

CASE

NUMBER:

99 - 065

SECTION 15401

DOMESTIC WATER PIPING SYSTEMS

PART 1 - GENERAL

RELATED DOCUMENTS:

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

Division 15 Basic Materials and Methods sections 15020, 15100, 15120, 15250 apply to work of this section.

DESCRIPTION OF WORK:

Extent of domestic water piping systems work, is indicated on drawings and schedules, and by requirements of this section.

Applications for domestic water piping systems include the following:

- Domestic cold-water piping
- Domestic hot-water piping
- Domestic recirculating water piping
- Exterior water piping
- Exterior meter pit
- Interior backflow preventers
- Trap primers for floor drains

Insulation for domestic water piping is specified in applicable Division-15 section 15250 and is included as work of this section.

Trenching and backfill required in conjunction with exterior water piping is specified in applicable Division-15 sections, and is included as work of this section.

Trenching and backfill required in conjunction with domestic water piping inside of building foundations is specified in applicable Division-15 sections, and is included as work of this section.

QUALITY ASSURANCE:

Manufacturers: Firms regularly engaged in manufacture of domestic water piping systems products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

Installer: A firm with at least 3 years of successful installation experience on projects with domestic water piping systems work similar to that required for project.

Plumbing Code Compliance: Comply with applicable portions of Kentucky Plumbing Code pertaining to plumbing materials construction and installation of products.

ANSI Compliance: Comply with applicable American National Standards pertaining to products and installation of domestic water piping systems.

SUBMITTALS:

Product Data: Submit manufacturer's data for domestic water piping systems, materials and products.

PART 2 - PRODUCTS

DOMESTIC WATER PIPING MATERIALS AND PRODUCTS:

General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in domestic water piping systems. Where more than 1 type of materials or products are indicated, selection is Installer's option.

BASIC IDENTIFICATION:

General: Provide identification complying with Division 15 Basic Materials and Methods sections in accordance with the following listing:

Domestic Water Piping: Plastic pipe markers

Water Service: Underground-type plastic line markers

Domestic Water Valves: Plastic valve tags

BASIC PIPE, TUBE, AND FITTINGS:

General: Provide pipe, tube, and fittings complying with Division-15 Basic Materials and Methods sections in accordance with the following listing:

Tube Size 2" and Smaller: Copper tube.

Wall Thickness: Type L, hard-drawn temper.

Fittings: Wrought-copper, solder-joints.

Tube Size 2-1/2" and Larger: Copper tube.

Wall Thickness: Type L, hard-drawn temper.

Fittings: Wrought-copper, solder-joints.

Exterior Water Piping:

Tube Size 3/4" and Smaller: Copper tube.

Wall Thickness: Type K, soft-annealed temper.

Fittings: Cast-copper, flared tube.

Tube Size 1" through 2": Copper tube.

Wall Thickness: Type K, soft-annealed temper.

Fittings: Wrought-copper, solder-joints.

Pipe Size 3" and Over: Ductile-iron pipe, with cement-mort lining.

Pipe Weight: Class per waterworks requirements.

Fittings: Ductile-iron, with rubber-gasket joints.

BASIC PIPING SPECIALTIES:

General: Provide piping specialties complying with Division-15 accordance with the following listing:

- Pipe escutcheons.
- Dielectric unions.
- Drip pans.
- Pipe sleeves.
- Sleeve seals.

SPECIAL PIPING SPECIALTIES:

Water Hammer Arresters: Provide bellows type water hammer arresters, stainless steel casing and bellows, pressure rated for 250 psi, tested and certified in accordance with PDI Standard WH-1.

Available Manufacturers: Subject to compliance with requirements, manufacturers offering water hammer arresters which may be incorporated in the work include, but are not limited to, the following:

Manufacturer: Subject to compliance with requirements, provide water hammer arresters of one of the following:

- Amtrol, Inc.
- Smith, (Jay R.) Manufacturing Co.
- Wade Division, Tyler Pipe
- Zurn Industries, Inc., Hydromechanics Division

BASIC SUPPORTS, ANCHORS, AND SEALS:

General: Provide supports, anchors, and seals complying with Division-15 Basic Materials and Methods sections in accordance with the following listing:

- Adjustable steel clevises, adjustable roller hangers, and adjustable pipe roll stands for horizontal piping hangers and supports.

Two-bolt riser clamps for vertical piping supports.

Concrete inserts, C-clamps, and steel brackets for building attachments.

Protection shields for insulated piping support in hangers.

Copper flashings for piping penetrations.

Fire barrier penetration seals.

BASIC VALVES:

General: All bronze valves shall be used for inside domestic water. Provide valves complying with Division-15 Basic Materials and Methods sections in accordance with the following listing:

Valves in copper tubing

Gate Valves - 125# Screw Bonnet, Rising Stem, Solid Wedge

Milwaukee #148/#F-2885
Crane #1334
Lunkenheimer #2132
Powell #1821 or approved equal

Globe Valves - 150# Union Bonnet, Composition or Buna Disc

Milwaukee #590T/#F-2981M
Lunkenheimer #126
Powell #1823 or approved equal

Angle Valves - 150# Angle/Bronze with Teflon Disc, Union Bonnet, Gland Packed, Threaded End.

Milwaukee #595T
Hammond #1B454
Powell #151 or approved equal

Ball Valves - (See "Valve" Section)

Check Valves - 125 Y Pattern, Composition Brass or Buna N Disc

Crane #17075
Hammond #18912
Lunkenheimer #2145
Powell #1825 or approved equal

Water Main - Kennedy Fig. 571X, Mueller A2380, Darling #55 or approved equal.

Hose Bibbs

1/2" - Chicago Faucet Co., No. 293, Crane or American
Standard or approved equal with vacuum breaker; 3/4" Chicago

Faucet No. 387, Crane or American Standard or approved equal with vacuum breaker.

Hydrants - Wall, 3/4" Zurn Z-1310 with vacuum breaker. Woodford, Wade, Josam, or Smith.

BASIC PUMPS:

General: Provide in-line pumps for hot water recirculating.

BASIC EXPANSION COMPENSATION:

General: Provide expansion compensation products complying with Division 15 Basic Materials and Methods section in accordance with the following listing:

Expansion compensators for hot water and hot water recirculating piping.

Pipe alignment guides.

BASIC METERS AND GAGES:

General: Provide meters and gages complying with Division 15 Basic Materials and Methods section in accordance with the following listing:

Pressure Gages, Glas Thermometers

PART 3 - EXECUTION

INSTALLATION OF BASIC IDENTIFICATION:

General: Install mechanical identification in accordance with Division 15 Basic Materials and Methods sections.

INSTALLATION OF DOMESTIC WATER DISTRIBUTION PIPING:

General: Install water distribution piping in accordance with Division 15 Basic Materials and Methods sections.

INSTALLATION OF EXTERIOR WATER PIPING:

General: Install new exterior water service piping from meter in pit in compliance with local governing regulations.

Copper Tube: Install in accordance with recommended procedures of the Copper Development Association.

Ductile-Iron Pipe: Install in accordance with ANSI/AWWA C-60.

Sterilization: At completion of water service line installation, flush and sterilize in conformance with AWWA C-601, to satisfaction of local authorities having jurisdiction.

INSTALLATION OF PIPING SPECIALTIES:

Install piping specialties in accordance with Division 15 Basic Materials and Methods sections.

Water Hammer Arresters: Install in upright position, in locations and of sizes in accordance with PDI Standard WH-201, and elsewhere as indicated.

INSTALLATION OF SUPPORTS, ANCHORS, AND SEALS:

Install supports, anchors, and seals in accordance with Division 15 Basic Materials and Methods sections.

INSTALLATION OF VALVES:

Install valves in accordance with Division 15 Basic Materials and Methods sections.

Sectional Valves: Install on each branch and riser, close to main, where branch or riser serves 2 or more plumbing fixtures or equipment connections, and elsewhere as indicated.

Shutoff Valves: Install on inlet of each plumbing equipment item, and on inlet of each plumbing fixture, and elsewhere as indicated.

Drain Valves: Install on each plumbing equipment item located to completely drain equipment for service or repair. Install at base of each riser, at base of each rise or drop in piping system, and elsewhere where indicated or required to completely drain domestic water piping system.

Check Valves: Install on discharge side of each pump, and elsewhere as indicated.

Balance Cocks: Install in each hot water recirculating loop, and elsewhere as indicated.

Hose Bibbs: Install on exposed piping where indicated, with vacuum breaker.

Sill Faucets: Install on concealed piping where indicated with vacuum breaker.

Hydrants: Installed where indicated, in accordance with manufacturer's installation instructions.

INSTALLATION OF PUMPS:

Install pumps on domestic hot water return.

INSTALLATION OF EXPANSION COMPENSATION PRODUCTS:

Install expansion compensation products as noted.

EQUIPMENT CONNECTIONS:

Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by Kentucky Plumbing Code.

Mechanical Equipment Connections: Connect hot and cold water piping system to mechanical equipment as indicated, and comply with equipment manufacturer's installation instructions. Provide shutoff valve and union for each connection, provide drain valve on drain connection.

SPARE PARTS:

Furnish to Owner, with receipt, one valve key for each key operated hydrant, bibb, or faucet installed.

END OF SECTION

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SECTION 15405

SOIL AND WASTE PIPING SYSTEMS

PART 1 - GENERAL

RELATED DOCUMENTS:

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

Division 15 Basic Materials and Methods sections 15020, 15100 apply to work of this section.

DESCRIPTION OF WORK:

Extent of soil and waste piping system work, is indicated on drawings and schedules, and by requirements of this section.

Applications for soil and waste piping systems include the following:

Above ground soil, waste and vent piping within buildings including soil stacks, vent stacks, horizontal branches, traps, and connections to fixtures and drains.

Underground building drain piping including mains, branches, traps, connections to fixtures and drains, and connections to stacks, terminating at connection to sanitary sewer manhole outside building.

Acid waste and vent piping for all lab sinks and emergency shower drains.

Trenching and backfilling required in conjunction with underground building drain piping is specified in applicable Division 15 sections, and is included as work of this section.

Note any special backfill requirements. Refer to soil engineer's report.

QUALITY ASSURANCE:

Manufacturers: Firms regularly engaged in manufacturer of piping products of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

Installer: A firm with at least three years of successful installation experience on projects with soil and waste piping systems work similar to that required for project.

Plumbing Code Compliance: Comply with applicable portions of local Plumbing Code pertaining to plumbing materials, construction and installation of products.

ANSI Compliance: Comply with applicable American National Standards pertaining to products and installation of soil and waste piping systems.

PDI Compliance: Comply with applicable Plumbing and Drainage Institute Standards pertaining to products and installation of soil and waste piping systems.

SUBMITTALS:

Product Data: Submit manufacturer's data for soil and waste piping systems materials and products.

PART 2 - PRODUCTS

SOIL AND WASTE PIPING MATERIALS AND PRODUCTS:

General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in soil and waste piping systems. Unless otherwise noted, where more than one type of material or product is indicated, selection is Installer's option. All underground soil and waste piping to be cast iron.

BASIC IDENTIFICATION:

General: Provide identification in accordance with the following listing:

Above Ground Soil, Waste, and Vent Piping: Plastic pipe markers.

BASIC PIPE, TUBE, AND FITTINGS:

General: Provide pipe, tube, and fittings in accordance with the following listing:

Cast iron soil piping and fittings service weight ASTM A-74 with ASTM C-564 gasketed joints.

Waste and vent piping 2-1/2" and under - Type "M" copper ASTM B88.62.

Soil, waste and vent piping 3" and over in size and all underground cast iron soil piping and fittings, ASTM A-74, service weight.

No-hub cast iron pipe and fittings may be used above floor for soil, waste and vent.

Schedule 40 PVC may be used for above and below floor piping as allowed by building code. Integrity of building fire ratings must be maintained.

SDR35 PVC pipe and fittings may be used outside building.

Acid waste and vent piping shall be schedule 40 polypropylene pipe and fittings as allowed by building code. Integrity of building fire ratings must be maintained. Provide polypropylene trap for all acid waste lab sinks and floor drains. Use fusion weld joints below floor and mechanical joints above floor slab.

BASIC PIPING SPECIALTIES:

General: Provide piping specialties complying with Division 15 Basic Materials and Methods sections in accordance with the following listing:

Pipe Escutcheons.

Sleeve Seals.

Vandal-Proof Vent Caps.
Fire Barrier Penetration Seals.

Pipe Sleeves.

BASIC SUPPORTS, ANCHORS, AND SEALS:

General: Provide supports, anchors, and seals in accordance with the following listing:

Adjustable steel clevises, steel pipe clamps, and pipe saddle supports for horizontal piping hangers and supports.

Two-bolt riser clamps for vertical piping supports.

Concrete inserts, C-clamps, and steel brackets for building attachments.

Copper flashings for piping penetrations.

DRAINAGE PIPING PRODUCTS:

General: Provide factory-fabricated drainage piping products of size and type indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements and governing regulations.

Cleanout Plugs: Cast-bronze or brass, threads complying with ANSI B2.1, countersunk head.

Floor Cleanouts: Cast-iron body and frame; cleanout plug; adjustable round top as follows:

Provide cleanouts where shown and at bends and angles. Extend to make flush installation with floor, wall or finish grade.

Grade: Heavy Duty clean out in concrete pad at grade.

Floors: Zurn Z-1420-2, Josam, Wade, Smith or approved equal, nickel bronze scoriated top

Walls: Zurn Z-1460-9, Josam, Smith or approved equal, nickel bronze with Z-1460 hex head plug

Provide square cleanout tops where tile floors occur.

FLOOR DRAINS

General: Provide floor drains of size as indicated on drawings, and type, including features, as specified herein.

Drains to be Zurn, Wade, Josam, Smith or approved equal.

Floor Drain #1: Zurn Z-508 with 9" heavy duty strainer.

Floor Drain #2: Polypropylene floor drain.

Provide trap primer for all floor drains in Mechanical Rooms.

PART 3 - EXECUTION

INSTALLATION OF BASIC IDENTIFICATION:

General: Install Soil, waste, and vent piping systems with Mechanical Identification.

INSTALLATION OF SOIL AND WASTE ABOVE GROUND PIPING:

General: Install soil and waste piping in accordance with local Plumbing Code.

INSTALLATION OF BUILDING DRAIN PIPING:

General: Install underground building drains as indicated and in accordance with local Plumbing Code. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Clean interior of piping of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

Install soil and vent piping pitched to drain at minimum slope of 1/4" per foot (2%) for piping 3" and smaller, and 1/8" per foot (1%) for piping 4" and larger.

INSTALLATION OF PIPING SPECIALTIES:

Install piping specialties in accordance with Division 15 Basic Materials and Methods section "Piping Specialties."

Frost-Proof Vent Caps: Install frost-proof vent caps on each vent pipe passing through roof, and elsewhere where indicated. Maintain 1" clearance between vent pipe and roof substrate.

INSTALLATION OF SUPPORTS, ANCHORS, AND SEALS:

Install supports, anchors, and seals in accordance with Division 15 "General Mechanical Requirements" and "Piping Specialties."

INSTALLATION OF DRAINAGE PIPING PRODUCTS:

Cleanouts: Install in sanitary above ground piping and sanitary building drain piping as indicated, as required by National Standard Plumbing Code; and at each change in direction of piping greater than 45 degrees; at minimum intervals of 50' for piping 4" and smaller and 100' for larger piping; and at base of each vertical soil or waste stack. Install floor and wall cleanout covers for concealed piping, select type to match adjacent building finish.

Flashing Flanges: Install flashing flange and clamping device with each stack and cleanout passing through waterproof membranes.

Vent Flashing Sleeves: Install on stacks passing through roof, secure over stack flashing in accordance with manufacturer's instructions.

INSTALLATION OF FLOOR DRAINS:

General: Install floor drains in accordance with manufacturer's written instructions and in locations indicated.

Coordinate with soil and waste piping as necessary to interface floor drains with drainage piping systems.

Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor.

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

Position drains so that they are accessible and easy to maintain.

EQUIPMENT CONNECTIONS:

Piping Runouts to Fixtures: Provide soil and waste piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by Kentucky Plumbing Code.

Locate piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

PIPING TESTS:

Test soil and waste piping system in accordance with requirements of Kentucky Plumbing Code.

END OF SECTION

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SECTION 15407

STORM WATER PIPING SYSTEMS

PART 1 - GENERAL

RELATED DOCUMENTS:

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

Division-15 Basic Materials and Methods sections 15020, 15120, 15250 apply to work of this section.

DESCRIPTION OF WORK:

Extent of storm water piping work, is indicated on drawings and schedules, and by requirements of this section.

Applications for storm water piping include the following:

Conductor piping from roof drains to storm building drain.

Footing foundation drains and drains under gym floor.

Storm building drain piping from conductor piping and drains to storm sewer connections outside building.

At downspout locations provide cast iron hub 12" above grade and make connections to downspout.

Insulation for storm water piping is specified in applicable Division-15 sections, and is included as work of this section.

Trenching and backfill required in conjunction with storm building drain piping is specified in applicable Division-15 sections, and is included as work of this section. Note special backfill requirements.

QUALITY ASSURANCE:

Manufacturers: Firms regularly engaged in manufacturer of piping products of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

Installer: A firm with at least three (3) years of successful installation experience on projects with storm water piping systems work similar to that required for project.

Plumbing Code Compliance: Comply with applicable portions of local plumbing code pertaining to plumbing materials, construction and installation of products.

ANSI Compliance: Comply with applicable American National Standards pertaining to products and installation of storm water piping systems.

PART 2 - PRODUCTS

STORM WATER PIPING MATERIALS AND PRODUCTS:

General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fitting of materials which match pipe materials used in storm water piping systems. Where more than one type of materials or products are indicated, selection is Installer's option.

BASIC PIPE, TUBE AND FITTINGS:

General: Provide pipe, tube and fittings complying with Division-15 Basic Materials and Methods sections in accordance with the following listing.

Above Ground Piping Within Buildings:

Pipe Size 10" and Smaller: Hubless cast-iron soil pipe.

Pipe Class: Service Weight

Fittings: Hubless cast-iron soil pipe fittings, hubless joints.

Underground Building Drain Piping:

Pipe Size 10" and Smaller: Cast-iron hub-and-spigot soil pipe.

Pipe Class: Service Weight

Fittings: Cast-iron hub-and-spigot soil pipe fittings, compression gasket joints.

Pipe Size 12" and Larger: Reinforced concrete pipe, ASTM-C76, Class 4, with compression gasket joints complying with ASTM C443.

Note: Schedule 40 PVC may be used above and below floor as allowed by building code. Integrity of fire rated connections must be maintained.

For footing drains and underdrains use Schedule 40 PVC perforated pipe.

BASIC PIPING SPECIALTIES:

General: Provide piping specialties complying with Division-15 Basic Materials and Methods sections in accordance with the following listing:

Pipe Escutcheons
Drip Pans
Pipe Sleeves
Sleeve Seals
Fire Barrier Penetration Seals.

BASIC SUPPORTS, ANCHORS AND SEALS:

General: Provide supports, anchors and seals complying with Division-15 Basic Materials and Methods sections in accordance with the following listing.

Adjustable steel clevises, steel pipe clamps, and pipe saddle supports for horizontal piping hangers and supports.

Two-bolt riser clamps for vertical piping supports.

Concrete inserts, C-clamps, and steel brackets for building attachments.

Copper flashings for piping penetrations.

DRAINAGE PIPING PRODUCTS:

General: Provide factory-fabricated drainage piping products of size and type indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements and governing regulation.

Cleanout Plugs: Cast-bronze or brass, threads complying with ANSI B2.1, countersunk head.

Floor Cleanouts: Cast-iron body and frame; cleanout plug; adjustable round top flush with finish floor.

Wall Cleanouts: Cast-iron body adaptable to pipe with cast bronze or brass cleanout plug; stainless steel cover including screws.

Flashing Flanges: Cast-iron watertight stack or wall sleeve with membrane flashing ring. Provide underdeck clamp and sleeve length as required.

Available Manufacturer: Subject to compliance with requirements, manufacturers offering drainage piping products which may be incorporated in the work include, but are not limited to, the following:

Manufacturer: Subject to compliance with requirements, provide drainage piping products of one of the following:

Josam Manufacturing Company
Smith (Jay R.) Company
Wade Division, Tyler Pipe
Zurn Industries, Hydromechanics Division

ROOF DRAINS:

General: Provide roof drains of size as indicated on drawings; and type, including features, as specified herein:

Zurn ZC-100ERC-VP (Secured Top)

Roof Drain Type: Cast-iron body and combined flashing collar and gravel stop, cast-iron vandal proof secured top dome, with following features:

Underdeck clamp
Extension as required
Sump receiver
Bottom outlet, inside caulk or threaded as required
Insulate underside of roof drain sump

Available Manufacturers: Subject to compliance with requirements, manufacturers offering roof drains which may be incorporated in the work include, but are not limited to, the following:

Manufacturer: Subject to compliance with requirements, provide roof drains of one of the following:

Josam Manufacturing Company
Smith (Jay R.) Manufacturing Company
Wade Division, Tyler Pipe
Zurn Industries Inc., Hydromechanics Division

PART 3 - EXECUTION

INSTALLATION OF BASIC IDENTIFICATION:

General: Install mechanical identification in accordance with Division-15 Basic Materials and Methods sections.

INSTALLATION OF STORM WATER PIPING ABOVE GROUND:

General: Install storm water piping in accordance with Division-15 Basic Materials and Methods sections and with local plumbing code.

INSTALLATION OF BUILDING DRAIN PIPING:

General: Install storm building drains as indicated and in accordance with local plumbing code. Lay storm building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements and other special installation requirements. Clear interior of piping of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

Install storm water piping pitched to drain at minimum slope of 1/4" per foot (2%) for piping 3" and smaller, and 1/8" per foot (1%) for piping 4" and larger.

INSTALLATION OF PIPING SPECIALTIES:

Install piping specialties in accordance with requirements of Division-15 Basic Materials and Methods sections.

INSTALLATION OF SUPPORTS, ANCHORS AND SEALS:

Install supports, anchors and seals in accordance with Division-15 Basic Materials and Methods sections.

INSTALLATION OF DRAINAGE PIPING PRODUCTS:

Cleanouts: Install in conductor piping and storm building drain piping as indicated, as required by National Standard Plumbing Code; at each change in direction of piping greater than 45 degrees; at minimum intervals of 50' for piping 4" and smaller and 100' for larger piping; and at base of each conductor. Install floor and wall cleanout covers for concealed piping, select type to match adjacent building finish.

Flashing Flanges: Install flashing flange and clamping device with each cleanout passing through waterproof membrane.

INSTALLATION OF DRAINS:

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

Coordinate metal flashing work with work of roofing, waterproofing and adjoining substrate work.

Coordinate with roofing as necessary to interface roof drains with roofing work.

Coordinate with storm water piping as necessary to interface drains with drainage piping system.

Install drains at low points of surface areas to be drained, or as indicated.

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

Position drains so that they are accessible and easy to maintain.

PIPING TESTS:

Test storm water piping system in accordance with requirements of local plumbing code.

END OF SECTION

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SECTION 15410

LAB GAS PIPING SYSTEMS

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

Division-15 Basic Materials and Methods Sections 15020, 15100, 15120 and 15250 apply to work of this section.

DESCRIPTION OF WORK:

Extent of lab gas piping systems work is indicated on drawings and schedules and by requirements of this section.

Applications for lab gas piping systems include the following:

- Oxygen piping
- Vacuum piping
- Air piping
- Lab gas nitrous oxide piping
- Lab gas helium piping
- Lab gas argon piping
- Lab gas acetylene piping
- Future lab gas piping

QUALITY ASSURANCE

Manufacturers: Firms regularly engaged in manufacture of lab gas piping systems products, of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

Installer: A firm with at least 3 years of successful installation experience on projects with lab gas piping systems work similar to that required for project.

Plumbing Code Compliance: Comply with applicable portions of local Plumbing Code pertaining to plumbing materials construction and installation of products.

ANSI Compliance: Comply with applicable American National Standards pertaining to products and installation of lab gas piping systems.

Comply with applicable NFPA standards.

SUBMITTALS:

Product Data: Submit manufacturer's data for lab gas piping systems, materials and products.

PART 2 - PRODUCTS

LAB GAS PIPING MATERIALS AND PRODUCTS:

General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in lab gas piping systems. Where more than one type of materials or products are indicated, selection is Installer's option.

BASIC IDENTIFICATION:

General: Provide identification complying with Division-15 Basic Materials and Methods section "General Mechanical Requirements" in accordance with the following listing:

Lab Gas Piping: Plastic pipe markers
Lab Gas Valves: Plastic valve tags

BASIC PIPE, TUBE AND FITTINGS:

General: Provide pipe, tube and fittings complying with Division-15 Basic Materials and Methods section "Pipe, Tube and Fittings" and per NFPA standards.

BASIC PIPING SPECIALTIES:

General: Provide piping specialties complying with Division-15 in accordance with the following listing:

Pipe escutcheons
Dielectric unions
Drip pans
Pipe sleeves
Sleeve seals

BASIC SUPPORTS, ANCHORS AND SEALS:

General: Provide supports, anchors and seals complying with Division-15 Basic Materials and Methods section "Supports, Anchors and Seals" and per NFPA standards.

BASIC VALVES:

General: Provide valves complying with Division-15 Basic Materials and Methods section "Valves" and NFPA standards.

LAB GAS PIPING:

Piping: Type "L" copper and fittings per NFPA requirements, specifically prepared for lab gas piping.

PART 3 - EXECUTION

INSTALLATION OF BASIC IDENTIFICATION:

General: Install mechanical identification in accordance with Division-15 Basic Materials and Methods section and per NFPA standards.

INSTALLATION OF LAB GAS DISTRIBUTION PIPING:

General: Install lab gas distribution piping in accordance with Division-15 Basic Materials and Methods section and per NFPA standards.

INSTALLATION OF PIPING SPECIALTIES:

Install piping specialties in accordance with Division-15 Basic Materials and Methods section "Piping Specialties" and per NFPA standards.

INSTALLATION OF SUPPORTS, ANCHORS AND SEALS:

Install supports, anchors and seals in accordance with Division-15 Basic Materials and Methods section "Supports, Anchors and Seals" and per NFPA standards.

INSTALLATION OF VALVES:

Install valves in accordance with Division-15 Basic Materials and Methods section "Valves" and per NFPA standards.

After installation, a pipeline system check to certify there are no cross connections shall be performed by an Ohmeda representative in accordance with NFPA requirements.

After installation, a pipeline system check to certify there are no cross connections shall be performed by the lab gas equipment representative in accordance with NFPA requirements and paid for by this contractor.

END OF SECTION

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SECTION 15420

PLUMBING EQUIPMENT

PART 1 - GENERAL

RELATED DOCUMENTS:

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

DESCRIPTION OF WORK:

Extent of plumbing equipment work is indicated on drawings and provisions of this section, including schedules and equipment lists associated with either drawings or this section.

Types of plumbing equipment required for project include the following:

Commercial Gas-Fired Water Heaters
Acid Dilution Sump - Refer to plans.

QUALITY ASSURANCE:

Manufacturers: Firms regularly engaged in manufacture of plumbing equipment of type and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

UL and NEMA Compliance: Provide electric motors and electrical components required as part of plumbing equipment, which have been listed and labeled by Underwriters Laboratories and comply with NEMA standards.

NEC Compliance: Comply with National Electrical Code (ANSI/NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of plumbing equipment.

ANSI Compliance: Comply with ANSI Z223.1 (NFPA 54) "National Fuel Gas Code" as applicable to installation of gas-fired water heaters.

AGA and NSF Labels: Provide water heaters which have been listed and labeled by American Gas Association and National Sanitation Foundation.

ASME Relief Valve Stamps: Provide water heaters with safety relief valves bearing ASME valve markings.

AWWA Compliance: Comply with applicable American Water Works Association standards pertaining to steel water tanks.

PDI Compliance: Comply with applicable Plumbing and Drainage Institute standards pertaining to grease interceptors.

SUBMITTALS:

Product Data: Submit manufacturer's plumbing equipment specifications, installation and start-up instructions, and capacity and ratings, with selection points clearly indicated.

Shop Drawings: Submit assembly type shop drawings indicating dimensions, weights, required clearances, and methods of assembly of all components.

Wiring Diagrams: Submit ladder-type wiring diagrams for all components, clearly indicating all required field electrical connections.

Maintenance Data: Submit maintenance data and parts lists for each item of plumbing equipment. Include "trouble-shooting" maintenance guides. Include this data in maintenance manual.

PART 2 - PRODUCTS

DOMESTIC WATER HEATER:

Commercial Gas-Fired Water Heater:

General: Provide commercial gas-fired water heaters and tanks of size, capacity as follows (refer to plans for piping diagram):

Furnish and install a factory-packaged water heater, model number BTH-199 as manufactured by A.O. Smith. The heater will be UL listed.

Recovery: The water heater shall have a gas input of 199,000 BTU/H and a recovery of 283 gallons per hour from 40°F to 120°F. The water heater will have an efficiency of 94%. The complete water heating system will comply with all current ASHRAE 90.1 requirements for thermal efficiency and standby heat losses.

Warranty: The heater shall have a one-year, cost-free service policy covering all parts and labor, or have additional coverage under a long-life service policy. The tank will have 5-year warranty against leakage or producing rusty water. The tank and heating surfaces will have a 3-year, non-prorated warranty against failure due to scale buildup. See complete policies and warranties for details.

The heater will fit properly in the space provided and installation will conform to all local, state, and national codes. Factory-authorized startup will be provided.

Available Manufacturers: Subject to compliance with requirements, manufacturers offering gas fired water heaters which may be incorporated in the work include, but are not limited to, the following:

A.O. Smith, Consumer Products Div.
Rheem Water Heater Div., City Investing Co.
Rudd Water Heater Div., City Investing Co.
State Industries
Lochinvar or PVI

PART 3 - EXECUTION

INSTALLATION OF DOMESTIC WATER HEATERS:

Gas-Fired Water Heater:

General: Install gas-fired water heater as indicated, in accordance with manufacturer's installation instructions, and in compliance with applicable codes.

Support: Set unit on concrete pad; orient so controls and devices needing service and maintenance have adequate access. Level and plumb unit.

Gas Supply: Connect to gas line with drip leg, tee, gas cock, and union; full size of unit inlet connection. Locate piping so as not to interfere with service of unit.

Piping: Connect hot and cold water piping to unit with shutoff valves and unions. Connect recirculating water line to unit with shutoff valve, check valve, and union.

Flue and Combustion Air: Provide and install for high efficiency water heaters.

Start-up: Start-up, test and adjust gas-fired water heater in accordance with manufacturer's start-up instructions, and Utility Company's requirements. Check and calibrate controls, adjust burner for maximum efficiency.

Testing: Upon completion of installation, pressure test water tanks hydrostatically to assure structural integrity and freedom from leaks in accordance with applicable sections of ASME Boiler and Pressure Vessel Code.

Flushing: Flush water tanks upon completion of installation in accordance with manufacturer's instructions, and comply with applicable health codes.

END OF SECTION

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SECTION 15450

PLUMBING FIXTURES AND TRIM

PART 1 - GENERAL

RELATED DOCUMENTS:

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

Section 15020 General Mechanical Requirements apply to work of this section.

DESCRIPTION OF WORK:

Extent of plumbing fixtures and trim work is indicated by drawings and schedules, and by requirements of this section.

Types of plumbing fixtures required for the project include the following:

- Lavatories.
- Service sinks.
- Water closets.
- Water coolers.
- Countertop sinks.
- Lab equipment connections
- Emergency showers

Refer to Division-16 sections for electrical connections to water cooler and other plumbing fixtures; not work of this section.

QUALITY ASSURANCE:

Manufacturers: Firms regularly engaged in manufacture of plumbing fixtures of the type, style and configuration required, whose products have been in satisfactory use in similar service for not less than 3 years.

Plumbing Fixture Standards: Comply with applicable portions of Kentucky Plumbing Code pertaining to materials and installation of plumbing fixtures.

ANSI Standards: Comply with applicable ANSI standards pertaining to plumbing fixtures and systems.

ANSI Standards: Comply with ANSI A171.1 standard and Kentucky Building Code pertaining to plumbing fixtures for handicapped.

PDI Compliance: Comply with standards established by Plumbing and Drainage Institute pertaining to plumbing fixture supports.

Federal Standards: Comply with applicable FS WW-P-541/-Series sections pertaining to plumbing fixtures and ADA requirements.

UL Labels: Provide water coolers which have been listed and labeled by Underwriters Laboratories.

SUBMITTALS:

Product Data: Submit manufacturer's specifications for plumbing fixtures and trim, including catalog cut of each fixture type and trim item furnished, roughing-in dimensioned drawings, templates for cutting substrates, fixture carriers, and installation instructions.

Maintenance Data: Submit maintenance data and parts lists for each fixture type and trim item, including instructions for care of finishes. Include this data in maintenance manual.

PRODUCT DELIVERY, STORAGE AND HANDLING:

Deliver plumbing fixtures individually wrapped in factory-fabricated containers.

Handle plumbing fixtures carefully to prevent breakage, chipping and scoring the fixture finish. Do not install damaged plumbing fixtures; replace and return damaged units to equipment manufacturer.

PART 2 - PRODUCTS

PLUMBING FIXTURES:

General: Provide factory-fabricated fixtures of type, style and material indicated. For each type fixture, provide fixture manufacturer's standard trim, carrier, seats, and valves as indicated by their published product information; either as designed and constructed, or as recommended by the manufacturer, and as required for a complete installation. Where more than one type is indicated, selection is Installer's option; but, all fixtures of same type must be furnished by single manufacturer. Where type is not otherwise indicated, provide fixtures complying with governing regulations.

MATERIALS:

General: Unless otherwise specified, comply with applicable Federal Specification WW-P-541/-Series sections pertaining to plumbing fixtures, fittings, trim, metals and finishes. Comply with requirements of WW-P-541/-specification relative to quality of ware, glazing, enamel, composition and finish of metals, air gaps, and vacuum breakers, even though some plumbing fixtures specified in this section are not described in WW-P-541.

Provide materials which have been selected for their surface flatness and smoothness. Exposed surfaces which exhibit pitting, seam marks, roller marks, foundry sand holes, stains, discoloration, or other surface imperfections on finished units are not acceptable.

Where fittings, trim and accessories are exposed or semi-exposed, provide bright chrome-plated or polished stainless steel units. Provide copper or brass where not exposed.

PLUMBING FITTINGS, TRIM AND ACCESSORIES:

Water Outlets: At locations where water is supplied (by manual, automatic or remote control), provide commercial quality faucets, valves, or dispensing devices, of type and size indicated, and as required to operate as indicated. Include manual shutoff valves and connecting stem pipes to permit outlet servicing without shut-down of water supply piping systems.

Vacuum Breakers: Provide with flush valves where required by governing regulations, including locations where water outlets are equipped for hose attachment.

P-Traps: Include removable P-traps where drains are indicated for direct connection to drainage system.

Carriers: Provide cast-iron supports for fixtures of either graphitic gray iron, ductile iron, or malleable iron as indicated.

Fixture Bolt Caps: Provide manufacturer's standard exposed fixture bolt caps finished to match fixture finish.

Escutcheons: Where fixture supplies and drains penetrate walls in exposed locations, provide chrome plated cast-brass escutcheons with set screw.

Aerators: Provide aerators of types approved by Health Departments having jurisdiction.

Comply with additional fixture requirements contained in fixture schedule attached to this section.

MANUFACTURERS:

Available manufacturers: Subject to compliance with requirements, manufacturers offering plumbing fixtures and trim which may be incorporated in the work include, but are not limited to, the following:

Plumbing Fixtures:

American Standard, U.S. Plumbing Products.
Crane Co.
Eljer Plumbingware Div., Wallace-Murray Corp.
Kohler Co.
Acorn Engineering Co.
Bradley Corp.

Plumbing Trim:

American Standard, U.S. Plumbing Products.
Chicago Faucet Co.
Eljer Plumbingware Div., Wallace-Murray Corp.
Kohler Co.
Speakman Co.
T & S Brass and Bronze Works, Inc.
McGuire.

Fixture Seats:

Bemis Mfg. Co.
Beneke Corp., Div. of Beatrice Foods.
Olsonite Corp., Olsonite Seats.

Water Coolers:

Ebco Mfg. Co.
Elkay Mfg. CO.
Halsey Taylor Div., King-Seeley Thermos Co.
Haws Drinking Faucet Co.
Western Drinking Fountains, Div. of Sunroc Corp.

Countertop Sinks:

American Standard, U.S. Plumbing Products.
Elkay Manufacturing Company
Just Manufacturing Company
Moen, Division of Stanadyne/Western
Bradley Corporation
Acorn Engineering Company

Service Sinks:

American Standard, U.S. Plumbing Products.
Crane Co.
Eljer Plumbingware Div., Wallace-Murray Corp.
Fiat Products, Unit of Mark Control Corp.
Kohler Co.
Stern-Williams Co., Inc.

