address, phone, fax, and email address.

1.3 QUALITY ASSURANCE

A. Paving Subcontractor Qualifications:

1. Utilize an installer having successfully completed concrete paver installation similar in design, material, and extent indicated on this project.
2. Utilize an installer holding a current certificate from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program.

1.4 DELIVERY, STORAGE & HANDLING

A. General: Comply with Division 1 Product Requirement Section.

B. Comply with manufacturer’s ordering instructions and lead-time requirements to avoid construction delays.

C. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged containers packaging with identification labels intact.

1. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.
2. Deliver concrete pavers to the site in steel banded, plastic banded or plastic wrapped packaging capable of transfer by fork lift or clamp lift.
3. Unload pavers at job site in such a manner that no damage occurs to the product.

D. Storage and Protection: Store materials protected such that they are kept free from mud, dirt, and other foreign materials. Store concrete paver cleaners and sealers per manufacturer’s instructions.

1. Cover bedding sand and joint sand with waterproof covering if needed to prevent exposure to rainfall or removal by wind. Secure the covering in place.

1.5 PROJECT/SITE CONDITIONS

A. Environmental Requirements:

1. Do not install sand or pavers during heavy rain or snowfall.
2. Do not install sand and pavers over frozen aggregate base materials.
3. Do not install frozen sand or saturated sand.
4. Do not install concrete pavers on frozen or saturated sand.

PART 2 - PRODUCTS

2.1 CONCRETE PAVERS

A. Manufacturer: Basis of Design:

1. Pavestone Company 800-245-7283.
2. Hanover Pavers.

B. Concrete Pavers:

1. Paver Type: City Scape Detectable Warning 4x8x6 cu.
   a. Material Standard: Comply with material standards in ASTM C 936.
   b. Color as selected from manufactures full range of colors.
   c. Color Pigment Material Standard: Comply with ASTM C 979.
   d. Size: 7 13/16” x 3 7/8” x 3 15/16”.
   e. Average Compressive Strength (ASTM C 140): 8000 psi (55 MPa) with no individual unit under 7200 psi (50 MPa) per ASTM C 140.
   f. Average Water Absorption (ASTM C 140): 5% with no unit greater than 7%.
   g. Freeze/Thaw Resistance (ASTM C 1645): Provide test results to 28 freeze/thaw cycles with no greater loss than 225 g/m2 of surface area or 49 cycles with no greater loss than 500 g/m2 of surface area.

2.2 BEDDING AND JOINT SAND

A. Provide bedding and joint sand as follows:

1. Washed, clean, non-plastic, free from deleterious or foreign matter, symmetrically shaped, natural or manufactured from crushed rock.
2. Do not use limestone screenings, stone dust, or sand for the bedding sand material that do not conform to the grading requirements of ASTM C 33.
3. Do not use mason sand or sand conforming to ASTM C 144 for the bedding sand.
4. Where concrete pavers are subject to vehicular traffic, utilize sands that are as hard as practically available.
5. Sieve according to ASTM C 136.
6. Bedding Sand Material Requirements: Conform to the grading requirements of ASTM C 33 with modifications as shown in Table 1.
   1) Table 1
   2) ASTM C 33Grading Requirements for Bedding Sand
   3) Sieve Size Percent Passing
   4) No. 16 (1.18 mm) 50 to 85
   5) Joint Sand Material Requirements: Conform to the grading requirements of ASTM C 144 as shown with modifications in Table 2 below:
   6) Table 2
   7) ASTM C 144 Grading for Joint Sand
   8) Natural Sand Manufactured Sand
   9) Sieve Size Percent Passing Percent Passing
   10) No. 30 (0.600 mm) 40 to 75 40 to 100

2.3 EDGE RESTRAINTS

A. Provide edge restraints installed around the perimeter of all interlocking concrete paving unit areas as follows:

1. Material: Concrete.

2.4 ACCESSORIES

A. Provide accessory materials as follows:

1. Geotextile Fabric:
   a. Material Type and Description: as recommended by manufacturer.
   b. Manufacturer: Acceptable to interlocking concrete paver manufacturer.
2. Cleaners Sealers Joint sand stabilizers
   a. Material Type and Description: as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Acceptance of Site Verification of Conditions:

1. General Contractor shall inspect, accept and certify in writing to the paver installation subcontractor that site conditions meet specifications for the following items prior to installation of interlocking concrete pavers.
   a. Verify that subgrade preparation, compacted density and elevations conform to specified requirements.
   b. Verify that geotextiles, if applicable, have been placed according to drawings and specifications.
   c. Verify that Concrete base materials, thickness, compacted density, surface tolerances and elevations conform to specified requirements.
   d. Verify location, type, and elevations of edge restraints, concrete utility structures, and drainage holes and inlets.
2. Do not proceed with installation of bedding sand and interlocking concrete pavers until subgrade soil and base conditions are corrected by the General Contractor or designated subcontractor.

3.2 PREPARATION

A. Verify base is clean and dry, certified by General Contractor as meeting material, installation and grade specifications.

B. Verify that base and geotextile is ready to support sand, edge restraints, and, pavers and imposed loads.

C. Edge Restraint Preparation:

1. Install edge restraints per the drawings and manufacturer’s recommendations at the indicated elevations.
2. Mount directly to finished base. Do not install on bedding sand.

3. The minimum distance from the outside edge of the base to the spikes shall be equal to the thickness of the base.

3.3 INSTALLATION

A. Spread bedding sand evenly over the base course and screed to a nominal 1 in. thickness. Spread bedding sand evenly over the base course and screed rails, using the rails and/or edge restraints to produce a nominal 1 in. thickness, allowing for specified variation in the base surface.

1. Do not disturb screeded sand.
2. Screeded area shall not substantially exceed that which is covered by pavers in one day.
3. Do not use bedding sand to fill depressions in the base surface.

B. Lay pavers in pattern(s) shown on drawings. Place units hand tight without using hammers. Make horizontal adjustments to placement of laid pavers with rubber hammers as required.

C. Provide joints between pavers between 1/16 in. and 3/16 in. wide. No more than 5% of the joints shall exceed 1/4 in. wide to achieve straight bond lines.

D. Joint (bond) lines shall not deviate more than ±□1/2 in. (±15 mm) over 50 ft. from string lines.

E. Fill gaps at the edges of the paved area with cut pavers or edge units.

F. Cut pavers to be placed along the edge with a masonry saw.

G. Adjust bond pattern at pavement edges such that cutting of edge pavers is minimized. All cut pavers exposed to vehicular tires shall be no smaller than one-third of a whole paver.

