

*Missouri
Department
of Transportation*



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**Addendum No. 001
9-100105**

To: Plans and Specifications Holders List for:

**Missouri Department of Transportation –
District – 2, Sewer Extension, Trenton, Missouri**

**THE BID OPENING DATE/TIME IS HEREBY CHANGED TO
JANUARY 8, 2010 AT 3:00 PM LOCAL TIME.**

IN THE SPECIFICATIONS, SECTION 16050 BASIC ELECTRICAL MATERIALS AND METHODS IS REPLACED IN ITS ENTIRETY WITH THE ATTACHED CORRECTED SECTION 16050 BASIC ELECTRICAL MATERIALS AND METHODS.

IN THE SPECIFICATION, ALL REFERENCES TO FAYETTE ARE ERRONEOUS; THIS PROJECT LOCATION IS TRENTON, MO.

IN THE PLANS (DRAWING) REMOVE PAGE 8 OF 11 AND REPLACE IT WITH THE ATTACHED.

-END SECTION-

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

- 1.1 SUMMARY: Provide complete distribution systems for electrical power and lighting as shown on the Drawings or required by other sections of these specifications.
- A. Work includes, but is not necessarily limited to:
1. Distribution system for power, including connection to existing panel, branch-circuit bolt-on type breakers, and any required metering equipment not provided by the electrical utility. Power system shall be 208 volt (V), 60 Hertz (Hz), 3-phase, 4-wire.
 2. Installation of control panel, motor starters, combination starters, safety switches, manual transfer switch, and controls, whether provided under this section or other sections of these specifications.
 3. Grounding system.
 4. Other items and services required to complete the electrical systems.
- 1.2 APPLICABLE PUBLICATIONS: Industry publications controlling the work of this Section include:
- A. American Society for Testing and Materials (ASTM):
ASTM B8: Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
- B. National Electrical Manufacturer's Association (NEMA):
NEMA FU 1: Low Voltage Cartridge Fuses.
NEMA ICS: Motor Starters.
- C. National Fire Protection Association (NFPA):
NFPA 70: National Electrical Code (NEC).
NFPA 78: Lightning Protection Code.
NFPA 101: Life Safety Code.
NFPA 110: Emergency and Standby Power Systems.
- D. Occupational Safety and Health Administration (OSHA):
Occupational Safety and Health Standards.
- E. Underwriters Laboratories Inc. (UL):
UL 57: Electric Lighting Fixtures.
UL 96: Lightning Protection Components.
UL 96A: Installation Requirements for Lightning Protection Systems.
UL 98: Enclosed and Dead-Front Switches.
UL 198E: Class R Fuses.
UL 498: Attachment Plugs and Receptacles.
UL 943: Ground-Fault Circuit Interrupters.
UL 1449: Standard for Safety, Transient Voltage Surge Suppressors, Revised Edition, July 1987.
- 1.3 SUBMITTALS: Submit the following in accordance with Division 1. Submittals are for the record or approval, as indicated.
- A. Catalog cuts of safety switches for approval. Provide time-current characteristic curves for all fuses supplied.

- B. Catalog cuts of grounding conductor, ground rods and connectors for the record.
- C. Catalog cuts of power and control cable and connectors for the record.
- D. Upon completion of this portion of the work, and as a condition of its acceptance, submit operation and maintenance manuals. Include within each manual:
- E. Copy of the Record Documents for this portion of the work.
- F. Copies of all circuit directories.
- G. Copies of all warranties and guarantees.
- H. Emergency instructions.
- I. Spare parts list.
- J. Wiring diagrams.
- K. Shop drawings and product data.
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions.
 - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
- L. Include the following information for equipment items:

1.4 COORDINATION: Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

- A. Coordinate connection into existing panel with on-site MoDOT staff for any required downtime of power supply.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Provide only materials that are new, of the type and quality specified, and free from defects and imperfections. Where Underwriters Laboratories Inc. has established standards for such materials, provide only materials bearing the UL label.
- B. Manufacturers that can provide products meeting these specifications have been identified. Other manufacturers' products meeting these specifications may be acceptable subject to submittal of certificate of compliance, review, and approval. Where catalog numbers are shown, they should be verified with the manufacturer to assure continued accuracy and compliance with these specifications.
- C. All materials and equipment of the same type shall be made by the same manufacturer.

- D. All materials and equipment shall be acceptable to the authority having jurisdiction as suitable for the use intended.