Emergency Showers:

Acorn
Bradley
Speakman

FIXTURE SCHEDULE

P1 - Water Closet: Floor mounted, tank type, Kohler "Highline" K-3427 with K-4650 open front white seat with cover and K-7637 angle supply with stop.

P2 - Lavatory: Wall hung, 20" X 18" vitreous china, Kohler "Greenwich" K-2032 with K-15597 single lever faucet with 0.5 gpm spray and open grid strainer, K-7606 angle supplies with stops and K-9000 1-1/4" P-trap. Provide Zurn concealed arm carrier.

P3 - Countertop Sink: One-compartment, 20 gauge, stainless steel, self-rimming, Elkay PSR-2219, three hole, with LK-4100 single lever faucet, LK-99 crumb cup strainer and 1-1/2" drain. Provide 17 gauge, 1-1/2" chrome P-trap and 1/2" hot and cold water chrome stops.

P4 - Emergency Shower - Eyewash: Bradley S19-310 with S19-330 privacy curtain and mounting. All P4 fixtures shall be fed from Leonard TM-800 mixing valve. Provide 3"F.D.#2 in floor.

P5, P6, P7, P10: Lab sinks to be furnished with casework including faucets and trim. Plumber shall mount and install same. Provide polypropylene trap and stops at each location.

P8 - Service Receptor: 24" X 24" molded stone floor sink, Fiat Model MSB-2424 with Speakman #SC-5811-RCP faucet with stops, vacuum breaker and 3" drain. Provide P-trap.

P9 - Water Cooler: Wall hung Elkay EBFS-8. Provide 17 gauge P-trap and stop. Mount at handicap height.

PART 3 - EXECUTION

INSPECTION AND PREPARATION:

Examine roughing-in work of domestic water and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Also examine floors and substrates, and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping, and other unsatisfactory conditions for installation of plumbing fixtures. Do not proceed with work until unsatisfactory conditions have been corrected.

Install plumbing fixtures of types indicated where shown and at indicated heights; in accordance with fixture manufacturer's written instructions, roughing-in drawings, and with recognized industry practices. Ensure that plumbing fixtures comply with requirements and serve intended purposes. Comply with applicable requirements of the National Standard Plumbing Code pertaining to installation of plumbing fixtures.

Fasten plumbing fixtures securely to indicated supports or building structure; and ensure that fixtures are level and plumb. Secure plumbing supplies behind or within wall construction so as to be rigid, and not subject to pull or push movement.

CLEAN AND PROTECT:

Clean plumbing fixtures of dirt and debris upon completion of installation.

Protect installed fixtures from damage during the remainder of the construction period.

FIELD QUALITY CONTROL:

Upon completion of installation of plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

Inspect each installed unit for damage to finish. If feasible, restore and match finish to original at site; otherwise, remove fixture and replace with new unit. Feasibility and match to be judged by Architect/Engineer. Remove cracked or dented units and replace with new units.

EXTRA STOCK:

General: Furnish special wrenches and other devices necessary for servicing plumbing fixtures and trim to Owner with receipt. Furnish 1 device for every 10 units.

END OF SECTION

SECTION 15500
FIRE PROTECTION SYSTEM

PART 1 - GENERAL

RELATED DOCUMENTS:

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

Requirements of Sections 15020, 15100, 15120 govern work specified in this section where applicable.

DESCRIPTION OF WORK:

Extent of fire protection systems work is indicated on drawings and schedules, and by requirements of this section.

Applications of fire protection systems include the following:

Fire protection service piping including exterior main, fire hydrant, and valves to building entrances. Leave 2" tap in 6" main for Plumbing contractor.

All exterior water main work shall be installed per water district requirements and NFPA 24.

Fire protection riser piping from building entrances to distribution systems.

Fire protection distribution piping from risers to sprinkler heads. Building shall be 100% sprinklered.

Trenching and backfill required in conjunction with exterior fire protection piping is specified is applicable Division-15 sections, and is included as work of this section.

QUALITY ASSURANCE:

Manufacturers: Firms regularly engaged in manufacture of fire protection piping systems products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

Installer: Firm with at least 3 years of successful installation experience on projects with fire protection piping systems work similar to that required for project.

NFPA Code: Comply with ANSI/NFPA 13, "Installation of Sprinkler Systems".

UL Labels: Provide fire sprinkler piping products which have been approved and labeled by Underwriters Laboratories.

Local Fire Department/Marshall Regulations: Comply with governing regulations pertaining to fire protection piping.

State Building Code: Comply with governing regulations pertaining to Fire Protection Systems.

SUBMITTALS:

Product Data: Submit manufacturer's data for fire protection systems, materials and product.

Shop Drawings: Submit scaled layout drawings for fire protection pipe and fittings including, but not necessarily limited to, pipe and tube sizes, locations, elevations and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between piping and proximate equipment.

Submit Shop Drawings to appropriate authority for review and approval prior to submission to Engineer's office and prior to installation of any portion of both underground and overhead systems.

Approval Drawings: Prepare approval drawings of fire protection systems indicating pipe sizes, pipe locations, fittings, shutoffs, equipment, etc. Submit to Agency having jurisdiction for approval. Submit one approved copy, bearing stamp and/or signature of Agency having jurisdiction, before proceeding with installation.

Approval Calculation: Prepare hydraulic calculations of fire protection systems. Submit to Agency having jurisdiction for approval. Submit one approved copy, bearing stamp and/or signature of Agency having jurisdiction, before proceeding with installation.

Certificate of Installation: Submit certificate upon completion of fire protection piping work which indicates that work has been tested in accordance with ANSI/NFPA 13, and also that system is operational, complete and has no defects.

PART 2 - PRODUCTS

FIRE PROTECTION PIPING MATERIALS AND PRODUCTS:

General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in fire protection piping systems. Where more than one type of materials or products are indicated, selection is Installer's option.

BASIC IDENTIFICATION:

General: Provide identification in accordance with the following listing:

- Fire Protection Piping: Plastic pipe markers.
- Fire Protection Service: Underground-type plastic line markers.
- Fire Protection Valves: Plastic valve tags.

BASIC PIPE, TUBE AND FITTINGS:

General: Provide pipe, tube and fittings in accordance with the following listing:

Interior Piping:

Black Steel Pipe:

Pipe Weight: Schedule 40 up to 8"; Schedule 30 for 8" and larger.

Fittings: Class 125, cast-iron threaded.

Fittings: Mechanical grooved pipe couplings and fittings; cut groove type.

Black Steel Pipe:

Pipe Weight: Schedule 10 for 5" and smaller; 0.134" wall thickness for 6"; and 0.188" wall thickness for 8" and 10".

Fittings: Wrought-steel buttwelding.

Fittings: Mechanical grooved pipe couplings and fittings; roll-groove or mechanical locking type.

Exterior Piping:

Ductile-Iron Pipe:

Lining: Cement-mortar lining for pipe and fittings.

Wall Thickness: Class as approved by waterworks.

Fittings: Ductile iron with rubber-gasket push-on joints.

BASIC PIPING SPECIALTIES:

General: Provide piping specialties complying with Division-15 Basic Materials and Methods section "Piping Specialties", in accordance with the following listing:

Pipe escutcheons
Dielectric unions
Drip pans
Sleeves
Sleeve seals
Fire Barrier Penetration Seals.

BASIC SUPPORTS, ANCHORS AND SEALS:

General: Provide supports, anchors and seals in accordance with the following listing:

Adjustable steel clevises, adjustable steel band hangers, adjustable band hangers, for horizontal piping hangers and supports.

Two-bolt riser clamps for vertical piping supports.

Steel turnbuckles and malleable iron sockets for hanger-rod attachments.

Concrete inserts, top-beam C-clamps, side beam or channel clamps and center beam clamps for building attachments.

Copper flashings for piping penetrations.

BASIC VALVES:

General: Provide valves complying with Division-15 Basic Materials and Methods section "Valves", in accordance with the following listing:

Interior Valves:

Sectional: Gate valves.

Check: Swing check valves.

Double Detector check valve assembly inside building per water district requirements.

Exterior Valves:

Underground: Gate valves with vertical indicator post.

SPECIAL VALVES:

General: Provide valves, UL listed, in accordance with the following listing. Provide sizes and types which mate and match piping and equipment connections.

Alarm Check Valves: Provide cast-iron water flow alarm check valves, 175 psi working pressure.

Fire Department Connection Valve: Provide at building to match local fire department thread. Verify with local fire department as to the type of connection required.

BASIC METERS AND GAGES:

General: Provide meters and gages in accordance with the following listing:

Pressure gages, 0-250 psi range.

FIRE PROTECTION SPECIALTIES:

General: Provide fire protection specialties, UL listed, in accordance with the following listing. Provide sizes and types which material match piping and equipment connections.

Water Flow Indicators: Provide vane type water flow detectors.

Water-Motor Gongs: Provide 10" weatherproof, red enameled finish, water-motor gongs or electric bells as required.

Supervisory Switches: Provide products recommended by manufacturer for use in service indicated.

Automatic Sprinklers: Provide automatic sprinklers of type indicated on Drawings, and in accordance with the following listing. Provide fusible links for 165 deg. F (74 deg. C) unless otherwise indicated.

Upright
Pendent
Alcove

Finish: Concealed white plate for occupied areas with ceilings, cast brass for unoccupied areas.

Sprinkler Cabinet and Wrench: Furnish steel, baked red enameled, sprinkler box with capacity to store 10 sprinklers and wrench sized to sprinklers.

Available Manufacturers: Subject to compliance with requirements, manufacturers offering fire protection specialties which may be incorporated in the work include, but are not limited to, the following:

Manufacturer: Subject to compliance with requirements, provide fire protection specialties of one of the following:

Allen (W.D.) Mfg. Div., J.W. Moon, Inc.
Automatic Sprinkler Corp. of America
Chemetron Corp.
Elkhart Brass Mfg. Co.
Grinnell Fire Protection Systems Co., Inc.
Viking Corp.
Western Fire Equipment Co.
Potter Roemer

PART 3 - EXECUTION

INSTALLATION OF BASIC IDENTIFICATION:

General: Install mechanical identification in accordance with Division-15 Basic Materials and Methods section "General Mechanical Requirements".

Install fire protection signs on piping in accordance with ANSI/NFPA 13 requirements.

INSTALLATION OF PIPE, TUBE AND FITTINGS:

General: Install pipe, tube and fittings in accordance with Division-15 Basic Materials and Methods sections "General Mechanical Requirements" and "Piping Specialties".

Fire Sprinkler Piping Systems:

General: Comply with requirements of ANSI/NFPA 13 for installation of fire sprinkler piping materials. Install fire sprinkler piping products where indicated, in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that fire sprinkler piping complies with requirements and serves intended purposes.

Coordinate with other work, including plumbing piping, as necessary to interface components of sprinkler piping properly with other work.

Install drain piping at low points of piping systems.

Install hose outlet valves in piping where hose outlets are indicated.

Install sectional valves in inlet piping, at bottom of each riser, and in loops as indicated.

Install fire department connection valves in piping where fire department connections are indicated.

Install water flow indicators where indicated.

Mount supervisory flow indicators where indicated.

Install manual shutoff at each audible alarm station.

Install valved hose connections of sizes indicated, or 3/4" size if not otherwise indicated on sprinkler at ends of branch lines and cross mains at locations where indicated.

Install Inspector's test connection where indicated, or at most remote point of riser. Do not locate in finished room areas.

INSTALLATION OF PIPING SPECIALTIES:

Install piping specialties in accordance with Division-15 Basic Materials and Methods section "Piping Specialties".

INSTALLATION OF SUPPORTS, ANCHORS AND SEALS:

Install supports, anchors and seals in accordance with Division 15 Basic Materials and Methods sections "General Mechanical Requirements" and "Piping Specialties".

INSTALLATION OF VALVES:

Install valves in accordance with Division-15 Basic Materials and Methods section "Valves".

INSTALLATION OF METERS AND GAGES:

Install meters and gages in accordance with NFPA Requirements.

INSTALLATION OF FIRE PROTECTION SPECIALTIES:

General: Install fire protection specialties as indicated, and in accordance with ANSI/NFPA 13.

ADJUST AND CLEAN:

Sprinkler Piping Flushing: Prior to connecting sprinkler risers for flushing, flush water feed mains, lead-in connections, and control portions of sprinkler piping. After fire sprinkler piping installation has been completed and before piping is placed in service, flush entire sprinkler system, as required to remove foreign substances, under pressure as specified in ANSI/NFPA 13. Continue flushing until water is clear, and check to ensure that debris has not clogged sprinklers.

FIELD QUALITY CONTROL:

Hydrostatic Testing: After flushing system, test fire sprinkler piping hydrostatically, for period of 2 hours, at not less than 200 psi or at 50 psi in excess of maximum static pressure when maximum static pressure is in excess of 150 psi. Check system for leakage of joints. Measure hydrostatic pressure at low point of each system or zone being tested.

Repair or replace piping system as required to eliminate leakage in accordance with ANSI/NFPA standards for "little or no leakage", and retest as specified to demonstrate compliance.

EXTRA STOCK:

General: For each style and temperature range required, furnish additional sprinkler heads, amounting to one (1) unit for every one hundred (100) installed units, but not less than five (5) units of each.

END OF SECTION

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SECTION 15530
REFRIGERANT PIPING

PART 1 - GENERAL

Codes and Standards:

ANSI Compliance:

ASHRAE Compliance:

PART 2 - PRODUCTS

MATERIALS AND PRODUCTS:

Tube Size 3/4" and Smaller: Copper tube; Type ACR, soft annealed temper fittings; cast copper-alloy fittings for flared copper tubes; flared joints.

Tube Size 7/8" through 4-1/8": Copper tube, Type ACR, soft annealed temper; wrought-copper, solder-joint fittings; soldered joints.

Soldered Joints: Solder joints using (silfos) solder.

SPECIAL REFRIGERANT VALVES:

General: Special valves required for refrigerant piping include the following types:

Globe and Check Valves:

Globe Shutoff Valves: Forged brass, packed, back seating, winged seal cap, 300 deg. F (149 deg. C) temperature rating, 500 psi working pressure.

Check Valves: Forged brass, accessible internal parts, soft synthetic seat, fully guided brass piston and stainless steel spring, 250 deg. F (121 deg. C) temperature rating, 500 psi working pressure.

Manufacturer: Subject to compliance with requirements, provide globe and check valves of one of the following:

Henry Valve Co.
Parker Hannifin Corp.; Refrigeration & Air-Cond. Div.
Sporlan Valve Co.

Solenoid Valves:

2-Way Solenoid Valves: Forged brass, designed to conform to ARI 760, normally closed, Teflon valve seat, NEMA 1 solenoid enclosure, 24 volt, 60 Hz., UL-listed, 1/2" conduit adapter, 250 deg. F (121 deg. C) temperature rating, 400 psi working pressure.

Manual Operator: Provide manual operator to open valve.

Manufacturer: Subject to compliance with requirements, provide solenoid valves of one of the following:

Alco Controls Div.; Emerson Electric Co.
Automatic Switch Co.
Sporlan Valve Co.

REFRIGERANT SPECIALTIES:

Refrigerant Strainers: Brass shell and end connections, brazed joints, monel screen, 100 mesh, UL-listed, 350 psi working pressure.

Moisture-Liquid Indicators: Forged brass, single port, removable cap, polished optical glass, solder connections, UL-listed, 200 deg. F (93 deg. C) temperature rating, 500 psi working pressure.

Refrigerant Filter-Driers: Steel shell, ceramic fired desiccant core, solder connections, UL-listed, 500 psi working pressure.

Refrigerant Filter-Driers: Corrosion-resistant steel shell, steel flange ring and spring, wrought copper fittings, ductile iron cover plate with steel cap screws, replaceable filter-drier core, 500 psi working pressure.

Evaporator Pressure Regulators: Provide corrosion-resistant, spring loaded, stainless steel springs, pressure operated, evaporator pressure regulator, in size and working pressure indicated, with copper connections.

Refrigerant Discharge Line Mufflers: Provide discharge line mufflers as recommended by equipment manufacturer for use in service indicated, UL-listed.

Manufacturer: Subject to compliance with requirements, provide refrigeration accessories of one of the following:

Alco Controls Div.; Emerson Electric Co.
Henry Valve Co.
Parker-Hannifin Corp.; Refrigeration & Air-Conditioning Div.
Sporlan Valve Co.

PART 3 - EXECUTION

INSPECTION:

General: Examine areas and conditions under which refrigerant piping systems materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

INSTALLATION OF REFRIGERANT PIPING:

Install refrigerant piping with 1/4" per foot (1%) downward slope in direction of oil return to compressor. Provide oil traps and double risers required to provide oil return.

Clean refrigerant piping by swabbing with dry lintless (linen) cloth, followed by refrigerant oil soaked swab. Remove excess oil by swabbing with cloth soaked in high flash point petroleum solvent, squeezed dry.

Provide bushings between copper piping and pipe supports to eliminate dissimilar metal condition.

Bleed dry nitrogen through refrigerant piping during brazing operations.

INSTALLATION OF SPECIAL REFRIGERANT VALVES:

Solenoid Valves: Install in refrigerant piping as indicated with stem pointing upwards.

Wiring of solenoid valves is specified in applicable Division-16 sections, and is included as work of this section.

INSTALLATION OF REFRIGERANT ACCESSORIES:

Refrigerant Strainers: Install in refrigerant lines as indicated, and in accessible location for service.

Moisture-Liquid Indicators: Install as indicated on refrigerant liquid lines, in accessible location.

Refrigerant Filter-Dryers: Install in refrigerant lines as indicated, and in accessible location for service.

Evaporator Pressure Regulators: Install in refrigerant suction lines or evaporator outlets as indicated. Adjust, if required, for proper evaporator pressure.

Refrigerant Discharge Line Mufflers: Install as indicated, in horizontal or downflow portion of hot-gas lines, immediately after leaving compressor; not in riser.

FIELD QUALITY CONTROL:

Refrigerant Piping Leak Test: Prior to initial operation, clean and test refrigerant piping in accordance with ANSI B31.5, "Refrigeration Piping". Perform initial test with dry nitrogen, using soap solution to test all joints. Perform final test with 27" vacuum, and then 200 psi using halide torch. System must be entirely leak-free.

Repair or replace refrigerant piping as required to eliminate leaks, and retest as specified to demonstrate compliance.

DEHYDRATION AND CHARGING SYSTEM:

Install core in filter dryer after leak test but before evacuation.

Evacuate refrigerant system with vacuum pump; until temperature of 35 deg. F (2 deg. C) is indicated on vacuum dehydration indicator.

During evacuation, apply heat to pockets, elbows, and low spots in piping.

Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.

Break vacuum with refrigerant gas, allow pressure to build up to 2 psi.

Complete charging of system, using new filter dryer core in charging line. Provide full operating charge.

ADJUSTING AND CLEANING:

Cleaning and Inspecting: Clean and inspect refrigerant piping systems.

END OF SECTION

SECTION 15670
CONDENSING UNITS

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

SUMMARY:

Section includes:

Air-cooled condensing units.

SPECIAL PROJECT WARRANTY:

Warranty on Motor/Compressor: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, motors/compressors with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation.

Warranty Period: 5 years from date of owner acceptance.

PART 2 - PRODUCTS

AIR-COOLED CONDENSING UNITS:

Manufacturers: Subject to compliance with requirements, provide air-cooled condensing units of one of the following:

BDP Co; Div Carrier Corp.
Carrier Air Conditioning; Div of Carrier Corp.
McQuay Air Conditioning Group; McQuay Inc.
Trane (The) Co; Div American Standard Inc.

General: factory-assembled and tested air-cooled condensing units, consisting of casing, compressors, condensers, coils, condenser fans and motors, and unit controls. Capacities and electrical characteristics are scheduled.

Unit Casings: designed for outdoor installation and complete with weather protection for components and controls, and complete with removable panels for required access to compressors, controls, condenser fans, motors, and drives. Additional features include:

steel, galvanized or zinc-coated, for exposed casing surfaces, treated and finished with manufacturer's standard paint coating;

lifting lugs to facilitate rigging of units;

factory-installed metal grilles, for protection of condenser coil during shipping, installation, and operation;

hinged and gasketed control panel door.

Compressor: reciprocating hermetic-type compressor, 1,750 RPM, designed for air-cooled condensing, complete with crankcase sight glass, crankcase heater, and backseating service access valves on suction and discharge ports. Capacity shall be controlled through cylinder unloading. Additional features include:

Crankcase heater in well within crankcase;

Capacity steps as scheduled, or greater number;

Compressor of same manufacturer as condensing unit.

Controls: Operating and safety controls shall include high and low pressure cutouts, oil pressure cutout, compressor winding thermostat cutout, 3-leg compressor overload protection, and condenser fan motors with thermal and overload cutouts. Control transformer if required shall be 115-volts. Provide magnetic contactors for compressor and condenser fan motors. Additional features include:

Reset relay circuit for manual resetting of cutouts from remote thermostat location;

Automatic nonrecycling pumpdown, and timing device to prevent excessive compressor cycling;

Hot Gas bypass

Condensing Section: Condenser coil shall be seamless copper tubing mechanically bonded to heavy-duty, configured aluminum fins, with separate and independent refrigeration circuit for each compressor. Units shall include liquid accumulator and subcooling circuit, and backseating liquid line service access valve. Condenser coils shall be factory-tested at 450 psig, vacuum dehydrate, and filled with a holding charge of nitrogen.

Condenser fans and drives: propeller-type condenser fans for vertical air discharge; either direct drive or belt drive. Additional features include:

Permanent lubricated ball bearing condenser fan motors;

Separate motor for each condenser fan;

Constant speed condenser fan motors;

Each fan assembly shall be dynamically and statically balanced.

Head pressure control to modulate condenser fan motor speed, thermostatic expansion valve, evaporator freeze stat, compressor start assist kit for low ambient conditions.

Provide subcooler and accumulator.

PART 3 - EXECUTION

EXAMINATION:

Verify roof structure, mounting supports, and membrane installations are completed to the proper point to allow installation of roof mounted units. Do not proceed with work until unsatisfactory conditions have been corrected.

INSTALLATION:

General: Install condensing units in accordance with manufacturers installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

Where units and refrigerant piping are located a distance of 10 feet or more from the building exit, provide 4" pvc sleeve with full radius elbows for refrigerant piping.

Support: Install ground-mounted units on 4" thick reinforced concrete pad, 4" larger on each side than condensing unit. Unit shall be anchored to the concrete pad. Concrete is specified in Division 3. Coordinate installation of anchoring devices.

Install roof-mounted units on equipment supports specified in Division 7. Anchor unit to supports with removable fasteners.

Air-Cooled Condensing Units:

Connect refrigerant piping to unit; maintain required access to unit.

Install furnished field-mounted accessories.

Filter Drier (replaceable cartridge)
Sight Glass
King Valve at Evap. and Cond.

FIELD QUALITY CONTROL:

Testing:

Charge systems with refrigerant and oil, and test for leaks. Repair leaks and replace lost refrigerant and oil.

DEMONSTRATION:

Provide services of manufacturer's authorized service representative to provide start-up service and to instruct Owner's personnel in operation and maintenance of condensing units.

Start-up condensing units, in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

Train Owner's personnel on start-up and shut-down procedures, troubleshooting procedures, servicing, and preventative maintenance schedule and procedures. Review with the Owner's personnel, the data contained in the Operating and Maintenance Manuals specified in Division One.

Schedule training with Owner, provide at least 7-day prior notice to Architect/Engineer.

END OF SECTION

SECTION 15776

HIGH EFFICIENCY GAS FIRED FURNACE

PART 1 - GENERAL

DESCRIPTION OF WORK:

Extent of Split System Furnaces required by this section is indicated on drawings and schedules, and by requirements of this section.

Refer to Division 16 sections for the following work; not work of this section.

Power supply wiring from power source to power connection on Air Conditioning units. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

Provide the following electrical work as work of this section, complying with requirements of Division 16 sections:

Interlock and Control wiring between field-installed controls, indicating devices, and unit control panels.

PART 2 - PRODUCTS

HIGH EFFICIENCY GAS FIRED FURNACE:

General: Provide factory-assembled and tested units as indicated, consisting of insulated casing, filter and rack, fan, motor and drive, fan and limit controls, two stage heat exchanger, mono-port burner direct vent sealed combustion chamber and control transformer. Provide evaporator coil.

Refrigeration Circuit: Provide refrigerant thermal expansion valve for refrigerant control. Provide access valves in suction and liquid lines.

Compressors: Provide welded shell, hermetic compressors, or serviceable hermetic compressors, 1750 RPM. Provide crankcase heaters. Provide 5 year extended warranty on compressor.

Evaporator Coil: Construct of copper tubing and aluminum fins, pressure and leak tested at 1.5 times working pressure.

Fans: Provide direct double-inlet, forward curved, centrifugal fans with drive. Provide permanently lubricated fan and motor bearings, and thermal overloads in motor.

Heat Exchanger: four-pass heat exchangers-both primary and condensing.
Condensing section to be high grade stainless steel.

Monoport Inshot Burners:

Electronic Ignition:

Direct Vent sealed combustion chamber.

Filters: Provide 1" thick throwaway filters.

Integral Air-Cooled Condensing Units: Provide condenser coil constructed of copper tubes and aluminum fins. Factory leak-test at 1.5 times working pressure, dehydrate and provide full charge of refrigerant. Provide subcooler and accumulator.

Low Ambient Control: Provide head pressure control, designed to operate at temperatures down to 0 deg. F (-18 deg. C).

Controls: Provide factory-installed and wired controls, with terminal strip. Provide connections for remote thermostat.

Provide the Following:

- Concentric Vent Termination Kit.
- Schedule 40 PVC combustion intake and exhaust piping with long radius elbows.
- Motor with individual overload protection.
- High and low refrigerant cutouts.
- Fan-auto and heat-off-cool switches.
- Time delay relay to prevent short cycling compressor.
- Manual indoor change-over thermostat.
- Two stage heat/cool for dual circuit units.
- Outdoor thermostat.
- Crankcase heater.
- Low ambient control.
- Moisture indicator.
- Filter drier.
- Refrigerant service valves.
- Sub base for bottom return for all units above 1800 CFM.

Manufacturer: Subject to compliance with requirements, provide AC units of one of the following:

- Bryant.
- Trane Co.
- Carrier.

PART 3 - EXECUTION

INSPECTION:

Examine areas and conditions under which furnaces are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

INSTALLATION OF HIGH EFFICIENCY FURNACES:

General: Install units in accordance with manufacturers installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

Support: Install interior units on 2" thick concrete pad.

Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-16 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

Ductwork: Connect supply and return ducts to unit with flexible duct connections. Provide transitions to exactly match unit duct connection size. Provide 1" acoustic duct lining on return air side a minimum of 10' from fan. Connect outside air duct to unit with flexible connection, provide manual damper and motorized damper.

Combustion Intake & Exhaust Piping: Provide long radius elbows on all combustion intake and exhaust piping. Provide 1/2" flexible unicellular insulation on all combustion intake and exhaust piping routed through uninsulated areas. Refer to section 15250 Mechanical Insulation.

Contractor shall provide pressure drop reading across the intake and combustion exhaust piping. Restrictors or piping changes shall be made as necessary to achieve manufacturers recommended pressure drops. The findings shall be reported to the engineer at project closeout.

Drain Piping: Connect unit drain to nearest indirect waste connection. Piping to be type L copper.

Start-up Furnaces units, in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

TRAINING OF OWNER'S PERSONNEL:

Provide services of manufacturer's technical representative for 1-half day to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7-day notice to Contractor and Engineer of training date.

SPARE PARTS:

General: Furnish to Owner, with receipt, the following spare parts for AC unit:

- 1 set of matched fan belts for each belt driven fan.
- 1 set filters for each unit.

END OF SECTION

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SECTION 15783

ROOFTOP HEATING AND VENTILATING UNITS

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Extent of rooftop heating and ventilating unit work required by this section is indicated on drawings and schedules, and by requirements of this section.

Types of rooftop heating and ventilating units specified in this section include the following:

Gas-fired heating and ventilating.

Refer to Division-16 sections for the following; not work of this section.

Power supply wiring from power source to power connection on rooftop heating and cooling units.

Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory installed, by manufacturer.

Provide the following electrical work as work of this section, complying with requirements of Division-16 sections.

Control wiring between field-installed controls, indicating devices, and unit control panels.

Refer to other Division-15 sections for automatic temperature controls not factory-installed, required in conjunction with rooftop heating and ventilating units; not work of this section.

QUALITY ASSURANCE:

Manufacturer's Qualifications: Firms regularly engaged in manufacture of rooftop heating and cooling units, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

Regulatory Requirements:

UL Compliance: Provide rooftop heating and ventilating units which are listed by UL and have UL label affixed.

AGA Compliance: Construct gas-fired furnace sections in accordance with AGA safety standards and provide AGA label.

SUBMITTALS:

Product Data: Submit manufacturer's technical product data, including rated capacity of selected model clearly indicated, weights, furnished specialties and accessories; and installation and start-up instructions.

Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring for rooftop units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

Maintenance Data: Submit maintenance data and parts list for each rooftop unit, control and accessory; including "trouble-shooting" maintenance guide.

Include this data and product data in maintenance manual; in accordance with requirements of Division-1.

PRODUCT DELIVERY, STORAGE AND HANDLING:

Handle rooftop heating and ventilating units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged rooftop units or components; replace with new.

Store rooftop units and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

Comply with Manufacturer's rigging and installation instructions for unloading rooftop units, and moving them to final location.

SPECIAL PROJECT WARRANTY:

Warranty On Heat Exchanger: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, heat exchangers with inadequate and defected materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation.

Warranty Period: Ten (10) years from date of final acceptance completion.

PART 2 - PRODUCTS

ROOFTOP UNITS:

General: Specifically designed for outdoor rooftop installation on roof. Completely assembled and tested, piped, internally wired and shipped in one piece. Units for natural gas, filters, outside air system and all operating and safety controls furnished factory installed. All units and safety controls furnished factory installed. All units are factory run tested. Units available with UL approval. All units have decals and tags to aid in service and indicate caution areas. Electrical diagrams on long life water resistant material ship attached to control panel door.

Heat Exchanger: Basic standard heat exchangers are furnished employing type 409 stainless steel on the entire primary and secondary surface. There are three (3) collector boxes and tube sheets. The collector boxes and tube sheet are fabricated from stainless steel.

Blower Assemblies: The standard main supply fan blower and motor assembly is furnished using three phase motors. These motors are open NEMA design B. Rigid frames are employed attached to an adjustable motor base.

Blower assemblies are furnished with adjustable drive motor sheaves. The standard blower access is at the rear of the blower assembly when facing the burner. Blowers are furnished with permanently lubricated ball bearings supporting a turned, ground and polished shaft. Extended grease lines are provided.

Heat Exchanger Casing: The heat exchanger casings are constructed of galvanized steel. All casings are furnished with 1"- 1-1/2# fiberglass insulation and galvanized metal radiation shields or liners and will maintain a jacket loss less than 2% of the heat output. A louvered galvanized enclosure suitable for outdoor application is attached to the heat exchanger protecting the power exhauster, burner and control cabinet.

Return Air Section: Fresh and returned air mixing dampers constructed of 16 gauge galvanized steel glades and framing with nylon bearings are furnished as standard. Filter rails arranged in a "V" configuration furnished with 2" throw-away filters. A galvanized steel inlet louver with rain shield is furnished on the fresh air inlet. Casings are insulated with 1" - 1-1/2# fiberglass insulation.

Provide the following unit configuration:

- Mixing Box with outdoor air intake hood and damper, down flow return damper and filters.
- DX cooling coil with (2) separate refrigeration circuits.
- Forward curved centrifugal fan with control panel
- Duct Furnaces
- Down flow supply plenum

Unit Base Frame: The entire bottom of the unit including return air section and heat exchanger is attached to a fabricated base frame designed for mounting on a perimeter roof curb.

Accessories: Provide the following accessories as indicated and/or scheduled:

- Provide matching roof curb for each unit.
- Central control panel.

Available Manufacturers: Subject to compliance with requirements, manufacturers offering rooftop units which may be incorporated in the work include, but are not limited to, the following:

- King Company
- Trane
- Reznor

PART 3 - EXECUTION

INSPECTION:

Examine areas and conditions under which rooftop units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer.

INSTALLATION OF ROOFTOP UNITS:

General: Install rooftop units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

Support installed units as detailed on plan, in accordance with National Roofing Contractor's Association (NRCA) installation recommendations.

Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirement of Division-16 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment Installer.

Ductwork: Refer to Division-15 section "Ductwork". Connect supply and return ducts to unit with flexible duct connections. Provide transitions to exactly match unit duct connection sizes.

Gas Piping: Connect gas piping to unit gas train with shut-off cock and drip let. Connect to gas tee provided by plumbing contractor.

Start-up rooftop units in accordance with manufacturer's start-up instructions. Test controls and demonstration compliance with requirements. Replace damaged or malfunctioning controls and equipment.

Balancing of rooftop unit systems is specified in Division-15 section "Testing, Adjusting, and Balancing"; not work of this section.

GROUNDING:

Provide positive equipment ground for rooftop unit components.

TRAINING OF OWNER'S PERSONNEL:

Provide services of manufacturer's technical representative for one half day to instruct Owner's personnel in operation and maintenance of rooftop units.

Schedule training with Owner, provide at least seven-day notice to Contractor and Engineer of training date.

SPARE PARTS:

General: Furnish to Owner, with receipt, the following spare parts for each rooftop unit:

- One set of matched fan belts for each belt-driven fan.
- One set filters for each unit.

END OF SECTION

SECTION 15830
TERMINAL UNITS

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplemental Conditions and Division 1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Extent of terminal unit work is indicated by drawings and schedules, and by requirements of this section.

Types of terminal units required for project include the following:

- Unit heaters.
- Coils.

Refer to Division 16 sections for the following work; not work of this section.

Power supply wiring from power source to power connection on terminal unit. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

Interlock wiring between electrically-operated terminal units; and between terminal units and field-installed control devices.

Interlock wiring specified as factory-installed is work of this section.

Provide the following electrical work as work of this section, complying with requirements of Division 16 sections:

Control wiring between field-installed controls, indicating devices, and terminal unit control panels.

PART 2 - PRODUCTS

UNIT HEATERS:

General: Provide unit heaters in locations as indicated, and of capacities, style, and having accessories as scheduled.

Gas Fired Unit Heaters:

Provide Unit Heaters as scheduled on the plans. Heaters shall be equipped with day/night thermostat, single stage, standing pilot, seam welded aluminized steel tubes and 18 gauge aluminized steel headers for the heat exchanger, aluminized steel burners which are individually removeable, 24 volt automatic gas valve including pilot safety shutoff, main operating valve, pressure regulator and adjustable pilot valve. Provide winter/summer switch.

Vent Pipe to be type B gas vent.

Manufacturer: Subject to compliance with requirements, provide unit heaters of one of the following:

McQuay Inc.
Modine Mfg. Co.
Reznor
Trane (The) Co.
Wing (The) Co., Div. Wing Industries, Inc.
Marlo

COILS:

General: Provide coils of size and in location indicated, and of capacities and having performance data as scheduled. Certify coil capacities, pressure drops, and selection procedures in accordance with ARI 410.

Cooling Coils:

Finns: Construct of continuous aluminum or copper configured plate-fin type with full fin collars for accurate fin spacing and maximum fin-tube contact.

Tubes: Construct of 5/8" seamless copper tubes, arranged in parallel pattern with respect to air flow.

Casings: Construct of 16-ga continuous coated galvanized steel for coil heights 33" and smaller; 14-ga for coil heights over 33". Provide formed end supports and top and bottom channels. Provide 16-ga steel center tube support for coil lengths 42" to 96", 2 or more supports for coil lengths over 96".

Air Bypass Arrestor: Provide foam sealing strip located between casing channels and fins along top and bottom.

U-Bends: Construct of 5/8" copper tubes, machine die-formed on each end to provide accurate fit for silver brazed joints.

Testing: Proof test water coils at 300 psi and leak test at 200 psi under water. Proof test refrigerant coils at 450 psi and leak test at 300 psi under water; clean, dehydrate, and seal with dry nitrogen charge.

Coil Types: Provide the following coil types as indicated, and as scheduled:

Refrigerant Coils: Provide refrigerant distributor of venturi type with low pressure drop design, arranged for down feed and maximum of 12 circuits per distributor. Provide seamless copper tube suction header. Construct distributor tubes of 5/16" copper tube for R-12, 1/4" copper tube for R-22.

Manufacturer: Subject to compliance with requirements, provide coils of one of the following:

American Air Filter, Allis-Chalmers Co.
Carrier Corp.
McQuay Inc.
Trane (The) Co.
York Div., Borg-Warner Corp.
HeatCraft Coils
Marlo Coils

PART 3 - EXECUTION:

INSPECTION:

Examine areas and conditions under which terminal units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

INSTALLATION OF UNIT HEATERS:

General: Install unit heaters as indicated, and in accordance with manufacturer's installation instructions.