H. Keep skid steer and forklift equipment off newly laid pavers that have not received initial compaction and joint sand.

I. Use a low-amplitude plate compactor capable of at least minimum of 4,000 lbf at a frequency of 75 to 100 Hz to vibrate the pavers into the sand. Remove any cracked or damaged pavers and replace with new units.

J. Simultaneously spread, sweep and compact dry joint sand into joints continuously until full. This will require at least 4 to 6 passes with a plate compactor. Do not compact within 6 ft of unrestrained edges of paving units.

K. All work within 6 ft. of the laying face must shall be left fully compacted with sand-filled joints at the end of each day or compacted upon acceptance of the work. Cover the laying face or any incomplete areas with plastic sheets overnight if not closed with cut and compacted pavers with joint sand to prevent exposed bedding sand from becoming saturated from rainfall.

L. Remove excess sand from surface when installation is complete.

M. Allow excess joint sand to remain on surface to protect pavers from damage from other trades. Remove excess sand when directed by Architect.

N. Surface shall be broom clean after removal of excess joint sand.

3.4 FIELD QUALITY CONTROL

A. The final surface tolerance from grade elevations shall not deviate more than ±□3/8 in. (±10 mm) under a 10 ft straightedge.

B. Check final surface elevations for conformance to drawings.

C. The surface elevation of pavers shall be 1/8 in. to 1/4 in. above adjacent drainage inlets, concrete collars or channels.

D. Lippage: No greater than 1/8 in. difference in height between adjacent pavers.

3.5 CLEANING SEALING JOINT SAND STABILIZATION

A. Clean Seal Apply joint sand stabilization materials between concrete pavers in accordance with the manufacturer's written recommendations.

3.6 PROTECTION

A. After work in this section is complete, the General Contractor shall be responsible for protecting work from damage due to subsequent construction activity on the site.

END OF SECTION

SECTION 321540 – Crushed Limestone Stone Surfacing

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents:

1. Drawings and general provisions of the Subcontract apply to this Section.
2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes:

1. Crushed stone paving course, compacted.

C. Related Sections:

1. Division 01 Section "General Requirements."
2. Division 01 Section "Special Procedures."
3. Division 31 Section "Rough Grading: for preparation of site for paving.
4. Division 31 Section "Backfilling" for compacted fill for paving.

1.2 REFERENCES

A. General:

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.

B. American Association of State Highway and Transportation Officials:

1. AASHTO T 27 Sieve Analysis of Fine and Coarse Aggregates.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Coarse Stone: Crushed Limestone natural stone; free of shale, clay, friable materials and debris; graded in accordance with AASHTO T 27 within the following limits:

Sieve Size	Percent Passing
No. 4	35 to 85

B. Sand: Natural river or bank sand; washed, free of silt, clay, loam, friable or soluble materials, and organic matter.

PART 3 - EXECUTION

3.1 INSPECTION

A. A. The owner may retain the services of an independent inspection agency to verify that compacted subgrade is dry and ready to receive work of this section.

B. The owner may retain the services of an independent surveyor to verify that gradients and elevations of base are correct.

C. Beginning of installation means acceptance of existing conditions.

3.2 PLACING STONE PAVING

A. Spread stone material over prepared base to a total compacted thickness as son.

B. Place stone in 3 inches layers and compact.

C. Level surfaces to elevations and gradients indicated.

D. Add small quantities of sand to stone mix as appropriate to assist compaction.

E. Compact placed stone materials to achieve 100 lb/cu.ft 2,000 kg/m3 aerate to reduce moisture content.

F. Perform hand tamping in areas inaccessible to compaction equipment.

END OF SECTION **321540**

SECTION 321713 - PARKING BUMPERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes concrete wheel stops.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 PARKING BUMPERS

A. Concrete Wheel Stops: Precast, steel-reinforced, air-entrained concrete, 4000-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners, transverse drainage slots on underside, and a minimum of two factory-formed or -drilled vertical holes through wheel stop for anchoring to substrate.

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

    a. American Eagle Precast, LLC.
    b. American Precast Concrete Inc.
    c. Bush Concrete Products, Inc.
    d. Cast-Crete USA, Inc.
    e. Century Group Inc.
    f. Dura-Crete, Inc.
    g. Granite Precasting and Concrete, Inc.
    h. Old Castle Precast, Inc.
    i. Steps Plus, Inc.

2. Mounting Hardware: Galvanized-steel spike or dowel, 1/2-inch diameter, 10-inch minimum length.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wheel stops according to manufacturer's written instructions unless otherwise indicated.

B. Install wheel stops in bed of adhesive before anchoring.

C. Securely anchor wheel stops to pavement with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer. Recess head of hardware beneath top of wheel stop.

END OF SECTION 321713

SECTION 321724 - PARKING ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Louisiana Department of Transportation (La DOTD) - Louisiana Standard Specifications for Roads and Bridges (LSSRB) - 2000 Edition.

1.2 SUMMARY

A. Section includes Parking Accessories including supplementary items necessary to complete the Work required for their installation.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Submit Product Data in the form of manufacturer's technical data, specifications, and installation instructions for each product specified.

1.4 SITE CONDITIONS

A. Apply pavement markings in strict accordance with manufacturer=s instructions. Do not apply marking paint when weather is foggy or rainy, or ambient or pavement temperatures are below 50 deg. F., nor when such conditions are anticipated during eight hours after application.

PART 2 - PRODUCTS

2.1 MARKING PAINT

A. Alkyd resin type, traffic marking paint, ready mixed, complying with Section 1015.12 (a) of the Louisiana Department of Transportation (La DOTD) - Louisiana Standard Specifications for Roads and Bridges (LSSRB).

1. White color for stalls and direction markings.
2. Blue and white for handicapped parking symbols.
3. Yellow color for roads.

2.2 PARKING BUMPERS (WHEEL STOPS)(WHEN SHOWN IN THE PLANS ONLY)

A. Precast Concrete: ASTM C 94, 5 sack normal weight concrete, minimum 4000 psi 28 day compressive strength.

B. Reinforcing: ASTM A 615, Grade 40, 2 continuous No. 3 deformed reinforcement bars.

C. Size: Approximately 8 in. wide by 6 in. high by 72 in. length with chamfered corners and drainage slots on underside.

D. Anchor Pins: 5/8 in. x 24 in. deformed steel bars, 2 for each wheel stop, or 5/8 in. deformed bar cast-in-place, 2 for each wheel stop, extending a minimum of 18 in. below bottom of wheel stop.

