

PART 602 – ELECTRICAL CONDUIT

602.1 DESCRIPTION

- 602.1.1 This work shall consist of furnishing and installing all the electrical conduit, fittings, expansion devices, and miscellaneous hardware necessary to complete the electrical conduit system in accordance with these specifications and the plans, and the latest adopted edition of the National Electric Code (NEC). The location of the conduit, as shown on the plans, is diagrammatic and may be subject to adjustment as the Traffic Engineer may direct in order to conform to existing field conditions.

602.2 MATERIALS

602.2.1 General:

- A) Ensure all conduits and fittings are liquid tight. Ensure outlet boxes, fittings, entrance caps, and other accessories comply with current industry standards and are compatible with the conduit material used.
- B) Ream conduit ends to remove burrs and rough edges. Make cuts square so ends will butt together for the full circumference. All conduit ends shall be bushed.
- C) Provide factory conduit bends in accordance with the latest edition of the NEC, or bend conduit without crimping or flattening using the longest centerline radius for each installation, not less than six times the conduit inside diameter.

602.2.2 Rigid Metal Conduit (RMC):

- A) Provide a UL rated rigid galvanized steel conduit that meet the requirements shown on the plans. All exposed conduit shall be rigid galvanized steel.
- B) Galvanized conduit ends shall be threaded, reamed to remove rough edges, and bushings shall be installed prior to installing any wires.
- C) The City will not allow slip joints or running threads for coupling conduit. If standard couplings are not practical, use threaded-union couplings to couple metal conduit, as approved by the Traffic Engineer. Pop rivets, sheet metal screws, or any other unapproved method shall not be used to connect any conduit. Tighten couplings until the ends come together; do not leave threads exposed.
- D) If damage to galvanized conduit exposes bare metal, re-galvanize, metalize, or paint with zinc dust-oxide paint at no additional cost to the City.

602.2.3 Liquid Tight Flexible Metal Conduit (LFMC):

- A) Provide LFMC electrical conduit in accordance with UL-360.

- B) LFMC ends shall be reamed inside and outside to remove rough edges and bushings shall be installed prior to installing any wires.
- C) All couplers and connectors shall be approved and listed for use with LFMC.

602.2.4 Rigid Polyvinyl Chloride Conduit (PVC):

- A) Provide polyvinyl chloride (PVC) schedule 40 electrical conduit in accordance with UL-651. For solvent cement to join conduit refer to ASTM 2564.
- B) PVC conduit ends shall be reamed to remove rough edges and bushings shall be installed prior to installing any wires.
- C) Connections shall be solvent weld type. Connection point shall be properly cleaned as required by the adhesive manufacturer's directions.
- D) All PVC conduit attached to HDPE conduit shall be attached by means of E-LOC, or approved equal, coupling suited for this purpose. Normal primer and PVC cement shall be used. Payment for E-LOC coupling shall be included in the cost of HDPE conduit.
- E) All fittings shall be of the same schedule as the conduit run.

602.2.5 High Density Polyethylene Conduit (HDPE):

- A) Provide High-density polyethylene (HDPE) conduit in accordance with the requirements of NEMA TC7. HDPE conduit shall be smooth wall coilable duct meeting the requirements of ASTM D1248 Type III Class C, Grade P33, Category 5, Schedule 40, unless otherwise specified in the Plans.
- B) All PVC conduit attached to HDPE conduit shall be attached by means of E-LOC, or approved equal, coupling suited for this purpose. Normal primer and PVC cement shall be used. Payment for E-LOC coupling shall be included in the cost of HDPE conduit.

602.2.6 Outlet Boxes, Fittings, and Entrance Caps

- A) Outlet boxes, fittings, and entrance caps shall comply with current industry standards and be compatible with the conduit material used.
- B) Fittings and cement used with PVC and/or HDPE conduit shall be compatible with conduit material.

602.2.7 Acceptance: Conduit may be accepted on the project without testing provided it is visually inspected and all pieces are clearly labeled with the UL label or a type D certification is furnished by the manufacturer.

602.3 CONSTRUCTION METHODS

602.3.1 General: The contractor shall obtain the necessary permits for electrical inspection on all signal and lighting work. Electrical inspections shall include all electrical equipment, enclosures, devices, cables, conductors, and raceways as defined by the NEC. High or low voltage shall be installed, maintained, connected, or removed by a State of Oklahoma licensed Electrical contractor. All work shall meet the requirements of the NEC. City of Tulsa shall reserve the right to define workman like manner. Proof of license shall be carried on person at all times and be available to City of Tulsa personnel upon request per Title 158 – Construction Industries Board Chapter – 40 Subchapter 11-2(a)(9). Contractor shall contact City of Tulsa Traffic Operations to obtain the address needed to obtain the permit.

602.3.2 Location:

- A) All conduits shall be installed to fit the existing field conditions. However, if major relocations are necessary that may affect the overall design of the electrical system, the contractor shall receive approval of the Traffic Engineer prior to making the relocations.
- B) Conduit runs shall not terminate in corner wheel drag paths.
- C) The maximum distance of a conduit run between pull boxes is 180’.
- D) Termination of multiple conduit runs shall be installed vertically and clustered toward the center of the pull box. Conduit runs within a pull box shall not cross one another.