Uncrate units and inspect for damage. Verify that nameplate data corresponds with unit designation.

Hang units from building substrate, not from piping. Mount as high as possible to maintain greatest headroom possible unless otherwise indicated.

Support units with rod-type hangers anchored to building substrate.

Install piping as indicated.

Protect units with protective covers during balance of construction.

INSTALLATION OF COILS:

General: Install coils as indicated, and in accordance with manufacturer's installation instructions.

Mount coils on steel supports to form banks or stacks as indicated, brace, secure to air intake chamber. Place in location to permit installation of bypass damper if required, provide steel baffles where required to prevent bypassing of air.

Pitch coil casings for drainage, not less than 1/8" toward return connections, except where drainage feature is included in coil design.

Provide for each bank of cooling coils, stainless steel drain pan under each coil supported off of floor of sufficient height to allow installation of condensate trap to allow drainage of condensate from pan when installed on suction side of fan.

ELECTRICAL WIRING:

General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-16 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

ADJUSTING AND CLEANING:

General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.

Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

Install new filter units for terminals requiring same.

END OF SECTION

SECTION 15860

FANS AND VENTILATORS

PART 1 - GENERAL

DESCRIPTION OF WORK:

Extent of fans work required by this section is indicated on drawings and schedules, and by requirements of this section.

All fans with outboarded motors shall be factory wired with metallic raceway to their respective factory mounted disconnect switch.

Types of fans required for project include the following:

- Inline Centrifugal Fans.
- Centrifugal Roof Ventilators.
- Prefabricated Roof Curbs.

Refer to Division 16 sections for the following work; not work of this section.

Power supply wiring from power source to power connection on fan motor. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

Interlock wiring between fan units; and between fans and field-installed control devices.

Interlock wiring specified as factory-installed is work of this section.

Provide the following electrical work as work of this section, complying with requirements of Division 16 sections:

Control wiring between field-installed controls, indicating devices, and fan starters.

PART 2 - PRODUCTS

INLINE CENTRIFUGAL FANS:

General: Provide inline centrifugal fans of sizes and arrangement as indicated, and of capacities and having accessories as scheduled.

Housing: Aluminum or galvanized steel housing inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

Direct-Drive Units: Provide ball bearing motor encased in housing so as to be out of air stream. Provide factory wiring to disconnect switch located on outside of fan housing.

Provide NEMA 1 disconnect factory mounted. For single phase fractional HP fans use a toggle type disconnect switch. On three phase integral HP fans use a NEMA 1 safety switch.

Belt-Drive Units: Provide ball bearing motor mounted on adjustable base, with adjustable sheaves. Provide enclosure around belts. Provide lubricating tubes from fan bearings to outside of fan housing.

Wheel: Backward or forward inclined as scheduled, non-overloading, statically and dynamically balanced.

Vibration Control: Provide as listed, the following types of vibration isolators to meet intended service, with number and size of isolators selected by manufacturer.

Base Type A: No base, isolators attached directly to equipment.

Accessories: Provide the following accessories as indicated.

Volume Control Damper: Provide manual controlled volume damper in fan outlet with quadrant and lock.

Companion Flanges: Provide matching flanges on inlet and outlet to connect ductwork to fan.

Motor, Belt and Fan Guards: Provide guards on inlets and outlets not connected to ductwork, constructed of expanded metal in removable frame.

Duct Lining: Provide 1" thick, 3-lb density duct liner a minimum of 10' (ten feet) up and down stream of fan.

Speed Control: For direct drive fans, provide variable speed switch with off-on control, and speed control for 100% to 50% of fan air delivery.

Manufacturer: Subject to compliance with requirements, provide inline centrifugal fans of one of the following:

Acme
Carnes
Cook (Loren) Co.
Greenheck.
Penn Ventilator Co.
Jenn Fan

CENTRIFUGAL ROOF VENTILATORS:

Provide centrifugal roof type, curb mounted, power ventilators of type, size, and capacity as scheduled, and as specified herein.

Type: Centrifugal fan, direct or belt driven as scheduled. Provide aluminum, galvanized steel, or fiberglass weatherproof housings as scheduled. Provide square base to suit roof curb. Provide permanent split-capacitor type motor for direct driven fans; capacitor-start, induction-run type motor for belt driven fans.

Provide the Following Types of Housing Design:

Hooded dome type.
Upblast type for Fume Hoods

Electrical: Provide factory-wired non-fusible type disconnect switch at motor in fan housing. Provide thermal overload protection in fan motor. Provide conduit chase within unit for electrical connection.

Provide NEMA 1 disconnect factory mounted. For single phase fractional HP fans use a toggle type disconnect switch. On three phase integral HP fans use a NEMA 1 safety switch.

Bird Screens: Provide removable bird screens, 1/2" mesh, 16-ga aluminum or brass wire.

Dampers: Provide motor-actuated louvered dampers in curb bases.

Dampers utilized for pressure relief applications shall be tight seal, motorized, with blade and edge seals.

Duct Lining: Provide 1" thick, 3-lb density duct liner a minimum of 10' (ten feet) up stream of fan.

Coatings: Provide factory applied coating to fan blades and all parts of the fan in contact with the exhaust air stream, equal to Greenheck "Greenkote" finish. This shall be applied to all rooftop fans.

Roof Curb: Provide factory fabricated roof curb by the same manufacturer as the equipment. Roof curb to be insulated.

Manufacturer: Subject to compliance with requirements, provide centrifugal roof ventilators of one of the following:

Acme
Carnes
Cook Co., Loren.
Greenheck Fan Corp.
Penn Ventilator Co., Inc.
Jenn Fan

PREFABRICATED ROOF CURBS:

General: Provide manufacturer's standard shop-fabricated units, modified if necessary to comply with requirements.

Fabricate structural framing for units of structural quality sheet steel, formed to manufacturer's standard profiles for coordination with roofing, insulation and deck construction. Include 45 deg. cant strips and deck flanges with offsets to accommodate roof insulation. Weld corners and seams to form watertight units.

Clean and paint units with manufacturer's standard rust-inhibitive metal primer paint.

Reinforce continuous runs of over 3'-0" length, by inserting welded stiffeners of heavy gage with flanges as required to provide sufficient rigidity and strength to withstand maximum lateral forces in addition to superimposed vertical loads.

Sloping Roof Decks: For deck slopes of 1/4" per foot and more, fabricate support units to form level top edge.

Gage and Height: Fabricate units of metal gage and to height above roof surface as indicated.

Where gage or height are not indicated, fabricate units of 14-ga metal, and nominal height of 14".

Provide pressure treated wood nailer, not less than 1-5/8" thick and of width indicated, but not less than width of support wall assembly. Anchor nailer securely to top of metal frame unit.

Provide lumber pressure treated with water-borne preservatives for "above ground" use.

Insulate units inside structural support wall with rigid glass fiber insulation board of approximately 3-lb. density and 1-1/2" minimum thickness, except as otherwise indicated.

Manufacturer: Subject to compliance with requirements, provide prefabricated roof curbs of one of the following:

Custom Curb, Inc.
Equipment Manufacturer.
Pate Co.
Shipman.
Thycurb.

PART 3 - EXECUTION

INSPECTION:

General: Examine areas and conditions under which power and gravity ventilators are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

INSTALLATION OF POWER AND GRAVITY VENTILATORS:

Coordinate ventilator work with work of roofing, walls, and ceilings, as necessary for proper interfacing.

Provide access door in duct below ventilator to service damper.

Solder bottom joints and up 2" of side joints of duct under roof ventilator to retain any moisture entering ventilator.

Access: Provide access and service space around and over fans as indicated, but in no case less than that recommended by manufacturer.

Roof Curbs: Furnish roof curbs to roofing installer for installation. Install according to roofing manufacturer's recommendation and specifications.

Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-16 sections. Ensure that rotation is in direction indicated and intended for proper performance. Do not proceed with centrifugal fan start-up until wiring installation is acceptable to fan installer.

FIELD QUALITY CONTROL:

Testing: After installation of ventilators has been completed, test each ventilator to demonstrate proper operation of units at performance requirements specified. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

ADJUSTING AND CLEANING:

Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

SPARE PARTS:

General: Furnish to Owner, with receipt, one spare set of belts for each belt drive power ventilator.

END OF SECTION

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SECTION 15891
METAL DUCTWORK

PART 1 - GENERAL

DESCRIPTION OF WORK:

Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

Codes and Standards:

SMACNA Standards:
ASHRAE Standards:
NFPA Compliance:

PART 2 - PRODUCTS

DUCTWORK MATERIALS:

Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting.

Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel, lock forming quality; with G 90 zinc coating and mill phosphatized for exposed locations. Minimum gauge shall be 24.

PVC Coated Sheet Metal: All fume exhaust ductwork shall be Polyvinyl Coated Ductwork, (PCD). All ducts shall be PCD formed into spiral tubes. All couplings and fittings shall be factory fabricated of PCD. All joints and connections shall be screw fastened and taped in accordance with the manufacturer's recommendations to assure an air tight system. Any damage to the coating shall be repaired with PCD touch up paint or PCD aerosol spray. All ducts and fittings shall be installed according to manufacturer's recommendations. Manufacturer equal to Foremost Manufacturing Company.

Aluminum sheet: Where indicated, provide aluminum sheet, Alloy 3003, Temper H14.

MISCELLANEOUS DUCTWORK MATERIALS:

Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15 deg. change of direction per section. Unless specifically detailed otherwise, use 45 deg. laterals and 45 deg. elbows for branch takeoff connections. Where 90 deg. branches are indicated, provide conical type tees.

Duct Liner: Fibrous glass of thickness indicated. 3-lb density.

Duct Liner Adhesive:

Duct Liner Fasteners: Comply with SMACNA HVAC Duct Construction Standards.

Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork.

Duct Cement: Non-hardening migrating mastic or liquid neoprene based cement, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork.

Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

For aluminum ductwork, provide aluminum support materials except where materials are electrolytically separated from ductwork.

Flexible Ducts: Either spiral-wound spring steel with flameproof vinyl sheathing, or corrugated aluminum. Unless specifically mentioned, the maximum length of flex duct on the supply equals 5 feet. Flex is not allowed for return, relief or exhaust applications.

Where installed in unconditioned spaces other than return air plenums, provide 1" thick continuous flexible fiberglass sheath with vinyl vapor barrier jacket.

Installation is not permitted above inaccessible ceilings.

FABRICATION:

Shop fabricate ductwork in 4, 8, 10 or 12-ft lengths, unless otherwise indicated or required to complete runs. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.

All ductwork shall be Pittsburgh Construction with a minimum of thickness of 24 gauge. In addition, ductwork used in systems over 3" H₂O shall have cold sealant applied.

Size of ductwork shown on the drawings is free net area, outside dimension of ducts will need to be increased if lined duct is used.

Shop fabricate ductwork of gages and reinforcement complying with SMACNA "HVAC Duct Construction Standards".

Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30 deg. for contracting tapers and 20 deg. for expanding tapers.

Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners. Duct liner to be 3 lb density for acoustic requirements 1" thick or as noted. Size of ductwork shown on the drawings is free net area, outside dimension of ducts will need to be increased if lined duct is used.

FACTORY-FABRICATED LOW PRESSURE DUCTWORK:

General: At installer's option, provide factory-fabricated duct and fittings, in lieu of shop-fabricated duct and fittings.

Material: Galvanized sheet steel, lock forming quality, G90 zinc coating, mill phosphatized.

Gage: 28-gage minimum for round and oval ducts spiral ducts, 24 gauge for round duct and fittings, 4" through 24" diameter.

Elbows: One piece construction for 90 deg. and 45 deg. elbows 14" and smaller. Provide multiple gore construction for larger diameters with standing seam circumferential joint.

Divided Flow Fittings: 90 deg. tees, constructed with saddle tap spot welded and bonded to duct fitting body.

Manufacturers: Subject to compliance with requirements, provide factory-fabricated ductwork of one of the following:

Semco Mfg., Inc.
United Sheet Metal Div., United McGill Corp.

PART 3 - EXECUTION

INSPECTION:

INSTALLATION OF METAL DUCTWORK:

General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.

Inserts: Install concrete inserts for support of ductwork in coordination with form work, as required to avoid delays in work.

Sealing: Seal all longitudinal seams, S's and drives and all joints with mastic or cement. Install according to Smacna standards.

Balancing Dampers: The sheet metal contractor shall be fully responsible for installing balancing dampers in the ductwork, (whether shown on the drawing or not) in order to arrive at the intended air flow. The balancing sub-contractor shall provide direction and assistance in determining locations where dampers are required. Additional dampers, if required shall be installed at no additional cost to the owner.

Wall Penetrations: Seal and pack around all ducts and piping sleeves which pass through walls that extend to bottom side of structure and rated walls.

Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.

Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or

above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

Electrical Equipment Spaces: Do not route ductwork through transformer vaults and their electrical equipment spaces and enclosures.

Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2". Fasten to duct and substrate.

Where ducts pass through fire-rated floors, walls, or partitions, provide fire dampers and firestopping between duct and substrate, in accordance with requirements of Division-7 Section "Firestopping".

Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

INSTALLATION OF DUCT LINER:

General: Install duct liner in accordance with SMACNA HVAC Duct Construction Standards. Size of ductwork shown on the drawings is free net area, outside dimension of ducts will need to be increased if lined duct is used.

Store internally lined ductwork up off of the floor. Protect internally lined ductwork from water and dust. Butter the leading edge of all internal duct lining with the manufacturer's recommended adhesive.

Inspect and repair all damaged lining prior to installation of ductwork.

INSTALLATION OF FLEXIBLE DUCTS:

Maximum Length: For any duct run using flexible ductwork, do not exceed 5' - 0" extended length. Installation shall have smooth full radius turns down to diffuser.

Installation not permitted above inaccessible ceilings.

FIELD QUALITY CONTROL:

Leakage Tests: After each duct system which is constructed for duct classes over 3" is completed, test for duct leakage in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Repair leaks and repeat tests until total leakage is less than 1% of system design air flow.

EQUIPMENT CONNECTIONS:

General: Connect metal ductwork to equipment as indicated, provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors.

ADJUSTING AND CLEANING:

Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.

Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

END OF SECTION

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SECTION 15910
DUCTWORK ACCESSORIES

PART 1 - GENERAL

DESCRIPTION OF WORK:

Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this section.

Types of ductwork accessories required for project include the following:

- Dampers.
- Low pressure manual dampers.
- Control dampers.
- Fire and smoke dampers.
- Turning vanes.
- Duct hardware.
- Duct access doors.
- Flexible connections.

PART 2 - PRODUCTS

DAMPERS:

Low Pressure Manual Dampers: Provide dampers of single blade type or multiblade type, constructed in accordance with SMACNA "HVAC Duct Construction Standards".

Control Dampers: Provide dampers with parallel blades for 2-position control, or opposed blades for modulating control. Construct blades of 16-ga steel, provide heavy-duty sealed ball bearings, 1/2" diameter steel axles spaced on 9" centers. Construct frame of 2" x 1/2" x 1/8" steel channel for face areas 25 sq. ft. and under; 4" x 1-1/4" x 16-ga channel for face areas over 25 sq. ft. Provide galvanized steel finish with aluminum touch-up.

Control Damper size shall be based on an air velocity of 1200 to 1500 fpm and 1/4" s.p. drop when wide open. HVAC contractor shall provide transition in ductwork to arrive at this velocity (if required). Consult engineer for exact type of transition.

Damper shall be low leak with extruded vinyl edge seals and flexible metal compression type jamb seals.

Manufacturer: Subject to compliance with requirements, provide dampers of one of the following:

- Air Balance, Inc.
- American Warming & Ventilating, Inc.
- Arrow Louver and Damper, Div. of Arrow United Industries, Inc.
- Louvers & Dampers, Inc.
- Penn Ventilator Co.
- Ruskin Mfg. Co.

FIRE AND SMOKE DAMPERS:

Fire Dampers: Provide fire dampers, of types and sizes indicated. Construct casings of 11-ga galvanized steel with bonded red acrylic enamel finish or galvanized steel. Provide fusible link rated at 160 to 165 deg. F (71 to 74 deg. C) unless otherwise indicated. Dampers in their opened position shall be located out of the air stream, (high hat dampers).

Blade Material: Steel, match casing.

Fire/Smoke Dampers: Provide fire/smoke dampers, of types and sizes indicated. Construct casings of 11-ga galvanized steel with bonded red acrylic enamel finish. Provide fusible link rated at 160 to 165 deg. F (71 to 74 deg. C) unless otherwise indicated. Provide additional frangible link containing explosive charge, connected in series with fusible link. Provide stainless steel spring loaded leakage seals in sides of casing, and 36" long wire leads for connecting smoke link to smoke detector. Dampers in their opened position shall be located out of the air stream, (high hat dampers).

Blade Material: Steel, matching casing.

Motor-Driven Fire/Smoke Dampers: Provide motor-driven fire/smoke dampers in types and sizes indicated, with casing constructed of 11-ga galvanized steel with bonded red acrylic enamel finish, fusible link 160 to 165 deg. F (71 to 74 deg. C), unless otherwise indicated, and curtain type stainless steel interlocking blades, with electric motor equipped with instant closure clutch, stainless steel cable damper blade linkage, motor mounting bracket, and 32" long wire leads for connecting to smoke detector, and with the following construction feature:

Unit Assembly: Motor mounted outside air stream.

Dampers in their opened position shall be located out of the air stream, (high hat dampers).

Manufacturer: Subject to compliance with requirements, provide fire and smoke dampers of one of the following:

Air Balance, Inc.
American Warming & Ventilating, Inc.
Arrow Louver and Damper, Div. of Arrow United Industries Inc.
Louvers and Dampers, Inc.
Penn Ventilator Co.
Prefco
Ruskin Mfg. Co.

TURNING VANES:

Fabricated Turning Vanes: Provide fabricated turning vanes and vane runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards".

Manufactured Turning Vanes: Provide turning vanes constructed of 1-1/2" wide curved blades set at 3/4" o.c., supported with bars perpendicular to blades set at 2" o.c., and set into side strips suitable for mounting in ductwork.

Acoustic Turning Vanes: Provide acoustic turning vanes constructed of airfoil shaped aluminum extrusions with perforated faces and fiberglass fill.

Manufacturer: Subject to compliance with requirements, provide turning vanes of one of the following:

Aero Dyne Co.
Anemostat Products Div., Dynamics Corp. of America.
Barber-Colman Co.
Hart & Cooley Mfg. Co.
Register & Grille Mfg. Co., Inc.

DUCT HARDWARE:

General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.

Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

Manufacturer: Subject to compliance with requirements, provide duct hardware of one of the following:

Ventfabrics, Inc.
Young Regulator Co.

SPLITTER DAMPERS:

General: Provide splitter dampers made of 16 ga. galvanized steel installed in branch ducts.

DUCT ACCESS DOORS:

Construction: Construct of same or greater gage as ductwork served, provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one side hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors.

Latch equal to Ventlok-figure 140 and 260

Manufacturer: Subject to compliance with requirements, provide duct access doors of one of the following:

Air Balance Inc.
Register & Grille Mfg. Co., Inc.
Ruskin Mfg. Co.
Ventfabrics, Inc.
Zurn Industries, Inc., Air Systems Div.

FLEXIBLE CONNECTIONS:

General: Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for

thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment.

Manufacturer: Subject to compliance with requirements, provide flexible connections of one of the following:

American/Eigen Co., Energy Div.
Duro Dyne Corp.
Flexaust (The) Co.
Ventfabrics, Inc.

PART 3 - EXECUTION

INSPECTION:

Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

INSTALLATION OF DUCTWORK ACCESSORIES:

Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

Balancing dampers shall be installed in the duct system to arrive at intended air quantities. These dampers, whether shown on the drawings or not, shall be installed at no additional cost to the owner.

Install turning vanes in square or rectangular 90 deg. elbows in supply and exhaust air systems.

Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

FIELD QUALITY CONTROL:

Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

ADJUSTING AND CLEANING:

Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.

Label access doors.

Final positioning of manual dampers shall be based on the Testing, Adjusting and Balancing of the duct system.

Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

EXTRA STOCK:

Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION

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SECTION 15932
AIR OUTLETS AND INLETS

PART 1 - GENERAL

DESCRIPTION OF WORK:

Extent of air outlets and inlets work is indicated by drawings and by requirements of this section.

Types of air outlets and inlets required for project include the following:

Ceiling air diffusers.
Registers and grilles.
Louvers.

PART 2 - PRODUCTS

CEILING AIR DIFFUSERS:

Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.

Types: Provide ceiling diffusers of type, capacity, and with accessories as listed. The following requirements shall apply.

Diffuser Faces:

Square: Square housing, core of square concentric louvers, square or round duct connection.

Diffuser Mountings: Coordinate mounting type with architectural ceiling type prior to ordering:

Flush: Diffuser housing above ceiling surface with flush perimeter flange and gasket to seal against ceiling.

Lay-In: Diffuser housing sized to fit between ceiling exposed suspension tee bars and rest on top surface of tee bar.

Diffuser Patterns:

Adjustable: Manual adjustable core with concentric rings or louvers, fully adjustable for horizontal to vertical air flow.

Diffuser Acoustic Performance:

NC less than or equal to - 30

Diffuser Dampers:

Opposed Blade Dampers: Multiple opposed blade dampers connected to linkage adjustable from face of diffuser with key.

Diffuser Accessories:

Equalizing Deflectors: Adjustable parallel blades in frame for straightening air flow.

Plaster Ring: Perimeter ring designed to act as plaster stop and diffuser anchor.

Diffuser Finishes:

White Enamel: Semi-gloss white enamel prime finish.

Type:

Square:

Model: Titus, Model TMS with opposed blade damper and operating key.

Note: Provide aluminum diffusers with "Greenkote" finish in Glass Wash and Pot Wash.

Manufacturer: Subject to compliance with requirements, provide diffusers of one of the following:

Anemostat Products Div., Dynamics Corp. of America.
Krueger
Metal-Aire
Titus Products Div., Philips Industries, Inc.
Tuttle and Bailey.
Price

REGISTERS AND GRILLES:

Performance: Provide wall and ceiling registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

Wall and Ceiling Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall and ceiling systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall and ceiling construction which will contain each type of register and grille.

Types: Provide registers and grilles of type, capacity, and with accessories and finishes as listed.

Register and Grille Materials:

Steel Construction : Manufacturer's standard stamped sheet steel frame and adjustable blades.

Aluminum Construction: Manufacturer's standard extruded aluminum frame and adjustable blades.

Register and Grille Faces:

Horizontal Straight Blades: Horizontal blades, individually adjustable, at manufacturer's standard spacing.

Vertical Straight Blades: Vertical blades, individually adjustable, at manufacturer's standard spacing.

Horizontal 45 deg. Fixed Blades: Horizontal blades, fixed at 45 deg., at manufacturer's standard spacing.

Register and Grille Patterns:

Double Deflection: 2-sets of blades in face, rear set at 90 deg. to face set.

Register and Grille Dampers:

Opposed Blade: Adjustable opposed blade damper assembly, key operated from face of register.

Register and Grille Accessories:

Plaster Frame: Perimeter frame designed to act as plaster stop and register or grille anchor.

Operating Keys: Tools designed to fit through register or grille face and operate volume control device and/or pattern adjustment.

Register and Grille Acoustic Performance:

NC less than or equal to - 30

Register and Grille Finishes:

White Enamel: Semi-gloss white enamel prime finish.

Type:

Supply:

Model: Titus, model 300RL with opposed blade damper
(301RL is aluminum)

Return:

Model: Titus, model 350RL with opposed blade damper
(3/4" slot, 35 degree deflection, steel)

Note: Provide aluminum supply & return registers with "Greenkote" finish in Glass Wash and Pot Wash.

Manufacturer: Subject to compliance with requirements, provide registers and grilles of one of the following:

Anemostat Products Div., Dynamics Corp. of America.
Krueger
Price
Metal-Aire
Titus Products Div., Philips Industries, Inc.
Tuttle and Bailey.

LOUVERS:

Performance: Provide louvers that have minimum free area, and maximum pressure drop for each type as listed in manufacturer's current data, complying with louver schedule.

Substrate Compatibility: Provide louvers with frame and sill styles that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation. Refer to general construction drawings and specifications for types of substrate which will contain each type of louver.

Materials: Construct of aluminum extrusions. Weld units or use stainless steel fasteners.

Louver Screens: On inside face of exterior louvers, provide 1/2" square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.

Color: Architect shall select factory painted color of louver from manufacturer's standard range of 20 colors.

Provide the following types of Finish for louvers:

Finish: Coating to be ACROFLUR, consisting of 50% PVDF (Kynar or Hylar) spray paint. System shall include a 20 year warranty.

Provide the following equivalent Model:

Model: Ruskin, Model ELF-375DX
Model: Airo-Lite, Brick Vent

Manufacturer: Subject to compliance with requirements, provide louvers of one of the following:

Airolite Co.
American Warming & Ventilating, Inc.
Arrow United Industries, Inc.
Carnes
Louvers & Dampers, Inc.
Penn Ventilator Co., Inc.
Ruskin Mfg. Co.
Dowco.

PART 3 - EXECUTION

INSPECTION:

Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

INSTALLATION:

General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.

Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

Locate ceiling air diffusers, registers, and grilles, as indicated on general construction documents. Coordinate installation with Reflected Ceiling Plan and Electrical Lighting Plan. Locate diffusers in the center of ceiling modules.

SPARE PARTS:

Furnish to Owner, with receipt, 3 operating keys for each type of air outlet and inlet that require them.

END OF SECTION

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SECTION 15960

AUTOMATIC CONTROL SEQUENCES

PART 1 - GENERAL

DESCRIPTION OF WORK:

Control sequences are hereby defined as the manner and method by which automatic temperature controls function. Requirements for each type of operation are specified in this section.

Controls equipment and control panels to provide control sequences as outlined herein.

Coordinate control work with controls provided by Equipment Manufacturers.

SUBMITTALS

Shop drawings: Submit shop drawings for each system automatically controlled, containing the following information:

Schematic flow diagram of system showing fans, pumps, coils, dampers, valves, and control devices.

Label each control device with setting or adjustable range of control.

Indicate electric wiring; factory and field wiring.

Indicate each control panel required, with internal and external wiring clearly indicated. Provide detail of panel face, including controls, instruments, and labeling.

General Control Requirements:

This contractor shall be familiar with and responsible for wiring of all auxiliary equipment (control and power wiring), and controllers required under the mechanical division 15. Equipment and controllers shall include but not be limited by the following items.

All fresh air intakes and exhaust louvers shall have motor operated dampers. Dampers shall be low leak with blade and edge seals. Motor operated dampers shall be line voltage, provided, installed and wired by the mechanical contractor unless otherwise noted. Provide all necessary transformers, contactors, controls and wiring for interlocking equipment to motor operated dampers.

Split System ACU:

The unit shall operate on a 7-day/night schedule with three hour occupied and/or un-occupied override. Provide motorized outdoor air damper. During the day cycle, the unit shall operate with the outdoor air damper opened. The fan shall run 100 percent of the time and the heating/cooling coils shall cycle to maintain space temperature. The heating/cooling switch-over shall be automatic. During the night cycle, the outdoor air damper shall remain closed. The fan shall cycle in sequence with the heating/cooling coils to maintain night setback space temperature.

Provide Low Ambient Controls on condensing unit for operation down to -20 degrees F.

Rooftop Unit:

The unit shall operate on a 7-day/night schedule with three hour occupied and/or un-occupied override. Provide motorized outdoor air damper and return air dampers. Provide a room static pressure sensor that will modulate the outside air damper open and return air damper closed on a negative pressure reading in the space. During the day cycle, the unit shall operate with the outdoor air damper opened at minimum position and modulated as required to maintain equal pressure in the space. The fan shall run 100 percent of the time and the heating/cooling coils shall cycle to maintain space temperature. The heating/cooling switch-over shall be automatic.

During the night cycle, the outdoor air damper shall remain closed. The fan shall cycle in sequence with the heating/cooling coils to maintain night setback space temperature.

Provide drybulb economizer cycle. An outdoor air thermostat, mixed air thermostat and receiver controller shall modulate the outdoor air damper and return damper in sequence to maintain setpoint during economizer operation.

Toilet Exhaust Fans:

Exhaust fans shall be tied to timeclock with 3 hour manual override switch. Timeclock shall be provided and installed by electrical contractor. All wiring and interlocks shall be by mechanical contractor. When activated, exhaust fan motor damper shall open and fan shall start.

Fume Hood Exhaust Fans:

Provide connection to fume hood switch for control. Upon activation, exhaust fan motor damper shall open and fan shall start.

Unit Heaters:

Provide a remote mounted line voltage room thermostat to cycle the unit fan motor and coil in order to maintain the space temperature at its setpoint.

General Control Wiring:

Control Wiring: Install control wiring, without splices between terminal points, color-coded. Install in neat workmanlike manner, securely fastened. Install in accordance with ANSI/NFPA 70, "National Electrical Code".

Install circuits over 25-volt with color-coded No. 12 wire in electric metallic tubing.

Install circuits under 25-volt with color-coded No. 18 wire with 0.031" high temperature (105 degrees F (41 degrees C) plastic insulation on each conductor and plastic sheath over all. All wiring shall be plenum rated.

Install electronic circuits with color-coded No. 18 wire with 0.023" polyethylene insulation on each conductor with plastic-jacketed copper shield over all.

Install low voltage circuits, located in concrete slabs and masonry walls, or exposed in occupied areas or mechanical rooms, in electric conduit.

Final Adjustment of Equipment: After completion of installation, adjust thermostats, control valves, motors and similar equipment provided as work of this section.

Final adjustment shall be performed by specially trained personnel in direct employ of manufacturer of primary temperature control system.

Provide owner personnel with 8 hours of instruction of complete control sequences. Instructions shall be video taped and turned over to owner (2 copies) for future use.

END OF SECTION

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SECTION 16010

GENERAL ELECTRICAL REQUIREMENTS

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplemental Conditions and Division-1 Specification sections, apply to work of all Division-16 sections.

SCOPE

The base bid shall include furnishing all materials, labor, tools, equipment and installation of all work required to install complete electrical systems as shown on the plans and outlined in all Division-16 sections.

Submittal of a bid indicates that the contractor has examined the drawings, specifications, and visited the site and has included all required allowances.

Contractor: shall be designated as the sub-contractor for that section of work unless specifically stated otherwise.

Work includes but is not limited to the following.

Relocation/rerouting of existing electrical work as required to accommodate new construction.

Providing all new electrical work as required to accommodate new construction.

The following work is not included under this contract.

Painting of any equipment, except as hereinafter mentioned in the specifications or shown on drawings.

Temperature Control Wiring, except as hereinafter mentioned in the specifications or shown on drawings.

Telephone and Data Wiring (see Section 16880).

ALLOWANCES

In addition to all work shown on the drawings, the electrical contractor shall include a \$5000. cost allowance in the base bid for miscellaneous moves, adds and/or changes to the electrical systems which may occur. This allowance or portions of this allowance shall not be used unless written permission is first obtained in the form of a change order from the Architect or Engineer. Any and all unused portions of this allowance shall be refunded by the respective contractor at the close of the contract.

SPECIAL CONDITIONS

Owner's representative or engineer shall be permitted to relocate any fixture, device or equipment outlet prior to installation within a 15 foot limit at no additional change in contract price.

The electrical contractor shall complete his work or any part thereof at such time as may be designated by the owner's representative, so that it can be used for temporary or permanent use. Such use of the system shall not be construed as an acceptance of same by Owner.

MATERIALS AND EQUIPMENT

Materials installed shall be new, full weight, of the best quality. All similar materials shall be of the same type and manufacturer. All materials, apparatus and equipment shall bear the Underwriter's Laboratory, Inc. label where regularly supplied.

Contractor is responsible for the safety and good condition of the materials and equipment installed until final acceptance by the Owner. Materials shall be stored to prevent damage or weathering prior to installation.

When several materials, products or items of equipment are specified by name for one use, the contractor may select any one of those specified and shall include with his bid an Equipment List listing the equipment selected.

Bidders may bid on other materials, products or equipment. All material manufacturers listed in the contract documents as an equal shall be equal in quality, performance, aesthetics, and product support to that specified. Other products, material, article, device, fixture or form of construction not mentioned as approved equal must be approved by the Engineer. Request for approval must be made in writing and approved by the Architect ten (10) days prior to bid opening date, and issued by addendum.

The responsibility for costs incurred from deviation from the base equipment shall be the equipment supplier and this contractor. Use of any equipment will be considered as a statement that clearances and arrangements have been checked and found satisfactory.

GENERAL STANDARDS

The applicable provisions of the following standards shall govern. All electrical equipment must contain UL label and be manufactured and assembled in the USA.

All work shall be installed in strict accordance with the latest edition of all applicable codes including (but not limited to) the following codes and standards.

- National Electrical Code, NFPA 70.
- Kentucky Basic Building Code.
- Life Safety Code, NFPA 101.
- Local Electrical Codes.
- Local utility company requirements.
- A.D.A. requirements.

EXPLANATION AND PRECEDENCE OF DRAWINGS

For the purposes of clearness and legibility, drawings are essentially diagrammatic and although size and locations of equipment are drawn to scale wherever possible, Subcontractor shall make use of all data in all of the contract drawings and shall verify this information at building site.

The drawings indicate required size and points of termination of conduit and suggest proper routes to conform to the structure, avoid obstructions and preserve clearances. However, it is not intended that drawings indicate all necessary offsets, and it shall be the work of this section to install conduit and

equipment in such manner as to conform to structure, avoid obstructions, preserve headroom and keep openings and passageways clear without further instructions or cost to the Owner.

The electrical contractor shall coordinate his work with all other trades and locate equipment accordingly. This contractor shall refer to coordination drawings of the other trades. Any mechanical and/or electrical work fabricated or installed before the above referenced coordination with all other trades will be done at the respective contractors' risk.

It is intended that all apparatus be located symmetrical with architectural elements and shall be installed at exact height and locations as shown on architectural drawings.

The Subcontractor shall fully inform himself regarding all peculiarities and limitations of space available for installation of all work and materials furnished and installed under the contract. He shall exercise due and particular caution to determine that all parts of his work are made quickly and easily accessible. Although the locations of the equipment and conduit may be shown on the drawings in certain positions, the Subcontractor shall be guided by the architectural details and conditions existing at the job site, correlating his work with that of others. Provide all offsets as required to provide a neat workmanlike arrangement.

Immediately upon award of contract and before any work is started, the Subcontractor shall confer with the Engineer or his representative concerning the work under these sections.

PERMITS AND REGULATIONS

All electrical materials used in this work and all workmanship tests performed therein, unless otherwise specified shall conform to the latest rules, regulations and specifications of the National Electrical Code, the National Board of Fire Underwriters, local and state codes having jurisdiction and utility company.

Any discrepancy between these drawings and specifications and the codes, laws, ordinances, rules and regulations shall be immediately brought to the attention of the engineer, prior to any installation.

This Subcontractor shall obtain and pay for all permits or certificates of inspection and approval required for this branch of the work.

Owner shall be furnished with certificates of final inspection and approval prior to final acceptance of this branch of the work.

ELECTRICAL SUPERINTENDENT

The Subcontractor shall furnish the service of an experienced superintendent who shall be constantly in charge of the work, together with the qualified journeymen wireman and specialists as required to properly install, connect, adjust, start, operate and test the work involved.

The superintendent's qualifications shall be subject to the review and acceptance by the owner's representative. Unless prior special permission is granted by the owner's representative, the same electrical superintendent shall be utilized throughout the duration of the project.

SUBMITTALS

All items of material and equipment shall be listed on an Equipment List prepared by the Subcontractor and shall be reviewed by the Engineer prior to the start of any work. Submittal shall be provided in a timely manner allowing for long lead items. No item of equipment will be permitted on the site until acceptance of that equipment has been given. Copies of drawings and manufacturer cuts and performance data will be required for approval. Submittals shall be organized in same order as listed in equipment list and include

reference to page and paragraph numbers of the specifications and shall be bound in sets; all sets identical. The Subcontractor is not authorized to purchase any material until the shop drawings are approved by the Engineer.

Submittals shall clearly indicate sufficient definition so that they can be properly reviewed for compliance with contract documents.

See Division 1 Section "Submittals".

PRODUCT DELIVERY, STORAGE AND HANDLING

Deliver equipment and materials according to factory shipping requirements. Pack components in factory-fabricated protective containers. Units shall be delivered in sections of such size as will pass through available openings.

Store equipment and materials in clean dry place and protect from weather and construction traffic. When stored inside, do not exceed structural capacity of the floor.

Handling and rigging of equipment and products shall be as recommended by the manufacturer. Components and equipment damaged during shipment or handling shall not be installed. Replace and return damaged components to the manufacturer.