2.2 DISTRIBUTION

A. Conduit, Fittings

1. Rigid Galvanized Steel Conduit (RGS)
 - a. Each length threaded on both ends.
 - b. All scale, grease, dirt, burrs, and other foreign matter removed from inside and outside prior to application of coating materials.
 - c. Galvanized by the hot-dip process as follows:
 - 1) Interior and exterior surfaces coated with a solid, unbroken layer of 99% virgin zinc by dipping.
 - 2) One coat of zinc chromate finish on inside and outside surfaces to prevent oxidation and white rust.
 - d. Couplings and elbows fabricated, coated, and finished by the same process as conduit.
 - e. Where conduits enter boxes or cabinets without threaded hubs, double locknuts shall be used plus a phenolic insulated metallic bushing on the open end.
2. Rigid Polyvinyl Chloride (PVC) Conduit
 - a. Fabricated from self-extinguishing, high-impact, polyvinyl chloride designed for above ground and underground installations.
 - b. Type EPC, Schedule 40, heavy-wall rigid conduit, Schedule 80 where noted on the Drawings, unless noted otherwise.
 - c. Fittings and accessories fabricated from same material as conduit.
 - d. Solvent-cement-type joints as recommended by manufacturer.
3. Flexible Liquidtight Nonmetallic Conduit Type B
 - a. UL listed and CSA Certified.
 - b. Conduit shall have a smooth inner diameter, and a smooth outer jacket approved for outdoor use.
 - c. Conduit shall be sunlight resistant and oil resistant.
 - d. Liquidtight fittings shall be designed for use with steel conduit or PVC conduit as required.
4. Conduit clamps, straps and supports shall be steel or malleable iron, hot dip galvanized.
5. Special Fittings: Conduit sealing, explosion-proof, dustproof, and other types of special fittings shall be provided as required by the Drawings and these specifications and shall be consistent with the area and equipment with which they are installed. Fittings installed outdoors or in damp locations shall be sealed and gasketed. Outdoor fittings shall be of heavy cast construction. Hazardous area fittings shall conform to UL 886 and to NEC requirements for the area classification designated.

B. Wire and Cable

1. Sizes indicated on the Drawings.
2. Service-entrance cable shall have type RHW insulation.
3. Feeders and Branch Circuits:
4. Flame-retardant, moisture- and heat-resistant thermoplastic with single conductor copper cable, Type THHN/THWN, 600V.
5. Rated 75EC maximum conductor temperature in wet locations and 90EC in dry locations.
6. Conductor composed of 98% IACS, (International Annealed Copper Standards) soft annealed copper conforming to ASTM B8.
7. Conductor insulated with polyvinyl chloride to conform to or exceed Insulated Cable Engineers Association (ICEA) Standards.

C. Control Cable

1. Use size 14.

2. Multiple-conductor shielded control cable, each conductor polyethylene insulated with a polyvinyl chloride covering and the cable having an overall polyvinyl chloride jacket.
3. Rated 600V, 90EC maximum conductor temperature in wet and dry locations.
4. Individual conductors composed of 98% IACS soft annealed copper, 7-wire stranded.
5. ICEA Method 1 color coding, colored insulation, and printed, colored tracers.

D. Connections to Equipment

1. Power Cable Connectors:
 - a. For all wire, cable, equipment and bus terminals, designed and sized for the specific cable or bus being connected.
 - b. Solderless, pressure-type connectors constructed of high-strength, non-corrodible, tin-plated copper designed to furnish high-pullout strength and high-conductivity joints.
 - c. Rated current-carrying capacity equal to, or greater than, the cable being connected and with silver-plated contact surfaces for conductors of 500-kcmil copper capacity or greater.
2. Control Cable Connectors
 - a. For control, alarm, and instrumentation wiring, use pre-insulated, diamond-grip type with ring tongue. Spade lugs will not be permitted.
 - b. Designed for the specific size and type conductor being used.

E. Wiring Devices

1. GFCI Receptacles
 - a. Rated 20A, 125 VAC, specification grade, NEMA 5-20R.
 - b. Flush-mounted, ivory color.
 - c. A contrasting color band on the reset button provides visible indication of a ground fault trip.
 - d. Duplex, arc-resistant and prewired, 3-wire, grounding-type.
 - e. Five milliampere trip level, feed-thru type, capable of protecting connected downstream receptacles.
 - f. Provide matching cover plates.
 - g. Weatherproof receptacles shall be supplied with a die cast aluminum, spring held cover with a rubber, watertight gasket.