E. Epoxy Anchoring Adhesive: Preco Ind. "Gold Label" two component anchoring/adhesive system or approved substitutions.

2.3 TRAFFIC CONTROL SIGNS

A. Handicapped Parking Sign:

1. Size: 12 inches x 18 inches x .063 inch aluminum blank.
2. Design: Symbol and lettering silk-screened on blank.
3. Finish: Baked enamel.
4. Lettering Design: Helvetica Medium.
5. Posts and Anchors: As indicated on the drawings.

B. Vehicle Parking Signs:

1. Size: 18 inches x 12 inches x .063 inch aluminum blank.
2. Design: Symbol and lettering silk-screened on blank.
3. Finish: Baked enamel.
4. Lettering Design: In accordance with the Manual of Uniform Traffic Control Devices.
5. Posts and Anchors: As indicated on the drawings.

C. Stop Signs: (Furnished and installed by Contractor)

1. Size: 24 inches x 24 inches x .063 inch aluminum blank.
2. Design: Symbol and lettering silk-screened on blank.
3. Finish: Baked enamel.
4. Lettering Design: In accordance with the Manual of Uniform Traffic Control Devices.
5. Posts and Anchors: As indicated on the drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Thoroughly clean surfaces free of dirt, sand, oil, grease or other foreign matter.

B. Coordinate location of Parking Bumpers with pavement marking layout.

3.2 INSTALLATION

A. Pavement Markings:

1. Apply in accordance with manufacturer's latest published requirements, specifications and details. Immediately before applications, paint shall be agitated and mixed thoroughly to a uniform consistency, free from lump or agglomerates. Paint shall be kept covered to retain volatiles. Paint shall not be thinned without approval.
2. Paint shall be applied at the rate required to provide striping of 4 inch width at a thickness of 15 wet mils.
3. Tolerances of +1/2 inch and -1/8 inch from the specified widths will be allowed, provided the variation is gradual. Segments shall be squared off at each end without mist or drip.
4. Apply handicap parking symbols at handicap parking stalls.
5. Apply required appropriate designations with approved stencils at small or compact car stalls.

B. Parking Bumpers:

1. Install a precast parking bumper at each parking space in accordance with layout as indicated.
2. Install wheel stops at asphalt paving with anchors pins in accordance with manufacturer's instructions.
3. Install wheel stops at concrete paving with epoxy anchoring adhesive in accordance with manufacturer's instructions.
4. Leave wheel stops securely anchored and in proper alignment.

C. Traffic Control Signs

1. Install in accordance with manufacturer's latest published requirements, specifications and details, and as indicated.
2. Set steel posts in 8 inch diameter concrete footing 18 inches deep.
3. Install handicapped sign at handicapped parking space and other signs at locations indicated.

END OF SECTION

SECTION 323100 – GABION-FACED (M.S.E.) WALL

PART 1 - MECHANICALLY STABILIZED EARTH WALL MATERIALS

1.1 Welded wire fabric for soil reinforcement.

A. Reinforcing mesh shall be steel welded wire fabric conforming to ASTM A-185 (AASHTO M 55), except that weld shear testing will be required on all welded wire mat configurations. Galvanizing shall be applied after the wire fabric is fabricated in accordance with ASTM A-123 (AASHTO M 111). A minimum coating of 2.0 oz/ft2 (605 g.m2) shall be applied.

PART 2 - Gabion Materials

2.1 Basket mesh

A. Use a 5 ga galvanized wire fabric conforming to ASTM A-185 (AASHTO M 55). Make a weld at each connection that has minimum shear strength of 800 lbf (3560 newtons). A minimum coating of 0.90 oz.ft2 (270 g/m2) shall be applied. Square mesh opening shall be 2” x 2”.

2.2 Permanent Fasteners

A. Lacing Wire

1. Furnish nominal-sized 13.5 ga (2.2-millimeter) diameter wire of the same type, strength and coating as the basket mesh.

B. Spiral Binders

1. Form with wire having at least the same diameter, type, strength and coating as the basket mesh.

C. Internal Connecting Wire

1. Furnish Galvanized Pre-Formed stiffeners (9 ga min.).
2. Overlapping ring wire fastener. Manufacture overlapping ring wire fastener (hog ring) from 0.12 inch galvanized wire of high tensile strength equal to 260,000 to 280,000 psi. Galvanizing shall conform to ASTM A641, Class 3 Coating. When closed the number of wires to be confined, the free ends along the longest axis of the ring (or against the overlap) shall be 600 lbf minimum.

2.3 Revet Mattresses (less than 0.3 meter in the vertical dimension).

A. Fabricate the mesh from nominal-sized 2.2-millimeter or greater diameter wire.

2.4 Welded Wire Mesh

A. Weld each connection to obtain a minimum average weld shear strength of 1300 newtons with no value less than 1000 newtons.

B. Fabricate revet baskets in the dimensions required with a dimension tolerance of + 5 percent in length and width and + 10percent in height. Where the length of the basket exceeds 0.5 times its width, equally divide the basket into cells less than or equal to 0.5 times the basket width using diaphragms of the same type and size mesh as the mattress panels. Prefabricate each basket with the necessary panels and diaphragms secured so they rotate into place.

2.5 Welded Wire Mesh for Galvanized-Coated Baskets

A. Weld each connection to obtain minimum average weld shear strength of 2,600 newtons with no value less than 2000 newtons. Fabricate gabion baskets in the dimensions required with a dimension tolerance of + 5 percent. Where the length of the basket exceeds 1.5 times its width, equally divide the baskets into cells less than or equal to the basket width using diaphragms of the same type and size mesh as the basket panels. Prefabricate each basket with the necessary panels and diaphragms secured so they rotate into place.

PART 3 - Not used

END OF SECTION 323100

SECTION 328100 - AUTOMATIC LAWN IRRIGATION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Work described in this section includes the design, preparation of and submittal of shop drawings, installation, materials, equipment and instructions necessary for a complete, operable, automatic sprinkler irrigation system, both at time of installation and at maturity of the plant materials.

