

Electrical for Water and Sewer Stations

Section 1000

1010 General

The contractor shall furnish all labor, supervision, materials, tools, equipment, and services necessary for the complete installation of the electrical power and control wiring to the Lift Station. In general, the work shall consist of, but is not limited to the following items:

- A. The Contractor shall provide all temporary electrical wiring for power, tools, and lights as required at the project site and shall remove the same on completion of the work.
- B. The Contractor shall coordinate his work with authorities having jurisdiction to arrange for required permits, inspections, and other required services.
- C. The Contractor shall furnish and install electrical feeders, control circuits, and other electrical equipment including lighting fixtures as shown on the Drawings or specified herein.
- D. The Contractor shall make all electrical connections required for equipment to be provided by equipment manufacturers or others at the project site.
- E. The Contractor shall install a grounding system as required by Code, and as specified herein.
- F. It is the intent of these specifications and the accompanying Drawings that the Contractor furnish and install a system complete in every respect and ready to operate. All miscellaneous items and accessories required for such installation and for the correct and convenient operation of the entire installation, whether or not each item or accessory is shown on the Drawings or mentioned in the Specifications shall be furnished and installed. All electrical materials must bear the Underwriter's Laboratory seal and be guaranteed for one year unless otherwise stated herein.

1020 Applicable Codes

All work and materials shall conform to the current edition of the following standards or codes:

- National Electric Code (NEC)
- National Electric Manufacturer's Association (NEMA)
- National Electric Safety Code (NESC)
- National Fire Protection Association (NFPA)
- Occupational Safety and Health Administration (OSHA)
- American National Standards Institute (ANSI)
- Illuminating Engineering Society (IES)
- Institute of Electrical and Electronic Engineers (IEEE)

All work shall be in compliance with all applicable state and local ordinances, and Regulations relating to the building and public safety.

In those instances where capacities, sizes, etc., of electrical equipment, devices, or materials as designated in these Specifications, or indicated on the Drawings, are in excess of the minimum requirements of the NEC, such designated sizes and or capacities shall prevail.

1030 Construction Documents

1030.01 Construction Drawings: The accompanying Drawings are diagrammatic and indicate only approximate locations of feeders, circuits, panels, switches, lights, etc., except in those cases

where specific notes appear. Exact locations are subject to the Engineer's approval and may differ a reasonable amount from the approximate locations shown on the Drawings without additional cost to the Owner.

1030.02 Submittals: The Design Engineer shall submit a minimum of three (3) copies of Shop Drawings of electrical equipment to the Engineer for approval prior to ordering or manufacturing this equipment. The Shop Drawings shall include equipment or systems as shown on the Drawing and stated in the Specifications, including electrical control related cabinets and equipment. Shop Drawings shall include the manufacturer's printed information with each labeled as on the Contract Documents for identification. The information submitted shall include specific dimensions, voltage ratings, wiring diagrams, nameplate data, as well as detailed equipment drawings of fabricated items, installation data, and other pertinent information. Where literature is submitted covering a group or series of similar items, the items in consideration shall be clearly indicated. All submittals shall be assembled in one brochure.

The Contractor shall be responsible for checking Shop Drawings and wiring diagrams for compliance with the Construction Drawings and Specifications, including spare part requirements, arrangements, and performance; and shall indicate same by stamp and signature on all submittals before submitting to the Engineer for approval.

Equipment or materials shall not be ordered until the shop drawing submittals have been approved in writing by the Engineer. Shop drawings shall be submitted for, but are not limited to the following items:

1. Wire, Cable, and Conduit
2. Wiring devices
3. Circuit breakers, combination type motor starters, and all main power equipment
4. Triplex pump controller (DFS PCU-001)
5. Wiring schematics

The Engineer's approval does not relieve the Contractor of final responsibility. These submittals are a means of coordinating the work in relation to the construction plans and for the proper selection and installation of equipment. All materials and equipment shall be subject to final acceptance by the Engineer at the completion of the contract.