F. Disconnects

1. Provide safety switches of the heavy-duty type and rating as shown on the Drawings or required for proper completion.
2. Provide heavy-duty, dead-front, positive, quick-make, quick-break, fused type or non-fused, as indicated on the Drawings, rated 600 VAC for 480Y/277V system and 250 VAC for 240/120V system or 208/120V system.
3. Switch shall be selected according to poles, amperes, volts and NEMA type enclosure as indicated on the Drawings.
4. Unit shall be UL listed and externally operable with provision for padlocking.
5. Provide copper contacts in safety switches.
6. All switches shall have switch blades which are fully visible in the "OFF" position when the switch door is open.
7. The operating handle shall be an integral part of the box, not the cover. The handle position shall indicate whether the switch is "ON" or "OFF".
8. The covers shall be securable in the open position.
9. NEMA 3R switches shall have interchangeable, bolt-on hubs. Hub connections shall be watertight, dustproof, and airtight.
10. The finish shall be a baked enamel gray, electrodeposited on cleaned, phosphated steel.
11. Provide enclosures clearly marked for maximum voltage, current, horsepower rating, NEMA Type 3R, raintight.
12. Fuse clips for fusible units shall accommodate Class R fuses.

13. Sources: General Electric; Siemens; Square "D"; Westinghouse
- G. Fuses
1. Fuses shall be Class RK1, dual element, current limiting, one-time fuse, 250V or 600V as required per NEMA FU1 and UL 198E.
 2. Interrupting rating shall be 200,000 amperes rms.
 3. Sources: Brush; Bussman
- H. Supporting Devices
1. Conduit or equipment supports shall be galvanized steel support channel adequate for the weight of equipment or conduit, including wiring, which they carry.
 2. Fastening hardware shall be corrosion resistant.
- I. Identification
1. Identify all safety switches and other apparatus used for operation and control of circuits, appliances, and equipment. Provide plastic laminate nameplates, white face with black core letters, showing proper identification. Minimum size nameplate shall be 1" x 3" with 1/4" letters. Labels shall be secured using silicone glue.
 2. Wire and cable markers shall be printed tape markers or split sleeve type.
- J. Handhole/Junction Box: Handholes/junction boxes shall be fabricated from an aggregate consisting of sand and gravel bound together with a polymer and reinforced with continuous woven glass strands. The compressive strength shall be 11,000 psi, tensile strength of 1700 psi, and flexural strength of 7500 psi. The cover of the handholes must have a non-skid surface and must hold a vertical design load of 8000 pounds over 10' x 10" surface with no physical damage or excess deflection. The cover logo shall be "Lighting". Size per NEC. It shall be as manufactured by Quazite.

2.3 POWER SYSTEM

- A. Grounding
1. Ground all power distribution equipment, branch circuit loads, etc. by conductor to the grounding system. All metallic parts of electrical equipment which do not carry current shall be grounded with an equipment grounding conductor whether or not shown on the Drawings. The equipment grounding conductor shall be a green insulated copper conductor. Sizes of grounding conductors shall be in accordance with the NEC unless shown otherwise on Drawings. The NEC shall govern and shall not be violated.
- B. Provide the following wire for direct buried grounds
1. Bare, uncoated copper cable, unless otherwise noted.
 2. Conductors composed of 98% IACS soft or annealed copper to conform to the following requirements:
 - a. 250 kcmil stranded, unless otherwise noted.
 - b. Solid conductors in sizes No. 4 AWG and smaller.
 3. Sources: Anaconda; General Cable; General Electric; Triangle
- C. Ground Rods
1. Copper-clad steel or copper alloy, sectional type rods.
 2. One end pointed to facilitate driving.
 3. 3/4" diameter and 10'-0" long with diameter and length stamped near top of rod.
- D. Connection Materials
1. Cable-to-cable, cable-to-rod, cable-to-connector, and cable-to-building steel connections of exothermic welding process, unless otherwise noted.
 2. Cable-to-equipment ground lugs:

- a. Bolted to equipment housing with silicon bronze bolts and lock washers.
 - b. All equipment grounding shall be free of paint or any other material covering bare metal.
- 3. Sources: Cadweld; OZ/Gedney; Weaver
- E. Other Materials: The Contractor shall provide other materials, though not specifically described, which are required for a completely operational system and proper installation of the work.

PART 3 EXECUTION

3.1 LABOR AND WORKMANSHIP: All labor for the installation of materials and equipment furnished for the electrical system shall be done by experienced mechanics of the proper trades.