B. The extent of the sprinkler irrigation system shall include, but is not limited to:

1. Plumbing connection to potable water source and water meter.
2. Installation of sleeves and piping.
3. Excavation and backfilling of trenches.
4. Electrical service to and from system controller.
5. Supplying and installing all required system equipment and related materials.
6. Programming and adjustment of automatic system controller.
7. System testing and detailed adjustment of all system components.
8. Maintenance of the system for a one-year period from substantial completion.

1.2 SUBMITTALS

A. Make all submittals far enough in advance of scheduled dates of installation to provide required time for reviews, for possible revisions, and resubmittals, and for placing orders and securing deliveries.

B. The sprinkler system shall be installed to the greatest extent possible to promote water, soil and energy conservation.

C. Product Manual: Submit technical specification sheets, system layout and design and performance data for all proposed system components. Submit the address and telephone number of the subcontractor installing the system and the local representative for the equipment.

1.3 QUALITY ASSURANCE

A. To the greatest extent possible, provide system components produced by a single manufacturer. Provide secondary materials as recommended by the primary system manufacturer.

B. Provide installation by a licensed sprinkler contractor with a minimum of two (2) consecutive years experience in this area of work and having installed other jobs of similar size and scope. Evidence of the contractor's qualifications shall be presented before the award of contract.

C. Conform to all codes, statutes, laws and regulations governing the protection

of public safety.

1.4 PROJECT CONDITIONS

A. Determine the locations of all utilities, subsurface drainage and underground construction so that proper precaution may be taken not to disturb or damage during all operations. The Irrigation Contractor to repair immediately, at his expense, any damage to utilities or other construction resulting from the work covered by the contract. Contact the City and utility companies for dig permit requirements before initiating any work.

B. Coordinate work schedules with others to avoid interference with the work of other trades.

C. Store materials delivered to site, prior to actual usage, in a secure place not to interfere with other trades or construction and protect from vandalism, damage by weather or other elements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials shall be new and without flaws or defects, and of quality and performance as specified. Excess materials at completion are property of the Irrigation Contractor, to be removed from the site.

B. The sprinkler system design and installation shall be based on using the equipment of Rain Bird Corporation, Hunter Industries or approved equal.

C. Substitutions shall be made only with the written approval of the Landscape Architect. Substitutions will not be considered prior to opening of bids.

2.2 PIPE AND FITTINGS

A. Mainline Piping Aboveground shall be Copper tube, Type K, drawn temper; copper tube fittings; soldered joints.

B. Mainline Piping Belowground shall be polyvinyl chloride (PVC) pipe; meeting ASTM D1785, Sch40 for solvent weld and threaded connections.

C. Lateral Piping Belowground shall be polyvinyl chloride (PVC) pipe; meeting ASTM D1785, Sch40 for solvent weld and threaded connections. The minimum pipe size shall be 3/4" in diameter.

D. Polyvinyl chloride (PVC) fittings; meeting ASTM D2466, Sch40 for solvent weld connections; Sch40 for threaded connections. Fittings shall be of domestic manufacture.

E. PVC solvent cement shall comply with ASTM D2564, regular-bodied for pipe 2" and smaller, and medium-bodied for pipe 2 1/2" and larger.

F. Use Teflon tape or an appropriate sealant for all threaded connections.

2.3 CONTROL WIRES AND CONNECTORS

A. Use 1/c #14 type direct burial 600 volt wiring for all 24VAC low voltage wiring. Color code the common neutral wiring from all other wires.

B. Wire Connectors shall be either 3M DBY or King "One Step" Connectors or approved equal.

2.4 VALVES

A. The remote control valves shall be a normally closed, 24VAC solenoid actuated, globe / angle type valve. It shall have a manual flow control stem for accurate regulation and/or shutoff of outlet flow.

B. The quick coupling valves shall be a one piece type, constructed of heavy cast brass. The self-closing cover shall be made of a durable, highly visible, rubber. The valve shall be opened and closed by a brass key of the same manufacturer having a 3/4" brass hose swivel permanently attached. Provide two (2) keys.

C. Manual gate valves for use as a cut off, isolation or manual drain valves on lines up to 3" in diameter shall be as manufactured by Nibco, Inc., Elkhart, IN or approved equal.

2.5 VALVE BOXES

A. Provide valve boxes for all remote control valves and manual gate valves. The manufacturer shall be Rain Bird Corporation, Pentek or approved equal.

B. When used with a single valve use a 10" round box with green cover. When used with multiple valves use the rectangular box with 20 inch by 14 inch green cover.

2.6 SPRINKLER HEADS

A. Provide 4" pop-up spray heads in small turf areas or in clusters of trees where rotary heads are not feasible. The sprinkler shall have a pressure activated wiper seal that will clean debris from the pop-up stem as it retracts. Use matched precipitation rate nozzles that can be mixed with various arcs and radii on the same circuit.

B. Provide 12" pop-up spray heads in all shrub and groundcover beds. The sprinkler shall have a pressure activated wiper seal that will clean debris from the pop-up stem as it retracts. Use matched precipitation rate nozzles that can be mixed with various arcs and radii on the same circuit.

C. Provide 4" pop-up rotary sprinklers in all large turf areas. The full or part circle sprinkler shall be a single stream, gear driven rotor with a rotating nozzle turret that is independent of the riser stem. The sprinkler shall have a pressure activated wiper seal that will clean debris from the pop-up stem as it retracts. Matched precipitation shall be obtained by the changing of nozzles.

PART 3 - EXECUTION

3.1 GENERAL

A. Verify that the work of this section is installed in accordance with all pertinent codes and regulations and manufacturer's current recommendations.

B. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this work may properly commence. Coordinate the installation of the sprinkler system with the turf installation.

C. When sprinkler system work is to be installed close to or will interfere with the work of other trades, the Irrigation Contractor shall assist in working out space conditions to permit all work to be installed satisfactorily. If a Contractor installs his work before coordination with other trades, he shall make necessary changes in his work to correct the condition without additional compensation.

D. Flag the location of all sprinklers in accordance with the approved design and

1. In the event of a discrepancy, immediately notify the Landscape Architect and university representative. Do not proceed until such discrepancies have been resolved.

3.2 WATER METER

A. Install dedicated irrigation system water meter (size as noted on plans) with radio reading technology as manufactured by Badger Meter, Inc. or approved equal. VERIFY THE WATER PRESSURE IS ADEQUATE FOR EFFICIENT OPERATION OF SPRINKLER SYSTEM AS DESIGNED AND INSTALLED. Coordinate exact location of Point-of-Connection with the General Contractor and Owner.

