



Document Title:  
**15 kV Primary Copper Cable, Jacketed Concentric Neutral**

Document Type: **Specification**      Engineering Type: **Material Specification**      Document No.: **4350.160**

Department  
**Distribution**

Version:  
**08**

Effective Date:  
**Dec 18, 2023**

**Shared document with: N/A**

*\*Select the Departments impacted by the document*

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**Related/Referenced Documents**

N/A

**Version History**

Version	Date	Revision Comments
1	Feb 24, 2022	Initial Release (Cables 2, 2/0, 4/0, 500, and 750).
2	Mar 11, 2022	Cables 1/0 and 3/0 added.
3	Apr 13, 2022	Sections 3, 4 & 7 edited.
4	Jun 22, 2022	TOC added and all cables changed from 100% & 175 mils of insulation to 133% & 220 mils.
5	Aug 01, 2022	Section 5, 9.14.b, and 9.15 edited. Section 12 added.
6	Oct 11, 2022	Cover Page and Section 4.3 added. Sections 1, 2.1, 3.1, 8.2, and 9.2 edited.
7	Nov 16, 2022	TOC edited and Cables 1/0 and 3/0 removed.
8	Dec. 18, 2023	General format modifications, document name changed, and adding requirement to include "Property of PREPA" as part of the jacket markings.



## Item Version History

Warehouse Catalog #	Asset Suite #	Version	Date
006-82624	82624	8	12/18/2023
006-82625	82625	8	12/18/2023
006-82626	82626	8	12/18/2023
006-82627	82627	8	12/18/2023
006-82628	82628	8	12/18/2023



## 1. Introduction

This is a general specification that covers the minimum requirements for a 15 kV primary copper cable, jacketed concentric neutral to be used in the underground distribution system in Puerto Rico. Further information will be provided by LUMA Energy at the time of order placement and will provide information on site specific conditions, quantity, and other requirements. This document includes the general electrical and mechanical characteristics of the equipment/material.

## 2. Special Requirements

- 2.1. Samples shall be furnished as requested by LUMA Energy. All documented testing required by applicable specifications and standards shall be submitted with product samples, including mechanical and electrical drawings, prior to approval. Vendors that have supplied this equipment/material to LUMA Energy on previous orders will not have to furnish samples at bid opening. If any material or design changes were made to an approved product, it must be re-submitted to the material specification engineer for approval before shipping.
- 2.2. Upon inspection of incoming equipment/material, the purchaser reserves the right to refuse the product and to determine the acceptability or rejection of such product. The supplier shall be liable for all costs incurred for products that are refused/rejected.
- 2.3. The equipment/material will be received at the LUMA's general warehouse (011) at Palo Seco, Puerto Rico. Shipping will include transportation and unloading at the indicated warehouse.
- 2.4. Vendor shall submit two (2) quotes: one for cables/conductors on steel reel and another for cables/conductors on wood reel. See detail of reels in section 6.

## 3. Literature

- 3.1. Descriptive and technical literature must be supplied by the vendor at time of bidding. This literature may include, but is not limited to details of equipment, drawings, documented testing, and instructions for use and installation. Failure to submit documents on time will cause bidder disqualification.
- 3.2. Vendor must submit with his proposal information about the cables/conductors electrical and mechanical properties including but not limited to the following parameter:
  - a. DC Resistance per unit length
  - b. AC Resistance per unit length
  - c. Capacitive Reactance @ 60 Hz per unit length
  - d. Inductive Reactance @ 60 Hz per unit Length

- e. Charging Current per unit length
- f. Dielectric Loss per unit length
- g. Zero Sequence Impedance per unit length
- h. Positive Sequence Impedance per unit length
- i. Short Circuit Current @ 30 Cycle
- j. Cable outside diameter
- k. Weight per unit length
- l. Minimum bending radius
- m. Maximum pull tension

#### **4. Markings**

- 4.1. The cables/conductors' reels shall be marked outside with LUMA Energy's purchase order, item number, description of cable & specification date, name, net length (including beginning and ending sequential footage marks (SFM)) & size, gross & tare weights, manufacturer's name, & lot/production number.
- 4.2. Packaging labels and tags shall be waterproof.
- 4.3. All cables shall have the following marks printed on the outer jacket as per ICEA S-94-649:
  - a. Identification of the manufacturer
  - b. Type of insulation TRXLPE
  - c. Cable gauge
  - d. Cable material
  - e. Nominal voltage
  - f. Year of manufacture
  - g. Insulation thickness
  - h. Cover material (Jacket)
  - i. Compliance standard
  - j. Sequential footage marks (SFM)
  - k. In addition, "Property of PREPA" shall be printed in the jacket as a requirement.