- A. All electrical equipment furnished shall be adjusted, aligned and tested by the Contractor as required to produce the intended performance.
- B. Upon completion of the work, thoroughly clean all exposed portions of the electrical installation, removing all traces of soil, labels, grease, oil, and other foreign material, and using only the type of cleaner recommended by the manufacturer for the item being cleaned.

3.2 COORDINATION: Coordinate as necessary with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

- A. Coordinate the installation of electrical items with the schedule for work of other trades to prevent unnecessary delays in the total work.
- B. Installation of exposed conduit, lighting fixtures, or other equipment shall not occur until all piping, pipe hangers, ducts and equipment which are above have been installed, and provided on site by others.
- C. Where lighting fixtures and other electrical items are shown in conflict with locations of structural members, mechanical items, or other equipment, provide required supports and wiring to clear the encroachment.
- D. Coordinate installation of Owner-furnished equipment and placement of conduits using vendor Drawings, plans, and the established construction schedule.
- E. Data indicated on the Drawings and in these specifications are as exact as could be secured, but their absolute accuracy is not warranted. The exact locations, distances, levels, and other conditions will be governed by actual construction and the Drawings and specifications should be used only for guidance in such regard.
- F. The electrical Drawings are diagrammatic, but shall be followed as closely as actual construction and work of other trades will permit. Where deviations are required to conform with actual construction and the work of other trades, make such deviations without additional cost to the Owner.
- G. Perform trenching, bedding, and backfilling associated with the work of this Section in strict accordance with the provisions of Section 02210, EARTHWORK, of these specifications.

3.3 INSTALLATION

- A. Conduits
 - 1. Install using as few joints as possible.
 - 2. Provide RGS conduit for all conduit penetrating concrete walls and floors and for all exposed, exterior conduit. Provide Schedule 80 PVC conduit where noted on the Drawings.

3. Provide Schedule 40 PVC or RGS conduit below grade, unless noted otherwise. Minimum burial depth outside of building shall be 24" clear to top of conduit, unless noted otherwise.
4. Install liquidtight nonmetallic conduit at all points of connection to equipment mounted on supports to allow for expansion and contraction or ease of maintenance.
5. The number of raceways shall be installed per Drawings. Circuits shall not be combined to reduce number of raceways.
6. Where conduit has to be cut in the field, it shall be cut square with a pipe cutter using cutting knives.
7. All conduits shall be swabbed clean by pulling an appropriate size mandrel through the conduit before installation of wire or cable. Clear all blockages and remove burrs, dirt, and debris.
8. Provide insulated grounding bushings for all conduits stubbed into equipment enclosures.
9. Where conduit size is not indicated, install ¾" conduit.
10. Plugs shall be installed in all unused openings of all fittings, boxes, and panel boards.
11. Contractor is responsible for protecting all conduits during construction. Temporary openings in the conduit system shall be plugged or capped to prevent entrance of moisture or foreign matter. Contractor shall replace any conduits and/or ducts containing foreign materials that cannot be removed.

B. Conductors

1. All wire shall be color coded as follows:

<u>Description</u>	<u>208/120 Volt</u>
Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Ground	Green
2. Single conductor and multi-conductor cable shall not be bent to radii smaller than that specified by the manufacturer or by the National Electrical Code. Special pull boxes or oversized conduits shall be used to meet this requirement.
3. Pulling lubricants shall be soapstone powder, powdered talc, or a commercial pulling compound. No soap suds, soap flakes, oil, or grease shall be used, as these may be harmful to cable insulation. Contractor shall use nylon or hemp rope for pulling cable to avoid scoring the conduit.
4. Cables shall be neatly trained, without interlacing, and be of sufficient length in all boxes, equipment panels, etc. to permit making a neat arrangement. Jackets of multiconductor control cables shall be removed as required to properly train and terminate the conductors. Cables shall be secured in a manner to avoid tension on conductors or terminals, and shall be protected from mechanical injury and from moisture at the unprotected end. Sharp bends over conduit bushings are prohibited. Damaged cables shall be removed and replaced at the Contractor's expense.

C. Wiring Devices

1. Install wiring devices as indicated, in compliance with manufacturer's written instructions, applicable requirements of the NEC and NEMA standards and in accordance with recognized industry practices.
2. Coordinate with other work as necessary to interface installation of wiring devices.
3. At time of completion, replace those items that have been damaged, including those burned and scored by faulty plugs.

D. Grounding

1. Install grounding system as shown on the Drawings.
2. Install ground rods as indicated on the Drawings, by driving and not by drilling or jetting.