B. Immediately after Contract award, conduct tests at the Point-of-Connection and note as such on the written results provided to the Landscape Architect of the following:

1. Static Water Pressure
2. Dynamic Water Pressure
3. Gallons per minute

C. The Irrigation Contractor shall be responsible that all materials, operations, installed conditions and personnel shall be in strict accordance with all applicable codes, ordinances and restrictions.

3.3 BACKFLOW PREVENTER

A. The Irrigation Contractor shall install a double check valve type Backflow Preventer that complies with all requirements and codes of the local governing authority regarding backflow prevention.

3.4 SLEEVING

A. Sleeving shall be polyvinyl chloride (PVC) Sch40 pipe and fittings, buried at a 18 inch depth minimum and 24 inch depth maximum.

B. Upon completion of site filling and compaction operations, and prior to the construction of foundations, roadways, walks or other pavements or obstructions, install sleeves in sufficient sizes to accommodate future irrigation piping and/or control wiring. Ends of sleeves shall extend 12 inches past the edges of all paving and curbs. Clearly mark for future use by the Irrigation Contractor.

C. INSTALL ALL SLEEVES WHETHER OR NOT IRRIGATION STAYS IN PROJECT.

3.5 TRENCHING AND BACKFILLING

A. Excavate trenches to a depth of minimum pipe coverage plus six inches. Remove all lumber, rubbish and large rocks from the trenches. Provide a uniform bearing for the entire length of each pipe line to prevent uneven

1. Make the width of the trench a minimum of 1 1/2 times the diameter of the piping.

B. Upon completion of pipe installation and system testing, backfill the trenches with clean soil. Backfilling shall be done in six inch layers and tamped down after each layer is put back to prevent excessive settling.

C. If settling occurs within the warranted period, the Irrigation Contractor shall be responsible for bringing the trenches up to finish grade and repairing plant damage without additional compensation.

3.6 PIPE INSTALLATION

A. Never lay PVC pipe when there is water in the trench. Never lay PVC pipe when the temperature is 32 degrees Fahrenheit or below.

B. Install the mainline at a bury depth of 18 inches and the lateral lines at a bury depth of 12 inches below finished grade. Maintain a 4 inch clearance between pipes that cross at an intersection and a 2 inch clearance between pipes that are buried in the same trench.

C. Remove all foreign matter or dirt from the inside of the pipe before joining. Cap or plug all lines after installation and prior to testing to minimize infiltration of foreign matter or dirt.

D. Snake pipe from side to side of trench bottom to allow for expansion and

1. Install main lines and lateral lines in common trenches wherever possible.

3.7 PIPE AND FITTING CONNECTIONS

A. Make all solvent connections meeting ASTM D2855, Standard Practice for making solvent cemented joints with PVC pipe and fittings.

B. Use only the solvent supplied and recommended by the manufacturer to make solvent cemented joints. Thoroughly clean pipe and fittings of dirt, dust and moisture before applying solvent.

C. Allow all joints to set a minimum of 24 hours prior to pressurization of system.

3.8 WIRE INSTALLATION

A. Verify that the work of this section is installed in strict accordance with the latest edition of the National Electric Code and local electrical codes.

B. Install neutral and control wires in the same trenches as the main and lateral

1. The wires shall be bundled together and taped every 10 feet. Provide expansion loops at every splice, change of direction, at the valves and where the wire enters the conduit for the automatic controller. The expansion loops shall be created by wrapping 3 feet of wire around a 1/2 inch diameter pipe to form a coil.

C. Connect each solenoid to the existing controller with a "control wire" which is typically red in color. Connect a "common neutral wire" to all solenoids which is typically white in color.

D. Solder or join all wire connections by positive mechanical connectors. Splices must be properly insulated and waterproofed. Control wire splices will be allowed only in runs more than 500 feet.

3.9 VALVE INSTALLATION

A. The remote control valves shall be installed in accordance with manufacturer's instructions. Valves shall be installed in approved valve boxes. Boxes shall be installed to a height that will not cause them to interfere with maintenance machinery and which is sufficient to prevent soil or mulch from washing into the box. Provide a 6 inch layer of washed gravel in the bottom of the valve box.

B. The quick coupling valves shall be installed on PVC threaded swing joints on the irrigation mainline. Provide a 1"x1"x3' piece of angle iron next to the quick coupling valve and anchor with two (2) stainless steel hose clamps.

C. Install in the low points of the mainline, manual gate valves as needed for draining. Install 24" off of the mainline in 10" valve boxes.

3.10 FLUSHING AND PRESSURE TESTING

A. Prior to backfilling and installation of sprinkler heads, open all control valves and use full line pressure to completely flush lines of foreign matter and dirt.

B. With zone valves closed, pressure test mainlines by supplying and maintaining full static pressure continuously for one full hour. Observe for evidence of leakage by monitoring flow meter and by visual inspection of the exposed lines. Repair all leaks and retest until no water flow is observed.

3.11 SPRINKLER HEAD INSTALLATION

A. Sprinkler heads to be spaced so as not to throw water on the buildings, walks or driveways. Install the sprinkler heads so they are flush with finished grade and not a hazard to pedestrians and/or maintenance machinery. Set sprinkler heads to plumb within 1/16" and a minimum of 4 inches and a maximum of 6 inches from walls, walks and curbs.

~~B.~~ Provide connection to the PVC lateral lines, for spray heads and small rotors, with barbed fittings and swing pipe. Do not use more than 18 inches of swing pipe for each sprinkler head.

3.12 SEASONAL WINTERIZATION FOR COLDER CLIMATES

A. The following measures for winterization are considered suggestions only and do not guarantee that freeze damage will not occur. Follow these and other local practices for winterizing the sprinkler system.

B. "Air Blow-out Method":

1. Shut off the water supply to the system.
2. Connect an air compressor to the quick coupling valve downstream of the isolation valve and activate the furthest zone of sprinklers before opening the valve on the compressor.
3. Gradually introduce air into the system to 50 psi.
4. Do not leave the air compressor unattended.
5. Do not stand over system components while the system is under air pressure.
6. Cycle the automatic controller through the stations with a minimum time set for each zone; repeat the cycle several times.
7. When all water has been "blown out" shut the compressor off and disconnect.

C. To reactivate the system:

1. Activate the furthest zone of sprinklers.
2. Gradually open the main isolation gate valve.
3. Insure that the gate valve is completely open during normal operation.
4. Cycle the automatic controller through the stations. Inspect each zone for damage caused during the shut-down and repair those damages found.