QUALITY ASSURANCE

Contractor if requested shall demonstrate his ability to perform all work to be included under the contract. Assurance if requested, shall be in the form of a list of past projects of similar size and complexity and a list of six (6) references pertaining to those projects. Failure to demonstrate these quality assurances shall be taken as a statement of the contractors inability to perform.

Contractor shall have a minimum five (5) years experience in the installation of electrical systems similar to the systems specified.

The quantity or quality level shown or specified shall be the minimum provided or performed. In complying with these requirements, indicated numeric values are minimum or maximum, as appropriate for the context of the requirements. Should there be a conflict between the plans and specifications, the greater quantity or better quality shall be furnished.

Install all equipment and materials in strict accordances with manufacturer's written instructions.

Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified by applicable UL Standards. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Ensure that sealing grommets expand to form watertight seal.

Upon completion of installation of equipment and electrical circuitry, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

Prior to energizing, check installed wires and cables with megohm meter to determine insulation resistance levels to assure requirements are fulfilled. Prior to energizing, test wires and cables for proper phase to

phase connections, for electrical continuity and for short-circuits. Ensure that direction of rotation of each motor fulfills requirement.

SPECIFICATIONS

Wherever the words "Contractor" or "This Contractor" "Subcontractor" or "E.C." appears in Division 16 specifications or on electrical drawings, it shall refer to the Electrical Contractor (or sub-contractor of the Electrical Contractor where applicable).

Wherever the word "Provide" appears on electrical drawings or in Division 16 specifications, it shall be interpreted to mean that the electrical contractor shall "Furnish and Install", including all necessary accessories to render respective system fully operational.

Specifications shall be interpreted in connection with the drawings hereinbefore described, and if anything is shown on drawings and not mentioned in the specifications, or vice versa, it is to be included in the work the same as though clearly set forth by both.

Furthermore, all materials or labor previously required to fully complete the work shall be included in the contractor's work even though each item necessarily involved be not specifically mentioned or shown. Such work and/or materials shall be of the same grade or quality as the parts actually specified and shown. Should there be a conflict between the plans and specifications, the greater quantity or better quality shall be furnished.

TEMPORARY ELECTRICAL SERVICE

Refer to Section 01500.

Electrical contractor shall furnish all temporary light (including lamps) and power complete with all wiring and similar equipment as required, for all work on the site and within the affected buildings during the construction period.

Where applicable, provide temporary security site lighting as required and/or as directed in field.

Make all necessary arrangements with local utility companies for temporary electrical service and pay all associated fees for inspections, connections, initiation, etc.

Feeders shall be properly fused and ground fault protected per N.E.C. and per all authorities having jurisdiction. Feeders and lamps shall be physically protected along their entire length. Temporary branch circuit wiring shall be installed per NEC in each area with receptacles on minimum ten foot centers to accommodate lamps and extension cords provided by the contractor in need of them.

The electrical contractor shall furnish and maintain all lamps required for the duration of the job. Sufficient sockets and circuit capacity shall be provided for all construction areas. A minimum of 10 foot candles of illumination shall be maintained in all spaces or as required by OSHA. Provide all necessary specialty temporary power and/or supplementary light for all trades requiring same.

At the conclusion of the project, all temporary electric service materials shall be removed by the electrical contractor and become the property of same.

Unless directed otherwise, the general contractor will pay for all current for all trades during construction.

The electrical contractor shall provide and maintain all power lines (including circuit protection, physical protection, grounding, etc.) to the temporary offices and sheds of all trades requiring same, extending from

the temporary electrical service. Electrical wiring, lighting, etc. within the trailers, sheds, etc. shall be provided by the individual contractor supplying such trailers, sheds, etc.

Route all temporary service lines on the site overhead as required so that the work does not interfere with existing site operations or new construction related work of any trade. Unless directed otherwise in field by owner's representative, all overhead lines shall be at least 18 feet (from the lowest point) above grade/pavement. Coordinate carefully in field prior to installation. All overhead lines shall be properly supported by messenger cable, shall be physically protected at risers and drops and shall be properly mounted to supporting structures with insulators and drip loops.

CLEANING EQUIPMENT AND PREMISES

Clean all parts of the apparatus and equipment. Exposed parts which are to be painted shall be cleaned of cement, plaster and other materials and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all corners and cracks scraped out.

Exposed metal work shall be brushed down with steel brushes to remove rust and other spots and left smooth and clean. Remove trapped elements during cleaning and flushing period, after which they shall be replaced and adjusted.

During the progress of the work, the contractor shall clean up after his men and leave the premises and all portions of the building in which he is working in a clean and safe condition. This cleaning shall occur on a daily basis.

PROJECT CLOSEOUT

General

Final payment of contract will not be made until receipt, review and acceptance, by the owner's representative, of all documentation defined hereafter.

Refer to Division 1 Section 01700 "Contract Closeout".

Where applicable, refer to applicable General Conditions and similar sections of the project manual for details on record drawing submittals. In addition to the requirements specified in Division 1 or other applicable project manual sections, include the following as a minimum.

Owner shall be furnished with certificates of final inspection and approval prior to final acceptance of this branch of the work.

The system shall ring entirely free from ground when tested out in the presence of the owner's representative.

At the conclusion of the project when the system is in full operation, a final balance of circuits shall be made by the electrical contractor, witnessed by the Engineer. The electrical contractor shall provide necessary man-power, metering, etc., to accomplish this task. Provide written documentation of same.

The owner's representative shall make arrangements for a meeting at such time as will be convenient to all parties concerned for the purpose of instructing the designated personnel on the correct operation and maintenance of each individual system furnished and/or installed by this contractor under this contract. These instructions shall be video-taped (VHS format) by the electrical contractor with one tape submitted for each O & M manual.

The electrical contractor shall be responsible for the proper instruction of each system to the satisfaction of the owner's representative.

Record Documents

In addition to the requirements specified in Division 1 or other applicable project manual sections, include the following for record documents.

Make arrangements for obtaining two complete sets of electrical prints which shall be used to provide record drawings which shall be separate, clean, prints reserved for the purpose of showing a complete picture of the work as actually installed (including routing of all conduit and cables).

These drawings shall also serve as work progress report sheets and the electrical contractor shall make any notations, neat and legible thereon daily as work proceeds. The drawings shall be available for inspection at all times and shall be kept at the job at a location designated by the owner's representative.

Maintain the clean, undamaged set of prints of Contract Drawings as well as a set of submittal drawings and coordination drawings where applicable. Mark the sets to show the actual installation where the installation varies from the Contract Documents as originally shown. Record drawings shall include locations of underground and concealed items if placed other than shown on the Contract Documents. Do not permanently conceal any construction until this required information is recorded. Mark which drawing is most capable of showing conditions fully and accurately. Where shop drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

Record documents shall show changes in: size, type, capacity, etc., of material device or piece of equipment, location of device or piece of equipment; location of outlet or source of building service systems; routing of piping, conduit, or other building services. These drawings shall also record location of concealed equipment, electrical service work, conduits and other piping/work by indication of measured dimensions to each line from readily identifiable and accessible walls or corners of building. Indicate all approved substitutions, contract modifications, and actual equipment and materials installed.

For electrical work installed below slabs, pavements, grade, etc., these drawings shall also record location of nearby concealed water piping, sewers, wastes, vents, ducts, conduit and other piping, etc. by indication of measured dimensions to each line from readily identifiable and accessible walls or corners of building and from adjacent electrical work. Show invert elevation of underground electrical work relative to work installed by other trades.

Upon substantial completion of the work, pay for and make arrangements for obtaining a complete set of erasable blackline reproducible drawings. All information from the print record drawings shall be neatly drafted onto the above referenced reproducibles. Neatly erase and redraft work on the reproducibles as required to reflect the work as actually installed. Perform drafting in a manner in which all work shall be shown in its actual locations, existing as well as new, by erasing inaccurate locations and redrawing proper routing/locations. This applies for all concealed work as well as work visible.

Affix near the titleblock on each drawing of the set of record drawing prints and the set of reproducibles the Contractors' Company Names, signature of Contractors' Representative and current date. Deliver one set of prints to the engineer. Deliver the second set of prints, the original reproducibles and the marked-up field prints to the architect.

All prints and reproducibles shall be signed and dated by the both the general contractor and the electrical contractor.

In addition to the above, provide "as-built" record documentation for shop drawings (and coordination drawings where applicable).

Maintenance Manuals

In addition to the requirements specified in Division 1 or other applicable project manual sections, include the following.

Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

Manufacturer's printed operating procedures shall include start-up, break-in, normal operating instructions, regulation, control, stopping, shutdown, and emergency instructions.

Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

Provide a minimum of three neatly bound (3-ring binder) copies of maintenance and instruction (O & M) manuals, including a parts list pertaining to all equipment furnished and/or installed by the electrical contractor. Submit to owner's representative for review.

Manuals shall be bound in hard cover, post type binders.

Manuals shall contain the following as a minimum:

- 1) Index, typed at front w/typed tabs for each section;
- 2) Lists of all materials and equipment furnished with name, address and telephone number of vendor;
- 3) Itemized list of each piece of mechanical equipment having electrical connections with circuit and panelboard locations. Also list with each item any related expendable equipment required such as fuse size and type, pilot lights, Cat. no. of magnetic starter overload, etc.;
- 4) Operating Instruction Manuals and Service Manuals for all equipment furnished by the Electrical Contractor;
- 5) A complete set of final approved shop drawings as submitted during construction;
- 6) An itemized list of each fixture type with catalog number of replacement lamps and ballasts.
- 7) A complete spare parts schedule for all components of all equipment furnished and/or installed under this contract; the schedules shall not be factory generic information, but shall be complete and accurate for the equipment actually provided.
- 8) A complete set of detailed wiring diagram and schematic drawings for all components of all systems furnished and/or installed under this contract; the drawings shall not be factory generic information, but shall be complete and accurate for the equipment actually provided.

Guarantee

The contractor shall provide a guarantee in written form stating that all work, materials, equipment and parts shall be free of defect for a period of one year from the date of owner's final acceptance, and shall repair, revise or replace at no cost to the owner any such defects occurring within the guarantee period.

Contractor shall also state in written form that any items or occurrences arising during the guarantee period will be attended to in a timely manner and will in no case exceed four (4) working days from date of notification by owner.

Any defective items or work shall be removed and replaced at the contractor's expense and to the satisfaction of the owner's representative and the Engineer.

END OF SECTION

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SECTION 16020

BASIC ELECTRICAL MATERIALS AND METHODS

EXPLOSIVES

Use of explosives shall not be permitted.

WELDING

Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel." Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

HEIGHT OF BOXES

Outlet mounting heights as indicated on the plans are approximate to be used for bidding purposes only. The exact mounting height of outlets shall be determined in the field with relation to architectural detail and equipment being served. It shall be the responsibility of the electrical contractor to coordinate outlet location with equipment, with furniture plans and with architectural elevation plans. Where mounting heights are not detailed or dimensioned, contact the owner's representative for direction.

Prior to rough-in, coordinate final mounting heights of all system outlet boxes in field with Owner's representative. Height of boxes from finished floor to center of boxes shall be as follows, unless directed otherwise in field or otherwise noted on plans.

Switches	4'0"
Receptacles	
Counters	3'8" (verify)
Elsewhere	1'6"
Telephone Outlets	
Desk Phone	1'6"
Wall Phone	4'0"
Data Outlets	1'6"
Starters	4'0"
Disconnects	4'0"
Circuit Breaker Panelboards	6'0" to top of panel,
Wall Mounted Lighting Fixtures	As noted on plans or as directed in field by Architect.
Fire Alarm Manual Pull Stations	3'10"
Fire Alarm Audio/Visual Alarm Indicating Devices	6'8"
Control Stations	4'0"
Other Outlets/Fixtures/Equipment	As directed by Arch.

Height of boxes dimensioned from ceiling as given above apply to rooms having ceilings 9' or less. In rooms having higher ceilings, these outlets shall be located as directed in the field.

ACCESS DOORS

Access doors shall not be used unless special prior written permission is granted from the Owner's representative. All pull boxes, junction boxes, etc. shall be installed in areas which are readily accessible

after completion of construction. Pull boxes and junction boxes shall not be installed above gypsum board or similar ceiling systems.

For installation in masonry, concrete, ceramic tile, or wood paneling provide 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors. For gypsum wallboard or plaster provide perforated flanges with wallboard bead. For full-bed plaster applications provide galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.

Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces. Adjust hardware and panels after installation for proper operation. Locking Devices shall be flush, screwdriver-operated cam locks.

Provide factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces. Frames shall be 16-gage steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling. Standard Flush Panel Doors shall be 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint. Fire-Rated Units shall be insulated flush panel doors, with continuous piano hinge and self-closing mechanism.

Subject to compliance with requirements, provide products by one of the following:

Bar-Co., Inc.
J.L. Industries.
Karp Associates, Inc.
Milcor Div. Inryco, Inc.
Nystrom, Inc.

ELECTRICAL INSTALLATIONS

All electrical work installed in finished areas shall be concealed. All electrical work installed in unfinished areas may be exposed at the discretion of the Owner's representative. Where exposed conduit and boxes are installed in areas which are already finished, such work shall be painted by the electrical contractor to match adjacent surfaces as directed in field.

Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work.

Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible.

Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and architectural/structural components.

Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations.

Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

Verify all dimensions by field measurements. Take measurements and be responsible for exact size and locations of all openings required for the installation of work. Figured dimensions are reasonably accurate and should govern in setting out work. Where detailed method of installation is not indicated or where variations exist between described work and approved practice, direction of the owner's representative on job shall be followed. Where applicable, remove and/or relocate any existing electrical work conflicting with new construction.

Branch subfeeder circuits shall be installed as shown on the plans. The symbols used to indicate the purpose of which the various outlets are intended are identified in the Legend. Where outlets are indicated by letters on plans, they shall be controlled by corresponding switches.

No wire size smaller than No. 12 shall be used for any branch circuit unless otherwise noted on plans for control circuits. Larger sizes shall be used where required and/or indicated on the plans. Minimum conduit size shall be 3/4".

Device or fixture outlets shall not be installed directly back to back, where located on opposite sides of common walls.

All wires shall be run continuous from outlet to outlet and all joints shall be properly spliced. Insulation value of joints shall be 100% in excess of that of the wire. Mechanical wire splicers may be used. Friction and rubber tape shall conform to Federal Specifications HH-T-11 and HH-T-111. Plastic electrical tape shall be Scotch #33 or approved equal. The conductors terminating at each wired outlet shall be left not less than 8" long at their outlet fittings to facilitate installment of devices of fixtures.

If during construction it becomes apparent that certain minor changes in layout will effect a neater job or better arrangement, such alterations shall be made a part of the contract. Engineer's review shall be obtained before making such changes.

Workmanship throughout shall conform to the standards of best practice. Marks, dents or finish scratches will not be permitted on any exposed materials, fixtures or fittings. Inside of panels and equipment boxes shall be left clean.

COORDINATION

Coordination shall commence immediately upon award of contract. Failure of this contractor in coordinating (including providing related information to other trades for review) in a timely manner, shall not result in any subsequent additional reimbursement, special allowances or additional construction time being made for any facet of the project. Any work fabricated or installed before properly coordinating with all other trades will be done at this contractor's risk.

Plans are diagrammatic indicating design intent and indicating required size, points of termination and, in some cases, suggested routes of raceways, etc. However, it is not intended that drawings indicate fully coordinated conduit routing, all necessary offsets, etc. All ductwork, piping, conduit, raceways, cable assemblies, etc. shall be run as straight as possible and symmetrical (perpendicular to or parallel with) with architectural items. Work installed diagonal to building members shall not be permitted.

The contract document drawings are an outline to indicate the approximate location and arrangement of ductwork, piping, equipment, outlets, raceways, cables, etc. The drawings shall be followed as closely as possible in coordination and in execution of the work.

The electrical contractor shall work in harmony with all building contractors and sub-contractors, so as not to cause any delays in pouring concrete, building masonry walls, etc. The location of risers and branch conduits are approximate, but owing to the lack of space in some instances, the all trades must work in harmony to insure space and satisfactory arrangement for all work to be installed under this contract. The

electrical contractor shall consult the Architectural, Plumbing, HVAC and Structural plans in all instances before installing his work so that his piping will not interfere with those branches.

This contractor shall participate in coordination efforts and in preparation of coordination drawings prior to fabrication or installation of any equipment, materials, etc. Coordinate actual clearances of all installed equipment. Exact location of electrical outlets, lighting fixtures, conduits, raceways, equipment, cable assemblies, applicable devices, etc. and of mechanical equipment, piping, ducts, fixtures, diffusers, grilles, louvers, dampers, etc., shall be coordinated well in advance by all affected contractors so there will be no interferences at installation between the various trades. Ensure that work of all trades, as well as working clearances, in electrical rooms or spaces complies with NEC Article 110.

Conflicts in equipment and materials shall be corrected prior to installation. Should there be a conflict with drawings of other trades, this contractor shall work with the trades to correct the conflict while coordinating the project (prior to installation). If the conflict cannot be resolved, refer the matter to the owner's representative for a final decision as to method or material. This contractor shall refer to drawings of all other trades for details, dimensions and locations of other work and route their work so as not to conflict with any other branch. Any work installed or equipment placed in position by this contractor creating a conflict shall be readjusted to the satisfaction of the owner's representative at the expense of this contractor.

IDENTIFICATION

General

Submit manufacturer's data on electrical identification materials and products. Submit detailed nameplate schedule indicating proposed nomenclature, colors, text heights, fastening methods, etc. If requested by Owner's representative, submit samples of each color, lettering style and other graphic representation required for each identification material or system.

Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

Where identification is to be applied to surfaces which require finish, install identification after completion of painting.

Comply with governing regulations and requests of governing authorities for identification of electrical work.

Cable and Conductor Identification

Provide manufacturer's standard vinyl-cloth self-adhesive conductor markers of wrap-around type, either pre-numbered plastic coated type, or write-on type with clear plastic self-adhesive cover flap; numbered to show circuit identification. Provide on all conductors of all systems.

All conductors of all systems shall have color coded insulation. All cables of all systems shall have color coded jackets. Match color schemes with marking system used in existing systems (where applicable), shop drawings, contract documents, and similar previously established identification for project's electrical work. Apply cable/conductor identification on each cable in each box/enclosure/cabinet for cables which are not available with color coded insulation or jackets.

The following insulation color code shall be used for power system and voltage identification. This shall apply to both feeder and branch circuit wiring. Interchange of colors shall not be permitted. The use of Scotch color coding tapes for phase identification shall be permitted on feeder cables only (#4 AWG and larger).

208Y/120V System	-	Black, Red, Blue & White (neutral)
Equipment Grounding	-	Green
Electronic Ground	-	Green with Yellow tracer (neutral)

Raceway Identification

Provide manufacturer's standard self-adhesive vinyl tape not less than 3 mils thick by 1-1/2" wide. Unless otherwise indicated or required by governing regulations provide black lettering on orange base with minimum 1/2" high lettering. As a minimum, neatly install markers at each and every entry point to rooms, junction boxes, pull boxes, equipment connections, etc. Do not install these markers on exposed raceways in finished areas which will be occupied.

Where electrical conduit is exposed in spaces with exposed mechanical piping which is identified by color-coded method, apply painted color-coded identification on all electrical conduit, boxes, etc. in color schemes as indicated on the chart at the end of this section or as otherwise directed in field.

Emergency and Fire Alarm Systems

Provide permanent identification for all boxes, enclosures, etc. that are associated with emergency system work. All emergency and fire alarm system pull boxes, junction boxes, and other access/pull points shall be painted red (boxes and covers) by this contractor and shall be marked "EMERGENCY CIRCUITS" or "FIRE ALARM" as applicable. All emergency system equipment components, cabinets, enclosures, etc. shall be provided with red mechanically fastened engraved nameplates with the first line of text to read "EMERGENCY CIRCUITS" and the remaining lines to include the necessary descriptive text.

Underground Cable Identification

Provide manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide X 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried cable. During back-filling/top-soiling of each exterior underground electrical, signal or communication cable, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single line marker. Install line marker for every buried cable, regardless of whether direct-buried or protected in conduit.

All conductors/cables installed in manholes, grade mounted junction boxes and/or handholes shall be correctly identified and shall be tagged in each location with not less than two tags per cable, one near each duct through which the cable enters and leaves the hole. Tags shall be attached immediately after cable is installed. Tags shall be of non-corroding metal and shall be plainly marked (engraved).

Tags shall be circular in shape, 2 inches in diameter (minimum) and of not less than 0.020" thick copper or brass. Steel lettering dies, 1/4" minimum height of letters or figures, or the equivalent engraving process, may be used to mark the tags. The 14 copper wire tags shall be marked so as to contain an abbreviation of the name of the system/facility served by the cable. Verify all identification nomenclature in field prior to fabrication of tags. Attach all tags in strict accordance with manufacturer's recommendations.

The identification described below is shown for schematic purposes only. Where applicable, identify electrical primary loop at all manholes, JB's, building penetrations and at all switchgear. Electrical HV primary conduits shall be identified as to which switches (at either end of run) control same.

"P"	-	Power
"T"	-	Telephone
"C"	-	Control
"F"	-	Fire Alarm
"S"	-	Signal
"6"	-	600V Class

"1"	-	Under 100V Class of System
"A,B,C,N"	-	Phase or Neutral

Operational Identifications and Warnings

Provide pre-manufactured operational and/or warning signage if indicated on drawings and where required by NEC and/or the local authority having jurisdiction.

Engraved Plastic-Laminate Signs

Install signs at locations for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with stainless steel fasteners, except use permanent adhesive where fasteners should not or cannot penetrate substrate.

All equipment & system identification nomenclature shown on drawings or listed herein is shown for general design and installation reference only. The actual nameplate, etc. nomenclature for this project shall be verified by electrical contractor in field prior to fabrication and where applicable, shall be an extension of existing nomenclature used on the site as determined in field by electrical contractor. Record documents shall be prepared accordingly. Unless determined otherwise in field, provide text matching terminology and numbering of the contract documents and shop drawings.

Unless directed otherwise, provide black face and white core plies (letter color) for normal power applications and red face and white core plies (letter color) for emergency power applications, punched for mechanical fastening except where adhesive mounting is mandatory because of substrate. Provide 1/2" minimum text height for all equipment identification and 1/4" minimum text height for all nameplates with narrative descriptions/instructions. Thickness shall be 1/16", for units up to 20 sq. in. or 8" length; 1/8" for larger units. As a minimum provide signs for each unit of the following categories of electrical work where such work exists on the project.

- Electrical access panel doors.
- Starters and disconnects.
- Panelboards, electrical cabinets and enclosures.
- Control panels for all systems.
- Other similar equipment designated by owner's representative or engineer in field.

CUTTING, PATCHING AND SEALING

General

The electrical contractor shall do all cutting as required for the admission of his work. Any damage done by this contractor to the building during the progress of his work shall be made good at his expense. Unless directed otherwise in field, all patching and painting shall be provided by the electrical contractor.

Perform cutting, fitting, and patching of electrical equipment and materials required to:

- Uncover Work to provide for installation of ill-timed Work.
- Remove and replace defective Work.
- Remove and replace Work not conforming to requirements of the Contract Documents.
- Remove samples of installed Work as specified for testing.
- Install equipment and materials in existing structures.

Upon written instructions from the owner's representative, uncover and restore work to provide for observation of concealed work by owner's representative or by inspection authority having jurisdiction.

During cutting and patching operations, protect adjacent installations (structure, finishes, furnishings, etc.). Where applicable, provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to system components and components of other trades.

Patch existing and/or new finished surfaces and building components using new materials matching existing materials and using experienced installers. Refer to Division 1 for definition of experienced "Installer" or determine qualifications as directed in field by owner's representative.

Patching through fire rated walls and enclosures shall not diminish the rating of that wall or enclosure. All materials used for patching shall be installed to meet or exceed the smoke and fire rating of the respective surface being patched.

Neatly cut and drill all openings in walls and floors required for the installation. Secure approval of Owner's Representative before cutting and drilling in existing facilities. Neatly patch all openings cut.

Cutting and patching shall be held to a minimum by arranging with other contractors for all sleeves and openings before construction is started.

Provide factory-assembled watertight wall and floor seals, of types and sizes required; suitable for sealing around conduit, pipe, or tubing passing through concrete floors and walls. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.

Pipe sleeves shall be fabricated from Schedule 40 rigid, heavy wall, full weight galvanized steel pipe; remove burrs. Use sleeves which are two standard sizes larger than conduit passing through respective sleeve.

Provide sleeve seals for piping which penetrates foundation walls below grade, exterior walls or roofs, caulk between sleeve and pipe with non-toxic, UL-classified caulking material to ensure watertight seal. Elsewhere modular provide mechanical type seals, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

Install standard Schedule 40 black steel pipe sleeves two sizes larger than pipes passing through floors, bearing walls, fire walls and masonry construction. Sleeves through walls shall be cut flush with both faces. Sleeves through floor shall extend one inch above floor top elevation. Pipes penetrating roof shall use a pipe curb assembly equal to Pate Co. Furnish and set all forms required in masonry walls or foundation to accommodate pipes.

Grout

Provide non-shrink, nonmetallic grout, premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout, recommended for interior and exterior applications.

General Joint Sealer Application

Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.

Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

Clean all affected surfaces, joints, etc. immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.

Apply sealant primer to substrates as recommended by manufacturer. Protect adjacent areas from spillage and migration of sealant, using masking tape. Remove tape immediately after tooling without disturbing seal.

Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.

Comply with recommendations of ASTM C 962 for use of elastomeric joint sealers.

Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.

Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

Colors for exposed seals shall be as selected by the Owner's representative from manufacturer's standard colors.

Elastomeric Joint Sealers

One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.

One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.

Silicone Sealant shall be equal to the following:

- "Dow Corning 790", Dow Corning Corp.
- "Gesil N SCS 2600", General Electric Co.
- "Dow Corning 786", Dow Corning Corp.

Acrylic-Emulsion Sealants

One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications or interior and protected exterior locations involving joint movement of not more than plus or minimum 5 percent.

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

- "Chem-Calk 600", Bostik Construction Products Div.
- "AC-20", Pecora Corp.
- "Sonolac", Sonneborn Building Products Div.
- "Tremco Acrylic Latex 834", Tremco, Inc.

General Fire Stopping Material Application

Fire stopping requirements/locations are not indicated on electrical drawings. It shall be the responsibility of the electrical contractor to review all architectural and other drawings to determine fire/smoke rated walls and floors and rating requirements of same. Electrical contractor shall provide all required fire stopping work associated with all electrically related penetrations. Provide fire stop pillows, putty and/or sealant, as applicable, with minimum UL classification for 3 hour fire and cold side temperature ratings.

Clean all affected surfaces, joints, etc. immediately before applying fire stopping to comply with recommendations of manufacturer.

Comply with fire stop material manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.

Install fire stop materials, including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide fire-stops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

Caulk between sleeves and pipes with rockwool and caulk around sleeves with sealing compound. Material must meet all applicable fire ratings required.

Patch shall be equal to rockwool, firestop, caulk or approved "rated" patch.

Where a smoke and/or fire-resistance classification is indicated on architectural drawings or otherwise, provide the following as applicable.

Fire stop pillows, putty and/or sealant with minimum UL classification for 3 hour fire and cold side temperature ratings for all electrically related penetrations.

Access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating required; Provide UL Label on each fire-rated access door.

Wall & Floor Opening Fire Stopping for Work Likely to Require Ongoing Moves, Adds and Changes

Provide Fire Stop Putty equal to Nelson FSP #AA400 series, UL Classified for 3 hour fire and cold side temperature ratings, reusable when penetrating items are removed or added and requiring no special tools, mixing, curing or drying time.

Fire Stopping for All Other Wall and Floor Openings

Provide Fire Stop Sealant shall be equal to Nelson #AA491 series, UL Classified for 3 hour fire and cold side temperature ratings, non-sagging, permanently flexible, non-toxic, non-shrinking, water/air/smoke-tight and easily repenetrated.

The following shall be considered equal.

For Floor Openings:	Instant Firestop; 305-SL.
For Wall Openings:	Instant Firestop; 344-GG.
Mineral Felt:	Instant Firestop; Type MW.
For Insulated Pipes:	Instant Firestop; Type PI.
For Fill Areas:	Instant Firestop; C-1000.

Apply sealant primer to substrates as recommended by manufacturer (if any). Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

END OF SECTION

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SECTION 16030

SPECIAL ELECTRICAL SYSTEMS REQUIREMENTS

GENERAL

The system equipment suppliers shall provide complete design and installation drawings. These drawings shall show layouts, conduit sizes, number and types of cables/conductors required to all components and detailed wiring connections required at each type of device. The final vendor designs shall be in full compliance with requirements of all authorities having jurisdiction. In addition to the one year warranty required under Division 16 for all work, provide the following under base bid.

One year service contract (beginning after Owner's final acceptance of the work).

Cost of renewing each contract for an additional one, two and three year period at the Owner's option.

Unit prices (including Owner's discount) in "today's dollars" for all system components which could be affected by system expansions and by ongoing maintenance.

Provide all required design, accessories, devices, supplemental wiring, cable, programming etc. as required to render all systems fully operable. Each system shall be programmed, checked and tested by a certified factory technician. After making all tests and corrections, the systems shall be demonstrated to the Owner's Representatives and the authorities having jurisdiction.

Custom Programming, Configuration & Identification

All custom programming described below shall be provided for all programmable systems and all systems with any room number identifications which are required for successful system operation. Wherever the term "programming" is used below, it shall be taken to mean "programming, configuration and identification".

Custom programming shall be provided in full. Room names and numbers may change from architectural drawing names and numbers to actual Owner's room names and numbers. Provide all interim and permanent programming and configuration work under base bid.

All programming related services (including all required machine language, English language, etc.) associated with rendering all work fully operational shall be provided and neatly documented in detail by the respective vendors. Archive all intermediate and final programming work as required. Provide, replace and/or re-burn EPROM's and other integrated circuits as required.

All programming shall be custom and detailed to a level satisfactory to the Owner, including revised room numbers, revised room names, etc. Provide neatly typed orderly and logical submittal of proposed programming for review; prior to entering data, revise this submittal as much as required to satisfy the Owner. Determine specific requirements in field.

Provide programming for all auxiliary control and interface functions. Provide custom programming for all address labels. Provide detailed English language print statements for each system point/address and for each respective auxiliary control sequence. These print statements shall include as many characters, sentences, lines or paragraphs as required to provide extremely detailed descriptions of system status including any alarm or trouble condition and status of related auxiliary controls. The level of detail shall be

at the discretion of the Owner. Remote annunciators shall also include clear specific English language descriptions.

SOFTWARE UPGRADES

Latest release of system software shall be provided (furnished, installed and adapted) at no additional cost to base bid under the following conditions.

Year 2000 upgrades.

Upgrades at final close-out of project, where system software originally installed has been upgraded.

END OF SECTION

SECTION 16050
ELECTRICAL SITE WORK

SITE INFORMATION

Subsurface conditions may have been investigated during the design of the project. If so, reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information.

EXISTING UTILITIES

Locate existing underground utilities in excavation areas. Unless utilities are specifically indicated to be removed, support and protect services during excavation operations.

Remove existing underground utilities indicated to be removed.

Uncharted or Incorrectly Chartist Utilities: Contact utility owner immediately for instructions.

Provide temporary utility services to affected areas. Provide minimum of 48-hour notice to Owner's representative prior to utility interruption.

EXCAVATING AND BACKFILLING

Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.

Comply with all codes in jurisdiction. Provide slope sides, shore and brace as required for stability. Refer to Division 2, "Earthwork" for further requirements.

The contractor shall perform all excavation and backfilling required for his work and shall consult with utilities prior to beginning excavation.

Remove materials of every nature and description encountered in obtaining indicated lines and grades as shown on drawings. No extras will be allowed due to variations of proportion and the variation of materials.

All piping shall be laid on a bed of sand, 6" deep, well tamped into place and properly graded to permit the pipe to have an even bearing throughout its entire length.

Excess excavated earth materials shall be removed from the site.

All backfilling of excavation under concrete slabs, concrete drives and walks or blacktop surfaces shall be bankrun gravel. All excavations shall be compacted to prevent settling.

Roadways, walks and slabs	100%
Yard areas	95%

Compaction shall be performed in 12" lifts and spread evenly.

The contractor shall pay for all expenses for the proper restoration of all streets, sidewalks, concrete and blacktop surfaces broken for installing piping.

Excavation Definitions

Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.

Subbase: Subbase, as used in this Section, refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.

Subgrade: Subgrade, as used in this Section, refers to the compacted soil immediately below the slab or pavement system.

Unauthorized Excavation: Unauthorized Excavation, as used in this Section, consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Owner's representative.

Shoring and Bracing

Establish requirements for trench shoring and bracing to comply with local codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Slope sides of excavations to comply with local codes and ordinances. Shore and brace as required for stability of excavation.

Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.

Install sediment and erosion control measures in accordance with local codes and ordinances.

Dewatering

Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.

Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.

Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.

Material Storage

Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.

Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.

Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.

Trenching

Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of raceways and equipment.

Excavate trenches to depth indicated or required.

Limit the length of open trench to that in which installations can be made and the trench backfilled within the same day.

Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceways and equipment. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and electrical installations.

Cold Weather Protection

Protect excavation bottoms against freezing when atmospheric temperature is less than 35 deg F (1 deg 2 C).

Backfilling and Filling

Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.

Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.

Under building slabs, use drainage fill materials.

Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.

Other areas, use excavated or borrowed materials.

Backfill excavations as promptly as work permits, but not until completion of the following:

Inspection, testing, approval, and locations of underground utilities have been recorded.

Removal of concrete formwork.

Removal of shoring and bracing, and backfilling of voids.

Removal of trash and debris.

Placement and Compaction

Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of raceways and equipment by carrying material uniformly around them to approximately same elevation in each lift.

Compaction

Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.

Percentage of Maximum Density Requirements

Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 and not less than the following percentages of relative density, determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).

Areas Under Structures, Building Slabs and Steps, Pavements

Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for non-cohesive material.

Areas Under Walkways

Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.

Other Areas

Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.

Moisture Control

Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations.

Subsidence

Where subsidence occurs at electrical installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

Subbase Material

Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, or natural or crushed sand.

Drainage Fill

Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1-1/2-inch sieve, and not more than 5 percent passing a No. 4 sieve.

Backfill and Fill Materials

Materials complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP; free of clay, rock, or gravel larger than 2 inches in any dimension; debris; waste; frozen materials; and vegetable and other deleterious matter.

END OF SECTION

SECTION 16110

RACEWAYS

PART 1 - GENERAL

DESCRIPTION OF WORK

Types of raceways specified in this section include the following:

Electrical metallic tubing (EMT).
Rigid steel conduit.
Flexible metal conduit.
Liquid-tight flexible metal conduit.
Wireways.
Connectors.
Expansion Fittings.
Rigid nonmetallic conduit and ducts.

SPECIAL REQUIREMENTS

In addition to other contract document requirements, the following special requirements shall be strictly enforced.

All wiring of all systems shall be installed in conduit (sized per NEC, minimum 3/4"). The only permitted exceptions shall be where specifically permitted otherwise under Section 16120 and Section 16880.

All wiring for different power voltages shall be installed in raceway systems separate from each other (i.e. 24V separate from 208Y/120V, etc.).

All wiring for the various electrical systems shall be installed in raceway systems separate from each other (i.e. fire alarm separate from telephone/data separate from etc.).

Conduits shall not be installed within slabs.

Unless special case by case permission is granted in the field, no conduit shall be installed beneath slabs on grade, except where specifically indicated otherwise on drawings and where installed a minimum of 24" below the bottom of the slab.

All conduit installed indoors above the slabs shall be steel as specified hereafter; all fittings for same shall be steel, as specified hereafter, with insulated throats.

Conduit runs exceeding 100 feet in length or having in excess of three 90 degree turns shall be provided with pull boxes.

Conduit fill shall not exceed 40 percent or per NEC, whichever is less.

Refer to Section 16020 for raceway related identification requirements.

Normal system power feeders and branch circuits shall be installed in separate raceways from emergency system (battery-pack output) power.

PART 2 - PRODUCTS

Electrical Metallic Tubing (EMT)

EMT shall be FS WW-C-563, ANSI C80.3 and UL 797, galvanized or zinc coated steel.

Use galvanized or zinc coated steel compression or set-screw fittings, concrete-tight as manufactured by Steel City, T & B, Regal or Efcor.

Except where indicated otherwise herein, under other Division 16 sections or on drawings, all conduit shall be EMT.

Rigid Steel Conduit

Provide rigid steel, heavy wall, full weight, zinc-coated, threaded type (galvanized after cutting/threading) conforming to ANSI C80.1 and UL 6. Provide zinc coating fused to inside and outside walls.

Use galvanized or zinc coated steel threaded fittings.

Provide for the following applications.

Indoor conduit installed embedded in concrete or masonry.

