

GENERAL:

The scope of this document is to provide instruction for installation and testing of medium voltage electric power duct banks.

DESIGN GUIDELINES:

1. Materials

1.1. Conduit

- 1.1.1. Underground concrete encased electric conduit duct banks shall consist of Type DB-60 or schedule 40 polyvinyl chloride (PVC) conduit rated for 90°C cable and meeting NEMA Standard TC-6 and ASTM F-512 for underground applications.
- 1.1.2. The standard conduit sizes shall be 2", 3", 4", and 5" for all conduits.
- 1.1.3. Conduits shall have long sweep rigid steel metallic or fiberglass elbows, 48" minimum radius for horizontal bends and 36" radius for vertical bends. Steel conduit elbows shall be PVC coated with taped ends.
- 1.1.4. All joints shall have watertight seals.
- 1.1.5. Conduit End Bells
 - 1.1.5.1. Conduit end bells for PVC conduit shall be polyvinyl chloride (PVC).
 - 1.1.5.2. Conduit end bells for rigid galvanized steel conduit shall be hot-dipped galvanized malleable iron or steel, threaded to the end of the rigid galvanized steel conduit.

1.2 Concrete

1.2.1 Color Additive

- 1.2.1.1 The concrete for all medium voltage concrete encased conduit duct banks shall have a medium red color additive. The color additive shall have a minimum concentration per manufacturer's recommendation per yard of concrete and shall be mixed throughout the entire duct bank concrete.

1.2.2 Admixtures

- 1.2.2.1 Air-entraining mixture shall be used for all exterior concrete and shall conform to ASTM C260. The total calculated air content by volume as determined by ASTM C231 shall be as follows:

Maximum	Total Air
Coarse	Content, %
<u>Aggregate</u>	<u>Includes</u>
<u>Size</u>	<u>Trapped Air</u>
3/4"	3-8
1"	4-6

1.2.2.2 Water reducing admixture shall be used to reduce the total water requirements. Water reducing admixture shall meet the requirements of ASTM C494, Type A.

1.2.2.3 Calcium chloride or accelerating admixtures containing calcium chloride shall not be used.

1.2.3 Proportioning

1.2.3.1 Concrete slump at the time of placement as determined by ASTM C13 shall be 3" to 4". Tolerance up to 1" above maximum will be allowed providing average of batches tested does not exceed maximum.

1.2.3.2 The minimum 28 day concrete compressive strength for concrete shall be 4,000 psi (6 sacks/cu. yd. minimum).

1.2.4 Reinforcement

1.2.4.1 All concrete encased electric conduit duct banks shall contain steel reinforcing throughout the entire length as indicated on standard detail drawings. The minimum size of reinforcing steel shall be size No. 4.

1.2.5 Backfill

1.2.5.1 Backfill material shall be compacted clean dirt or ¾" minus waste rock fill. No concrete or large rocks are to be used.

1.3 Accessories

1.3.1 The pull string installed in spare conduits shall have a minimum of 240 lbs. tensile strength, shall be rot and mildew resistant, and shall be made of nylon or polypropylene. Pull string shall have permanently printed sequential measurements at one foot increments.

1.3.2 Use plastic plugs with wick for drainage to seal spare conduits in manholes.

1.4 Underground Warning Tape

1.4.1 Warning tape shall be fabricated from polyethylene film, shall contain no metal, and shall be 6 inches wide and not less than 3.5 mils thick.

1.4.2 Warning tape shall be high visibility red in color and imprinted at frequent intervals with black letters having the following wording: CAUTION BURIED ELECTRICAL LINE BELOW

2. Installation

2.1. Conduit and Duct Banks

2.1.1. Conduit shall be adequately and properly supported with base spacers on solid earth, or other indicated means, throughout the entire length of the run. All conduits shall be laid straight and true.

2.1.2. Verify routing locations of conduit prior to rough-in.

2.1.3. Couplings for conduits in a group shall be staggered at least six (6) inches.

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- 2.1.4. Underground conduit duct banks shall be installed a minimum of 36" below finished grade to the top surface of the duct bank.
- 2.1.5. Underground conduit duct banks shall be at least 12 inches away from all other underground utilities; gas, water, electric, telephone, communications, etc., and at least 36 inches away from steam pipe lines and steam tunnels, trenches, or manholes.
- 2.1.6. Intermediate and base spacers shall be used to obtain uniform separation and alignment during the installation of the concrete for concrete encased duct banks. Maximum intervals between spacers shall be 8 feet.
- 2.1.7. Concrete encased conduit duct bank penetrations into manholes shall continue completely through the wall of the manhole and shall use one large hole rather than several smaller holes. If this method is not practical, the concrete may stop outside the manhole but must be pinned to the manhole with steel pins to prevent any differential settlement.
- 2.1.8. Conduit end bells shall be installed at all conduit terminations in each manhole.
 - 2.1.8.1. Conduit end bells for PVC conduit shall be cast in place in the concrete wall of the manhole and glued to each end of each PVC conduit.
 - 2.1.8.2. Conduit end bells for rigid galvanized steel conduit shall be cast in place in the concrete wall of the manhole 3" between conduits and on outside including the bottom.

2.2. Concrete

- 2.2.1. All duct banks used for 13.8Kv system shall be encased in red concrete.
- 2.2.2. Placing, Curing, and Backfill
 - 2.2.2.1. Precautions shall be used to prevent ducts from floating.
 - 2.2.2.2. Concrete shall be placed with the aid of a mechanical vibrator.
 - 2.2.2.3. Curing shall be continued for at least 7 days in the case of all concrete except high-early-strength concrete for which the period shall be at least 3 days. Excavations should not be backfilled until concrete has cured.
 - 2.2.2.4. In no cases shall ductbank sidewall thickness exceed 12" from side of duct.
- 2.2.3. Reinforcement
 - 2.2.3.1. The reinforcing steel shall be installed longitudinally, at each corner of the duct bank (in cross section) and along the top and bottom and sides at a maximum of 12 inches on center. All reinforcing steel (including bottom) shall have a minimum concrete cover of 1-1/2 inches. Reinforcing shall be installed latitudinal, as needed, to hold the longitudinal steel in place during the placement of the concrete but no more than 48" apart. Refer to standard detail drawings.

2.3. Accessories

- 2.3.1. All empty or "spare" conduits shall have a nylon or polypropylene pull string installed for future use. Leave not less than 2 feet of slack at each end of pull string.

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- 2.3.2. Seal the ends of all conduits at manhole penetrations. Seal water tight with plastic plugs with wick for drainage. Conduit pull string shall penetrate through seal.
- 2.4. Underground Warning Tape
- 2.4.1. The location of all underground conduit duct banks shall be marked by burying one or more warning tapes below grade in the backfill. The warning tape shall be placed 18 inches above the top of the conduit(s) or duct bank and shall be parallel along the full length of the run.
- 2.4.2. If the widths of the conduits or duct bank is wider than 2 feet, two or more warning tapes shall be used, all in the same plane, spacing the tapes no more than 12 inches apart horizontally across the top width of the conduits or duct bank and equally spacing the tapes in from each longitudinal outer edge of the buried conduits or duct bank
3. Testing
- 3.1. All duct banks shall be inspected by system owner prior to concrete placement.
- 3.2. Upon completion of the installation of each duct bank, demonstrate that all conduits are clear of obstructions by pulling a mandrel ½ inch smaller than the nominal size of the conduit through the entire length of each conduit.
4. Commissioning
- 4.1. All soil and debris shall be removed from manholes and equipment pads where ductbanks terminate.
- 4.2. Verify all pull strings and caps are installed