602.3.3 Installation:

- A) Install conduit in accordance with the NEC. Install direct runs with no less than the minimum size shown on the plans. The use of a larger conduit for the entire length of the run will be allowed, at no additional cost to the City.
- B) If conduit is installed on top of slab surface, it shall be anchored or staked every 8’ to prevent rising (floating) during island forming. Conduits shall be installed 1’ from one edge of the island if not centered in island. See Standard Drawing 602 for details.
- C) No long radius 90° or 45° bends will be allowed unless specified in the plans.
- D) There shall be no more than three 90° bends or 270° total of all the bends in a single run of conduit.
- E) All conduits shall have a green #12 THHN electrical conductor installed to be used as a pull wire (wire to be paid for separately).
- F) Complete all potentially damaging work before installing conductors or cables in the conduit system.

- G) All conductors or cables in a damaged conduit shall be replaced to the next joint of undamaged conduit at contractor's expense. No exceptions shall be made.
- H) All 90-degree bends in conduit shall be galvanized rigid steel conduit.
- I) All conduit stub ups above concrete foundations and in pull boxes shall be PVC, unless approved otherwise by the Traffic Engineer. Galvanized conduit stub ups, if approved by the Traffic Engineer, shall be properly bonded and grounded via a #4 bare copper wire connected to 5/8" x 8' copper clad ground rod. The ground rod shall be extended a minimum of 8' into the soil.

602.3.4 Termination of Conduit:

- A) Termination in Signal Pole or Pedestal Base: Stub base conduits 4" to 6" above finished base for mast arm bases and 2" for pedestal bases. All conduit ends shall be reamed and bushed.
- B) Termination in Pull Box: Extend conduit entering pull box sides no more than 2" inside the box wall and slope the conduit toward the top of the box. Conduit entering through the bottom of a pull box shall extend 9" to 12" below the lid and shall be located near the center of the box. All conduit ends shall be reamed and bushed.
- C) Connection to Existing Conduit: If incorporating existing underground conduit into a new system, clean with compressed air until clean air is exhausted from the conduit. This shall be an inspected process by traffic inspector.
- D) For Future Use: Cap conduit ends not terminating in a junction box or electrical enclosure.
- E) General: Cap all conduit ends with standard pipe caps until wiring starts. After removing the caps, install conduit bushings on the threaded ends.

602.3.5 Pushed or Bored Conduit:

- A) Bored conduit shall be continuous (no joints) HDPE schedule 40 and shall be extended 2' from the back of curb or edge of pavement on both ends. "No thread" couplings shall not be used under pavement.
- B) Place the conduit under pavement by approved pushing or boring methods. Do not disturb the pavement without permission from the Traffic Engineer. Keep pushing or boring pits at least 2' clear of the edge of any type of surface area whenever possible.
- C) Excessive use of water, such that the pavement might be undermined or the subgrade softened, will not be permitted. If pits are to be left overnight, cover them with substantial planking and mark them in a manner approved by the Traffic Engineer.

- D) Unless otherwise shown on the plans, install bored conduit or pushed conduits a minimum depth of 30" below top of ground line.
- E) Restoration and repair of right-of-way damage by boring operations shall be included in the price for boring.
- F) Damaged bored HDPE conduit shall be re-bored at the contractor's expense; no under pavement repairs shall be made.

602.3.6 Trenched Conduit and Backfilling:

- A) Conduit installed in a trench shall be of the type and size specified on the Plans.
- B) Excavate trenches deep enough to provide for 30" minimum cover over the conduit, unless otherwise specified. Do not use cinders, broken concrete, or other hard or abrasive materials in backfilling. Also, clear the trench of such materials before the conduit is placed.
- C) Excavate immediately before installing conduit, placing the material in a position where there is the least damage and obstruction to vehicular and pedestrian traffic and the least interference with the surface drainage. Be careful not to excavate the trenches wider than necessary for the proper installation of the electrical conduits or cables.
- D) Dispose of all surplus excavated material in a manner approved by the Traffic Engineer.
- E) When rock is encountered during trenching and the required trench depth cannot be attained the trench depth or location may be altered at the discretion of the Traffic Engineer. The minimum trench depth shall meet NEC minimum requirements.
- F) Reconstruct all disturbed surfaced areas, base materials, and sodded areas using replacement materials of equal or better quantity; this is to be done at the expense of the Contractor and to the satisfaction of the Traffic Engineer.
- G) Whenever a part of an existing concrete sidewalk or driveway is broken or damaged, remove the entire square or slab unless otherwise specified by the Traffic Engineer, and reconstruct the concrete as specified above.
- H) If trenched conduit must cross under existing guardrail it should be between posts and as close to perpendicular to the rail as feasible.
- I) Backfill all trenches with acceptable material as soon as possible after installation of conduit; deposit the backfill material in the trench in layers not to exceed 6" in depth and compact to 95% density of the surrounding earth. The first layer shall be free of rocks and debris and compacted, and each successive layer shall be free of rock and debris and compacted before the next layer is placed.