All conduits which turn up from below grade or below slab (including the 90 degree fittings which connect to conduits 24" below grade/slab).

Other applications as indicated in contract documents or as otherwise required for special physical protection (nearby vehicular/equipment traffic, site maintenance equipment, etc.).

FLEXIBLE METAL CONDUIT

Flexible metal conduit shall be FS WW-C-566 and UL 1. Formed from continuous length of spirally wound, interlocked zinc-coated or galvanized (inside & outside) strip steel.

Provide conduit fittings for use with flexible steel conduit of threadless hinged clamp type and insulated throats.

Straight Terminal Connectors shall be one piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.

45 deg. or 90 deg. Terminal Angle Connectors shall not be used for flexible or water-tight flexible metal conduit in locations which will not be fully accessible after completion of construction.

Where applicable provide flexible metal conduit for the following applications:

- 1) Conduits within movable partitions.
- 2) Final 72" from outlet/junction boxes to recessed lighting fixtures which are located in accessible ceiling systems; optionally, AC/MC cable may be used for "fixture whips" (refer to Section 16120).
- 3) Final 24" of connection to motors or control items subject to movement or vibration.
- 4) In cells of precast concrete panels.

Provide full size insulated green ground wire for all applications, regardless of length.

Liquid-Tight Flexible Metal Conduit

Provide liquid-tight flexible metal conduit; construct of single strip, flexible, continuous, interlocked, and double-wrapped steel; galvanized inside and outside; provide smooth-wall liquid-tight jacket of flexible polyvinyl chloride (PVC).

Liquid-Tight Flexible Metal Conduit Fittings shall be FS W-F-406, Type 1, Class 3, Style G. Provide cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated, or noninsulated throat.

Straight Terminal Connectors shall be one piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.

45 deg. or 90 deg. Terminal Angle Connectors shall be two-piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut. 45 deg. or 90 deg. Terminal Angle Connectors shall not be used for flexible or water-tight flexible metal conduit in locations which will not be fully accessible after completion of construction.

Where applicable provide flexible metal conduit for the following applications:

- 1) Provide for connections from wall outlet boxes/raceways to all furniture systems.
- 2) Provide for same applications as listed above for flexible metal conduit where subject to moisture or corrosive conditions.

Provide full size insulated green ground wire for all applications, regardless of length.

WIREWAYS

Provide electrical wireways of types, grades, sizes, and number of channels for each type of service as indicated. Provide complete assembly of raceway including, but not limited to, couplings, offsets, elbows, expansion joints, adapters, hold down straps, end caps, and other components and accessories as required for complete system.

Construct lay-in wireways with hinged covers, in accordance with UL 870 and with components UL-listed, including lengths, connectors, and fittings. Select units to allow fastening hinged cover closed without use of parts other than standard lengths, fittings and connectors. Construct units to be capable of sealing cover in closed position with sealing wire. Provide wireways with knockouts.

Provide wireway connectors suitable for "lay-in" conductors, with connector covers permanently attached that removal is not necessary to utilize the lay-in feature.

Protect sheet metal parts with rust inhibiting coating and baked enamel finish. Plate finish hardware to prevent corrosion. Protect screws installed toward inside of wireway with spring nuts to prevent wire insulation damage.

CONNECTORS

All steel connectors of all sizes shall have insulated throats. Where insulated throats are not available for a particular size, provide threaded bushings.

EXPANSION FITTINGS

Provide expansion fittings and appropriate couplings in raceways wherever structural expansion joints are crossed, wherever deflection is expected and as otherwise required. All expansion fittings shall be provided with ground bonding jumpers.

Provide OZ Type AX expansion fittings. Where deflection is expected, provide Crouse-Hinds XC couplings.

RIGID NONMETALLIC CONDUIT AND DUCTS

Electrical Plastic Conduit

Electrical plastic conduit shall be equal to Carlon Plus 40, Heavy Wall EPC Type EB-35.

Electrical plastic conduit shall be heavy wall, Schedule 40, 90 C, construct of polyvinyl chloride and conforming to NEMA TC-2, UL listed and labelled for direct burial, concrete encasement or above ground use, and in conformity with NEC Article 347.

Conduit Accessories

Provide conduit/duct accessories of types, sizes, and materials, complying with manufacturer's published product information, which mate and match conduit and tubing.

Duct Spacers ("chairs") shall be equal to Carlon #S288*L series for base spacers and #S289*L series for intermediate spacers (minimum of 3" spacing from outside wall of conduit to any other conduit and to outside of concrete encasement).

Horizontal elbows for service entrance conduits shall be maximum 45 degree, minimum 24" radius; provide larger minimum radius if directed in field. Provide multiple units as required to obtain required offset (i.e. provide two 45 degree elbows to obtain a 90 degree offset).

All other elbows shall be maximum 90 degree, minimum 24" radius; provide larger minimum radius if directed in field.

Provide all other couplers, adapters, "O" rings, sealing, etc. as required.

Unless noted otherwise in contract documents, provide for all horizontal conduit runs below grade and for other applications as indicated in contract documents.

Installation

Install at minimum of 24" below grade to top of conduit.

Such applications shall be securely mounted on chairs and shall be encased in concrete where located below areas subject to vehicular traffic, with base of bank in newly disturbed earth, as indicated in contract documents or as otherwise required. All extensions (including final 90 fittings) from 24" below grade to above grade shall be made using matching rigid steel conduit sweep elbow below grade and grounded rigid steel conduit extension.

Underground plastic ducts shall be electrical schedule 40 PVC. Encasement shall not be less than 4" thick on all sides and separation shall not be less than 4". Necessary excavation framework and concrete work for the underground work shall be done by the Electrical Contractor. Ducts shall be properly aligned on

chairs before concrete is poured. Provide not less than four properly located no. 4 reinforcing rods in all encased runs. Materials shall be Orangeburg, McGraw-Edison or Kyova.

Install miscellaneous fittings that have been specifically designed and manufactured for their particular application. Provide heavy nylon pull cord (200# minimum strength) in all empty conduits.

Make changes in direction of raceway run with proper fittings, supplied by raceway manufacturer. No field bends of raceway sections will be permitted unless required radius exceeds that available from manufacturer where field bends shall be made using factory kit per factory instructions.

Properly support and anchor raceways for their entire length with factory base and intermediate spacers. Provide spacers at each coupling location, each termination location and at maximum five foot intervals between. Raceways shall not span any space unsupported.

Install end bells to provide rounded pulling surfaces at all manholes, pull boxes and other end points of underground raceways. Seal all joints with Carlon Cement.

Make solvent cemented joints in accordance with recommendations of manufacturer. Install PVC conduits in accordance with NEC and in compliance with local utility practices.

Provide full parity size green insulated ground wire in all PVC runs except for those used exclusively for optical fiber cables.

Conduit Bodies

Provide galvanized cast-metal (steel) conduit bodies of types, shapes and sizes as required to fulfill job requirements and NEC requirements. Construct conduit bodies with threaded-conduit-entrance ends, removable covers, either cast or of galvanized steel, and corrosion-resistant screws.

PART 3 - EXECUTION

General

Provide conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) for each service indicated. Where types and grades are not indicated, provide proper selection determined by Installer to fulfill wiring requirements, and comply with applicable portions of NEC for raceways.

Install concealed conduits in new construction work, either in walls, slabs, or above hung ceilings. Run conduits concealed in existing work where practicable. Where conduits can not be concealed in finished areas, use surface metal raceways.

Mechanically fasten together metal conduits, enclosures, and raceways for conductors to form continuous electrical conductor. Connect to electrical boxes, fittings and cabinets to provide electrical continuity and firm mechanical assembly. Conduit shall be continuous between outlets to make a complete installation and to effect a continuous ground.

Use of dissimilar metals shall be avoided throughout the systems to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.

Install miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs that have been specifically designed and manufactured for their particular application.

Use rough-in dimensions of electrically operated equipment furnished by equipment supplier. Set conduit and boxes for connection to equipment only after reviewing dimensions and after coordinating with other trades.

Provide heavy nylon pull cord in all empty conduits.

Properly support and anchor raceways for their entire length by structural materials. Raceways are not to span any space unsupported. See Section 16150.

Use boxes as supplied by raceway manufacturer wherever junction, pull or device boxes are required. Standard electrical "handy" boxes, etc. shall not be permitted for use with surface raceway installations.

Level and square raceway runs, and install at proper elevations and heights.

Wherever possible, install horizontal raceway runs above water and steam piping.

Cut conduits straight, properly ream, and cut threads for heavy wall conduit deep and clean.

Field-bend conduit with benders designed for purpose so as not to distort nor vary internal diameter.

Fasten conduit terminations in sheet metal enclosures by 2 locknuts, and terminate with bushing. Install locknuts inside and outside enclosure.

Conduits shall not cross shafts, or ventilating duct openings.

Keep conduits a minimum distance of 12" from parallel runs of flues, hot water pipes or other sources of heat.

Support riser conduit at each floor level with clamp hangers.

Use of running threads at conduit joints and terminations is prohibited. Where required, use 3-piece union or split coupling.

Complete installation of electrical raceways before starting installation of cables/wires within raceways.

Conduit shall be cleaned inside before any wires are pulled. Conduit ends shall be capped and plugged with standard accessories as soon as conduit has been permanently installed. Conduit installed without conductors shall be provided with heavy nylon drag line for pulling.

All joints shall be made tight with water tight couplings matching conduit and all corners shall be made with long radius, except conduit sizes 1" and over where standard elbows may be used. The ends of all conduit shall be cut square and reamed and all joints brought to a shoulder.

Suitable supports and fasteners shall be provided for conduit.

Exposed conduit shall run parallel to walls and plumb on walls. Secure to walls or ceiling with pipe straps at intervals not exceeding six feet.

Conduit shall be supported by approved straps, fasteners and hangers. Hangers shall be suspended from rods. Perforated strap will not be acceptable. Fasteners shall be lead expansion shields in block or concrete, toggle bolts in hollow walls, machine screws on metal surface and wood screws on wood construction.

Conduit passing thru structural members shall be provided with sleeve in member.

Where moisture conditions are encountered, a hole shall be drilled at the lowest point in the conduit run so that drainage will not interfere with conditions below.

Conduit capped at wall for future additions shall extend not more than threads length past wall. Electrical metallic tubing shall extend not more than 3/4" past wall.

Concealed Conduits Below Slab or Grade

Necessary excavation framework and concrete work for the underground work shall be performed by the Electrical Contractor. Concrete used in construction of duct bank envelopes, junction box envelopes and hand hole envelopes shall conform to the structural concrete used in the building (3000 psi minimum). Junction boxes and hand holes shall be constructed in a manner similar to manholes and shall be of the dimensions shown on drawings or as determined in field.

Metallic raceways installed underground or in floors below grade, or outside shall have conduit threads painted with corrosion inhibiting compound before couplings are assembled. Draw up coupling and conduit sufficiently tight to ensure water tightness. Where metallic conduits are used below grade, use rigid steel.

Underground conduit shall be a minimum of 24" below finished grade to top of conduit.

Provide minimum 4" separation and 4" envelope encasement of concrete (reinforced with minimum of four #4 re-bars) where indicated on drawings.

Where conduits are run in cinders or cinder concrete, they shall be protected by a casing of concrete to a thickness of not less than 4" (reinforced).

Underground conduit capped at wall for future additions shall extend 5' beyond building.

Excavation for exterior conduits shall be arranged so that

- a) The lines are straight and true;
- b) Grades required for drainage are maintained;
- c) The top of the concrete envelope for raceways is not less than 24" below finished grade.

Conduits in Concrete Slabs

Conduits shall not be installed within concrete slabs.

Exposed Conduits

Install exposed conduits and extensions from concealed conduit systems neatly, parallel with, or at right angles to walls of building.

Install exposed conduit work as not to interfere with ceiling inserts, lights or ventilation ducts or outlets.

Run conduits for outlets on waterproof walls exposed. Set anchors for supporting conduit on waterproof wall in waterproof cement.

Above requirements for exposed conduits also apply to conduits installed in space above hung ceilings, and in crawl spaces.

Conduit Fittings

Install locknuts for securing conduit to metal enclosure with sharp edge for digging into metal, and ridged outside circumference for proper fastening.

Bushings of standard or insulated type shall have screw type grounding terminal.

Miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs shall be specifically designed for their particular application.

END OF SECTION

SECTION 16120
WIRES AND CABLES

PART 1 - GENERAL

SUMMARY

This Section includes wires, cables, and connectors for power, lighting, signal, control and related systems rated 600 volts and less.

Refer to Section 16110 for special raceway related requirements.

PART 2 - PRODUCTS

MANUFACTURERS

Subject to compliance with requirements, provide products by one of the following:

Wire and Cable:

American Insulated Wire Corp.
Brintec Corp.
Cablec.
Carol Cable Co. Inc.
General Cable.
Senator Wire and Cable Co.
Southwire Company.

Connectors for Wires and Cable Conductors:

AMP
3M Company
O-Z/Gedney Co.
Square D Company.

General

Provide wire and cable suitable for the temperature, conditions and location where installed.

Conductors

Provide stranded conductors for all sizes unless indicated otherwise.

Conductor material shall be copper for all wires and cables.

Conductor sizes indicated are based on copper. Minimum conductor size shall be #12 AWG.

Distances from panel to first outlet of a 15 or 20 ampere branch circuit shall require the following minimum wire size to the first outlet.

Distance	AWG Wire Sizes
Up to 100 feet	#12
100 to 200 feet	#10
More than 200 feet	# 8

All branch circuits more than 200 feet in length shall be minimum No. 10 to the last outlet. Control circuits shall be No. 14 except for runs exceeding 300 feet where they shall be No. 12.

Install all wire in raceway.

All conductor insulation shall be rated at 600VAC/90 deg. C.

Provide THHN/THWN insulation for all conductors size 500 kcmil (MCM) and larger, and No. 8 AWG and smaller. For all other sizes provide THW or THHN/THWN insulation as appropriate for the locations where installed.

Provide XHHW insulation for isolated power systems, for all wiring below grade and/or for all wiring subject to moisture conditions.

Color Coding for phase identification shall be in accordance with Division 16 Section 16020.

TYPE AC/MC CABLES

Type AC and MC Cables shall be 90 deg. C. rated with all components and fittings listed for grounding and compliant with the following.

- a) NEC Articles 250 (including 250-91(b), 333 and 517 (including 517-13).
- b) UL Std.4 and UL Std. 83.
- c) ANSI E119 and E814.

Cable shall be formed from continuous length of spirally wound, interlocked zinc-coated or galvanized (inside & outside) strip steel. All conductors shall be rated for 90 deg. C. minimum. Provide with full parity sized green insulated equipment ground conductor.

Provide compatible steel fittings with integral red plastic insulated throat bushings, compliant with NEC 350-5.

Type AC and MC cable may be utilized only where NEC approved, where approved by local authority having jurisdiction and where prior approval is given by engineer. Utilize Type AC or MC cable only for the following limited applications.

Final connection to lighting fixtures which are installed in accessible tile ceiling systems (limited to 6' maximum in length).

New 15 or 20 ampere branch circuit drops to outlets in existing hollow partitions for remodeling work. This shall apply only under the following circumstances.

- a) Limited to 10' maximum cable length.
- b) And, only where Owner or Architect specifically directs contractor not to slot walls.
- c) And, only where installed for normal utility circuits (not emergency circuits).

Portable Cord

Portable Cord shall be Type S. Provide with full parity sized insulated equipment ground conductor.

Type S Portable Cord may be used for flexible pendant leads to outlets and equipment where indicated and only where NEC approved, where approved by local authority having jurisdiction and where prior approval is given by engineer.

CONNECTORS FOR CONDUCTORS

Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

CABLE JACKETS

Provide color coded factory-applied heat and moisture resistant PVC compound with external heat and light stabilized nylon jacket, tightly applied.

Provide conduit or plenum-rated cables for all cables passing through any air plenum ceiling cavities, etc.

SYSTEMS CABLES

Refer to respective Division 16 Section and/or to drawings. Whether or not specified on electrical documents, all necessary systems cables shall be provided under base bid as required to render all systems fully operable. Determine specific system cable requirements from respective vendor/supplier prior to bidding.

PART 3 - EXECUTION

GENERAL INSTALLATION

Wires #6 AWG and larger shall be connected to panels and apparatus by means of approved lugs or connectors large enough to enclose all strands of the conductors. Connectors shall be of the solderless type.

Solderless connectors shall be O.Z. Type XW or XTP of proper size and type required with Bakelite covers and stainless steel spring clips.

Solderless lugs shall be O.Z. Type XL of proper size as required.

Raceways shall be complete before wires are installed. No wire shall be pulled until plastering is complete and raceways are free of moisture.

Joints or splices shall be permitted only at NEC approved panels, junction boxes or accessible outlet boxes.

Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary.

Use pulling means including, fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.

Conceal all cable in finished spaces.

Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours, where possible.

Keep conductor splices to minimum.

Install splice and tap connectors which possess equivalent or better mechanical strength and insulation rating than conductors being spliced. Use splice and tap connectors which are compatible with conductor material.

All wires shall be run continuous from outlet to outlet/fixture to fixture. Insulation value of joints to be 100% in excess of wire.

If wire splicing is required in new or existing grade J.B.'s, factory splice kits (U.L. approved for submersion in water and direct burial) shall be used.

Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than no 10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.

END OF SECTION

SECTION 16130

ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

DESCRIPTION OF WORK

Types of electrical boxes and fittings specified in this section include the following:

- Outlet boxes.
- Junction boxes.
- Pull boxes.
- Bushings.
- Locknuts.
- Knockout closures.

Refer to Section 16110 for further requirements regarding fittings, bushings, etc.

PART 2 - PRODUCTS

INDOOR BOXES

Outlet Boxes

Provide galvanized coated flat rolled sheet-steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations. Construct outlet boxes with mounting holes, and with cable and conduit-size knockout openings in bottom and sides. Provide boxes with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding.

Minimum size for all device outlet boxes shall be 4" square X 1-1/2" deep.

Outlet Box Accessories

Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations.

Device Boxes

Provide galvanized coated flat rolled sheet-steel non-gangable device boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations. Construct device boxes for flush mounting with mounting holes, and with cable-size knockout openings in bottom and ends, and with threaded screw holes in end plates for fastening devices. Provide cable clamps and corrosion-resistant screws for fastening cable clamps, and for equipment type grounding.

Device Box Accessories

Provide device box accessories as required for each installation, including mounting brackets, device box extensions, switch box supports, plaster ears, and plaster board expandable grip fasteners, which are compatible with device boxes being utilized to fulfill installation requirements for individual wiring situations.

Junction and Pull Boxes

Provide galvanized code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.

Manufacturers

Subject to compliance with requirements, provide interior outlet boxes of one of the following:

- Adalet;
- Appleton Electric;
- Bell Electric;
- Bowers;
- Eagle Electric Mfg Co., Inc.;
- Midland-Ross Corp.;
- OZ/Gedney;
- Pass and Seymour, Inc.;
- RACO;
- Hubbell;
- Thomas & Betts Co.;
- Thepitt.

RAINTIGHT OUTLET BOXES

Provide corrosion-resistant cast-aluminum raintight outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening electrical conduit, cast-metal face plates with spring-hinged watertight caps/doors (hinged on top) suitably configured for each application, including face plate gaskets and corrosion-resistant plugs and fasteners.

Provide weathertight outlets for interior and exterior locations exposed to weather or moisture.

Subject to compliance with requirements, provide raintight outlet boxes of one of the following:

- Appleton Electric;
- Arrow-Hart;
- Bell Electric;
- Eagle Electric Mfg Co., Inc.;
- Gould, Inc.;
- OZ/Gedney;
- Pass and Seymour, Inc.;

OUTDOOR JUNCTION AND PULL BOXES

Provide flush grade mounted junction/pull boxes, equal to "Composolite" "PC" Style #PC1212GD with #PC1212SB cover as manufactured by Quazite Corporation. If required provide larger sizes as necessary so as not to exceed 40 percent fill.

Enclosures shall be constructed of polymer concrete and reinforced by a heavy-weave fiberglass. Enclosures shall be resistant to sunlight exposure, weathering, chemicals and unaffected by freeze/thaw cycles. Enclosures shall be gasketed with stainless steel inserts and bolts. Covers shall be provided with minimum coefficient of friction of 0.5 and with factory logo for service type contained within.

Enclosures and covers shall be rated for a minimum of 20,800 lb. load over a 10" X 20" area (H2O loading) and designed and tested to temperatures of -50 deg. F. Minimum material compressive strength shall be 11,000 psi.

All outdoor mounted junction/pull boxes shall be flush grade mounted (level & plumb) and shall be encased in concrete in strict accordance with written factory recommendations.

All required conduit holes for these outdoor junction/pull boxes shall be provided in strict accordance with written factory recommendations.

Prior to rough-in of outdoor grade mounted junction/pull boxes, verify specific installation requirements with Owner's representative and engineer in field.

Subject to compliance with requirements, provide outdoor junction and pull boxes of one of the following:

- Appleton Electric;
- Bell Electric;
- Quazite;
- Spring City Electrical Mfg Co.

BUSHINGS, KNOCKOUT CLOSURES AND LOCKNUTS

Provide corrosion-resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

Subject to compliance with requirements, provide bushings, knockout closures, locknuts and connectors of one of the following:

- Adalet;
- AMP, Inc.;
- Arrow-Hart;
- Appleton Electric Co.;
- Bell Electric;
- Midland-Ross Corp.;
- Midwest Electric;
- OZ/Gedney Co.;
- RACO;
- Thomas & Betts Co., Inc.

PART 3 - EXECUTION

INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

Access doors shall not be used unless special prior written permission is granted from the Owner's representative. All pull boxes, junction boxes, etc. shall be installed in areas which are readily accessible after construction. Pull boxes and junction boxes shall not be installed above gypsum board, plaster or similar ceiling systems.

Provide knockout closures to cap unused knockout holes where blanks have been removed.
Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.

Boxes shall not be installed back-to-back in walls. Provide not less than 6" (150 mm) separation in general and not less than 24" separation in acoustic rated walls. Where outlet boxes are shown back-to-back on common walls, they shall be offset accordingly when installed.

Where outlet boxes occur in block, cinder or concrete block, facing tile or other material where such materials form the finished wall surface, the opening for the box shall be neatly cut and shall be of the same size that the standard size (i.e. not "midway" or "jumbo") cover plate will cover all parts of the opening.

Aluminum products shall not be installed in concrete.

Position recessed outlet boxes accurately to allow for surface finish thickness.

Round boxes shall not be used.

Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.

All box supports shall be independent of conduit.

Refer to Section 16150 for further supporting requirements.

Provide electrical connections for installed boxes.

Subsequent to installation of boxes, protect boxes from construction debris and damage.

The outlet, junction and pull box locations indicated on the drawings shall be considered approximate, and therefore, it shall be incumbent upon this contractor to study the general construction with relation to spaces and equipment surrounding each outlet.

All junction and pull boxes shall be recorded by this contractor on as-builts and shall be permanently marked and labeled (as directed by owner's representative in field) as to which types of electrical services are within. Refer to Section 16020 for further related requirements.

END OF SECTION

SECTION 16140
ELECTRICAL CONNECTIONS

PART 1 - GENERAL

DESCRIPTION OF WORK

Electrical connections are hereby defined to include connections used for providing electrical power, control or monitoring to equipment.

Refer to sections of all other Divisions and/or to drawings of all other trades for specific individual equipment power, control and/or signal requirements, which are work of this section.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS

Subject to compliance with requirements, provide products of one of the following (for each type of product):

Adalet-PLM Div, Scott and Fetzer Co.
Allen-Stevens Conduit Fittings Corp.
AMP Incorporated.
Appleton Electric Co.
Arrow-Hart Div, Crouse-Hinds Co.
Atlas Technologies, Inc.
Bishop Div, General Signal Corp.
Burndy Corporation.
Eagle Electric Mfg Co., Inc.
Electroline Mfg Co.
Gardner Bender, Inc.
General Electric Co.
Gould, Inc.
Harvey Hubbell Inc.
Ideal Industries, Inc.
Pyle National Co.
Reliable Electric Co.
Square D Company.
Thomas and Betts Corp.

MATERIALS AND COMPONENTS

General

For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, electrical solder, electrical soldering flux, heat-shrinkable insulating tubing, cable ties, solderless wire-nuts, and other items and accessories as needed to complete splices and terminations of types indicated.

Provide wires, cables, and connectors complying with Division-16 basic electrical materials and methods section "Wires and Cables".

Wires/Cables

Unless otherwise indicated, provide wires/cables (conductors) for electrical connections which match, including sizes and ratings, of wires/cables which are supplying electrical power. Provide copper conductors with conductivity of not less than 98% at 90 deg. C.

Connectors and Terminals

Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals and are recommended by equipment manufacturer for intended applications.

Electrical Connection Accessories

Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, wirenuts, cable ties, etc. as recommended for use by accessories manufacturers for type services indicated.

PART 3 - EXECUTION

INSTALLATION OF ELECTRICAL CONNECTIONS

Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

Maintain existing electrical service and feeders to existing facilities, unless otherwise indicated, or when authorized otherwise in writing by Owner, or Architect/Engineer. Provide temporary service during interruptions to existing facilities. When necessary, schedule momentary outages for replacing existing wiring systems with new wiring systems. When that "cutting-over" has been successfully accomplished, remove, relocate, or abandon existing wiring as indicated.

Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.

Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.

The electrical contractor shall connect all electrical equipment furnished under all branches as well as the equipment hereinbefore specified and/or equipment furnished by the owner.

Metal frames of all portable and stationary electricity heated and motor driven equipment shall be grounded by connecting frames to the grounded metal raceway.

The electrical contractor shall make the necessary electrical connections between the specified equipment and the junction box near equipment with flexible metallic conduit and matched connectors. No flexible conduit shall be exposed in finished areas.

Review contract documents of all other trades to identify all electrically operated/controlled equipment which shall be furnished and/or installed by the owner or by other trades.

Unless specifically directed otherwise in field, this contractor shall be responsible, under base bid, for providing all required electrical power, signal and/or control work to render such equipment (and associated ancillary components) fully operable (including relays, disconnects, starters, etc. as may be applicable).

Determine exact requirements in field from respective trade and/or manufacturer's representative.

END OF SECTION

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SECTION 16150
SUPPORTING DEVICES

PART 1 - GENERAL

It shall be the responsibility of the electrical contractor to supervise the installation of and pay for all additional members, wood or metal and labor which may be required to support any type of permanent or temporary electrical apparatus employed in the execution of the electrical contractor's work. Supports, anchors, sleeves and seals furnished as part of factory-fabricated equipment shall be provided as required.

PART 2 - PRODUCTS

Provide materials of the contractor's choice as required.

Provide supporting devices which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation; and as herein specified.

Provide clevis hangers for supporting rigid metal conduit; galvanized steel; with 1/2" dia. hole for round steel rod.

Provide riser clamps for supporting rigid metal conduit; galvanized steel; with 2 bolts and nuts, and 4" ears.

Provide galvanized steel rod reducing couplings, 1/2" x 5/8".

Provide galvanized steel clamps; 1/2" rod size.

Provide galvanized steel clamps, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2".

Provide one-hole conduit straps for supporting 3/4" rigid metal conduit; galvanized steel.

Provide two-hole conduit straps for supporting 3/4" rigid metal conduit, galvanized steel; 3/4" strap width; and 2-1/8" between center of screw holes.

Provide hexagon nuts for 1/2" rod size; galvanized steel.

Provide galvanized steel rods; 1/2" dia.

Provide offset conduit clamps for supporting rigid metal conduit; galvanized steel.

Provide 1/2" lead expansion anchors.

Provide springhead galvanized steel toggle bolts; 3/16" x 4".

Provide cable supports with insulating wedging plug for non-armored type electrical cables in risers; construct body of galvanized steel.

Provide U-channel strut system for supporting electrical equipment, 12-gage hot-dip galvanized steel, of types and sizes indicated; construct with 9/16" dia. holes, 8" o.c. on top surface, with standard green finish, and with the all necessary fittings which mate and match with U-channel.

PART 3 - EXECUTION

GENERAL

ALL ELECTRICALLY RELATED WORK SHALL BE SUPPORTED DIRECTLY FROM BUILDING STRUCTURAL MEMBERS. ELECTRICALLY RELATED WORK SHALL NOT BE SUPPORTED FROM DUCTWORK, DUCTWORK HANGERS, CEILING SUPPORTS, ETC. ALL CONDUITS (AND CABLE ASSEMBLIES, WHERE APPLICABLE) SHALL BE ROUTED PARALLEL TO BUILDING STRUCTURAL MEMBERS. ANY AND ALL NONCOMPLYING WORK INSTALLED BY THE ELECTRICAL CONTRACTOR SHALL BE REMOVED AND REINSTALLED TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE AND THE ENGINEER, AT THE EXPENSE OF THE ELECTRICAL CONTRACTOR.

Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports with spacings indicated and in compliance with NEC requirements.

Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment. Field welding shall comply with AWS "Structural Welding Code."

Stem lengths of all pendant fixtures shall be as directed by the owner's representative. All fasteners, hangers and method of hanging exposed work in finished areas shall be submitted to the owner's representative for review before installation.

Fasteners shall be zinc-coated, type, grade, and class as required.

WOOD SUPPORTS AND ANCHORAGE

Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.

Provide plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 3/4 inches. Provide marine grade plywood where subject to moisture conditions.

Provide Ackerman-Johnson (or equal) expansion screw anchors. Unless otherwise noted, board shall be painted with two coats of good grade weatherproof flat gray non-conductive fire-retardant paint on all sides and edges (prior to mounting) and plumbed in a true vertical position. Provide nominal 1" spacers between back of plywood and wall.

Unless directed otherwise in field, plywood equipment boards shall be provided for all surface mounted distribution and systems "head-end" equipment. Unless directed otherwise in field, boards shall be 8 feet high by width shown on drawings (as dimensioned or as scaled) or width as required to accommodate equipment.

Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members. Attach to substrates as required to support applied loads.

CONCRETE BASES/HOUSEKEEPING PADS

Concrete bases/housekeeping pads shall be installed by the electrical contractor beneath all electrical power and systems distribution equipment which is floor mounted or wall mounted within 4" of the floor. Extend the pads at least 4" beyond the bed or frame of the supported equipment. Bases shall be at least 4" thick and shall have straight and finished sides and a 1"-45 degree chamfer at the top perimeter. Reinforcing steel bars shall be placed in both directions of the bases. Where required for supplemental support, provide lateral support work to adjacent wall(s).

END OF SECTION

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SECTION 16160

GROUNDING

PART 1 - GENERAL

Minimum requirements for the all grounding related work shall be Article 250 (and all related articles/sections) of the latest edition of N.E.C. Grounding and bonding work is defined to encompass all systems, circuits, and equipment.

PART 2 - PRODUCTS

Subject to compliance with requirements, provide grounding and bonding product manufacturers of the contractor's choice.

Except as otherwise indicated, provide copper electrical grounding and bonding systems and materials; with assembly of materials, including, but not limited to, cables/wires, connectors, solderless lug terminals, grounding electrodes and plate electrodes, bonding jumper braid, surge arresters, and additional accessories needed for a complete installation. Where materials or components are not indicated, provide products which comply with NEC, UL, and IEEE requirements and with established industry standards for those applications indicated. Utilize compatible metallic materials throughout system to eliminate galvanic action.

Grounding electrodes shall be Steel with copper welded exterior, 3/4" dia. by 10 feet. Plate electrodes shall be sheet copper plate, 20-gage by 36" by 36", with 2 cable attachments sized for either 1/0 or 2/0 cables as required. Provide copper ground plates where ground rods cannot be used. Connections to ground electrodes shall be made at a point not less than 1 foot below grade level and not less than 2 feet away from foundations/footings. Weld grounding conductors to underground grounding electrodes where mechanical connections can not or should not be utilized.

Provide exterior mounted, watertight lightning/surge arrestor at each service disconnect location and install in strict accordance with manufacturer's recommendations.

PART 3 - EXECUTION

GENERAL

Terminate feeder and branch circuit insulated equipment grounding conductors with grounding lug, bus, or bushing. Route grounding connections and conductors to ground and protective devices in shortest and straightest paths as possible to minimize transient voltage rises.

Apply corrosion-resistant finish to field-connections, buried metallic grounding and bonding products, and places where factory applied protective coatings have been destroyed, which are subjected to corrosive action.

Install clamp-on connectors on clean metal contact surfaces, to ensure electrical conductivity and circuit integrity. Install braided type bonding jumpers with ground clamps on valved water piping where such piping penetrates fire walls. Install clamp-on connectors on clean metal contact surfaces, to ensure electrical conductivity and circuit integrity. All water pipe connector fittings shall make contact with the water pipe for a minimum distance of 1-1/2", measured along the axis, and having a minimum contact

surface area of 3 square inches. Install clamp-on connectors only on thoroughly cleaned metal contact surfaces, to ensure electrical conductivity and circuit integrity.

All ground conductors used for bonding shall be routed in protective conduit sleeves. Both ends of such conduit sleeves shall be provided with ground bushings which shall be bonded to enclosures and ground terminations at both ends via jumpers. Such ground jumper conductors shall be sized same as the respective ground conductor which is being protected within the respective conduit.

All ground potentials associated with the electrical distribution system, separately derived systems and steel structural related systems shall be equalized (bonded together) by the electrical contractor under this installation.

SERVICE ENTRANCE AND DERIVED SERVICE GROUNDING REQUIREMENTS

General

Each service feeder shall include a parity sized insulated grounded conductor (neutral), terminated and bonded to all service equipment (i.e. to each and every disconnect). This shall apply whether or not downstream loads require a grounded conductor/neutral. Such conductors shall be installed unspliced and unbroken.

All electrical service locations shall be provided with an external accessible means for intersystem ground bonding. Provide a minimum 8" X 8" X 4"D. junction box at each service location, with screw cover and knockouts as required. Provide a single ground bus (or lug block), bonded to J.B. and bonded to service ground with full parity sized green insulated ground conductor (sized same as service ground conductor). The ground bus shall contain quantity and size of lugs large enough to accommodate bonding to service ground plus 200 percent spare lugs. In addition, provide a minimum of 12 lugs, each rated at #14 AWG to #2/0 AWG. Lugs shall be UL listed for use with copper or aluminum conductors.

Connect together system neutral, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.

New Service Entrances

Connect grounding electrode conductors to 1-inch diameter, or greater, metallic cold water pipe at service entrance using a suitably sized ground clamp. Provide connections to flanged piping at street side of flange. Ground electrical service system neutral at service entrance equipment to grounding electrodes. Install braided type bonding jumpers with code-sized ground clamps on water meter piping to electrically bypass water meter(s) and service entrance valve(s).

Upon completion of installation of electrical grounding and bonding systems, test ground resistance with ground resistance tester. Where tests show resistance-to-ground is over 3 ohms, take appropriate action to reduce resistance to 3 ohms, or less, by driving additional ground rods and/or installing additional ground plates and/or by chemically treating adjacent soil; then retest to demonstrate compliance.

Derived Services (downstream from service entrance equipment).

Ground each separately-derived system neutral to effectively grounded structural steel member or effectively grounded metallic water pipe or to separate grounding electrode system as required per National Electrical Code. Connect grounding electrode conductors to 1-inch diameter, or greater, metallic cold water pipe using a suitably sized ground clamp.

END OF SECTION

SECTION 16210
WIRING DEVICES

PART 1 - GENERAL

SUMMARY

Refer to Section 16020 for requirements for legends to be engraved on wall plates.

Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards. Verify color selections with Owner's representative.

PART 2 - PRODUCTS

MANUFACTURERS

Subject to compliance with requirements, provide products by one of the following.

Receptacles:	Leviton, Hubbell, Bryant, Pass & Seymour.
Switches:	Leviton, Hubbell, Bryant, Pass & Seymour.
Dimmers:	Lutron.
Occupancy Sensors:	Watt Stopper Inc., Leviton, Tork, P & S.
Wall Plates:	Leviton, Hubbell, Bryant, Pass & Seymour.

WIRING DEVICE COLORS

Wiring device colors shall ivory.

RECEPTACLES

Standard Specification Grade Duplex/Single Receptacles

Duplex receptacles shall be equal to Leviton #5362 series.

Single receptacles shall be equal to Leviton #5361 series.

Clock hanger receptacles shall be equal to Leviton #5361-CH.

Provide self-grounding, duplex and single specification grade receptacles, 2-pole, 3-wire grounding, self-grounding, green grounding screw, ground terminals and poles internally connected to mounting yoke, color coded base, 20-amperes, 125-volts, with metal plaster ears, back & side wiring, NEMA configuration 5-20R.

Ground-Fault Interrupter Specification Grade Receptacles

Ground fault circuit interrupter duplex receptacles shall be equal to Leviton #6898 series.