#### **5. Compatible with**

- 5.1. For compatible suppliers/manufacturers and models see Table 2.
- 5.2. These models are examples of the equipment/material described in this document and do not represent a preference. LUMA will evaluate equally any model not listed here during any acquisition event.

## 6. Packaging

- 6.1. All equipment/material shall be packaged and marked in such a way as to facilitate handling and protection from damage and that the receiving warehouse can readily identify it and send it, in one complete unit, to a field location without opening crates or boxes to sort items and/or parts.
- 6.2. Shall be shipped in a non-returnable new reel of continuous cable/conductor. The cables/conductors won't be accepted by sections.
- 6.3. Wood reels shall be made of treated wood conforming with AWWA (U1 & T1-17), with a retention of 0.3 lbs./cu ft (4.81 kg/cu m) of pentachlorophenol or chromated-copper-arsenate (CCA). Treatment material shall comply with AWWA P9.
- 6.4. Steel reel shall consist of a finishing high pressure hot phosphate wash and bonding agent, zinc chromate-iron oxide primer, and a final enamel coat to provide the necessary extra durability.
- 6.5. Reels shall have a minimum arbor hole diameter of 2.5 in (6.35 cm).
- 6.6. Each end of the cable shall be firmly and properly secured to reel.
- 6.7. Reels shall be protected against damage in ordinary handling and shipping.
  - a. Upper layers shall be protected with pieces of wood along the transverse section of reel for cable protection with NEMA Level 2 wrapping of protective material.
  - b. The cables/conductors ends shall be protected from water entrance or damage by means of an adequate seal.
- 6.8. Other types of reels will be evaluated by Luma Energy.

## 7. Number Per Package (Logistics)

Approximately 1,100 ft (335.28 m)  $\pm$  5% of material per reel or as requested by LUMA.

## 8. Acceptance Criteria

- 8.1. Test required: certified by external laboratories.
- 8.2. Latest applicable codes, standards, and other regulations:
  - a. AIEE CS8: For extruded dielectric shielded power cables rated 5 through 46 kV.
  - b. ASTM B3: For soft or annealed copper wire for electrical purposes.
  - c. ASTM B8: For concentric-lay-stranded copper conductors, hard, medium-hard, or soft.
  - d. ASTM B496: For compact round concentric-lay-stranded copper conductors.
  - e. ICEA T-31-610: Water penetration resistance test, sealed conductor.
  - f. ICEA T-34-664: Test method for conducting longitudinal water penetration resistance.

- g. ICEA S-94-649: For materials, constructions, and testing of crosslinked polyethylene, tree retardant crosslinked polyethylene, ethylene alkene copolymer and ethylene propylene rubber insulated single conductor or multiplexed concentric neutral cables rated 5 to 46 kV which are used for the transmission and distribution of electrical energy.
- h. UL 1072: For safety medium-voltage power cables. These requirements cover the shielded and non-shielded medium-voltage power cables.
- i. NEMA WC 26: Binational wire and cable packaging standard.

## 9. Description

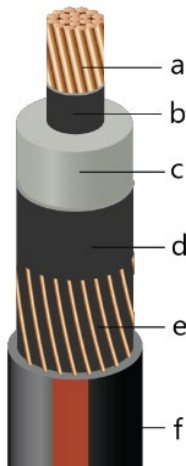
- 9.1. The 15 kV jacketed concentric neutral cable is for underground electric distribution, 13.2 kV phase to phase nominal voltage power system.
- 9.2. Shall be 15 kV shielded, in accordance with UL 1072, consisting of one (1) stranded soft drawn, class B compressed or compact, annealed uncoated copper wire as per ASTM B3, and concentric lay stranded as per ASTM B8 and ASTM B496, and covered with an extruded semi-conducting composed shield.
- 9.3. The cable conductor shall have a water blocker compound in accordance with ICEA T-31-610 and ICEA T-34-664.
- 9.4. Shield thickness maximum volume resistivity shall be 1,000 ohm-mt and shall be free of any voids larger than three (3) mils at the insulation interface and shall have an operating temperature equal to that of the insulation.
- 9.5. The insulation material shall be tree-retardant cross-linked polyethylene (TRXLPE) or ethylene propylene rubber (EPR) at 133% insulation level, 220 mils thickness.
- 9.6. The insulation of the completed cable shall be free of any void larger than three (3) mils (0.003"). The number of voids larger than two (2) mils (0.002") shall not exceed 30 per cubic inch of insulation.
- 9.7. Over the insulation shall be applied an extruded semiconducting thermosetting compound as per AEIC CS-8 standard, compatible with the insulation. It shall be properly identified as semiconducting.
- 9.8. Shall have a helically applied soft drawn bare copper 1/3 concentric neutral as per ICEA S-94-649. A water blocker shall be applied over the concentric neutral.
- 9.9. The cable shall be constructed with an overall encapsulating low linear density polyethylene (LLDPE) jacket.
- 9.10. The outside cable jacket markings shall include "Property of PREPA", sequential footage marks (SFM), and all required markings as per the applicable standards and regulations. The supplier shall provide an example of the final legend at bid opening.
- 9.11. A dry-curing method and triple head extrusion shall be employed for the three layers.