1030.03 As-Built Drawings: The Contractor shall provide to the Engineer a complete record set of blue-line prints which shall be corrected daily with daily notations, and shall show every change from the original Contract Drawings. This set of prints shall be kept on the job site and shall be used only as a record set. This shall not be construed as authorization to make changes in the layout without definite instructions in each case. Upon completion of the work, a set of As-Built transparencies, together with six sets of blue-line prints, shall be delivered to the Engineer. Failure to submit the As-Built transparencies may delay the final acceptance of the project.

1040 Equipment

1040.01 General: All materials purchased shall be in new condition and specification grade. Where manufacturer's names and model numbers are used on the Drawings or in the Specifications, it is not the intention to discriminate against an equal product or other manufacturers, but rather to set a standard of quality and shall not be construed as limiting competition. The words, or approved equal shall be assumed to follow any material without specific authorization in writing from the Engineer. The substitution shall be listed by manufacturer, catalog number, and all other data necessary for comparison. Should a substitution be accepted under the above provisions, and should the substitution prove defective or otherwise

unsatisfactory for the intended service, within the warranty period, the Contractor shall replace the substitution with the equipment or material specified, and on which the Specification required him to base his proposal.

The storage and protection of materials and equipment shall be in accordance with the manufacturer's recommendations and as supplemented herein. Electrical equipment and material shall not be stored on bare earth. All electrical equipment and material shall be protected from physical damage and damage due to the weather (moisture). Failure to comply with the above shall be sufficient cause for rejection of the equipment or materials in question. Any factory finish that becomes marred, stained, or otherwise damaged shall be fully and satisfactorily restored.

1040.02 Conduit: All wiring shall be installed in conduit no smaller than 3/4" trade size unless noted otherwise on the Drawings. Conduits shall be UL-listed and approved for the use intended. Furnish and install grounding bonding jumpers where required by NEC.

Schedule 40, heavy wall, rigid polyvinyl chloride (PVC) conduit shall be installed in all underground or under slab locations unless otherwise noted on the Drawings. PVC couplings, fittings, bell ends, caps, adaptors, and conduit elbows shall be of the same manufacturer as the PVC conduit. Use approved PVC cement at all conduit joints to produce a sealed, liquid tight conduit system.

Where underground conduits turn up and are exposed to mechanical damage, the exposed portion along with its connected long radius bend shall be galvanized rigid steel conduit protected against corrosion by two coats of asphalt paint.

Rigid galvanized steel conduit shall be installed in all damp or wet locations, inside and outside of buildings and structures, or where conduit is exposed to mechanical damage. Conduits shall be furnished in 10-foot lengths with both ends threaded and with a coupling screwed on one end. Conduits, couplings, and fittings shall be hot-dipped galvanized, both inside and outside.

Liquid-tight flexible metal conduit shall be installed for all motor connections and where conduit connections are subject to vibration or movement. Connectors shall be insulated, gasketed, threaded, and furnished in straight sections and 45 and 90-degree angles.

1040.03 Wires and Cables: All wiring used in this installation shall be soft drawn, annealed copper wire with a conductivity of not less than 98 percent of that of pure copper and shall have a 600 volt insulation.

Wiring installed in buildings and dry locations shall have type THHN, THW, or THWN insulation rated for 90 degrees Celsius. Wiring installed in wet locations and outside of buildings shall have type XHHW insulation rated for 75 degrees Celsius.

Feeder wire for motors smaller than 10 horsepower shall be as specified. Feeder wires and cables for motors larger than 10 horsepower shall have type XHHW insulation rated for 75 degrees Celsius and suitable for wet locations.