3.13 OPERATION AND BALANCING

A. Upon completion of the irrigation system the entire system shall be tested for proper operation. Observe that all zones function properly and in sequence.

B. The Contractor shall balance and adjust the various components of the system so that the overall operation is most efficient. This work shall include adjustment to all sprinkler heads and individual station adjustments on the controller.

C. When the Irrigation Contractor is satisfied that the entire system is operating properly, that it is balanced and adjusted so that all work and clean up is completed, he shall issue a written notice of completion to the Landscaper Architect to request inspection for initial acceptance of irrigation system

3.14 INSPECTION AND ACCEPTANCE

A. The Architect and the Landscape Architect and Library representative shall inspect the total work for acceptance upon written request from the Irrigation Contractor. The request shall be received at least seven (7) days before the anticipated date of inspection. During the inspection, a list of items which need completion or correction will be compiled by the Landscape Architect. The Irrigation Contractor shall have two (2) weeks to complete and/or correct all items listed. Under unusual circumstances a longer time period may be granted to the Contractor. If such work is not completed within the specified time the Irrigation Contractor may be considered to have defaulted on the contract, and the owner may use the contract retainage and/or pursue other Contractors to finish the work.

B. Upon completion and/or correction of all items on the list, the Architect shall certify in writing to the Owner as to the total acceptance of the work.

3.15 RECORD DRAWINGS AND OWNER ORIENTATION

A. Upon acceptance of the system, prepare two copies of as-built drawings, product manuals, specifications and operating and maintenance instructions which fully and accurately describe the irrigation system and its components. Bind all information in a hard-cover, labeled binder and furnish to the Library's representative. The Owner requires two (2) complete copies of this document.

B. Upon acceptance of the system, the Irrigation Contractor shall orient the User to the operation and adjustments of the controller according to local seasonal requirements. The Irrigation Contractor shall also familiarize the User with sprinkler and valve adjustments. The Library representative is, in general, to be totally familiarized with the overall operation, adjustment, maintenance and intent of the irrigation system, including the measures that should be taken to provide winterization for the system. Such instructions should be in written form and presented to the party responsible for the care and maintenance of the irrigation system and its components.

C. Upon acceptance of the system, the Irrigation Contractor shall furnish a certificate of warranty registration and a written guarantee of all new work and materials, excluding vandalism, occupancy of the project, owner neglect and acts of God, for a one-year period from the date of final acceptance of the project by the Landscape Architect representative.

END OF SECTION **028100**

SECTION 329000 LANDSCAPE WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Extent of landscape development work is shown on drawings and in schedules.

B. Subgrade Elevations: Excavation, filling and grading required to establish elevations shown on drawings.

1.3 QUALITY ASSURANCE

A. Subcontract landscape work to a single firm specializing in landscape work. The Landscape Architect reserves the right to review the qualifications of the prospective landscape contractor(s) to ascertain the previous experience demonstrated for a project of the scope specified. A contractor submitting a landscape bid on this project shall include in his bid package the following information in order for his bid to be considered a responsible one:

1. Active license in good standing under the Louisiana Contractor's Licensing Law, R.S. 37:2150-2163, Classification II and Licensure as a Louisiana Landscape Contractor with the Louisiana Department of Agriculture and Forestry and the Louisiana Horticulture Commission.
2. Successful and satisfactory completion of a project of similar scope, budget, and difficulty within the past three (3) years
3. Attendance at the pre-bid conference for this project.

1.4 SOURCE QUALITY CONTROL

A. General: Ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials.

B. Do not make substitutions. If specified landscape material is not obtainable, submit proof of non-availability to Landscape Architect, together with and proposal for use of equivalent material.

C. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agricultural Chemists, wherever applicable. Contractor responsible for gathering representative soil samples from the project site and the soil analysis to determine the existing soil composition. These results shall be forwarded to the Landscape Architect. The contractor will be responsible for the application of soil amendments based upon the soil analysis to provide adequate soil nutrients capable of supporting the growth and health of the plantings

D. Trees, Shrubs and Plants: Provide trees, shrubs and plants of quantity, size, genus, species and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 "American Standard for Nursery Stock". Provide healthy, vigorous stock, grown in recognized nursery in accordance with good horticultural practice and free of disease, insects, eggs, larvae and defects such as knots, sun-scald, injuries, abrasions, or disfigurement.

E. Label at least one tree and one shrub of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name.

F. Where formal arrangements or consecutive order of trees or shrubs are shown, select stock for uniform height and spread, and label with number to assure symmetry in planting.

G. Inspection: The Landscape Architect will inspect and tag trees and shrubs either at place of growth before planting, for compliance with requirements for genus, species, variety, size and quality. Landscape Architect retains right to further inspect trees and shrubs 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. The contractor shall remove rejected trees or shrubs immediately from project site.

1.5 SUBMITTALS

A. Certification: Submit certificates of inspection as required by governmental authorities. Submit manufacturer's or vendors certified analysis for soil amendments and fertilizer materials. Submit other data substantiating that materials comply with specified requirements.

B. Planting Schedule: Submit proposed planting schedule to the Landscape Architect, indicating dates for each type of landscape work during normal seasons for such work in area of site. Correlate with specified maintenance periods to provide maintenance from date of substantial completion. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.

B. Sod: Place sod within 24 hours of delivery to the site.

C. Trees and Shrubs: Provide freshly dug trees and shrubs. Do not prune prior to delivery unless otherwise approved by the Landscape Architect. Do not bend or bind-tie trees or shrubs in such manner as to damage bark, break branches or destroy natural shape. Provide protective covering during delivery. Do not drop balled and burlapped stock during delivery.

D. Deliver trees and shrubs after preparations for planting have been completed and plant immediately. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and keep roots moist by covering with mulch, burlap or other acceptable means of retaining moisture.

E. Do not remove container grown stock from containers until planting time.

1.7 JOB CONDITIONS

A. Proceed with and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.

B. Utilities: Determine location and depth of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

C. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Architect before planting.

D. Planting Time: Plant or install materials during normal planting seasons for each type of landscape work required. Correlate planting with specified maintenance periods to provide maintenance from date of substantial completion.

E. Coordination with Lawns: Plant trees and shrubs after final grades are established and prior to planting of lawns, unless otherwise acceptable to Landscape Architect. If planting of trees and shrubs occurs after lawn work, protect lawn areas and promptly repair damage to lawns resulting from planting operations.