Provide commercial specification grade, duplex receptacles, ground-fault circuit interrupters; feed-thru type, capable of protecting connected downstream receptacles on single circuit, grounding type UL-rated 943, Class A, Group 1, specification grade, 20-amperes rating (device & feed-thru), 125-volts, 60 Hz; with solid-state ground-fault sensing and signaling (maximum threshold of 5mA at 0.025 seconds maximum); equip with 20-ampere plug configuration, NEMA 5-20R.

Surge Suppression Specification Grade Receptacles

Surge suppressor duplex receptacles for standard applications shall be equal to Hubbell #5362_S series.

Surge suppressor quadruplex (4-plex) receptacles for retrofit isolated ground applications shall be equal to Hubbell #HBL420_S series with #HBL4AP_ surface mounted adapter plate for use on 1-gang or 2-gang outlet boxes.

Provide commercial specification grade, duplex receptacles, surge suppressor; feed-thru type, capable of protecting connected downstream receptacles on single circuit, grounding type UL-rated 1449 and 498; suitable for ANSI/IEEE C 62.41-1980 (IEEE 587 A & B), specification grade, 20-amperes rating (device & feed-thru), 125-volts, 60 Hz; with solid-state transient voltage surge sensing and suppression; power-on light, damage alert audible beeper; blue in color; equip with 20-ampere plug configuration, NEMA 5-20R. Where isolated ground surge suppression receptacle units are called for in contract documents, provide same unit as above except with isolated ground construction with factory triangular marking on face.

SWITCHES

Wall switches, in general shall be flush self-grounding with green ground screw and color coded cover, toggle type, back & side wired, specification grade, rated 20A, 120/277 volts, 1 HP at 120V, A.C. quiet type, equal to Leviton catalog numbers as follows:

Single pole, toggle:	1221-2 series.
Double-pole, toggle:	1222-2 series.
3-way, toggle:	1223-2 series.
4-way, toggle:	1224-2 series.

Locking type switches shall be same as above except with "L" suffix. Provide six keys.

DIMMER SWITCHES

Dimmer switches shall be specification grade, equal to Lutron "Nova T" (NT) series with thin profile and matching factory wall plates. Dimmer and wall plate colors shall be to match other wiring devices in the respective room.

Incandescent Lamp Dimmer Switches shall be solid state type, conforming to NEMA WD 1, modular dimmer switches for incandescent fixtures; switch poles and wattage as required to serve respective load, 120-volts, 60-Hz, with continuously adjustable slide control (down to off). Equip with filter to eliminate noise, RF and TV interference, and 5 inch wire connecting leads. Provide separate neutrals for the circuits which feed lighting served by dimmer switches. Do not break off side sections when ganging.

OCCUPANCY SENSORS

Occupancy sensor lighting switches for individual room applications shall be equal to Watt Stopper Inc. #WS-120 or WS-277 series as required. Install these sensors at standard switch heights and locations.

WIRING DEVICE WALL PLATES

Provide single and combination, of types, sizes, and with ganging and cutouts as required. Provide plates which mate and match with wiring devices to which attached. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates. Provide wall plate color to match wiring devices except as otherwise indicated. Provide wall plates with engraved legends where indicated on drawings and/or where required per Section 16020. Provide plates possessing the following additional construction features.

All device wallplates shall be standard size; "midway", "oversized" ("jumbo") or "extra deep" wallplates shall not be acceptable. Construct with metal screws for securing plates to devices; screw heads colored to match finish of plates.

Wallplates in finished areas shall be commercial specification grade, satin finish stainless steel, with beveled edges, equal to Leviton Type 430 series. Wallplates in unfinished areas shall be galvanized steel.

PART 3 - EXECUTION

INSTALLATION OF WIRING DEVICES AND ACCESSORIES

Install wiring devices only in electrical boxes which are clean; free from building materials, dirt, and debris.

Install galvanized steel wallplates in unfinished spaces.

Install wiring devices after wiring work is completed.

Install wall plates only after respective wall surfaces have received their final finish.

FIELD QUALITY CONTROL

Prior to energizing circuits, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity and grounding of connections is maintained. Subsequent to energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six times.

Test ground fault interrupter operation with both local and remote fault simulations in accordance with manufacturer recommendations.

END OF SECTION

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SECTION 16220

PEDESTAL COUNTERTOP OUTLETS

PART 1 - GENERAL

DESCRIPTION OF WORK

Types of electrical outlets specified in this section include the following:

Pedestal activation outlets
Outlet Accessories

PART 2 - PRODUCTS

MANUFACTURERS

Subject to compliance with requirements, provide outlets of one of the following:

Wiremold.
Hubbell.
Steel City.

PEDESTAL ACTIVATION OUTLETS

Outlet assemblies shall be as indicated on drawings. Provide watertight seals at bases of units.

OUTLET ACCESSORIES

Provide receptacles and plates as specified under Section 16210 and/or specialty communication related outlets/plates as required. Provide factory plates, adapters, inserts, extensions, nipples, flanges, mudcaps, rings, conversion kits, etc. accessories as required for complete working units for each application.

PART 3 - EXECUTION

INSTALLATION

Do not scale outlet locations from drawings. Determine exact locations of each outlet, case by case, after consulting with Owner and Architect and reviewing architectural documents so that outlets are properly located to accommodate the final furniture and equipment layouts.

The locations indicated on the drawings shall be considered approximate, and therefore, it shall be incumbent upon this contractor to study the general construction with relation to spaces and equipment surrounding each outlet.

Provide sealed knockout closures to cap unused knockout holes where blanks have been removed.

Install outlets in those locations which ensure ready accessibility to enclosed electrical wiring.

Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached.

All box supports shall be independent of conduit.

Refer to Section 16150 for further supporting requirements.

Provide electrical connections for installed boxes.

Subsequent to installation of boxes, protect boxes from construction debris and damage.

END OF SECTION

SECTION 16310
SERVICE ENTRANCES

PART 1 - GENERAL

DESCRIPTION OF WORK

Electrically related service entrances shall consist of the following.

Electrical Power Service.
Telephone Service.
CATV Service.

Electrical Power Service

The electric service shall consist of a pad mounted transformer as indicated on drawings, furnished by local utility company, with secondary voltage as indicated on drawings.

The electric contractor shall provide pad, primary ducts and secondary ducts and cable. Primary ducts shall consist of minimum two 4" conduits from terminal pole to pad. Provide a minimum of one spare secondary duct. Utility Company shall furnish and install primary cables, transformer and make all service transformer connections.

Metering shall be installed at the utility transformer in strict accordance with utility company requirements.

This contractor shall make all arrangements with the utility company to provide the service in strict accordance with regulations of utility company and of all authorities having jurisdiction. This contractor shall pay all related utility company charges and shall include same in bid.

Telephone Service

Provide empty conduits (minimum of two 4" conduits) with drag lines as shown on drawings or as otherwise directed by local telephone operating company for telephone service entrance to building. Terminate the service entrance conduits directly beneath the telephone plywood equipment board and stub up 4" above slab as directed by telephone company.

This contractor shall make all arrangements with the telephone company prior to rough-in to provide the service in strict accordance with regulations of telephone company and of all authorities having jurisdiction. This contractor shall pay all related telephone company charges, if any, and shall include same in bid. As a minimum, provide the following.

- a) Provide a minimum of 12" earth separation between telephone related conduits and other conduits (or minimum of 4" separation where encased in concrete).
- b) Telephone conduit shall be installed at a minimum depth of 24" and a maximum depth of 36". Provide record documentation.
- c) Provide minimum 200 lb. test pull line in all conduits.
- d) All bends shall be long sweeping bends with radii not less than ten times the internal diameter of conduit.

- e) Conduit entering the building interior shall extend not less than 4" above finished floor elevation.
- f) Provide a 4"W. X 8"H. X 3/4"D. plywood equipment panel (painted on all sides & edges with 2 coats of nonconductive, fire retardant paint - see Section 16150) within the building in a continually accessible, well lighted and environmentally clean room.
- g) Provide a double duplex receptacle (on dedicated circuit) on the plywood equipment board.
- h) Provide 1 #6 AWG green insulated ground conductor (in 3/4" EMT) from electrical service entrance ground junction box to telephone plywood equipment board. Terminate as directed by telephone company. Refer to Section 16160 for further requirements as relates to system grounding.

CATV Service

Provide empty conduit (minimum of one 3" conduit) with drag lines as shown on drawings, or as otherwise directed by local CATV operating company, for future CATV services.

This contractor shall make all arrangements with the CATV company prior to rough-in to provide the service in strict accordance with regulations of CATV company and of all authorities having jurisdiction. Terminate the service conduit adjacent to the telephone equipment board in the electrical equipment room on the lower level. Install the service conduit using parameters set forth above for the telephone service conduits.

PART 2 - PRODUCTS

Refer to applicable Division 16 Sections.

PART 3 - EXECUTION

INSTALLATION

Coordinate with other electrical work, including utility company wiring, as necessary to interface installation of service entrance equipment work with other work.

Where indicated in project manual or on drawings or where required by NEC, install ground-fault protection devices complying with electrical winding polarities indicated. Set field-adjustable GFP devices and circuit breakers for pickup and time-current sensitivity ranges as indicated, subsequent to installation of devices and CB's.

All service entrance conduits shall be provided with sweep L's and shall be properly sealed, immediately upon installation, to prevent water, moisture, dirt, rodents, insects, etc. from entering ducts.

Prior to trenching, during installation and at terminations, carefully coordinate installation of all service work with all affected utility companies, with the Owner's representative, with all other trades and/or affected parties and with all authorities having jurisdiction.

Provide tight system and equipment grounding and bonding connections for service-entrance equipment and wiring/cabling as required. Refer to Section 16160 for further grounding requirements.

END OF SECTION

SECTION 16320

TRANSIENT VOLTAGE SURGE SUPPRESSORS (TVSS)

PART 1 - GENERAL

SUMMARY

Specific Transient Voltage Surge Suppressor (TVSS) related work may not be indicated on drawings. Work indicated hereafter is intended to schematically describe all related work. All TVSS related work shall be included by electrical contractor under base bid.

The Electrical Contractor shall provide a complete TVSS installation. Verify all conditions in field.

All equipment described herein shall be the product of a manufacturer of established reputation and experience who has been in operation of sufficient length of time to establish proof of high quality, acceptable to the Owner.

The TVSS installation shall be Underwriter's Laboratory UL Standard 1449 Listed, CSA Certified and ANSI/IEEE C62.41-1980 compliant.

Submit manufacturer's TVSS data. Submittals shall include a tabulation of all system features and performance characteristics. If equipment other than that specified herein is proposed, the tabulation shall include line by line comparison of all data for the proposed equipment to the specified equipment. All characteristics shall meet or exceed those specified.

PART 2 - PRODUCTS

TRANSIENT VOLTAGE SURGE SUPPRESSION SYSTEM (TVSS)

General

Provide TVSS materials and components, that comply with manufacturer's standard design, in accordance with published product information.

Where TVSS components are provided with factory installed box connector fitting with factory leads, the leads shall not be spliced. All wiring shall be installed in strict accordance with manufacturer's recommendations.

Leviton equipment is listed below as the basis of design. Liebert and Advanced Protection Technologies (APT) shall be considered as an equal manufacturer.

Service Entrance Distribution Panel Mount 208Y/120V, 3 Ph., 4W Units

TVSS units shall be equal to Leviton #57120-M3. Provide one 30 Amp, 3 Pole branch circuit breaker. Connect the field phase leads to the breaker, the neutral lead to the neutral bar and the ground lead to the equipment ground bar. Provide flush mounted units where indicated on the riser diagram on the drawings.

Provide Remote Supervisor Unit equal to Leviton #52000-RS. Provide conduit and wiring (per manufacturer) as required to the remote location indicated on drawings. If location is not indicated on drawings, allow for a run 300 feet run from the TVSS location and determine exact location in field. In addition, provide conduit and wiring (per manufacturer) as required to the Building Automation System

(BAS) control panel; provide connections to contacts in the BAS control panel as directed by BAS supplier and TVSS supplier in field.

Branch Panel Mount 208Y/120V, 3-Phase, 4-Wire TVSS Units

TVSS units shall be equal to Leviton #42120-DY3. Provide one 30 Amp, 3 Pole branch circuit breaker. Connect the factory phase leads to the breaker, the neutral lead to the neutral bar and the ground lead to the equipment ground bar.

PART 3 - EXECUTION

INSTALLATION

Minimum requirements for grounding work shall be the latest edition of the National Electrical Code (NEC), including Article 250.

Coordinate with existing conditions as necessary to interface installation of TVSS.

Unless otherwise indicated on drawings, provide one appropriately rated TVSS unit for each service, distribution and branch panel. Provide flush mounted enclosures where protecting flush mounted distribution equipment.

Install conductors with direct paths to and from TVSS devices avoiding sharp bends, loops and excessive lengths. Factory leads shall not be spliced. Install TVSS components to the panelboard boxes as near as possible to the interior connection points; position the related branch breakers accordingly. Cut factory or field leads as required to minimize cable lengths.

Provide minimum of one year written full labor and materials warrantee covering installation and defective materials.

END OF SECTION

SECTION 16470

PANELBOARDS

PART 1 - GENERAL

SUMMARY

Types of panelboards and enclosures required for the project include the following.

Power-distribution panelboards.
Lighting and appliance panelboards.

PART 2 - PRODUCTS

MANUFACTURERS

Subject to compliance with requirements, provide panelboard products of one of the following (for each type and rating of panelboard and enclosure):

Square D Company.
General Electric Company.
Siemens/ITE.
Westinghouse/Cutler-Hammer.

PANELBOARDS

General

Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials; with the design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes, or ratings are not indicated, comply with NEC, UL and established industry standards for those applications indicated.

Panelboards shall be new and manufacturer's latest standard catalog design.

Panelboards shall bear UL labels for their specific applications.

Panelboards shall be suitable for service voltage with number of branch circuits of capacity scheduled. Unless otherwise indicated, panelboards and sections thereof, if any, shall have main lugs only of capacity equal to, or greater than, the rating or setting of the over the current protective device next back on the line.

The panelboards shall be arranged for their specific services as applicable to this project. In general, 20 amp circuits shall feed lighting and receptacles.

Panels shall incorporate branches as scheduled on the drawings.

All bus assemblies shall be copper.

All circuit breaker panelboard bus assemblies shall be of the distributed (sequence) bussing type throughout, so that any 2 adjacent single pole breakers and/or spaces shall be replaceable by a 2 pole internal common trip breaker, and any 3 adjacent single pole breakers and/or spaces shall be replaceable by a 3 pole internal common trip breaker, 15 amp through 70 amp inclusive, without disturbing any other breaker.

All panelboards shall be UL listed and labeled for use as service entrance equipment.

Power Distribution Circuit Breaker Panelboards

Provide dead-front safety type power distribution panelboards as indicated, with panelboard switching and protective devices in quantities, ratings, types, and with arrangement shown; with anti-turn solderless pressure type main lug connectors approved for use with copper conductors.

Equip with copper bus bars with not less than 98-percent conductivity, and with full-sized neutral bus; provide suitable lugs on neutral bus for outgoing feeders requiring neutral connections.

Provide molded-case main and branch circuit-breaker types for each circuit, with toggle handles that indicate when tripped. Where multiple-pole breakers are indicated, provide with common trip so overload on one pole will trip all poles simultaneously.

Provide panelboards with bare uninsulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturer as panelboards, which mate and match properly with panelboards.

Power distribution circuit breaker panelboards shall be equal to Square D I-Line, with bolt-on branch breakers.

Lighting and Appliance Circuit Breaker Panelboards

Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types and arrangements shown.

Provide with anti-burn solderless pressure type lug connectors approved for use with copper conductors. Construct unit with copper bus bars, full-sized neutral bar and with bolt-in type heavy-duty, quick-make, quick-break, single or multi-pole circuit-breakers, with toggle handles that indicate when tripped.

Provide suitable lugs on neutral bus for each outgoing feeder required; and provide bare uninsulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturer as panelboards, which mate and match properly with panelboards.

208Y/120V Lighting and Appliance panelboards shall be equal to Square D NQOD with bolt-on branch breakers.

Circuit Breaker Panelboard Enclosures

Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage, minimum 16-gage thickness.

Boxes shall have code size side and end gutters, minimum 4" constructed of code gauge galvanized steel. Boxes shall be 20" wide minimum and 5-3/4" deep minimum. Construct with multiple knockouts and wiring gutters.

Panelboard trims shall be flush or surface as required, constructed of code gauge steel, finished with rust inhibiting prime coat and then factory applied hot spray lacquer or baked-on enamel, manufacturer's standard light gray. Trims shall be complete with concealed hinges and concealed trim clamps, door with

flush chromium plated combination cylinder lock and catch and directory suitable for glass or clear plastic. All locks shall be keyed alike. Directory shall be typewritten.

Provide enclosures which are fabricated by same manufacturer as panelboards, which mate and match properly with panelboards to be enclosed.

Molded-Case Circuit Breakers

Provide factory-assembled, molded-case circuit breakers of frame sizes, characteristics, and ratings including RMS symmetrical interrupting ratings required. Provide breakers with permanent thermal and instantaneous magnetic trip, and with fault-current limiting protection, ampere ratings as indicated.

Construct breakers for mounting and operating in any physical position, and operating in a minimum ambient temperature of 40 deg C. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated.

All branch circuit breakers shall be full ambient compensated thermal magnetic molded case with quick-make and quick-break action and positive handle trip indication, both on manual and on automatic operation. Breakers shall be of the over-the-center toggle operating type with the handle going to a position between "on" and "off" to indicate automatic tripping.

All circuit breakers shall be full size. "Tandem" or "split" breakers shall not be permitted.

All multi-pole breakers shall have internal common trip with all load side box lugs of one breaker in the same gutter. All circuit breakers shall have sealed cases to prevent tampering.

All circuit breakers above 225 ampere capacity shall be equipped with adjustable trip mechanism, compliant with NEC requirements.

All 15-70 ampere branch circuit breakers shall be HACR Type.

All circuit breakers serving all ballasted (fluorescent/HID) lighting loads shall be HID rated.

All 15 and 20 ampere branch circuit breakers shall be UL Listed as SWD (switching duty).

All GFI circuit breakers shall be UL Class A with maximum threshold of 5 mA.

Fault Current Ratings

All electrical distribution related equipment shall be provided with appropriately rated/braced fuses/equipment for the fault currents indicated on the drawings.

Accessories

Provide panelboard accessories and devices including, but not necessarily limited to, branch circuit breakers, neutral & ground busses, ground-fault protection units, etc., as recommended by panelboard manufacturer for ratings and applications indicated.

All distribution equipment shall be equipped with ground bus bars. Except where used as service entrance equipment, provide insulated stand-off for all neutral bus bars.

Provide a minimum of 20 handle, lock-on devices of the non-padlocking type for life safety, special systems and other essential circuits.

PART 3 - EXECUTION

INSTALLATION OF PANELBOARDS

Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.

Provide properly wired electrical connections for panelboards within enclosures.

Anchor enclosures firmly to walls and structural surfaces, ensuring that they are level, and permanently & mechanically secure.

Fill out panelboard's circuit directory card upon completion of installation work. Directories shall be neatly typewritten.

All specific scheduling shown on drawings is shown to indicate new branch circuiting requirements. Exact numbering sequence of circuits shall be determined by this contractor in field after this contractor has performed final balancing.

END OF SECTION

SECTION 16490

DISCONNECTS, STARTERS AND CONTACTORS

PART 1 - GENERAL

Provide units as indicated on drawings and as indicated under Division 16 sections.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS

Subject to compliance with requirements, provide equipment of one of the following (for each type and rating):

Allen-Bradley Co.
General Electric Co.
Siemens/ITE
Square D Co.
Westinghouse/Cutler-Hammer

DISCONNECT SWITCHES

All Safety Switches/Disconnects shall be heavy duty, safety type, quick make and quick break and externally operated.

Unless noted otherwise on drawings or directed otherwise in field, all disconnect switches shall be fused. Unless noted otherwise on drawings or directed otherwise in field, brace all disconnect switches for 200,000 A.I.C.

Provide heavy duty switches, with fuses of classes and current ratings indicated and UL listed for use as service equipment under UL Standard 98 or 869. See Section "FUSES" for specifications. Where current limiting fuses are indicated, provide switches with non-interchangeable feature suitable only for current limiting type fuses.

Install disconnect switches within sight of controller position unless otherwise indicated.

Disconnect switches shall be equal to Square D Type HD.

STARTERS

General

Except as otherwise indicated, provide motor starters and ancillary components; of types, sizes, ratings and electrical characteristics indicated, which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installations.

All starters shall be equipped with pilot lights.

All starters shall be sized according to load being served or as noted on drawings, whichever requirement is larger.

Manual and magnetic starters thermal overload elements shall be rated between 115% and 125% full load current or as called for under NEC. Install and connect capacitors furnished by HVAC Contractors ahead of overloads where applicable.

Manual Starters

Provide single-phase AC fractional HP manual motor starters, of sizes and ratings required. Equip with manually operated quick-make, quick-break toggle mechanisms; and with one-piece melting alloy type thermal units. Equip with thermal overload relay with field adjustment capability of plus or minus 10% variation of nominal overload heater rating, for protection of fractional HP motors as shown on drawings. Starter shall become inoperative when thermal unit is removed. Provide starters with double break silver alloy contacts, visible from both sides of starter; green pilot lights, and switch capable of being padlocked-OFF.

Manual Starters shall be equal to the following.

Manual Starter in Finished Areas:

Square D #2510 (or Allen-Bradley Bul. 600-TQX109) flush mounted, 2 pole toggle switch type with neon pilot and NEMA 1 Type B enclosure for flush wall installation.

Manual Starter for Exposed Conduit Installation:

Square D #8536 (or Allen-Bradley Bul. 600-TAX109) surface mounted, 2 pole toggle switch type with neon pilot and NEMA 1 Type FG-2P enclosure for surface wall installation.

Combination H.O.A. Starters

Provide AC motor starters, of types, ratings and electrical characteristics required; equip with thermal overload relays with field adjustment capability of plus or minus 10% variation of nominal overload heater rating, for protection of motors as shown on drawings.

Coordinate specific coil voltage requirements (case-by-case) in field with the respective contractor who is providing the equipment to be served.

Provide each Combination H.O.A. Starter with the following:

- External quick-make/quick-break non-fused disconnect switch in cover;
- External "HAND-OFF-AUTO" selector switch in cover (for local or remote control as required);
- External green pilot light in cover;
- External reset button in cover;
- Form 2 auxiliary contacts (rated at 15A/120V);
- Fused control power transformer.

Combination H.O.A. Starters shall be equal to the following.

3-Phase Combination H.O.A. Starters in Finished Areas

Provide Size I minimum, equal to Square D #8538 (or Allen-Bradley Bul. 512) with NEMA 1 Type B enclosure for flush wall installation.

3-Phase Combination H.O.A. Starters for Exposed Conduit

Provide Size 1 minimum, equal to Square D #8538 (or Allen-Bradley Bul. 512) with NEMA 1 surface mount enclosure.

1-Phase Combination H.O.A. Starters

Same as above described 3-Phase equipment/applications except reconnect 3-pole units for single phase application per factory recommendations.

CONTACTORS

General

All contactors shall be equipped with external green pilot lights in cover and external H.O.A. selector switches in cover. Lighting contactors shall be wired so that the "AUTO" position is the normal photocell activated condition; the "OFF" position shall be a manual override to turn lighting off; the "HAND" position shall be a manual override to turn lighting on.

Contactors

Lighting contactors shall be equal to Square D Class 8903 (or Allen-Bradley Bul. 500L-BA*94 series) for tungsten & ballast lighting and resistance heating loads. Lighting contactors shall be electrically held in NEMA 1 enclosure, with 120V coil and characteristics as indicated on drawings or as required. "Dry" contacts shall be rated at 30A, 250V or 600V as required. Provide number of poles (minimum of four poles) and number of contactors as required for each application. Verify all coil voltage ratings in field.

Magnetic contactors shall be equal to Square D Class 8502 (or Allen-Bradley Bul. 500-BA*930 series) for heating, capacitor, transformer, motor, etc. loads. Magnetic contactors shall be provided with NEMA 1 enclosures, with 120V coils, with holding circuit contacts and with characteristics as indicated on drawings or as required. Magnetic contactors shall be NEMA Size 1 minimum and shall be rated 250V or 600V as required. Provide three pole units and number of contactors as required for each application. Verify all coil voltage and NEMA Size ratings in field and, under base bid, provide units sized as required for each application.

PART 3 - EXECUTION

Provide units with horsepower ratings suitable to the loads. All units shall be sized according to load being served or as noted on drawings, whichever requirement is larger.

Install overloads/fuses as required.

For types and ratings required, furnish additional fuses/overloads, amounting to 10 percent of fuses supplied, but not less than one set of 3 of each kind.

Where units are installed outdoors, in moist areas or in other atmospheres subject to similar moisture or exposure, provide minimum NEMA 3R enclosures.

Inspect operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.

Subsequent to completion of installation of equipment, energize circuits and demonstrate capability and compliance with requirements. Begin by demonstrating switch operation through six opening/closing cycles with circuit unloaded. Open each switch enclosure for inspection of interior, mechanical and electrical connections, fuse/overload installation, and for verification of type and rating of fuses/overloads installed. Correct deficiencies then retest to demonstrate compliance. Remove and replace defective units with new units and retest.

END OF SECTION

SECTION 16491

FUSES

PART 1 - GENERAL

DESCRIPTION

Types of fuses specified in this section include the following.

- Class L current limiting/time-delay.
- Class RK1 current limiting/time-delay.
- Class RK5 current limiting/time-delay.
- Class J current-limiting/time-delay.
- Class T current-limiting.

PART 2 - PRODUCTS

MANUFACTURERS

Subject to compliance with requirements, provide fuses of one of the following.

- Bussmann.
- Shawmut (A4BQ series).

FUSES

General

Except as otherwise indicated, provide fuses of types, sizes, ratings, and average time-current and peak let-through current characteristics indicated, which comply with manufacturer's standard design, materials, and constructed in accordance with published product information, and with industry standards and configurations.

Fuses 1 ampere through 600 amperes shall be rejection type.

Fuses 601 amperes through 6000 amperes shall be Hi-Cap, bolt type.

Class L Current-Limiting/Time-Delay Fuses

Provide UL Class L current-limiting, time-delay, dual-element (with pure silver links) fuses equal to Bussman # KRP-C (low peak) rated 600 volt, 60 Hz with 200,000 RMS symmetrical interrupting current rating for protecting transformers, motors, circuit-breakers, service entrances and distribution feeders above 600 amperes.

Class RK1 Current-Limiting/Time-Delay Fuses

Provide UL Class RK1 time-delay, dual-element (with pure silver links) fuses equal to Bussman #LPS-RK1 (600V) or Bussman #LPN-RK1 (250V) rated 60 Hz with 200,000 RMS symmetrical interrupting current rating for protecting service entrances and distribution feeders 600 amperes and below.

Class RK5 Current-Limiting/Time-Delay Fuses

Provide UL Class RK5 time-delay, dual-element (with pure silver links) fuses equal to Bussman #LPS-RK5 (600V) or Bussman #LPN-RK5 (250V) rated 60 Hz with 200,000 RMS symmetrical interrupting current rating for protecting general duty motors.

Class J Current-Limiting/Time-Delay Fuses

Provide UL Class J time-delay, dual-element (with pure silver links) fuses equal to Bussman #JJS (600V) or Bussman #JJN (250V) rated 60 Hz with 200,000 RMS symmetrical interrupting current rating for protecting service entrances and distribution feeders. Class J fuses shall only be used in equipment which is specifically designed to incorporate this size fuse.

Class T Current-Limiting Fuses

Provide UL Class T current limiting fuses rated 600-volts, 60 Hz with 200,000 RMS symmetrical interrupting current rating. Provide Class T fuses only where specifically called for on specialty applications in contract documents or where specifically directed in field.

Cable Limiters

Provide cable limiters rated 600-volts, 60 Hz with tubular type terminals for compression connection to 500 MCM copper cable. Provide cable limiters only where specifically called for in contract documents or where specifically directed in field.

ACCESSORIES

Maintenance Stock

For types and ratings required, furnish additional fuses, amounting to 10 percent of fuses supplied, but not less than one set of 3 of each kind.

Spare Fuse Cabinet

Provide a spare fuse cabinet mounted on the wall of the electrical service room or as otherwise shown on drawings or as otherwise directed in field. Cabinet shall be Buss #SFC or approved equal (minimum 30"H X 24"W X 12"D). Cabinet shall be sized to accommodate all required spare fuses.

Fuse Identification Labels

Provide factory fuse identification labels, installed on the inside of the door of each switch indicating type and size of fuses installed.

PART 3 - EXECUTION

INSTALLATION

All fuses shall be rated at 600 volts minimum unless the service entrance voltage does not exceed 240V.

Each fuse shall be clearly factory marked with classification, characteristics, ampere ratings, voltage ratings, etc.

Fuses shall not be shipped installed in switches nor shall they be installed in the equipment until the equipment until the equipment is ready to be energized.

All fuses shall be of the same manufacturer.

Prior to installing fuses for protection of specific equipment, motors, etc., verify recommended fuse size/type in field from respective equipment manufacturer. If a conflict in fuse size/type results between manufacturer's recommendations and above specifications, contact engineer. Provide all required fuses under base bid.

Install fuses in fused switches.

END OF SECTION

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SECTION 16492

MECHANICAL EQUIPMENT

PART 1 - GENERAL

DESCRIPTION OF WORK

Furnish and install all necessary electrically related work as required to render all plumbing, heating, ventilating, air conditioning, miscellaneous equipment, etc. fully operational and fully compliant with NEC.

PART 2 - PRODUCTS

Refer to applicable Division 16 sections.

PART 3 - EXECUTION

INSTALLATION REQUIREMENTS

General

Drawn locations of disconnects, starters, rooftop receptacles, motors, equipment, etc. are shown for schematic indication of wiring requirements. Coordinate with other trades as required to determine specific locations and termination requirements. Provide all related work under base bid.

The electrical contractor shall connect all electrical equipment furnished under all branches as well as the equipment hereinbefore specified and/or equipment furnished by the owner.

The electrical contractor shall provide all starters and disconnect switches for all mechanical equipment except as specifically indicated otherwise herein or as specifically noted or scheduled otherwise on the drawings. All starters shall be provided with nameplates listing equipment and areas served. Accordingly, this contractor shall furnish and install all necessary power conduit, wiring, starters, disconnects and fused disconnects (whether specifically shown on drawings or not) to operate the heating, ventilating, air conditioning systems and other mechanical equipment as indicated on drawings and/or as described elsewhere in the contract documents. All starters shall be provided with nameplates listing equipment and area served.

Each motor shall have disconnect switch ahead of motor magnetic starter, or manual starter ahead of motor, installed by the electrical contractor.

Provide NEMA 3R enclosures where installed outdoors or in areas subject to moisture.

Metal frames of all equipment shall be grounded by connecting frames to the grounded metal raceway and/or to a full size green ground conductor.

The electrical contractor shall make the necessary electrical connections between the specified equipment and the junction box near equipment with flexible metallic conduit and matched connectors (see Section 16120).

Sizes of HVAC related equipment and wiring shown on drawings are based on the HVAC design base manufacturers. If different manufacturer(s) or model(s) are actually supplied, it shall be this contractor's

responsibility to provide necessary coordination in field and provide the necessary size of related electrical equipment, wiring, conduit, etc. Coordinate all work carefully with the HVAC contractor prior to rough-in.

Refer to specifications and drawings of all trades for additional electrically related requirements or concerns and for schematic representation of this work. Exact locations, mounting heights, rough-in requirements, etc. of outlets, J.B.'s, etc. shall be as determined in field.

Prior to furnishing submittals and prior to rough-in, determine exact electrically related characteristics, loads, voltages, disconnect/starter requirements, locations, mounting heights, etc. of all mechanical equipment and rough-in as directed by contractor of the respective trade. No additional compensation shall be given to this contractor in the event that mechanical equipment requirements differ from the design base shown on the drawings. Provide all required coordination and all required electrical work.

HACR Breakers

The electrical contractor shall coordinate in field with the HVAC contractor and determine, case by case, which equipment is factory listed for use with Heating and Air Conditioning Rated (HACR) breakers. In an effort to minimize requirements for stocking of fuses by the owner, utilize HACR breakers at the source panelboards as the NEC required overcurrent protection wherever possible (in lieu of fusing the local disconnect switches).

Rooftop Unit Receptacles and Lights

Provide receptacle and switched lighting fixture at each rooftop mounted HVAC unit (RTU's, ACU's, MAU's and HRU's). Provide a "2-gang" w/p box with a duplex GFI receptacle on one side and a w/p single pole snap switch to control the lighting fixture on the other side. Provide a UL Wet Label 150W incandescent globe & guard lighting fixture with cast aluminum housing and guard, glass lense and 90 degree fitting threaded (water tight) to a threaded opening on the side of the w/p receptacle/switch box. See detail on drawings.

Rooftop Exhaust Fan Receptacles

Provide receptacle at each rooftop mounted exhaust fan where such fans are located more than 25 feet from another unit with a receptacle. Provide a weatherproof (w/p) box with a duplex GFI receptacle. Connect the receptacles ahead of the local disconnect switch.

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) EQUIPMENT

Unit Heaters

HVAC contractor shall furnish and install unit heaters. The electrical contractor shall provide power connections and a local manual starter/disconnect device on the wall below each unit (48" AFF). Provide engraved wall plates for these local disconnects to read "Unit Heater". The electrical contractor shall wire the units to operate thru a line voltage thermostat which will be furnished by the HVAC contractor and installed by the electrical contractor.

Exhaust Fans

Fans shall be provided by the HVAC contractor. Provide all required power wiring and connections. Control wiring for manual operation of fans shall be provided by the electrical contractor. Control wiring for automatic operation shall be provided by the HVAC contractor unless indicated otherwise herein or on drawings. Unless local disconnects are furnished with the fans by the HVAC contractor, all local disconnects shall be furnished and installed by the electrical contractor. All starters shall be furnished and installed by the electrical contractor (with pilot light and engraved plate to read "Exhaust Fan E-_" . All fans

shall be furnished with electric motor operated dampers which shall be powered/connected by the electrical contractor.

Package Rooftop Air Conditioning Unit (ACU)

The HVAC contractor shall provide package air conditioning units with prewired control panels. The electrical contractor shall provide NEMA 3R fusible disconnect switch at each unit and shall provide all required power wiring connections to control panels. The HVAC contractor shall provide control wiring.

Indoor Air Conditioning Unit (ACU)

The ACU shall be provided by the HVAC contractor. The electrical contractor shall provide a local disconnect and power wiring work.

Condensing Units (CU's)

The units shall be provided by the HVAC contractor. The electrical contractor shall provide NEMA 3R local disconnects at each unit and make power wiring connections to same and to the control panel on each unit. Routing of conduit/wiring to the units shall follow refrigerant piping routing. Control wiring shall be provided by the HVAC contractor.

H.V.A.C. CONTROL WIRING

General

Unless specifically shown as empty conduit, all electrical control and interlock work shown on electrical drawings shall be provided by this contractor. Provide additional control work as specifically indicated herein.

All other control related conduit and wiring shall be provided by HVAC contractor in accordance with Section 16110 and shall include insulated throat fittings (or bushings), sweep bends, pullboxes, etc.

Low Voltage Thermostats

Low voltage thermostats shall be furnished, installed and wired by the HVAC contractor. Provide wall outlet box at 60" A.F.F. (with single gang ring) and 3/4" conduit stubbed from outlet box and turned out above accessible ceiling (in joist space or against overhead slab/deck). Conduit shall be identified in ceiling cavity and shall be provided with sweep bends, bushings and drag line. Verify all thermostat locations, case by case, to ensure that they will not conflict with room finishes or be blocked by furniture/equipment.

Line Voltage Thermostats

Line voltage thermostats shall be furnished by the HVAC contractor and installed/wired by the electrical contractor. Provide wall outlet box at 60" A.F.F. (with single gang ring) and 3/4" conduit, with line voltage power wiring, from outlet box to equipment which is to be controlled by the thermostat. Verify all thermostat locations, case by case, to ensure that they will not conflict with room finishes or be blocked by furniture/equipment.

Motor Operated Dampers

Provide all wiring associated with interlock of motors to associated motor dampers for all exhaust fans.

PLUMBING EQUIPMENT

Domestic Water Heaters (Gas)

Water heater shall be gas fired with electric controls. Provide electrical 120VAC power connection for controls and/or electronic ignition. Provide interlock wiring with circulating pumps, flow switches and aquastat controls as applicable. Refer to wiring diagrams on drawings for further definition where applicable.

Domestic Hot Water Circulating Pumps (Return Line)

In-line circulating pumps shall be furnished and installed by the plumbing contractor and shall be 120V, single phase, 1/12 HP or 1/6 HP (verify in field). The plumbing contractor shall furnish and install a strap-on aquastat on the building hot water return line. The electrical contractor shall furnish and install a toggle type manual starter and shall wire pump to operate through the aquastat. Refer to wiring diagrams on drawings for further definition where applicable.