All conductors shall be color coded to identify the voltage and phase in each according to the following:

480 VOLT 3-PHASE, 3-WIRE
Phase A - Yellow
Phase B - Brown
Phase C - Violet
Ground - Green

120/240 VOLT, 3-PHASE, 4-WIRE
Phase A - Red
Phase B - Black
Phase C - Orange
Neutral - White

120/240 VOLT, 1-PHASE, 3-WIRE

Phase A – Red

Phase B – Black

Neutral – White

Ground – Green

Large wires and cables and other types of wire shall have one inch wide colored Scotch tape on the ends of each conductor. All circuits shall be identified by wire markers in panelboard gutters, pull boxes, control panels, etc. Markers shall be premarked, self-adhesive wrap around cloth-type similar to E-Z code or Brady "Perma" Code or equal.

1040.04 Boxes and Fittings:

- A. **Junction and Pull Boxes:** Junction and pull boxes shall be constructed of code-gauge galvanized sheet steel with no knockouts. Front covers shall be screw or hinged door with rigid handle type and all junction and pull boxes shall be gasketed. Covers larger than 3' by 4' shall be split.
- B. **Outlet Boxes:** Ceiling outlet boxes shall be galvanized and shall be 4" octagonal by 1-1/2" or 2-1/8" deep for exposed or hung ceiling use unless otherwise specified. Use 3/8" fixture studs through the back of the box where required for mounting a fixture. Furnish plaster rings for plaster surfaces where required. Where a 1" trade size conduit enters an outlet box, a 4-11/16" square box shall be provided. Wall outlet boxes for switches and convenience outlets shall be galvanized formed sheet steel, 4" square by 1-1/2" deep for flush mounted outlets with extension rings provided. Wall outlet boxes for surface mounting shall be zinc coated cast metal type FS or FD.

1040.05 Circuit Breakers:

- A. **General:** Molded case circuit breakers shall be used for the protection of all branch circuits unless otherwise noted on the Drawings. Circuit breakers shall be UL-listed; have a quick make, quick break, over-center toggle type mechanism; and be trip-free type with trip indication by handle position. Two and three pole circuit breakers shall have common trip. Contacts shall be of a silver alloy material.

Where circuit breakers are used to switch lighting fixtures, heaters, etc., that circuit breaker shall be UL-listed for switching duty.

B. **Molded Case Circuit Breakers**

- 1. Circuit breakers shall be 1" wide for one pole, 2" wide for two pole, and 3" wide for three pole. No 1/2" wide or tandem circuit breakers shall be used. Circuit breakers with 250 ampere frame sizes and larger shall have a front adjustable magnetic strip.
- 2. Branch thermal magnetic circuit breakers mounted in panelboards shall have fixed magnetic trip, normal duty rating for 10,000 amperes interrupting current. Provide bolt on type circuit breakers with trip ratings using Square D. Main circuit breakers shall have an interrupting rating equal to that of the panelboard.
- 3. Current limiting thermal magnetic circuit breakers shall be used for interrupting currents of 42,000 amperes or greater. Current limiting shall have a non-fusible type independently operating limiter section in series with each pole that shall

automatically reset after circuit interruption. Current limiting circuit breakers shall be Square D "I-Limiter".

4. Instantaneous trip, magnetic only circuit breakers shall be used in conjunction with, and immediately ahead of motor running overcurrent protective devices as herein specified or noted on the Drawings as motor circuit protector (MCP). They shall have a single front accessible and adjustable magnetic trip setting which simultaneously sets the magnetic trip level of each individual pole. Provide a pushbutton to trip the circuit break for testing. Instantaneous circuit breakers shall be Square D "Mag Guard".

1050 Installation and Execution

1051 General

1051.01 Site Visit: Each bidder shall visit the site of the proposed construction in order to fully understand the facilities, difficulties, and restrictions attending the execution of work on which he is bidding. No additional compensation will be allowed for work or items omitted from the original proposal due to his failure to visit the job site or to inform himself regarding such matters affecting performance of work in this Contract or necessary for installation and completion of work included therein.