1.8 SPECIAL PROJECT WARRANTY

A. Warranty trees, shrubs and ground covers through specified maintenance period, and until final acceptance. Warranty period shall be a one year period after planting established from the date of substantial completion.

B. Remove and replace trees, shrubs, or other plants found to be dead or in unhealthy condition during warranty period. Make replacements during growth season following end of warranty period. Replace trees and shrubs which are in doubtful condition at end of warranty period; unless, in opinion of Landscape Architect, it is advisable to extend warranty period for a full growing season.

C. Another inspection will be conducted at end of extended warranty period, if any, to determine acceptance or rejection. Replacements will be required at end of warranty period, except for losses or replacements due to failure to comply with specified requirements.

PART 2 - PRODUCTS

2.1 TOPSOIL

A. Topsoil for landscape work is not available at the project site.

B. Provide 2" of additional top soil, provide new topsoil which is fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than 2" in any dimension, and other extraneous or toxic matter harmful to plant growth.

C. Obtain topsoil from local sources or from areas having similar soil characteristics to that found at project site. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than 4"; do not obtain from bogs or marshes.

2.2 SOIL AMENDMENTS

A. Lime: Natural dolomitic limestone containing not less than 85% of total carbonates with a minimum of 30% magnesium carbonates, ground so that not less than 90% passes a 10-mesh sieve and not less than 50% passes a 100-mesh sieve.

B. Aluminum Sulfate: Commercial grade.

C. Peat Humus: FS Q-P-166 decomposed peat with no identifiable fibers and with ph range suitable for intended use.

D. Bonemeal: Commercial, raw, finely ground; 4% nitrogen and 20% phosphoric acid.

E. Superphosphate: Soluble mixture of treated minerals; 20% available phosphoric acid.

F. Sand: Clean, washed sand, free of toxic materials.

G. Perlite: Conforming to National Bureau of Standards PS 23.

H. Vermiculite: Horticultural grade, free of toxic substances.

I. Sawdust: Rotted sawdust, free of chips, stones, sticks, soil or toxic substances and with 7.5 lbs. nitrogen uniformly mixed into each cubic yard of sawdust.

J. Manure: Well rotted, unleached stable or cattle manure containing not more than 25% by volume of straw, sawdust or other bedding materials and containing no chemicals or ingredients harmful to plants.

K. Mulch: Organic mulch free from deleterious materials and suitable for top dressing of trees, shrubs or plants and consisting of one of the following:

L. Fine Ground Pine Bark (No cypress bark mulch allowed)

M. Commercial Fertilizer: Complete fertilizer of neutral character, with some elements derived from organic sources and containing following percentages of available plant nutrients:

N. For trees and shrubs, provide 3 year time-release fertilizer packets with not less than 16% total nitrogen 8% available phosphoric acid and 8% soluble potash. Provide at the manufacturers recommended rates(1 packet per caliper inch of tree and 1 packet per shrub)

O. Manufacturers:

1. Nutri-pak or equal

P. For lawns, provide fertilizer with percentage of nitrogen required to provide not less than 1 lb. of actual nitrogen per 100 sq. ft. of lawn area and not less than 4% phosphoric acid and 2% potassium. Provide nitrogen in a form that will be available to lawn during initial period of growth; at least 50% of nitrogen to be organic form.

Q. Pre Emergent Herbicides: Provide manufacturer's recommended applications and rates of granular pre-emergent herbicides to all plantings prior to mulching.
1. Accepted products: Eptam
Preen
Amaze

2.3 PLANT MATERIALS

A. Quality: Provide trees, shrubs, and other plants of size, genus, species and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 "American Standard for Nursery Stock".

B. Deciduous Trees: Provide trees of height and caliper scheduled or shown and with branching configuration recommended by ANSI Z60.1 for type and species required. Provide single stem trees except where special forms are shown or listed.

C. Provide balled and burlapped (B&B) deciduous trees.

D. Container grown deciduous trees will be acceptable in lieu of balled and burlapped deciduous trees subject to specified limitations of ANSI Z60.1 for container stock.

E. Deciduous Shrubs: Provide shrubs of the height shown or listed and with not less than minimum number of canes required by ANSI Z60.1 for type and height of shrub required.

F. Container grown deciduous shrubs will be acceptable in lieu of balled and burlapped deciduous shrubs subject to specified limitations for container grown stock.

G. Coniferous and Broadleafed Evergreens: Provide evergreens of sizes shown or listed. Dimensions indicate minimum spread for spreading and semi-spreading type evergreens and height for other types, such as globe, dwarf, cone, pyramidal, broad up-right, and columnar. Provide normal quality evergreens with well-balanced form complying with requirements for other size relationships to the primary dimension shown.

H. Provide balled and burlapped (B&B) evergreens.

I. Container grown evergreens will be acceptable subject to specified limitations for container grown stock.

2.4 GROUND COVER

A. Provide plants established and well-rooted in removable containers or integral peat pots and with not less than minimum number and length of runners required by ANSI Z60.1 for the pot size shown or listed.

2.5 GRASS MATERIALS

A. Grass Seed: Provide fresh, clean, new-crop seed complying with tolerance for purity and germination established by Official Seed Analyst of North America. Provide seed mixture composed of grass species proportions and minimum percentages of purity, germination, and maximum percentage of weed seed, as specified. See Plant List for specified seed mixture requirements.

B. Sod: Provide strongly rooted sod, not less than 2 years old and free of weeds and undesirable native grasses and machine cut to pad thickness of 3/4" (+1/4"), excluding top growth and thatch. Provide only sod capable of vigorous growth and development when planted (viable not dormant).

C. Provide sod of uniform sizes with maximum 5% deviation in either length or width. Broken pads or pads with uneven ends will not be acceptable. Sod pads incapable of supporting their own height when suspended vertically with a firm grasp on the upper 10% of pad will be rejected.

D. Provide sod composed principally of the following:

E. Centipede Grass, Eremochloa Ophiuroides ' Oaklawn' , Class A (Superior Quality), Shall be free from bahia grass, torpedo grass, and florida betony. Shall not contain more than five plants per 100 sq. ft. of any other grasses, broadleaf weeds, or sedges. Submit Sod Classification Form to Landscape Architect upon delivery of each load of sod as required by the Louisiana Department of Agriculture and Forestry.