Air Compressor

Air compressor shall be provided by the relocated and installed by the Plumbing Contractor. Provide duplex receptacle on a dedicated circuit at the unit. Verify exact location and mounting height in field.

Vacuum Pump

The vacuum pump and control package units shall be furnished and installed by the plumbing contractor. The system consists of a pump package with an integral unit mounted control panel which includes a factory installed disconnect switch. The electrical contractor shall make single-point line voltage connections to the controller.

Electric Water Coolers (Surface)

Electric water coolers shall be furnished and installed by the plumbing contractor with a cord & plug electrical connection. The electrical contractor shall provide 120V duplex receptacle, centered below cooler at 8" above floor (verify in field with plumbing contractor).

END OF SECTION

SECTION 16510
LIGHTING FIXTURES

PART 1 - GENERAL

DESCRIPTION OF WORK

Provide lighting fixtures as indicated on drawings and/or as indicated herein.

Provide submittals for all fixtures, ballasts, lamps and applicable accessories. Submit fixture shop drawings in booklet form with separate sheets for each fixture, assembled in luminaries "type" alphabetical order, with proposed fixture and accessories clearly indicated on each sheet. Submit details indicating compatibility with ceiling grid system. Provide separately tabbed sections for lamp submittals and for ballast submittals. The lamp and ballast submittal sections shall include lamp/ballast schedules (by fixture type) and related technical submittal data.

If indicated, submit one complete operating unit for each type of light fixture specified.

Upon request by engineer or owner's representative, provide isofootcandle plot diagram of footcandles on horizontal surfaces which show composite values of illuminance projected from the arrangement of light sources from indicated fixture locations and heights. Show on these graphic plots the locations, spacings and heights of Luminaries.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS

Subject to compliance with requirements, provide products of one of the manufacturers listed on the fixture schedule and/or herein. Various fixture types required are indicated within the lighting fixture schedule. Fixtures must comply with minimum requirements as stated therein. Review drawings and specifications of all other trades to verify ceiling types, modules, suspension systems appropriate to installation. Manufacturers for ballasts and lamps are specified hereafter.

All "approved equal" fixture, lamp and ballast manufacturers shall be subject to compliance with and equality in quality, performance, dimensions and aesthetics as the respective basis of design.

FIXTURES

General

All lighting fixtures shall be U.L. listed and labelled for their specific application for this project.

Provide lighting fixtures, of sizes, types and ratings indicated; complete with, but not limited to, housings, energy-efficient lamps, lampholders, reflectors, energy efficient ballasts, starters and wiring. Ship fixtures factory-assembled, with those components required for a complete installation. Design fixtures with concealed hinges and catches, with metal parts grounded as common unit, and so constructed as to dampen ballast generated noise.

Luminaries having medium base and mogul base sockets shall be wired with not smaller than No. 16 or No. 14 wire respectively in accordance with the latest requirements of the National Electric Code. Fluorescent Luminaries shall be wired with not smaller than No. 16 wire. All H.I.D. fixtures shall be fused.

All Metal-Halide fixtures with lamp wattages below 400 watts shall be provided with clear tempered glass lenses to protect persons from possible violent end of lamp life. This shall apply throughout the project whether or not indicated on drawings or on fixture schedule.

All surface mounted ballasted fixtures shall be mounted with air spaces between fixture and surface per latest edition of NFPA/NEC.

All factory fixture wiring shall be per NEC, #16 AWG minimum

Recessed Fixtures

All recessed fixtures shall be equipped with necessary plaster frames and surface trim.

All recessed fluorescent fixtures shall be equipped and suitably constructed to operate with "P" rated ballasts as specified hereafter.

All recess mounted incandescent and H.I.D. fixtures shall have UL approved thermal protection per latest edition of NFPA/NEC.

All junction boxes and serviceable components (ballasts, thermal protection devices, fuses, etc.) for recessed fixtures shall be readily accessible for service or replacement from below the ceiling, without removing any ceiling components.

Where plaster frames are inferred for lighting fixtures (either by narrative or by catalog number or by application) the actual function shall be taken to mean for mounting within gypsum board, wet plaster or similar type inaccessible ceiling system; verify requirements in field and provide all required accessories (frames, etc.).

Lighting Fixture Types

Fixtures designated by letters are defined as indicated on the Lighting Fixture Schedule.

BALLASTS

General

All ballasts of the same type shall be of the same manufacturer and catalog number.

Refer to Lighting Fixture Schedule and drawings for input voltage requirements.

If fusing requirements are indicated on Lighting Fixture Schedule, each ballast shall be separately fused with a replaceable fuse external to the ballast.

All fixtures shown on drawings with multi-level switching or similar special circuiting shall be provided with multiple ballasts to accommodate same. All other fixtures may contain either single ballasts or multiple ballasts as required to fulfill required function and as required to comply with construction schedule.

Solid State Rapid Start Electronic Fluorescent Lamp Ballasts

Provide low energy solid state **rapid start** electronic fluorescent lamp ballasts for all fluorescent lamps, specifically designed for operating lamp types indicated. Fluorescent lamp ballasts for specialty applications are specified in the "Energy Saving Rapid Start Core & Coil Fluorescent Lamp Ballasts" sub-section which follows this sub-section.

Electronic Ballasts shall be manufactured by Advance, Motorola or Magnetek, 100% electronic with reduced harmonics and the following characteristics:

- 1) High power factor (0.9 minimum).
- 2) Full and constant lumen output at voltage ranges of 90V to 145V (120V ballast) and 200V to 320V (277V ballast).
- 3) Minimum Ballast Factor of 0.95.
- 4) Rapid-start.
- 5) Type 1, Class P.
- 6) Sound rated "A".
- 7) Maximum sound level of 2 dB above 16 dB ambient.
- 8) Automatic reset type thermal protection.
- 9) U.L., CSA and CBM approved, listed and labeled.
- 10) NAECA/1988 and EPCA/1987 compliant.
- 11) FCC compliant (as relates to EMI and RFI).
- 12) Input current Third Harmonic Content (THD) maintained equal to or less than 20% of input current.
- 13) Crest Factor of less than 1.4.
- 14) Internal fusing.
- 15) Operation without visible flicker.
- 16) Capability of operating all types of Long Twin Tube fluorescent lamps and all types of two, three or four foot rapid start lamps.
- 17) Line transient withstand capability per IEEE 587-A.
- 18) Two year factory warrantee.

Energy Saving Rapid Start "Core & Coil" Fluorescent Lamp Ballasts

Magnetic "core & coil" ballasts shall be used only where solid state electronic ballasts can not properly operate special application lamps (i.e. outdoor applications, etc.).

These ballasts shall be energy saving, Class P high power factor (0.9 minimum) type, capable of operating lamp types indicated; and shall be manufactured by Advance, Motorola, Valmont or Magnetek, with the following characteristics:

- 1) High power factor (0.9 minimum).
- 2) Full and constant lumen output at voltage ranges +/- 10% of input voltage.
- 3) Minimum Ballast Factor of 0.95.
- 4) Rapid-start, instant start or pre-heat as required to accommodate respective lamps.
- 5) Type 1, Class P, encapsulated.
- 6) Sound rated "A".
- 7) Automatic reset type thermal protection.
- 8) U.L., CSA and CBM approved, listed and labeled.
- 9) NAECA/1988 and EPCA/1987 compliant.
- 10) External fusing (within fixture housing).
- 11) Operation without visible flicker.
- 12) Line transient withstand capability per IEEE 587-A.
- 13) Minimum one year factory warrantee.
- 14) Provide -20 deg. F. starting temperature ballasts for all outdoor applications.

High-Intensity-Discharge (HID) Lamp Ballasts

HID lamp ballasts shall be manufactured by Advance, Valmont or Magnetek. Provide HID lamp ballasts, capable of operating lamp types and ratings indicated; constant wattage type, high power factor, fused (one per ungrounded power conductor) extra-quiet core and coil assembly encapsulated in non-melt resin; install capacitor outside ballast encapsulation for easy field replacement; and enclose assembly in drawn aluminum alloy housing(s) unless otherwise specified.

Provide H.I.D. lamp ballasts, of ratings, types and makes as recommended by lamp manufacturer, which properly matches lamps to power line by providing appropriate voltages and impedances for which lamps are designed. Design of ballasts shall operate lamp within the lamp's power trapezoid requirements. All ballasts shall be low noise, low temperature (-20 deg. F. starting temperature) type.

LAMPS

General

All lamps of the same type shall be of the same manufacturer and catalog number.

If a fixture manufacturer requires a special lamp that is not addressed herein, electrical contractor shall contact engineer for direction prior to ordering such fixtures.

Unless specifically indicated otherwise on fixture schedule, wherever available all H.I.D. lamps shall be universal mount type.

Unless specifically indicated otherwise on fixture schedule, wherever possible, all H.I.D. lamps of same wattage and type shall have matching bases.

Incandescent Lamps

Incandescent lamps shall be General Electric, Sylvania or Philips. Incandescent lamps shall be of long life type (3000 hours). All incandescent lamps shall be inside frosted unless specifically directed otherwise. Provide socket adapters/extenders if required for accommodating the specified lamp.

F32T8 Fluorescent Lamps

F32T8 fluorescent lamps shall be rapid start, energy saving type, minimum 75 CRI, minimum 2850 initial lumens and minimum 20,000 hours rated. Lamps shall be manufactured by G.E., Sylvania, Osram or Philips, equal to Sylvania #FO32/RS series.

Lamp color temperature shall be 4000-4100 deg. K.

F25T8 Fluorescent Lamps

F25T8 fluorescent lamps shall be rapid start, energy saving type, minimum 75 CRI, minimum 2150 initial lumens and minimum 20,000 hours rated. Lamps shall be manufactured by G.E., Sylvania, Osram or Philips, equal to Sylvania #FO25/RS series.

Lamp color temperature shall be 4000-4100 deg. K.

Metal-Halide Lamps

Metal-Halide lamps shall be manufactured by Sylvania, General Electric or Philips, phosphor coated type (unless specifically directed otherwise), minimum 10,000 hours rated.

High Pressure Sodium Lamps

Outdoor High Pressure Sodium lamps, if required, shall be manufactured by Sylvania, General Electric or Philips, clear (unless specifically directed otherwise) universal mounting type, equal to G.E. "LU" series, minimum 24,000 hours rated.

PART 3 - EXECUTION

INSTALLATION OF LIGHTING FIXTURES

General

All surface and recessed ceiling fixtures installed on grid or tile ceilings shall be installed to agree with module of ceiling either displacing a tile, or unit on center of tile, or centered on grid lines.

Install flush mounted fixtures properly to eliminate light leakage between fixture frame and finished surface.

No splice or tap shall be located within an arm, stem or chain. Wire shall be continuous from splice in outlet box of the building wiring system to lamp socket or to ballasts terminals in fluorescent Luminaries.

All "drops" to suspended ceiling mounted lighting fixtures shall be made with AC/MC Cable per Section 16120 or with flexible metal conduit (1/2" minimum diameter, 72" maximum length and with full parity sized green ground wire - see Section 16110). All "drops" to lighting fixtures in gypsum board, and similar inaccessible ceiling systems, shall be made from identified fully and readily accessible junction boxes.

All lighting fixtures utilized for emergency egress lighting shall be connected ahead of switching.

Aim all adjustable lighting fixtures as directed in field by Owner's representative. All adjustable outdoor lighting shall be aimed after dark during a night test of the systems as directed by Owner's representative. Where applicable, verify that measure illuminance values comply with respective isolux (or equivalent) plot diagram values.

Fixture Support

Provide fixtures and/or fixture outlet boxes with hangers to properly support fixture weight. Submit design of hangers, method of fastening, other than indicated or specified herein, for review by Owner's representative.

All lighting fixtures installed in or on suspended ceiling systems shall be anchored in strict compliance with NEC, including all necessary advance coordination with the ceiling installation contractor.

Support surface mounted fixtures greater than 2 feet in length at a point in addition to the outlet box fixture stud.

Fasten electrical lighting fixtures and brackets securely to structural supports, including poles/standards. Install all lighting fixtures level and plumb. Where special mounting conditions are encountered, (i.e., mounting to rounded columns, etc.) provide special factory fabricated mounting means (i.e., brackets designed to conform with curvature of rounded columns, etc.).

Where necessary, provide stems or chains for fixtures as designated by the Owner's representative. If mounting height is not specified, stem/chain length shall be as directed in the field.

Provide plaster frames for recessed fixtures installed in other than suspended grid type acoustical ceiling systems. Brace frames temporarily to prevent distortion during handling.

FIELD QUALITY CONTROL

Where applicable, refer to Division-1 sections for the replacement/restoration of lamps in interior lighting fixtures, where used for temporary lighting prior to Date of Substantial Completion.

Where used for temporary lighting prior to time of Substantial Completion, replace all incandescent lighting fixture lamps, as well as any lamps which are defective, damaged or burned out.

Furnish stock of unused, unopened replacement lamps amounting to 15%, but not less than 4 lamps in each case, of each type and size lamp used in each type fixture. Deliver replacement stock as directed to Owner's storage space.

Replace defective and prematurely burned out lamps for a period of one year following the time of Substantial Completion.

LIGHTING STANDARDS

Utilize belt slings or rope (not chain or cable) to protect finishes of poles and standards when raising and setting finished poles and standards.

Provide sufficient space encompassing hand access and cable entrance holes for installation of underground cabling where applicable.

Fasten electrical poles, fixtures and brackets securely to structural supports.

Provide concrete base for each fixture standard pole. Base shall be reinforced and, unless indicated otherwise on drawings, shall be of the depth recommended by the manufacturer.

Provide galvanized steel anchor bolts, in diameters, lengths and classes as directed by pole manufacturer.

After ensuring that the poles are plumb, neatly fill the entire space between top of concrete bases and bottom of pole bases with grout.

All poles shall be provided with matching factory base covers ("skirts"). This shall apply whether specifically indicated on fixture schedule or not.

All luminaires shall be separately fused within the pole-base handhole.

END OF SECTION

SECTION 16720
FIRE ALARM SYSTEM

PART 1 - GENERAL

DESCRIPTION OF WORK

Provide Fire Protective Signaling System (NFPA 72) suitable for type occupancy as defined by Local Building Code and as approved by local Fire Marshall.

STANDARDS

The equipment and installation shall comply with the current applicable provisions of the following standards:

National Electric Code (including Article 760);

National Fire Protection Standards (including but not limited to):

NFPA 71 Central Station Signaling Systems-Protected Premises Unit

NFPA 72 Protective Signaling Systems

NFPA 72E Automatic Fire Detectors

Local and State building codes;

All requirements of the Local Authority Having Jurisdiction (AHJ);

Underwriters Laboratories, Inc.:

The system and all components shall be listed by Underwriters Laboratories, Inc. for use in Fire Protective Signaling Systems under the following standards as applicable:

UL 864 Control Units for Fire Protective Signaling Systems (including UUKL sublisting)

UL 268 Smoke Detectors for Fire Protective Signaling Systems

UL 268A Smoke Detectors for Duct Applications

UL 217 Smoke Detectors, Single and Multiple Station

UL 521 Heat Detectors for Fire Protective Signaling Systems

UL 228 Door Closers-Holders for Fire Protective Signaling Systems

UL 464 Audible Signaling Appliances

UL 1638 Visual Signaling Appliances

UL 38 Manually Actuated Signaling Boxes

UL 346 Waterflow Indicators for Fire Protective Signaling Systems

UL 1481 Power supplies for Fire Protective Signaling Systems

GENERAL REQUIREMENTS

The Fire Alarm System supplier shall submit complete documentation for the Fire Alarm/Life Safety System showing the Model Number, type, rating, size, style, Manufacturer's Names, and Manufacturer's Catalog Data Sheets for all items to ensure compliance with these specifications.

The Fire Alarm System supplier shall furnish detailed submittals clearly showing the intended location of all field devices and their connections to the system. Submittals shall be prepared utilizing AutoCad Release 14 Computer Aided Drafting system.

Copies of this information shall be submitted as required to the Engineer and shall be subject to the review of the Engineer.

The Authority Having Jurisdiction shall be notified prior to installation or alteration of equipment and wiring. At the AHJs request, complete information regarding the system or system alterations, including specifications, wiring diagrams, and floor plans, shall be submitted for approval.

Successful vendor shall pay all inspection fees and shall provide all necessary product data submittals, shop drawing submittals, working drawings, supervision, etc. and shall have submittals approved (in writing) by the State Fire Marshal's office and/or the local authority having jurisdiction prior to submittal to Engineer for review.

Manufacturer/Supplier shall supply detailed wiring diagrams and riser diagrams showing color coding of all wiring per manufacturer recommendations. Include also catalog information of each supplied and calculations showing adequate capacity of the standby batteries as required by code.

Submit maintenance data and parts lists for each type of fire alarm equipment installed, including furnished specialties and accessories. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS

Subject to compliance with requirements, provide fire alarm systems of one of the following (for each type of product):

Notifier Co. (basis of design);
EST (approved equal);
Simplex (approved equal).

FIRE ALARM SYSTEM

The system shall be equal to Notifier "intelligent" multiplex package Model AFP200 consisting of the following.

Panel shall contain:

Central Processor Unit

Display Interface Board With Keypad and LCD

Loop Interface Boards With 99 Intelligent Detectors and 99 Monitor/Control Functions Per Loop.

Serial Interface Board For Printer and/or CRT

Eighty Character Wide Display.

Each smoke detector shall be intelligent/addressable for the exact location in the building, capable of giving a print out of the sensitivity and have a sensitivity adjustment remotely from the console. This sensitivity shall also be adjusted automatically from the system clock if the user wishes changes during a 24 hour period. The system shall use analog data transmission in order to accomplish the previous requirements. Manual stations, sprinkler devices and all other "contact only" closing devices shall be Addressable. An Addressable only system will not be acceptable.

The system must have the following features:

- walk-test
- alarm verification
- warning message for smoke detector requiring "cleaning"
- multiple password protection
- enable and disable of any Addressable point
- manual on/off for any output point
- read status of any programmable point
- field programmable at the panel keyboard

Provide one LCD-80TM liquid crystal display remote annunciator on the Lower Level of the new building, near the main entrance.

Also, provide one LCD-80TM liquid crystal display remote annunciator on the main entry level of the existing office building, inside the main entrance at the existing location of the multi-system wall annunciator board. Determine exact location in field and utilize one of the new underground communication conduits for the fire alarm cable (see site plan).

The intelligent addressable photo smoke detectors shall be SDX-551 with BX-501 bases. Install per manufacturer's instructions, no further than 15 feet from a wall, no further than 30 feet from another detector in the same room and no closer than 3 feet to a supply air diffuser.

The Addressable Manual Stations shall be Notifier LNG-1R with MMX-101.

The Intelligent Addressable Heat Detector shall be FDX-551 with BX-501 base. This device shall be both rate of rise and fixed temperature.

The intelligent addressable duct mounted smoke detectors shall be photoelectric smoke detector unit DHX-502/SDX-551/ST-3/CMX-2. Provide sampling tube, test station and all other required accessories. Provide remote alarm indicating unit flush mounted in acoustical tile ceiling, visible from floor below. If test stations are not readily accessible, provide remote test station.

The electronic horn/strobes shall be Notifier HS24-15/75WR with semi-flush mounting plates (with ADA compliant strobes), wall mounted at 6'8" as shown on plans.

The "visual only" alarms shall be ADA compliant strobe units wall mounted at 6'8" as shown on plans, Notifier #ST24-15/5WR.

Strobe units shall be synchronized wherever required by any prevailing code, regulation or authority having jurisdiction.

Install ISO-X isolation modules to protect the system from faults and or grounds. The ISO-X shall permit the entire system to operate independently of the area disconnected by the ISO-X due to wiring faults.

Provide MMX-101 monitor modules to interface "non-intelligent" devices into the system as shown on the drawings. (Sprinkler Flow and Tamper Switches).

Provide CMX-1/CMX-2 control modules for door closures and all supervised control functions such as air handler shut-downs.

Provide carbon monoxide sensor(s) where shown on drawings, with integral local A/V alarm annunciation and connect to the fire alarm system as a "trouble" address similar to sprinkler tamper switches.

DIGITAL COMMUNICATOR

Furnish and install a remote mounted digital communicator on the telephone equipment panel, programmed to report to the owners U.L. approved CENTRAL STATION monitoring agency.

Digital Communicator shall be U. L. listed for fire alarm use, Notifier 911AC or approved equal, mounted in single equipment housing containing battery charger and battery with coupler cable.

Furnish an RJ31X telephone company jack on equipment panel for connection to telephone system.

Digital Communicator shall be connected to operate from two sets of dry contacts on fire alarm control panel; one set for alarm and one set for trouble.

PART 3 - EXECUTION

Coordinate placement of duct detectors with the Heating Subcontractor. Provide auxiliary contact as required to shut down equipment and wire into the stop circuit of the associated air handler starter.

The water flow and tamper switches will be provided by the Sprinkler Contractor. The Sprinkler Contractor will install these devices but the Electrical Contractor shall wire and connect to the fire alarm system. Each of these shall be addressed and supervised with a MMX-101 module.

The equipment supplier shall make complete wiring diagrams locating all devices and terminal cabinets. The terminal cabinets shall have pressure terminals with markings as determined by the fire alarm equipment supplier.

The fire alarm system supplier shall provide to the electrical contractor a complete set of floor plan drawings showing conduit sizes and number of conductors required to all components plus detailed wiring connections required at each type of device.

The Electrical Contractor shall submit these drawings to the applicable authority having jurisdiction for approval. This action shall be taken during the Shop Drawing procedure.

Upon completion of the installation, the system shall be checked and tested by a certified fire alarm inspector and an Underwriters Laboratories Inc. Fire Alarm Certificate Corporation.

After making all tests and corrections, the system shall be demonstrated to the consulting engineers, the inspecting authority and the owners.

Provide the owner with a one year service contract. Indicate the cost of renewing this contract for an additional one, two and three year period at the owner's option.

END OF SECTION

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SECTION 16810

ELECTRICAL SPECIALTIES

PLUGSTRIPS AND SURFACE RACEWAY SYSTEMS

"Plugstrips" shall be equal to Wiremold #G3000 series for single service applications and #4000 series for dual-service applications. Provide factory fittings, etc. as required for a complete installation. Provide duplex receptacles on 12" centers, with a minimum of three duplex receptacles for the shortest shown length of surface raceway. Provide with receptacles as specified under Section 16210.

PHOTOCELLS

Photocells shall be Paragon #CW201 series, 2000W rated nipped to weatherproof outlet box plate (or equal by Tork, Precision). Determine exact mounting locations and adjustment requirements in field relative to structural and site conditions.

MULTI-PURPOSE TIME CLOCKS (7 DAY)

Multi-Purpose Time Clocks shall be equal to Tork #T930L-E (or equal by Paragon, Intermatic). Time clocks shall be photocell initiated, 7-day, 24 hour with external accessibility of override controls. Unit shall be 3 zone (1-timer control only, 1-photocell control only and 1-photocell control on/timer control off). Provide all required external contactors, relays, etc. to render the control system fully operational. Verify zone control requirements in field prior to rough-in. Provide power carryover.

END OF SECTION

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SECTION 16830

LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

SUMMARY

Specific lightning protection system related work is not shown in plan view on drawings. Work shown on drawing details and defined in this section is intended to schematically describe all related work. All lightning protection related work shall be included by electrical contractor under base bid.

This Section includes lightning protection systems for buildings and associated structures and includes requirements for lightning protection systems components and work including, but not limited to, the following:

- Air terminals.
- Bonding plates.
- Conductors.
- Connectors.
- Counterpoise
- Fasteners
- Grounding plates.
- Grounding rods.
- Rod clamps.
- Splicers.
- Custom mounting modifications to roofing systems.

Raceways used for lightning protection system conductors are specified in Division 16 Section "Raceways."

QUALITY ASSURANCE

The Electrical Contractor shall provide a complete concealed Underwriter's Laboratory master labeled lightning protection system.

All equipment described herein shall be the product of a manufacturer of established reputation and experience who has been in operation of sufficient length of time to establish proof of high quality, acceptable to the Engineer.

All work shall be performed under the complete supervision of an accredited factory expert, furnished by the equipment manufacturer. This factory expert shall be locally available at all times during installation of the lightning protection system. It shall be the responsibility of this expert to supervise all unit locations and connections and he shall completely test the system after completion for strict conformance with U.L. master label requirements.

All equipment shall be furnished by the local vendor and supervision of installation shall be by same and installation may be by others.

The vendor shall provide all working drawings necessary for entire installation. Refer to contract documents of all trades for building roofing and structural system details.

SUBMITTALS

Product Data

Submit manufacturer's data on lightning protection systems and components, including adhesives where used.

Shop Drawings

Submit layout drawings of lightning protection system equipment and components including, but not limited to, air terminal locations, conductor routing, connections, bonding, custom modifications to roofing systems, grounding, counterpoise, etc. These drawings shall be complete working drawings.

UL Certification

Provide Owner with UL Master Label for overall system which is suitable for fastening to building for display purposes. Comply with UL 96A, "Master Labeled Lightning Protection Systems". Where additions or physical connections are to be made to existing structures under this contract, provide the above referenced UL Label for the resulting collective system.

PART 2 - PRODUCTS

MANUFACTURERS

Subject to compliance with requirements, provide products equal to those manufactured by the following:

- A-C Lightning Security Inc.
- Approved Lightning Protection Co., Inc.
- Carl Bajohr Co., Inc.
- East Coast Lightning Equipment.
- Heary Bros. Lightning Protection.
- Independent Protection Co., Inc.
- Robbins Lightning Protection Co.
- Sewell Manufacturing Co., Inc.
- Thompson Lightning Protection, Inc.
- West Dodd Lightning Conductor Corp.

LIGHTNING PROTECTION SYSTEM COMPONENTS

General

Provide lightning protection system materials and components, that comply with manufacturer's standard design, in accordance with published product information. Provide air terminals, bonding plates, conductors, connectors, conductor straps, fasteners, grounding plates, grounding rods, rod clamps, splicers and other components required for a complete system that meets LPI-175, UL 96A or NFPA 78 standards.

Cable

Lightning protection cable (for grounding, counterpoise, cross-runs, etc.) shall be minimum 28 strand (14AWG - each strand) bare copper.

Air Terminals

Metal for air terminals and cables shall be copper with solid air terminals.

Metal for air terminals and cables may be aluminum with solid air terminals only where required to avoid contact of dissimilar metals.

Provide air terminals with bases specially designed for the type of roofing system component on which they will be mounted.

Ground Electrodes

Provide 5/8-inch minimum diameter by 10-foot long, copper clad steel ground rods with minimum 27 percent of the rod weight in the copper cladding.

Provide equivalent copper ground plates where ground rods cannot be used.

PART 3 - EXECUTION

GENERAL INSTALLATION

General

Minimum requirements for the grounding system shall be Article 250 (and all related articles/sections) of the latest edition of N.E.C.

Coordinate with other work, including electrical wiring and roofing work, as necessary to interface installation of lightning protection system with other work.

Provide pitch pockets for all penetrations of the roofing material at each air terminal or other connection.

Bond all roof mounted fans, exhausters and other equipment, etc. to the lightning protection system/cables.

Bond and interface new system with all applicable rooftop and/or site equipment/structures (re-bars, parking lot lighting standards, condensing units, exhaust fans, plumbing stack vents, metal coping, flagpoles, towers, emergency generator system, utility transformer/services, etc.) requiring same and provide a resulting single UL master label.

All ground potentials associated with the structure and site shall be bonded and equalized.

Carefully coordinate all work with drawings of all other trades and with all other trades (including roofing contractor) in advance and during installation.

Except with special exceptions for special roofing materials, mounting of cross connector runs/devices on the roof (when away from parapets), no adhesives shall be used for mounting of devices, cables, etc. All mounting shall be mechanical. All other mounting shall be mechanical. Coordinate all work in advance with roofing contractor/manufacturer so as not to void any warranties.

Unless prior acceptance is granted by the owner's representative in field, use approved exothermic welded connections for all conductor splices and all connections between conductors and other components.

Cable

Install conductors with direct paths from air terminals to ground connections avoiding sharp bends and narrow loops.

Connect lightning protection cable to all terminals, ground rods, devices, structural members and equipment.

Provide cross connecting runs of cable at a maximum spacing of every 50 feet on roof. Where such cross connecting runs would occur on pitched roofing visible from below, contact engineer prior to completing working drawings.

All indoor cable shall be concealed from view. Conceal wiring from normal view from all exterior locations at grade within 200-feet of building.

Air Terminals

Air terminals shall be 12" projection above the parapet wall. These terminals shall be spaced a maximum of 20 feet on center around perimeter of each roof level. These air terminals shall be mechanically attached to the inside of the parapets.

Perimeter points shall be maximum 20' on center with 1/2" x 12" air terminals.

Counterpoise

Furnish and install a full cable counterpoise system around perimeter of building and, where applicable, bond to water service, building steel, emergency generator system, utility service entrance, service entrance pad-mount transformer, etc. per latest edition of NEC.

Ground electrodes shall be connected to every riser. Provide one connection between grid and water main and between counterpoise and electric service ground where it enters the building.

Provide cable risers at a maximum spacing of every 100 feet. Tie this cable to structural steel and floor mesh as well as to air terminals and ground rods. All metal objects on roof shall be bonded as required by UL & applicable codes.

Ground every 100' max. with 5/8" x 10' copperweld ground rod.

Risers shall be concealed within building chases and roof cable may be exposed.

Connect to each structural column, and to each driven electrode.

Work on Membrane or other Special Roofing Systems

The electrical contractor and/or the lightning protection system subcontractor shall provide all required special preparation of the new (and/or existing, if applicable) roofing systems as required by the roofing manufacturer for mounting air terminals, cables, etc.

It shall be the responsibility of the electrical contractor and/or the lightning protection system subcontractor to provide such preparation work under base bid and to sub-contract such work to the roofing contractor who is responsible for providing the roofing warranty.

Coordinate all such work in advance with the general contractor and the roofing contractor. Such work may include, but not be limited to, providing special fusion spliced (continuous heat welded) membrane caps and straps, special sealants, special solvents, special adhesives, etc.

Use mounting methods as recommended by manufacturer of air terminals and as approved by manufacturer of roofing material. Comply with air terminal and roofing manufacturers' installation instructions.

CORROSION PROTECTION

Use no combination of materials that may form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture, unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist that would cause deterioration or corrosion of conductors, use conductors with suitable protective coatings.

FIELD QUALITY CONTROL

Perform inspections of the lightning protection system installation in accordance with LPI-177, "Inspection Guide for LPI Certified Systems." Provide Owner's representative with one copy of LPI-177 and retain one copy at the project site throughout construction for reference.

Document the inspections on LPI forms LPI-C1-02 and LPI Form 1-R88. Provide one copy of each completed form to the Owner's representative.

Provide advance notice of at least 72 hours to the Owner's representative before concealing lightning protection system work.

Provide UL inspection and delivery of UL Master Label "C" to the Owner's representative (framed behind glass for mounting as directed in field by owner's representative).

Provide LPI Certification of the system, obtaining necessary certifications and signatures and preparing and handling necessary forms.

END OF SECTION

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SECTION 16880

COMMUNICATION TECHNOLOGY SPECIALTY WORK

WORK FURNISHED & INSTALLED BY DIVISION 16 ELECTRICAL CONTRACTOR

General

Provide general field coordination with Division 17 Contractor(s) and/or Owner's vendor(s) for same as required.

Refer to Section 16310 for service related work.

Provide outlet boxes (with 1" conduit stubs) for systems at each outlet indicated on drawings. Conduit stubs shall be turned out in joist space and, where located in areas with drywall ceilings, shall be extended to the nearest area with no ceiling or with acoustical tile ceiling.

Provide conduit, bridle rings and raceways as required.

Conduit stubs shall be 1" unless noted otherwise or directed otherwise in field.

Conduit stubs shall be installed in a manner which results in maintaining a minimum distance of 24 inches from motors, feeder/branch circuit wiring and from any ballasted lighting fixture.

All conduits shall be provided with sweep "L" 90's and insulated throat fittings (or bushings).

Refer to Section 16020 for raceway system identification requirements.

Outlets shall consist of a flush wall mounted 4" square box with a single gang plaster ring (verify with Div. 17 contractor). Maximum conduit fill for new work shall be 40%, based on manufacture's published data of cable outside diameter.

Use caution not to exceed the allowed bending radius for respective cables (coordinate with respective vendor). Raceway/Cabling bending radii shall be minimum as directed by cable manufacturer.

Refer to drawings for schematic representation of this work. The exact mounting heights and locations of all electrical system outlets shall be determined in the field with relation to architectural detail and equipment being served. It shall be the responsibility of this contractor to coordinate all outlet locations in field with owner's representative and with respective system vendor.

Conduit stubs (and systems furniture whips where applicable) shall be provided as follows.

<u>Conduit Diameter</u>	<u>Application</u>
(1) 3/4"	All Wall Phones
(1) 1"	All Wall Technology Outlets at Individual Desks or tables.
(1) 1"	All Wall Technology Outlets at Individual Server, Copier, Fax, etc. locations.
(1) 1"	Lab Counters.

Provide additional wall outlet boxes and additional whips as/if required at systems furniture to achieve the above.

Bridle Rings

Cable distribution bridle rings shall be equal to Caddy #4BRT64 or Mono-Systems Inc. "The Hook" (minimum 4" diameter or 4" square usable internal area) constructed of aluminum or corrosion resistant steel with rolled edges or equivalent to prevent damage to cable jackets and insulation. Provide splits or openings so that cables can be laid in the rings rather than threaded through.

Provide rings at four foot intervals and at all offsets. Route rings through corridors and similar open areas wherever possible to minimize wall penetrations.

Securely anchor (mechanical - not adhesive) all rings directly to structural components of the building. Rings shall not be anchored to ductwork, conduit, piping, fixtures, equipment, ceiling supports, etc.

All rings shall be fully and readily accessible after installation.

Provide maximum 30% fill (in cross section), based on outside diameter of cables. Accordingly, provide multiple sets of rings along any routes as/if required.

Route all bridle ring paths and cables perpendicular and parallel to the building architectural lines, keeping offsets to a minimum. Install bridle rings in a uniform plane/elevation wherever possible, keeping vertical offsets to an absolute minimum. Prior to installation, submit scaled coordination drawings showing all proposed routing and ring locations for review by Owner. Keep offsets to an absolute minimum. Bridle ring paths shall be routed so that a minimum of 24" exists between any cables and any EMI source such as ballasts, motors, power wiring, etc.

Group cables by system type wherever possible. Provide color coded jackets, or other approved labelling/identification method, to identify runs of different systems.

Provide UL Listed plenum cables in all plenum ceiling areas where applicable.

Provide a minimum of three (3) 4 inch bushed conduit sleeves at all penetrations of: floors, masonry walls, fire rated walls, smoke-tight partitions, smoke-rated partitions, etc. Provide smoke/fire stopping at all such penetrations per Section 16020.

WORK FURNISHED & INSTALLED BY DIV. 17 COMMUNICATION TECHNOLOGY CONTRACTOR

Provide, cable, terminations, jacks, labelling, hardware, etc. as required for complete working systems.

Coordinate all work in advance with Division 16 Electrical Contractor, prior to Division 16 Electrical Contractor's installation of outlet boxes, conduit stubs, etc.

Determine exact locations of communication technology equipment, equipment outlets, etc. in field.

Use caution not to exceed the allowed bending radius for respective cables and not to compromise the integrity of the cables during installation by pulling tie-wraps too tightly, damaging cables, etc. Raceway/Cabling bending radii shall be minimum as directed by cable manufacturer. Use pulling compound or lubricant, where necessary; compound must not deteriorate conductor or insulation.

Neatly dress all cable work.

Electrical work shall be installed in a manner which results in maintaining a minimum distance of 24 inches from feeder/branch circuit raceways and from any ballasted lighting fixture.

Review all termination and labeling requirements with Owner in advance. All cable shall be provided with permanent adhesive labeling identification by this contractor. Provide transparent adhesive coverings over each label, wrapped around the labels at least two times. The long axis of the labels shall installed be parallel to the long axis of the respective cable assemblies. Labels shall be approximately 1-1/2" long by 3/8" high.

Communications technology systems cables may be installed outside of conduit above accessible ceilings.

All such "free-air" cables shall be supported/anchored at maximum 4 foot intervals and within 12" of box or outlet. All cables which are routed above accessible ceilings (or in areas with no ceilings) shall be neatly bundled and secured to bridle rings or cable tray at four foot intervals. Wherever possible, bundle cables of the same system together.

Provide color coded jackets (colors as directed by Owner) to identify runs of different systems.

Neatly route cables parallel and perpendicular to building architectural lines.

