

# SUB-IC-600-T-3

## 600 VOLT MULTI-CONDUCTOR CABLE - TECHNICAL

Revision	Date	By	Description
0	3-2-05	MEP	Creation
1	7-24-08	MEP/LM	Add 1.3.2 L – “shielded cable”, Revise 1.1.1 “Scope” – Shielded/Non-shielded
2	10-21-13	MEP	Revised 1.3 and added 1.4
3	4-4-18	MEP	Revised 1.3.1 – changed “TC” to “TC-ER” added “TC-LS”; Revised 1.32 E and Appendix A to include 3/C# 6 color code & 2/C #6 color code. Added language about reel label to 1.3.2 H.

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# 1. GENERAL REQUIREMENTS

## 1.1. SCOPE

- 1.1.1. This specification covers the requirements for furnishing multi-conductor cable to be installed in outdoor substations by the City of Lakeland, Florida. Work under this specification includes design, manufacturer, procurement and delivery of cable(s). The City of Lakeland stock item description will state whether the cable is to be shielded or non-shielded cable.

## 1.2. STANDARDS

- 1.2.1. All equipment and materials shall be designed, constructed, assembled and tested in accordance with, but not limited to, the applicable standards listed in this specification.
  - A) National Electrical Manufacturers Association - NEMA
  - B) American National Standards Institute - ANSI
  - C) Institute of Electrical and Electronic Engineers - IEEE
  - D) American Society for Testing and Materials - ASTM
  - E) Insulated Cable Engineers Association - ICEA
  - F) Underwriter's Laboratories - UL
- 1.2.2. Any conflict between specifications, standards and the manufacturer's recommendations shall be referred to the Lakeland Electric Substation Engineering Department for final decision.

## 1.3. TECHNICAL REQUIREMENTS

- 1.3.1. The multi-conductor cable shall be suitable for wet or dry locations in ducts, conduits, cable trench or trays. The cable shall be designed for operation at ac and dc potentials of positive and negative polarity up to and including 600 volts. The control and power cables shall be listed by UL as Type TC-ER per Standard 1277 for Electrical Power and Control Tray Cables. The instrumentation cables shall be listed by UL as Type TC-LS.
- 1.3.2. 600 volt multi-conductor cable (FR-XLPE/CPE):
  - A) Conductors will be soft drawn, annealed, uncoated or tinned, copper wire. The physical and electrical properties shall comply with ASTM standards. All conductors shall have class "B" stranding.
  - B) The individual conductor insulation shall be flame retardant, cross-linked polyethylene FR-XLPE, rated 90 degree C wet and dry locations. It shall be approved by the Underwriter's Laboratories as Type XHHW-2 per UL Standard 44. Insulation shall be free stripping.
  - C) Jacket material shall be 90 degree C, black thermoplastic chlorinated polyethylene CPE, and shall be moisture, sunlight, heat, oil and abrasion-resistant.
  - D) The cable shall comply with UL 1581 VW-1 and UL 1581 Vertical Tray or IEEE 383 Vertical Tray flame tests.

- E) Identify individual conductors of multiple-conductor cable by coloring insulation with standard color sequence. Color coding will be in accordance with ICEA S-73-532/NEMA WC57 except for 2 conductor no. 10 and 3 conductor no. 6 which shall be black and red. The color coding is shown in Appendix A. Cables coded by printing name of color on each conductor will not be acceptable except for 3 conductor no. 6 power cable which can be identified using ICEA S-58-679 Method 4. Tracer lines shall be affixed to the conductor insulation so as to not easily be worn off or removed.
- F) The required number of conductors shall be cabled in accordance with NEMA standards. Non-hygroscopic flame retardant fillers shall be used to provide a firm, circular cross-section.
- G) The cable shall be identified throughout its entire length by a “permanent type” marking embossed in or white printed onto the outer jacket. The marking shall include the manufacturer of cable, conductor size (AWG), conductor material (CU), rated voltage, shield and insulation type and thickness, year of manufacture, UL label, number of conductors, and footage markings. The above marking shall be printed on the jacket at not more than 24 inch intervals or as approved. Reels should be classified with reel number and footage.
- H) Cable shall be supplied on non-returnable reels of heavy wood or metal construction with a hole through the center of the hub of not less than 2 inches. The manufacturer’s part number corresponding to their cut sheet on file with the OWNER shall be clearly marked on the label attached to each reel and the paperwork accompanying the shipment.
- I) Only one size of cable shall be wound on a reel. The cable shall be shipped in the manufacturer’s standard lengths but in no case less than 1000 foot lengths. Cables and conductors on individual reels shall be continuous and joint free.
- J) Reel shall become property of OWNER at receipt.
- K) A watertight seal shall be applied to each end of the cable to prevent the entrance of moisture during transit or outdoor storage prior to installation. Both ends of cable on each reel shall be readily accessible for “Megger” tests prior to installation.
- L) When specified a non-magnetic metal shield component consisting of either coated or uncoated copper tape shall be applied over the conductor binder tape or extended binder. The copper tape shall have a thickness of at least 5.0 mils and shall comply with NEMA and ICEA standards. The shield shall be copper tape applied longitudinally, so as to completely cover the insulation shield and shall have a minimum overlap of 10 percent. Shield shall be smooth or corrugated and in accordance with ICEA S-73-532/NEMA WC57.

## 1.4. CABLE SAMPLES

- 1.4.1. A cable sample and manufacturer’s literature and manufacturer’s part number shall be submitted to the Substation Engineering Standards Committee for review and approval prior to the manufacturer being added to the approved vendor list for any 600V multi conductor cable stocked in the Central Stores Warehouse.

## 1.5. FACTORY TESTS

- 1.5.1. Each reel of cable shall be fully tested in accordance with the production tests defined in the applicable ANSI, NEMA and ICEA standards. The Manufacturer shall notify the OWNER ten days in advance of the schedule for tests and shall provide the OWNER with a schedule for testing. The OWNER reserves the right for the OWNER to witness testing at the manufacturer's facilities and to inspect the cable before shipment for conformity to these specifications.
- 1.5.2. Certified test reports shall be furnished to the OWNER upon request.
- 1.5.3. Cables shall be rated for installation in wet locations and shall meet the requirements of ICEA, water immersion at 75 degrees C for six months. A certified test report from cable manufacturer, indicating compliance with ICEA standards shall be provided upon request.

**APPENDIX A**

<u>Conductor Number</u>	<u>Color - Tracer</u>
1	Black
2	White
3	Red
4	Green
5	Orange
6	Blue
7	White-Black
8	Red-Black
9	Green-Black
10	Orange-Black
11	Blue-Black
12	Black-White
13	Red-White
14	Green-White
15	Blue-White
16	Black-Red
17	White-Red
18	Orange-Red
19	Blue-Red
20	Red-Green
21	Orange-Green

**Special Exceptions:**

2 Conductor No. 10	Black, Red
2 Conductor No. 6	Black, Red
3 Conductor No. 6	Black, Black, Black w/printed #'s