2.6 MISCELLANEOUS LANDSCAPE MATERIALS

A. Stakes and Guys: Provide 7 x 7 galvanized steel guy wire cables of 1/8" for trees 3-6" Cal. and 1/16" for trees less than 3" Cal., along with 3 tree collars 12" long, made from .500" O.D. x .062 wall PVC tubing with ultra-violet inhibitors. Attach cables to tree as recommended with 3, 1/16" cable clamps. 3 DUCKBILL or EQUAL anchors per tree. Model 40 DTS for trees up to 3" Cal. and Model 68 DTS for trees 3 to 6" in Cal.. Refer to planting details for stake and guying details.

B. Decomposed Granite:

Decomposed granite must be crushed granite rock screenings graded from 3/8" inch particles to dust. The materials must comply with the following gradation:

Sieve Size	Percent Passing
3/8 inch	100%
1. 4	95-100%
2. 5	75-80
3. 16	55-65%
4. 30	40-50%

5.	50	25-30%
6.	100	20-25%
7.	200	5-15%

The decomposed granite must be uniform in color and uniform in texture. Color to be selected by Landscape Architect from color samples submitted prior to delivery to site.

Construct a test panel with a size of 3' x3' at a location within the work area. Landscape Architect will determine location on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Layout individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure Landscape Architect's acceptance before start of planting work. Make minor adjustments as may be requested.

B. Preparation of Planting Soil:

1. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.
2. Mix specified soil amendments and fertilizers with topsoil at rates specified. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.
3. For pit and trench type backfill, mix planting soil prior to backfilling, and stockpile at site.

C. For planting beds and lawns, mix planting soil either prior to planting or apply on surface of topsoil and mix thoroughly before planting.

1. Spread planting soil mixture to minimum depth required to meet lines, grades and elevations shown, after light rolling and natural settlement. Place approximately 1/2 of total amount of planting soil required. Work into top of loosened subgrade to create a transition layer, then place remainder of the planting soil.
2. Dig beds not less than 8" deep and mix with specified soil amendments and fertilizers. All beds are to be raised beds with a minimum of 6" in height unless otherwise directed by the Landscape Architect.

D. Excavation for Trees and Shrubs:

1. Excavate pits, beds and trenches with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.
2. For balled and burlapped (B&B trees and shrubs, make excavations at least half again as wide as the ball diameter and equal to the ball depth, plus following allowance for setting of ball on a layer of compacted backfill: Allow for 3" setting layer of planting soil mixture.
3. For container grown stock, excavate as specified for balled and burlapped stock, adjusted to size of container width and depth.
4. Dispose of subsoil removed from planting excavations. Do not mix with planting soil or use as backfill.
5. Fill excavations for trees and shrubs with water and allow to percolate out before planting.

3.2 PLANTING

A. Planting Trees and Shrubs:

1. Set balled and burlapped (B&B) stock on layer of compacted planting soil mixture, plumb and in center of pit or trench with top of ball at same elevation as adjacent finished landscape grades. Remove burlap from sides of balls; retain on bottoms. When set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 2/3-full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill.
2. Set container grown stock as specified for balled burlapped stock, except cut cans on 2 sides with an approved can cutter; remove bottoms of wooden boxes after partial backfilling so as not to damage root balls.
3. Dish top of backfill to allow for mulching.
4. Mulch pits, trenches and planted areas. Provide not less than following thickness of mulch and work into top of backfill and finish level with adjacent finish grades.
5. Provide 4" thickness of mulch. No Cypress Bark mulch allowed.
6. Apply anti-dessicant using power spray to provide an adequate film over trunks, branches, stems, twigs and foliage.
7. If deciduous trees or shrubs are moved in full-leaf, spray with anti-dessicant at nursery before moving and again 2 weeks after planting.
8. Prune, thin out and shape trees and shrubs in accordance with standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by Landscape Architect, do not cut tree leaders, and remove only injured or dead branches from flowering trees, if any. Prune shrubs to retain natural character.
9. Remove and replace excessively pruned or misformed stock resulting from improper pruning.
10. Guy and stake trees immediately after planting, as indicated.

B. Planting Ground Cover:

1. Space ground cover plants at 9" on center to attain full coverage of groundcover areas.
2. Dig holes large enough to allow for spreading of roots and backfill with planting soil. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water. Water thoroughly after planting, taking care not to cover crowns of plants with wet soils.
3. Mulch areas between ground cover plants; place not less than 3" thick.

3.3 MAINTENANCE

A. Begin maintenance immediately after planting.

B. Maintain and warranty all trees, shrubs, ground covers, and lawns for no less than the following period:

1. Maintain and Warranty period for trees, shrubs and ground covers shall be (1) one year after substantial completion of planting.
2. Maintain and Warranty period for lawns shall be (60)sixty days after substantial completion of planting

C. Maintain plantings of trees ,shrubs and ground covers for a one year period after substantial completion of planting.

D. Maintain and warranty all trees, shrubs, and other plants by pruning, cultivating, fertilizing, mulching and weeding as required for healthy growth. Water all plantings and turf , by hand, if necessary, during periods of irrigation malfunction, repair or mis-use. Monitor irrigation system operation, adjust and maintain as required to protect plantings and to assure the continued operation of the system. Restore planting saucers and add additional mulch. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required. Restore or replace damaged wrappings. Spray as required to keep trees and shrubs free of insects and disease. Remove all tree staking and guy wires upon expiration of the (1) one year maintenance period. The lawn areas shall be maintained to be healthy and disease free. Upon the completion of the (1) one year maintenance and warranty period, the Contractor, Owner, User, and Landscape Architect shall schedule a warranty and maintenance inspection to review the work and develop a punch list of items to be completed or corrected. The Contractor will have seven (7) days to correct the work for another inspection by the Landscape Architect, Owner, and User.

3.4 CLEANUP AND PROTECTION

A. During landscape work, keep pavements clean and work area in an orderly condition.

B. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged landscape work as directed.

3.5 INSPECTION AND ACCEPTANCE

A. When landscape work is completed, the Landscape Architect will, upon request, make an inspection to determine acceptability.

B. Landscape work may be inspected for acceptance in parts agreeable to Landscape Architect, provided work offered for inspection is complete.

C. Where inspected landscape work does not comply with requirements, replace rejected work and continue specified maintenance until re-inspected by Landscape Architect and found to be acceptable. Remove rejected plants and materials promptly from the project site.

END OF SECTION **329000**