END OF SECTION

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SECTION 16910

ELECTRICAL ALTERNATES

GENERAL

All work performed under the alternate(s) shall conform to all requirements of the base bid contract documents. State cost addition or deduction to base bid for purchasing, receiving, furnishing and installing all labor, coordination, equipment and material required for the following.

ALTERNATE #E-1

State "no change", "addition" or "deduction" to base bid for providing equipment manufactured by Square D Company for electrical power equipment specified under Section 16470 and Section 16490.

NO-CHANGE ADD DEDUCT \$ _____
(Circle one of the above)

ALTERNATE #E-2

State "no change", "addition" or "deduction" to base bid for providing equipment manufactured by Simplex Company for fire alarm system equipment specified under Section 16720.

NO-CHANGE ADD DEDUCT \$ _____
(Circle one of the above)

ALTERNATE #E-3

State addition to base bid for providing all work associated with the Lightning Protection System as defined on drawing Sheet E-8 and Specification Section 16830.

ADD \$ _____

END OF SECTION

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SECTION 17010

GENERAL REQUIREMENTS

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplemental Conditions and Division-1 Specification sections, apply to work of all Division-17 sections.

GENERAL

The base bid shall include furnishing all materials, labor, tools, equipment and installation of all work required to install complete communication systems as shown on the plans and outlined in all Division-17 sections.

Submittal of a bid indicates that the contractor has examined the drawings, specifications, and visited the site and has included all required allowances.

Contractor: shall be designated as the contractor for Division 17 work or, as applicable, sub-contractor for that section of work unless specifically stated otherwise.

SCOPE INCLUDED

Provide all communications technology work not specifically excluded. Work shall include, but is not limited to, the following.

Provide all communications technology work as required for complete operating systems.

Provide, cable, terminations, jacks, labeling, hardware, etc. as required for complete working systems.

Coordinate all work in advance with Division 16 Electrical Contractor, prior to Division 16 Electrical Contractor's installation of outlet boxes, conduit stubs, raceway systems, etc.

Determine exact locations of communications technology equipment, equipment outlets, etc. in field.

Use caution not to exceed the allowed bending radius for respective cables and not to compromise the integrity of the cables during installation by pulling tie-wraps too tightly, damaging cables, etc. Raceway/Cabling bending radii shall be minimum as directed by cable manufacturer. Use pulling compound or lubricant, where necessary; compound must not deteriorate conductor or insulation.

Neatly dress all cable work and provide bridle rings (or other approved method) for properly dressing all work at racks, control panels, etc.

Electrical work shall be installed in a manner which results in maintaining a minimum distance of 24 inches from feeder/branch circuit raceways and from any ballast type lighting fixture.

Review all termination and labeling requirements with Owner in advance. All cable shall be provided with permanent adhesive labeling identification by this contractor. Provide transparent adhesive coverings over each label, wrapped around the labels at least two times. The long axis of the labels shall be installed parallel to the long axis of the respective cable assemblies. Labels shall be approximately 1-1/2" long by 3/8" high. These labels shall appear within six (6) inches of each end of the finally terminated cable properly identifying each cable to assist in trouble shooting the system.

All cables shall be supported/anchored at maximum 4 foot intervals and within 12" of box or outlet. All cables shall be neatly bundled and secured to bridle rings or cable tray at four-foot intervals. Wherever possible, bundle cables of the same system together.

Provide color-coded jackets (colors as directed by Owner) to identify runs of different systems.

Neatly route cables parallel and perpendicular to building architectural lines.

SCOPE EXCLUDED

The following work is not included under this contract.

Field painting of any equipment, except as hereinafter mentioned in the specifications or shown on drawings.

120VAC power for equipment.

Providing wall outlet boxes.

Providing conduit.

Providing other raceways (cable tray, bridle rings, etc.)

SPECIAL CONDITIONS

Owner's representative or engineer shall be permitted to relocate any fixture, device or equipment outlet prior to installation within a 15 foot limit at no additional change in contract price.

The communication contractor shall complete his work or any part thereof at such time as may be designated by the owner's representative, so that it can be used for temporary or permanent use. Such use of the system shall not be construed as an acceptance of same by Owner.

MATERIALS AND EQUIPMENT

Materials installed shall be new, full weight, of the best quality. All similar materials shall be of the same type and manufacturer. All materials, apparatus and equipment shall bear the Underwriter's Laboratory, Inc. label where regularly supplied.

Contractor is responsible for the safety and good condition of the materials and equipment installed until final acceptance by the Owner. Materials shall be stored to prevent damage or weathering prior to installation.

When several materials, products or items of equipment are specified by name for one use, the contractor may select any one of those specified and shall include with his bid an Equipment List listing the equipment selected.

Bidders may bid on other materials, products or equipment. All material manufacturers listed in the contract documents, as an equal shall be equal in quality, performance, aesthetics, and product support to that specified. Other products, material, article, device, fixture or form of construction not mentioned as approved the Engineer must review equal. Request for approval must be made in writing and approved by the Architect ten (10) days prior to bid opening date, and issued by addendum.

The responsibility for costs incurred from deviation from the base equipment shall be the equipment supplier and this contractor. Use of any equipment will be considered as a statement that clearances and arrangements have been checked and found satisfactory.

STANDARDS

The applicable provisions of the following standards shall govern. All communication equipment must contain UL label and be manufactured and assembled in the USA.

All work shall be installed in strict accordance with the latest edition of all applicable codes including (but not limited to) the following codes and standards.

- National Electrical Code, NFPA 70.
- Ohio Basic Building Code.
- Kentucky Building Code.
- K.E.T.S. Building Wiring Standards.
- Life Safety Code, NFPA 101.
- City of Cincinnati Building Code.
- Local Electrical Codes.
- Local utility company requirements.
- A.D.A. requirements.

EXPLANATION AND PRECEDENCE OF DRAWINGS

For the purposes of clearness and legibility, drawings are essentially diagrammatic and although size and locations of equipment are drawn to scale wherever possible, Contractor shall make use of all data in all of the contract drawings and shall verify this information at building site.

The drawings indicate required size and points of termination of wiring and suggest proper routes to conform to the structure, avoid obstructions and preserve clearances. However, it is not intended that drawings indicate all necessary offsets, and it shall be the work of this section to coordinate the installation of wiring and equipment in such manner as to conform to structure, avoid obstructions, preserve headroom and keep openings and passageways clear without further instructions or cost to the Owner.

The communications contractor shall coordinate his work with all other trades and locate equipment accordingly. This contractor shall refer to coordination drawings of the other trades. Any communications work fabricated or installed before the above referenced coordination with all other trades will be done at the respective contractors' risk.

It is intended that all apparatus be located symmetrical with architectural elements and shall be installed at exact height and locations as shown on architectural drawings.

The contractor shall fully inform himself regarding all peculiarities and limitations of space available for installation of all work and materials furnished and installed under the contract. He shall exercise due and particular caution to determine that all parts of his work are made quickly and easily accessible. Although the locations of the equipment and conduit may be shown on the drawings in certain positions, the architectural details and conditions existing at the job site shall guide the Contractor, coordinating his work with that of others. Provide all offsets as required to provide a neat workmanlike arrangement.

Immediately upon award of contract and before any work is started, the contractor shall confer with the engineer or his representative concerning the work under these sections.

PERMITS AND REGULATIONS

All communication materials used in this work and all workmanship tests performed therein, unless otherwise specified shall conform to the latest rules, regulations and specifications of the National Electrical Code, the National Board of Fire Underwriters, local and state codes having jurisdiction and utility company.

Any discrepancy between these drawings and specifications and the codes, laws, ordinances, rules and regulations shall be immediately brought to the attention of the engineer, prior to any installation.

This contractor shall obtain and pay for all permits or certificates of inspection and approval required for this branch of the work.

Owner shall be furnished with certificates of final inspection and approval prior to final acceptance of this branch of the work.

SUPERINTENDENT

The contractor shall furnish the service of an experienced superintendent who shall be constantly in charge of the work, together with the qualified journeymen wireman and specialists as required to properly install, connect, adjust, start, operate and test the work involved.

The superintendent's qualifications shall be subject to the review and acceptance by the owner's representative. Unless the owner's representative grants prior special permission, the same communication superintendent shall be utilized throughout the duration of the project.

SUBMITTALS

All items of material and equipment shall be listed on an Equipment List prepared by the Contractor and shall be reviewed by the Engineer prior to the start of any work. Submittal shall be provided in a timely manner allowing for long lead items. No item of equipment will be permitted on the site until acceptance of that equipment has been given. Copies of drawings and manufacturer cuts and performance data will be required for approval. Submittals shall be organized in same order as listed in equipment list and include reference to page and paragraph numbers of the specifications and shall be bound in sets; all sets identical. The Contractor is not authorized to purchase any material until the Engineer reviews the shop drawings.

Submittals shall include a detail diagram of all mounting devices and method of rigging those devices to the structure.

Submittals shall clearly indicate sufficient definition so that they can be properly reviewed for compliance with contract documents.

See Division 1 Section "Submittals".

PRODUCT DELIVERY, STORAGE AND HANDLING

Deliver equipment and materials according to factory shipping requirements. Pack components in factory-fabricated protective containers. Units shall be delivered in sections of such size as will pass through available openings.

Store equipment and materials in clean dry place and protect from weather and construction traffic. When stored inside, do not exceed structural capacity of the floor.

Handling and rigging of equipment and products shall be as recommended by the manufacturer. Components and equipment damaged during shipment or handling shall not be installed. Replace and return damaged components to the manufacturer.

QUALITY ASSURANCE

Contractor if requested shall demonstrate his ability to perform all work to be included under the contract. Assurance if requested, shall be in the form of a list of past projects of similar size and complexity and a list of six (6) references pertaining to those projects. Failure to demonstrate these quality assurances shall be taken as a statement of the contractor's inability to perform.

Contractor shall have a minimum five (5) years experience in the installation of communication systems similar to the systems specified.

The quantity or quality level shown or specified shall be the minimum provided or performed. In complying with these requirements, indicated numeric values are minimum or maximum, as appropriate for the context of the requirements. Should there be a conflict between the plans and specifications, the greater quantity or better quality shall be furnished.

Install all equipment and materials in strict accordance with manufacturer's written instructions.

Tighten communication connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with tightening torque specified by applicable UL Standards. Accomplish tightening by utilizing proper torque tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Ensure that sealing grommets expand to form watertight seal.

Upon completion of installation of equipment and communication circuitry, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with re-testing.

Prior to energizing, check installed wires and cables to determine insulation resistance levels to assure requirements are fulfilled. Prior to energizing, test wires and cables for connections, for communication continuity and for short-circuits.

SPECIFICATIONS

Wherever the words "Contractor" or "This Contractor" "Subcontractor" appears in Division 17 specifications or on electrical drawings, it shall refer to the Division 17 Communications Contractor (or sub-contractor of the Communication Contractor where applicable).

Wherever the word "Provide" appears on plan drawings or in Division 17 specifications, it shall be interpreted to mean that the communication contractor shall "Furnish and Install", including all necessary accessories to render respective system fully operational.

Specifications shall be interpreted in connection with the drawings herein before described, and if anything is shown on drawings and not mentioned in the specifications, or vice versa, it is to be included in the work the same as though clearly set forth by both.

Furthermore, all materials or labor previously required to fully complete the work shall be included in the contractor's work even though each item necessarily involved be not specifically mentioned or shown. Such work and/or materials shall be of the same grade or quality as the parts actually specified and shown.

Should there be a conflict between the plans and specifications, the greater quantity or better quality shall be furnished.

CLEANING EQUIPMENT AND PREMISES

Clean all parts of the apparatus and equipment. Exposed parts, which are to be painted, shall be cleaned of cement, plaster and other materials and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all corners and cracks scraped out.

Exposed metal work shall be brushed down with steel brushes to remove rust and other spots and left smooth and clean. Remove trapped elements during cleaning and flushing period, after which they shall be replaced and adjusted.

During the progress of the work, the contractor shall clean up after his men and leave the premises and all portions of the building in which he is working in a clean and safe condition. This cleaning shall occur on a daily basis.

PROJECT CLOSEOUT

General

Final payment of contract will not be made until receipt, review and acceptance, by the owner's representative, of all documentation defined hereafter.

Refer to Division 1 Section 01700 "Contract Closeout".

Where applicable, refer to applicable General Conditions and similar sections of the project manual for details on record drawing submittals. In addition to the requirements specified in Division 1 or other applicable project manual sections, include the following as a minimum.

Owner shall be furnished with certificates of final inspection and approval prior to final acceptance of this branch of the work.

The owner's representative shall make arrangements for a meeting at such time as will be convenient to all parties concerned for the purpose of instructing the designated personnel on the correct operation and maintenance of each individual system furnished and/or installed by this contractor under this contract. These instructions shall be videotaped (VHS format) by the communication contractor with one tape submitted for each O & M manual.

The communication contractor shall be responsible for the proper instruction of each system to the satisfaction of the owner's representative.

Record Documents

In addition to the requirements specified in Division 1 or other applicable project manual sections, include the following for record documents.

Make arrangements for obtaining two complete sets of communication prints which shall be used to provide record drawings which shall be separate, clean, prints reserved for the purpose of showing a complete picture of the work as actually installed (including routing of all conduit and cables).

These drawings shall also serve as work progress report sheets and the communication contractor shall make any notations, neat and legible thereon daily as work proceeds. The drawings shall be available for inspection at all times and shall be kept at the job at a location designated by the owner's representative.

Maintain the clean, undamaged set of prints of Contract Drawings as well as a set of submittal drawings and coordination drawings where applicable. Mark the sets to show the actual installation where the installation varies from the Contract Documents as originally shown. Record drawings shall include locations of underground and concealed items if placed other than shown on the Contract Documents. Do not permanently conceal any construction until this required information is recorded. Mark which drawing is most capable of showing conditions fully and accurately. Where shop drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

Record documents shall show changes in: size, type, capacity, etc., of material device or piece of equipment, location of device or piece of equipment; location of outlet or source of building service systems; routing of piping, conduit, or other building services. These drawings shall also record location of concealed equipment, communication service work, conduits and other piping/work by indication of measured dimensions to each line from readily identifiable and accessible walls or corners of building. Indicate all approved substitutions, contract modifications, and actual equipment and materials installed.

For communication work installed below slabs, pavements, grade, etc., these drawings shall also record location of nearby concealed water piping, sewers, wastes, vents, ducts, conduit and other piping, etc. by indication of measured dimensions to each line from readily identifiable and accessible walls or corners of building and from adjacent communication work. Show invert elevation of underground communication work relative to work installed by other trades.

Upon substantial completion of the work, pay for and make arrangements for obtaining a complete set of erasable blackline reproducible drawings. All information from the print record drawings shall be neatly drafted onto the above referenced reproducible. Neatly erase and redraft work on the reproducible as required to reflect the work as actually installed. Perform drafting in a manner in which all work shall be shown in its actual locations, existing as well as new, by erasing inaccurate locations and redrawing proper routing/locations. This applies for all concealed work as well as work visible. Utilization of CAD for these drawings is preferred and related CAD files will be made available to the contractor.

Affix near the titleblock on each drawing of the set of record drawing prints and the set of reproducible the Contractors' Company Names, signature of Contractors' Representative and current date. Deliver one set of prints to the engineer. Deliver the second set of prints, the original reproducible and the marked-up field prints to the architect.

All prints and reproducible shall be signed and dated by the both the general contractor and the communication contractor.

In addition to the above, provide "as-built" record documentation for shop drawings (and coordination drawings where applicable).

Maintenance Manuals

In addition to the requirements specified in Division 1 or other applicable project manual sections, include the following.

Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

Manufacturer's printed operating procedures shall include start-up, break-in, normal operating instructions, regulation, control, stopping, shutdown, and emergency instructions.

Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and re-assembly; aligning and adjusting instructions.

Provide a minimum of three neatly bound (3-ring binder) copies of maintenance and instruction (O & M) manuals, including a parts list pertaining to all equipment furnished and/or installed by the communication contractor. Submit to owner's representative for review.

Manuals shall be bound in hard cover, post type binders.

Manuals shall contain the following as a minimum:

- 1) Index, typed at front w/typed tabs for each section;
- 2) Lists of all materials and equipment furnished with name, address and telephone number of vendor;
- 3) Operating Instruction Manuals and Service Manuals for all equipment furnished by the Communication Contractor;
- 4) A complete set of final approved shop drawings as submitted during construction;
- 5) A complete spare parts schedule for all components of all equipment furnished and/or installed under this contract; the schedules shall not be factory generic information, but shall be complete and accurate for the equipment actually provided.
- 6) A complete set of detailed wiring diagram and schematic drawings for all components of all systems furnished and/or installed under this contract; the drawings shall not be factory generic information, but shall be complete and accurate for the equipment actually provided.

Guarantee

The contractor shall provide a guarantee in written form stating that all work, materials, equipment and parts shall be free of defect for a period of one year from the date of owner's final acceptance, and shall repair, revise or replace at no cost to the owner any such defects occurring within the guarantee period.

Contractor shall also state in written form that any items or occurrences arising during the guarantee period will be attended to in a timely manner and will in no case exceed four (4) working days from date of notification by owner.

Any defective items or work shall be removed and replaced at the contractor's expense and to the satisfaction of the owner's representative and the Engineer.

END OF SECTION

SECTION 17020

BASIC MATERIALS AND METHODS

EXPLOSIVES

Use of explosives shall not be permitted.

WELDING

Welding shall not be performed under Division 17.

HIGH VOLTAGE WIRING

All 120 VAC wiring and terminations shall not be performed under Division 17

COMMUNICATIONS INSTALLATIONS

All work installed in finished areas shall be concealed. All work installed in unfinished areas may be exposed at the discretion of the Owner's representative.

Sequence, coordinate, and integrate installations of communications materials and equipment with the Division 16 electrical contractor (any other applicable trade) as for efficient flow of the Work.

Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible.

Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and architectural/structural components.

Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations.

Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

Verify all dimensions by field measurements. Take measurements and be responsible for exact size and locations of all openings required for the installation of work. Figured dimensions are reasonably accurate and should govern in setting out work. Where detailed method of installation is not indicated or where variations exist between described work and approved practice, direction of the owner's representative on job shall be followed.

The symbols used to indicate the purpose of which the various outlets are intended are identified in the Legend.

The conductors terminating at each wired outlet shall be left not less than 8" long at their outlet fittings to facilitate installment of devices.

If during construction it becomes apparent that certain minor changes in layout will effect a neater job or better arrangement, such alterations shall be made a part of the contract. Engineer's review shall be obtained before making such changes.

Workmanship throughout shall conform to the standards of best practice. Marks, dents or finish scratches will not be permitted on any exposed materials, fixtures or fittings. Inside of panels and equipment boxes shall be left clean.

COORDINATION

Coordination shall commence immediately upon award of contract. Failure of this contractor in coordinating (including providing related information to other trades for review) in a timely manner, shall not result in any subsequent additional reimbursement, special allowances or additional construction time being made for any facet of the project. Any work fabricated or installed before properly coordinating with all other trades will be done at this contractor's risk.

Plans are diagrammatic indicating design intent and indicating required size, points of termination and, in some cases, suggested routes of raceways, etc. However, it is not intended that drawings indicate fully coordinated conduit routing, all necessary offsets, etc. All cable assemblies, etc. shall be run as straight as possible and symmetrical (perpendicular to or parallel with) with architectural items and in a consistent elevation. Work installed diagonal to building members shall not be permitted.

The contract document drawings are an outline to indicate the approximate location and arrangement of required work. The drawings shall be followed as closely as possible in coordination and in execution of the work.

The Division 17 contractor shall work in harmony with all building contractors and sub-contractors, so as not to cause any delays in pouring concrete, building masonry walls, etc. The communications contractor shall consult the Architectural, Plumbing, HVAC and Structural plans in all instances before installing his work so that his work will not interfere with those branches.

This contractor shall participate in coordination efforts and in preparation of coordination drawings prior to fabrication or installation of any equipment, materials, etc. Coordinate actual clearances of all installed equipment.

Conflicts in equipment and materials shall be corrected prior to installation. Should there be a conflict with drawings of other trades, this contractor shall work with the trades to correct the conflict while coordinating the project (prior to installation). If the conflict cannot be resolved, refer the matter to the owner's representative for a final decision as to method or material. This contractor shall refer to drawings of all other trades for details, dimensions and locations of other work and route their work so as not to conflict with any other branch. Any work installed or equipment placed in position by this contractor creating a conflict shall be readjusted to the satisfaction of the owner's representative at the expense of this contractor.

IDENTIFICATION

General

Submit manufacturer's data on identification materials and products. Submit detailed nameplate schedule indicating proposed nomenclature, colors, text heights, fastening methods, etc. If requested by Owner's representative, submit samples of each color, lettering style and other graphic representation required for each identification material or system.

Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

Where identification is to be applied to surfaces, which require finish, install identification after completion of painting.

Comply with governing regulations and requests of governing authorities for identification of work.

Cable and Conductor Identification

Provide manufacturer's standard self-adhesive conductor markers of wrap-around type, write-on type with clear plastic self-adhesive cover flap; numbered to show cable identification. Provide on both ends of all conductors of all systems.

All conductors of all systems shall have color coded insulation. All cables of all systems shall have color coded jackets, with different colors used for the various systems (review with engineer and owner prior to ordering cables). Match color schemes with marking system used in existing systems (where applicable), shop drawings, contract documents, and similar previously established identification for project's work. Apply cable/conductor identification on each cable in each box/enclosure/cabinet for cables which are not available with color coded insulation or jackets.

END OF SECTION

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SECTION 17030

COMMUNICATION SYSTEMS SPECIAL REQUIREMENTS

GENERAL

The communication system equipment suppliers shall provide complete design and installation drawings. These drawings shall show layouts, conduit sizes, number and types of cables/conductors required to all components and detailed wiring connections required at each type of device. The final vendor designs shall be in full compliance with requirements of all authorities having jurisdiction. In addition to the one year warrantee required under Division 17 for all work, provide the following under base bid.

One year service contract (beginning after Owner's final acceptance of the work).

Cost of renewing each contract for an additional one, two and three year period at the Owner's option.

Unit prices (including Owner's discount) in "today's dollars" for all system components which could be affected by system expansions and by ongoing maintenance.

Provide all required design, accessories, devices, supplemental wiring, cable, programming etc. as required to render all systems fully operable. Each system shall be programmed, checked and tested by a certified factory technician. After making all tests and corrections, the systems shall be demonstrated to the Owner's Representatives and the authorities having jurisdiction.

CUSTOM PROGRAMMING, CONFIGURATION & IDENTIFICATION

All custom programming described below shall be provided for all programmable systems and all systems with any room number identifications which are required for successful system operation. Wherever the term "programming" is used below, it shall be taken to mean "programming, configuration and identification".

Custom programming shall be provided in full. Room names and numbers may change from architectural drawing names and numbers to actual Owner's room names and numbers. Provide all interim and permanent programming and configuration work under base bid.

All programming related services (including all required machine language, English language, etc.) associated with rendering all work fully operational shall be provided and neatly documented in detail by the respective vendors. Archive all intermediate and final programming work as required. Provide, replace and/or re-burn EPROM's and other integrated circuits as required.

All programming shall be custom and detailed to a level satisfactory to the Owner, including revised room numbers, revised room names, etc. Provide neatly typed orderly and logical submittal of proposed programming for review; prior to entering data, revise this submittal as much as required to satisfy the Owner. Determine specific requirements in field.

Provide programming for all auxiliary control and interface functions. Provide custom programming for all address labels. Provide detailed English language print statements for each system point/address and for each respective auxiliary control sequence. These print statements shall include as many characters, sentences, lines or paragraphs as required to provide extremely detailed descriptions of system status including any alarm or trouble condition and status of related auxiliary controls. The level of detail shall be at the discretion of the Owner. Remote enunciators shall also include clear specific English language descriptions.

EXISTING SYSTEMS

It shall be the collective responsibility of the successful communication technology contractor and the respective system manufacturer's representative, prior to bidding, to familiarize themselves with existing characteristics, devices, equipment, cabling, configuration, components, etc. of all affected systems so that all expansions/extensions/retrofits are fully compatible with the existing conditions and a complete fully operable system will be provided under Division 17 base bid. Any resulting modifications and/or supplements to Division 17 documents, which may be required accordingly, shall be considered to be included under base bid.

Programming services shall be provided for all new work, for all retrofit work and for all interfaces with new and existing systems. Provide schedule for cross reference of all new system labels to nomenclature used to enter same into the existing system.

Prior to beginning any work on any existing system, verify that the system is in proper working order; if not, bring defects to the attention of the Owner and the Construction Manager. If no notification occurs, it is assumed that the system was in working order and any subsequent system problems could become the responsibility of the Electrical Contractor.

PHASED CONSTRUCTION

Vendors submittal drawings shall account and indicate differentiation for all construction phasing and sub-phasing. All of the above custom programming (including all required machine language, English language, etc.), testing, certification, documentation, etc. related services shall be provided after each phase (and sub-phase) of the project (for projects with multi-phase construction) as required to render all systems fully operable after each construction phase. Room numbers shall change from architectural drawing names & numbers to actual Owner's room names & numbers, after each phase of construction. At the end of all construction phases, room names & numbers may change further.

Provide all interim and permanent programming and configuration work under base bid. Replace or re-burn EPROM's and other integrated circuits as required to accommodate multiple construction phases. Warrantee periods shall not begin until final acceptance of all work by the Owner after completion of the final construction phase.

SOFTWARE UPGRADES

Latest release of system software shall be provided (furnished, installed and adapted) at no additional cost to base bid under the following conditions.

Year 2000 upgrades.

Upgrades at final close-out of project, where system software originally installed has been upgraded.

END OF SECTION

SECTION 17710

TELEPHONE AND DATA CABLE PLANTS

PART 1 - GENERAL

SUMMARY

Unless noted otherwise on drawings or herein, furnish and install complete working telephone (voice) and data cable plants including all cables, wall-jacks, wall plates, labeling, blocks and terminations required for the telephone and data outlets shown on the drawings.

Coordinate with Division 16 electrical contractor including electrical boxes and fittings, and raceways, to properly interface installation of this work with other work.

All wiring terminations, and testing of this cable plant shall be performed by an experienced Data/Telephone installation organization having a minimum of 5 years experience.

The installation contractor shall provide documentation (with bid) proving at least five years company experience in successful cabling installations similar to the systems involved in this project.

All work associated with the Telephone and a Telephone and Data Cabling System Contractor shall provide Data Cabling System. This contractor shall provide documentation and references (with bid) as required to satisfy the Owner and Engineer as to the true qualifications of the installing contractor as an experienced, qualified Telephone and Data System Contractor.

Submit manufacturer's data on all system components and labeling. Submit layout drawings of ITS system-related components and accessories. Submit wiring diagrams for ITS system, including rack and terminal connections, patching, labeling and cable scheduling, etc.

Prior to time of substantial completion, the Installer shall submit 4 copies of an agreement for continued service and maintenance of the cable system related components and accessories, for Owner's possible acceptance. Offer terms and conditions for furnishing parts and providing continued testing and servicing, including replacement of materials and equipment, for one-year period (first year beyond the base bid one-year warranty) with option for renewal of Agreement by Owner.

The Owner reserves the right to reject any Subcontractor who does not satisfy the Owner as to their reliability and/or technical capability.

SCOPE

The installation of the data cable plant/computer cabling work shall be a "turnkey" system so that the Owner simply has to place microcomputer/terminal/printer equipment in place and plug in the respective cabling. All conduit, station cable assemblies, terminal connectors, terminations, raceway systems, labeling, etc. required for the data outlets shown on the drawings shall be furnished and installed by this Subcontractor. Wiring Scheme shall be T568B. All installation shall be in strict accordance with EIA/TIA 568 A&B, 569,606 & 607.

This contractor shall provide all devices and cable required to meet the requirements shown on the plan documents. All wall plate wiring shall have its wiring return to a wall mounted rack located on the West wall of Electrical Equipment Room 112.

Any symbols shown, as combination of telephone and data, shall have one of each type of cable terminated at that plate. Any symbols indicating a single application shall have only one of the type of cables indicated by the symbol.

Electrical boxes and fittings, raceways, cable trays, bridge rings, etc. which are required in connection with the installation of telephone and data systems, are specified in Division-16 sections and shall be provided by others.

The following equipment shall be furnished and installed by Owner:

- a) Telephone switch (existing).
- b) Regulated Line Telephone Cable Work.
- c) Telephone Handsets.
- d) Fax Machines and modems.
- e) Host Data Equipment/Hubs.
- f) Work Station Data Equipment (P.C.'s, Terminals, Printers, etc.).
- g) Whip Cords between work station equipment and voice/data jacks.
- h) Optical fiber related work.

PART 2 - EQUIPMENT

GENERAL

Provide color coded conductor insulation and gray outer jacket for all telephone cables.

Provide color coded conductor insulation and blue outer jacket for all data cables.

Provide separate home-run cable for each outlet jack shown ("star"/"radial" topology).

Duplex jacks shall be used where multiple outlets are shown immediately adjacent to each other or stacked on top of each other. Elsewhere, use single jacks.

Field install jack assemblies in wall outlets, floor outlets and systems furniture as required. All jacks (including those for system furniture installation) shall be provided by this contractor.

Data and Telephone cables shall be Category 5 - 4 Pr. #24 UTP, Type CMP/MPP, UL Subject 444. Belden #1585A or BerkTek, Com-Scope equal.

Data and Telephone Jack Receptacles shall be RJ45, Category 5 with lead frame design connector on the rear and mounted on single gang modular plates. Panduit Mini-Com Series Face Plates and receptacles. Plates shall be ivory. Provide red jacks for data and blue jacks for voice. Where jacks are to be installed in floor boxes, provide modular mounting straps configured for a duplex receptacle cover plate.

The Communication Technology Subcontractor shall install data and telephone cables to these station outlets of quantity and type as indicated by the symbol on the drawings.

All 4 pairs of all cables shall be punched down at both ends.

Wiring standard shall be EIA/TIA-568B.

Upon final installation and connections each cable shall be checked and tested for proper polarity, shorts and opens and a written report along with a cable identification schedule delivered to the Architect. All cable tests shall be performed in strict accordance with EIA/TIA 568B.

Furnish free standing self supporting data rack 84" high x 19" wide, DataTel #MK-19-45, with DataTel, HCM series cable management products as required or approved equal from CPI, Homaco, or Great Lakes. Include shelf and drawer accessories as detailed on the drawings. Provide shelves for Owner's hub equipment.

All data cross connect patch panels shall be Category 5 T568B Full Compliance. Panduit DataPatch patch panels or approved equal from AMP or Lucent Technologies.

VOICE (TELEPHONE) OUTLETS AND RELATED WORK

Provide Panduit Mini-Com Series CJ588BU or approved equal from Lucent or Ortronics

Quantity 1 per drop indicated on plan

Provide snap-in (or equivalent) identification at each jack (i.e. "VOICE", or graphic equivalent).

Telephone pin configuration wiring shall be as determined in field to match Owner's existing conditions.

Wall phones shall be mounted at 48" above finished floor to the center of the outlet box. They shall be provided with one cable drop each and with single-gang plaster rings. Provide hanger type wall jack for wall mounted handset.

DATA OUTLETS

Provide Panduit Mini-Com Series CJ588RD or approved equal from Lucent or Ortronics

Quantity 1 per drop indicated on plans

Provide snap-in (or equivalent) identification at each jack (i.e. "DATA", or graphic equivalent).

All data station cable home-runs shall terminate to Owner's rack mounted equipment, as directed by Owner in field.

DATA AND VOICE PATCH PANELS

Panduit DP24588110B data / voice patch panel or approved equal from Lucent Technologies or AMP
Quantity as needed

DATA RACKS

DataTel SGR-20-18, with DataTel HCM series cable management products as required or approved equal from CPI. Include shelf and drawer accessories as required. Provide shelves for Owner's hub equipment.
Quantity as needed

Provide Distribution Rack Grounding Kit installed in the rack. Provide one #6 AWG (3/4" conduit) from Room rack to the electric service ground.
Quantity as needed

Rack shall be provided with vertically mounted Middle Atlantic PD series, Wiremold #G-3000 series plug-strip assemblies with NEMA 5-20R duplex receptacles.
Quantity as needed

Terminate all station cabling to rack-mounted RJ-45, Cat. 5 compatible, patch panels. Provide cross connect patch cords from same to Owner's Concentrator Hubs.

CABLE

Provide Belden CM-00424 CAL - 5B Category 5 Data Cable or approved equal from BerkTek, Prestolite or Lucent Technologies

Provide Belden CM-00424 CAG - 5B Category 5 Voice Cable or approved equal from BerkTek, Prestolite or Lucent Technologies

PART 3 - EXECUTION

INSTALLATION

Use caution not to exceed the allowed bending radius for Cat. 5 cables and not to compromise the integrity of the cables during installation by pulling tie-wraps too tightly, damaging cables, etc. Raceway/Cabling bending radii shall be minimum as directed by cable manufacturer. Use pulling compound or lubricant, where necessary; compound must not deteriorate conductor or insulation.

Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors.

Review all termination and labelling requirements with Owner in advance.

Neatly dress all cable assembly work at all terminal locations and provide secure cable guides as required.

Refer to drawings for schematic representation of this work. The exact mounting heights and locations of all electrical system outlets shall be determined in the field with relation to architectural detail and equipment being served. It shall be the responsibility of this contractor to coordinate all outlet locations in field with owner's representative.

All station cable assemblies shall be terminated and identified by this Subcontractor.

All cables from overhead cable trays shall be neatly dressed behind distribution panels in a manner which provides adequate working space in back of the panels/racks.

Neatly dress all cable assembly work at all racks and at all termination points and provide cable management guides as required.

Work shall be installed in a manner which results in maintaining a minimum distance of 24 inches from feeder/branch circuit raceways and from any ballasted lighting fixture.

CABLE PLANT IDENTIFICATION/LABELLING

Refer to Electrical Identification Section for labelling material/methods.

Specific nomenclature of labels shall be as directed by owner's representative in field. Provide all necessary coordination.

All station cable assemblies shall be provided with permanent adhesive labeling identification by this contractor. Provide transparent adhesive coverings over each label, wrapped around the labels at least two times. The long axis of the labels shall installed be parallel to the long axis of the respective cable assemblies. Labels shall be approximately 1-1/2" long by 3/8" high. Labels and transparent coverings shall not be sensitive to light, heat or moisture. Allow for a minimum of two lines ("to" & "from") per label with a minimum of 12 characters per line.

At Owner's option, provide IBM #GX21-9345 labels in lieu of those described above.

Typical labeling logic shall be as follows. Verify logic in field prior to fabricating labels, etc. Provide all necessary coordination.

Telephone: CFRRRNT (where C indicates "Student Center", F indicates Floor (1 or 2), RRR is the respective Room Number, NN is the Device Number within the respective room and T indicates Telephone Cable).

Data: CFRRRNN (where C indicates "Student Center", F indicates Floor (1 or 2), RRR is the respective Room Number and NN is the Device Number within the respective room).

As a minimum, provide such labeling identification at the following locations:

- a) on each faceplate at each connector outlet.
- b) on each cable within outlet box at each connector outlet (on sheath after stripping).
- c) on each cable at exit from conduits in closets.
- d) on each cable at exit from conduits to cable tray.
- e) on each cable within each pullbox.
- f) on each cable at each telephone punchdown block and data rack port (on sheath after stripping).
- g) at each data port on the Cable Distribution Panel.
- h) on each cable at each host/hub equipment port.
- i) as otherwise directed in field by Owner.

Provide separately framed (behind glass) label logic legend, securely mounted at within Wiring Closet 226. Similarly provide separately framed (behind glass) reduced floor plan and riser drawings ("as-builts"). Framed legends/drawings shall be clearly legible and shall not be sensitive to light, heat or moisture.

TESTING

This Subcontractor shall perform all necessary acceptance testing insuring that operational parameters at selected points throughout the cable plant facility operate in accordance with manufacturer's hardware

specifications. Upon completion of testing, submit a bound set of printed test results consisting of a separate sheet for each cable tested.

This Subcontractor shall perform all necessary acceptance testing insuring that operational parameters at selected points throughout the cable plant facility operate in accordance with manufacturer's cable assembly and hardware specifications.

All testing shall be tabulated, documented, scheduled and witnessed by Owner's representative. Electrical Subcontractor shall provide all labor, materials, and documentation as required for all testing. Testing shall include, but not necessarily limited to, the following (including all conductors & connectors):

- a) Open circuit/Continuity testing.
- b) Short circuits between conductors of the same cable assembly.
- c) Reversed polarities.
- d) Grounds on individual conductors, either between a conductor and a shield or between a conductor and a grounded object.
- e) Attenuation testing. Submit printed test report for each cable. Include loop resistance, Attenuation, Capacitance, ACR and cable length.
- f) If any cable assembly or conductor or connector is found defective or not per specifications of manufacturer, it shall be immediately replaced with no additional compensation to the Subcontractor.

END OF SECTION