1051.02 Coordination: As it is not within the scope of the Drawings to show all necessary offsets and obstructions or structural conditions, it shall be the responsibility of the Contractor to install the work in such a manner that it will conform to the structure, avoid obstructions, and not interfere with other trades. Cooperation with other trades and related operations shall be considered a part of this work in order to effect timely and accurate completion of this contract in the proper and correct sequence.

1052 Installation

1052.01 Conduits: Installation

- A. All underground conduits shall be installed in trenches. The excavation shall be to a depth and width to allow 24" cover. The trench shall be cut to a flat bottom, true and uniform grade. Where rocks are encountered, they must be removed to a depth of 6" below the finished trench bottom and holes refilled with tamped earth. Backfill shall be applied in 12" layers with each tamped in place. Backfill material shall be free from rocks and other foreign material.
- B. If electrical conduit conflicts with water mains, the conduit shall be placed a minimum of 6" above the water main.
- C. All exposed conduit shall be installed in a neat and workmanlike manner, and as far as practical, it shall be installed parallel and perpendicular to the building lines. Multiple runs shall be supported by Unistrut conduit hangers. Each conduit shall be individually clamped at each Unistrut.
- D. All exposed conduit shall be rigidly supported at intervals not exceeding 7 feet or as dictated by the NEC. Exposed conduit shall be clamped with hot-dipped galvanized malleable iron conduit clamps or trapeze supports. Wire ties are not acceptable. Bends and offsets in conduit shall be made with standard factory elbows made for the purpose, or with field bending devices that will produce uniform bends without damaging the finish or reducing the cross sectional strength of the conduit. Do not install bends or

offsets in which pipe is crushed, deformed, or otherwise damaged.

- E. Conduit shall be cut square with ends reamed and drawn up tight with approved couplings and fittings. All threads shall be painted with an approved rust inhibiting and sealing compound before make-up.
- F. Conduit shall be pitched to drain to outlet boxes, pull boxes; or otherwise installed to avoid trapping moisture. All conduit shall be suitably capped or plugged during construction to prevent the entrance of water.

1052.02 Wire and Cables: Installation

- A. Each wire must be continuous without weld, splice, or joint throughout the length and it shall be uniform in cross section, new, unused, and free from flaws, scales, and other imperfections. All wiring shall comply with UL standards and shall bear its stamp of approval for size, type, and voltage rating.
- B. No wire smaller than No. 12 AWG shall be used for power wiring. All wire shall be stranded. Control wire shall be No. 16 AWG. All control wire shall be stranded.
- C. Branch circuit joints or splices shall be made electrically and mechanically secure with pressure connectors and nylon insulators. Twist-on connectors shall not be utilized. Connectors normally furnished with switchgear, motor starters, panels, etc., may be used for feeder terminations if they are compatible with the conductor. Other feeder connectors shall be bolted, wedge type or compression type designed specifically for the purpose or terminal strips.
- D. Perform a D.C. meg test on all feeder conductors size 2 AWG and larger using a 1000 volt 'megger'. Use a 500 volt 'megger' on all other feeders.

1052.03 Boxes and Fittings: Installation

All junction boxes, pull boxes, and outlet boxes shall be installed and sized according to the NEC with fasteners suitable for the installation intended. Outlet boxes shall contain the proper knockouts with all unused knockouts intended. Outlet boxes shall contain the proper knockouts remaining closed. Outlet or utility boxes concealed in construction shall be firmly secured in place, set true, square and flush with the finished surface for the correct application of cover plates or other devices.

1052.04 Circuit Breakers: Installation

All circuit breakers shall be capable of accepting copper, aluminum, or copper clad aluminum wiring. Furnish lugs which are constructed for the number and size of conductors which will be installed.

Mount circuit breakers in panelboards of control panels in accordance with the manufacturer's recommendations. Securely fasten bolt-on circuit breakers to assure positive connection to the panelboard bussing. Where main circuit breakers are installed, mount the circuit breaker upright in the panel top-center.

1052.05 Ground Rod: Installation

All ground rods and lugs shall be capable of accepting a bare copper wiring sized for the panel.