3. Drive ground rods into unexcavated portion of the earth where possible.
4. Where ground rods must be installed in excavated areas, drive rods into earth after compaction of backfill is completed.
5. Drive to a depth such that the top of ground rods will be approximately 12" below finish grade, or subgrade, and connect to counterpoise.
6. Rotate each ground rod 180E for every foot it is driven to prevent undetected deflection. If it cannot be rotated, a new ground rod shall be driven.
7. Conform to manufacturer's instructions for grounding system connections. All ground connections shall be inspected for tightness. Exothermic-welded connections shall be approved before being permanently concealed.
8. Chemically degrease and dry connections completely before welding.
9. Apply one coat of asphaltic coating to all exothermic-welded connections to be buried.
10. Make connections to equipment as follows:
 - a. Make up clean and tight to assure a low-resistance connection with resistance drop not exceeding 1 ohm.
 - b. Install so as not to be susceptible to mechanical damage during operation or maintenance of equipment.
 - c. Provide direct copper connection to counterpoise.
11. A separate, continuous, insulated equipment grounding conductor shall be installed in all feeder and branch circuits.
12. A separate neutral conductor shall be installed for each branch circuit. Combining neutrals shall not be allowed.
13. Bond all insulated grounding bushings with a bare #6 AWG grounding conductor to a ground plate or ground bus.
14. All grounding conductors embedded in or penetrating concrete shall be insulated.

E. Control Panels

1. Unless otherwise shown on the Drawings, install control panel with the top of the trim 6'-3" above grade. Mount on channel as indicated.

F. Lighting Fixtures

1. Completely install lighting fixtures for use and shall be located as shown on the Drawings.
2. Wire fixtures with conductors which comply with paragraph - Wire and Cable.
3. Use only galvanized steel and galvanized hardware for fixture installation to provide protection against rust and corrosion.
4. Install all lighting fixtures so that the weight of the fixture is supported either directly or indirectly by a sound and safe structural member of the building. Use adequate number and type of fastenings to assure safe installation.
 - a. Screw or toggle bolt fastenings to ceiling material or wall paneling are not acceptable.
 - b. Support fixtures directly from roof joists or roof trusses.
5. All luminaires shall be aligned and lenses and diffusers cleaned at the completion of the work. Failed lamps shall be replaced.

G. Hazardous (Classified) Locations

1. All work in hazardous locations shall be completed in accordance to the NEC and as shown on the Drawings. In the case of conflicts, the contractor shall notify the engineer in writing and await for written instructions.
2. All conduit shall be rigid galvanized steel, equivalent to Schedule 40 pipe. EMT and IMC, as defined in the NEC, shall not be used.
3. Conduit sealing fittings shall be installed as required by the NEC.
4. Drain seals shall be installed on vertical conduits immediately before entering equipment enclosures in order to prevent moisture from entering equipment. Drains shall be used at all low points in the conduit systems and as required to prevent accumulation of moisture in

conduit and equipment enclosures. All conduits passing through building walls shall be sealed within 18" of outside walls.

5. Conduit sealing fittings shall not be packed or poured until all systems have been inspected and tested.

3.4 ACCEPTANCE TESTING

A. General

1. Provide personnel and equipment, make required tests, and submit test reports upon completion of tests.
2. Provide temporary power source of proper type for testing purpose when normal supply is not available.
3. Make written notice to the Owner adequately in advance of each of the following stages of construction:
 - a. In the underground condition prior to placing concrete floor slab, when all associated electrical work is in place.
 - b. When all rough-in is complete, but not covered.
 - c. After all exothermic-welded connections are made, but not concealed.
 - d. At completion of the work of this section.
4. When material and/or workmanship is found not to comply with the specified requirements, the noncomplying items shall be removed from the jobsite and replaced with items complying with the specified requirements promptly after receipt of notice of such non-compliance.

B. Test Procedures

1. All feeders shall have their insulation tested after installation, but before connection to devices. The conductors shall test free from short circuits and grounds.
2. Prior to energizing circuitry, test wiring devices for electrical continuity and proper polarity connections.
3. After installation is complete, the equipment shall be demonstrated to operate satisfactorily and to conform to contract documents.
4. Measure and record voltages between phases and between phase wires and neutrals. Submit a report of maximum and minimum voltages.
5. Perform ground test to measure ground resistance of counterpoise. Resistance shall be 5 ohms or less.

C. System Functional Test

1. Upon completion of equipment tests, a system functional test shall be performed. It is the intent of this test to prove the proper interaction of the power and control systems.

END OF SECTION