- J) Unless otherwise directed by the Traffic Engineer, all trenches excavated across any sidewalk, driveway, parking lot or other paved area, across any traveled portion of unpaved streets or alleys, across any proposed roadways or proposed roadway fills, and as shown on the drawings shall be bedded and backfilled with 1-1/2" Type A Aggregate Base, placed in 8" maximum lifts and compacted to 95% Standard Proctor Density, as measured by the Nuclear Density Method. Compaction shall be done by a vibratory hand tamper. Trenches excavated across existing street or alley paving shall be backfilled in accordance with the City of Tulsa Standard Detail for Pavement Removal and Replacement.
- K) Utility marking tape shall be installed 6" below finished grade and conduit shall be blown clear of water and debris after backfilling. Utility marking tape shall be a minimum of 4 mil thickness, 6" wide polyethylene tape; color shall be in accordance with AWWA uniform color code. Tape used to mark underground electrical cable shall be safety red color with printed legend "caution electrical cable buried below" The cost of the tape shall be included in the cost of trenching.

602.3.7 Exposed Conduit:

- A) Refer to ODOT Standard Drawing T-302 Typical Conduit Construction Details for exposed conduit installation for installation details.
- B) When conduit is to be installed on the surface of structures, poles, or other exposed locations, use rigid metal-type unless otherwise specified.
- C) Run surface-mounted conduit straight and true, so that it's horizontal or vertical on the surface of the structure or pole. Support it at intervals of not more than 5', unless otherwise specified, using galvanized malleable iron conduit clamps and bolts with expansion shield anchor devices approved by the Traffic Engineer.
- D) Lag or machine bolt shields and percussion driven anchors in concrete or masonry will not be accepted.
- E) When conduit installed on a concrete structure crosses an expansion joint in the structure, install an expansion device of the type and size shown on ODOT Standard Drawing T-302.
- F) Use only Approved Products List approved supporting devices for conduit that's attached to structural steel members.
- G) Where exposed rigid conduit installed on bridges or other structures transition to an underground trenched installation, only threaded fittings will be permissible until run of conduit has fully turned horizontal in the trench, no PVC to rigid adaptors or fittings. No thread couplings or connectors shall be used.

602.3.8 Testing:

- A) After clearing and backfilling the conduit blow in each conduit run a 1/8" 1,000 lb. test polypropylene string the full length of the conduit. The City Traffic Inspector shall be present during blow in.
- B) The polypropylene string shall be blown in with the appropriately sized conduit position, I.E. 2" conduit use 2" piston, 3" conduit use 3" piston, etc.
- C) Blowing the string shall be in the direction away from the controller cabinet. This is an inspection point required by Traffic Operations.
- D) After clearing and installing string, conduit ends shall be capped with PVC cap or sealed bushings to prevent entry of debris. Duct tape is not an approved method of capping. If capping is removed before cable is installed, contractor shall reprove conduit with inspector present.
- E) For conduit not accepted contractor shall replace conduit to the next joint and have the new conduit inspected and wired pulled before it will be accepted.

602.4 METHOD OF MEASUREMENT

Electrical conduit of the size and type specified will be measured by the linear foot along a horizontal plane of the centerline of the installed conduit from end to end, and shall include all fittings, outlets, entrance caps, pull wires, conduits, expansion devices, and other miscellaneous hardware necessary to complete the conduit system. Each size and type of conduit shall constitute a separate pay items, unless otherwise provided. Unless otherwise provided, trenching and backfilling and boring will not be measured for payment.

602.5 BASIS OF PAYMENT

Accepted quantities of electrical conduit, measured as provided above, will be paid for at the contract unit price as follows:

- A) 2" PVC Sch 40 Conduit (Trenched).....LINEAR FOOT
- B) 3" PVC Sch 40 Conduit (Trenched).....LINEAR FOOT
- C) 2" HDPE Sch 40 Conduit (Directional Bore).....LINEAR FOOT
- D) 2 – 3" HDPE Sch 40 Conduit (Directional Bore).....LINEAR FOOT
- E) 3" HDPE Sch 40 Conduit (Directional Bore).....LINEAR FOOT
- F) 2 – 3" PVC Sch 40 Conduit (Trenched).....LINEAR FOOT
- G) 1 1/2" Galv. Steel Electrical Conduit (Exposed).....LINEAR FOOT
- H) 2" Galv. Steel Electrical Conduit (Exposed).....LINEAR FOOT

- I) 3" Galv. Steel Electrical Conduit (Exposed).....LINEAR FOOT
- J) 1" PVC Sch 40 Conduit (Trenched).....LINEAR FOOT
- K) 1" HDPE Sch 40 Conduit (Directional Bore).....LINEAR FOOT
- L) 1 1/2" PVC Sch 40 Conduit (Trenched).....LINEAR FOOT

Such payment shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.