9.12. The cable shall withstand a maximum operating temperature of 90°C during normal operation and shall be suitable for use in wet and dry locations.

9.13. General cable minimum characteristics:

- a. Conductive strand shielding      0.012" (12 mils)
- b. Insulation thickness              0.220" (220 mils)
- c. Insulation shield thickness      0.040" (40 mils), 50 mils for cables  $\geq$  500 MCM
- d. Jacket thickness (LLDPE)        0.050" (50 mils), 80 mils for cables  $\geq$  500 MCM

9.14. Construction:



- a. Class B compressed or compact soft drawn bare uncoated copper conductor.
- b. Conductor shield: conventional semi-conducting cross-linked copolymer.
- c. Insulation: tree retardant cross-linked polyethylene (TRXLPE), 133 % Insulation Level.
- d. Insulation shield: strippable semi-conducting cross-linked copolymer.
- e. Helically applied soft drawn bare copper one-third (1/3) concentric neutral.
- f. Linear low-density polyethylene (LLDPE) jacket, black with red extruded stripes.

9.15. Table 1: Characteristics by cable sizes:

Item	Size	Stranding / Diameter	Approximate Concentric Neutral No. Wires/AWG	Approximate Diameter Over Insulation	Approximate Overall Diameter	Net Weight Lb./MFT
1	2 AWG	7 / 0.283" (7.19 mm)	6 / 14	0.760" (19.30 mm)	1.068" (27.13 mm)	628 (936 kg/km)
3	2/0 AWG	19 / 0.406" (10.32 mm)	11 / 14	0.882" (22.40 mm)	1.190" (30.23 mm)	958 (1,428 kg/km)
5	4/0 AWG	19 / 0.512" (13.00 mm)	18 / 14	0.989" (25.12 mm)	1.297" (32.94 mm)	1,344 (2,004 kg/km)
6	500 MCM	37 / 0.789" (20.04 mm)	17 / 10	1.275" (32.39 mm)	1.739" (44.17 mm)	2,862 (4,268 kg/km)
7	750 MCM	61 / 0.968" (24.59 mm)	25 / 10	1.463" (37.16 mm)	1.952" (49.58 mm)	4,041 (6,026 kg/km)

## 10. Inspection

The acceptance of any equipment/material shall in no way relieve the vendor from his responsibility to meet all the requirements of this specification, and it would not prevent subsequent rejection if such equipment/materials were found later to be defective.

## 11. Warranty

The cable/conductor shall be designed and manufactured to provide a minimum life expectancy of 40 years. Replacement costs associated with premature conductor failure due to inadequate design or faulty manufacturing is to be the responsibility of the supplier/manufacturer. The supplier/manufacturer shall guarantee that each part of the finished cable/conductor has been manufactured in accordance with the requirements of the referenced specifications and standards. The supplier/manufacturer shall agree to replace any length of cable/conductor for two years after date of delivery if defective material or workmanship is found during installation or if the cable/conductor fails from normal use during its first year of service. In either case, the supplier/manufacturer shall be given a reasonable opportunity to inspect such defect or failure. A technical report detailing the cause(s) of the defect and the corrective measures implemented to prevent recurrence shall be provided upon request of the purchaser.

## 12. Proposal Information

12.1. Submitted proposals must include:

- a. Technical information
- b. Table of Compliance completed by the bidder with reference (see Appendix 1).

## 13. Table 2: Warehouse and Asset Suite Identification Number

Item	Size	Warehouse #	Asset Suite #	AWG Model (With Water Blocker)	Southwire Model (SPEC 81114) (With Water Blocker)
1	2 AWG	006-82624	82624	-	430074
3	2/0 AWG	006-82625	82625	220-TRXLP-27	628161
5	4/0 AWG	006-82626	82626	220-TRXLP-29	628165
6	500 MCM	006-82627	82627	220-TRXLP-32	612883
7	750 MCM	006-82628	82628	220-TRXLP-33	628171

— End of Specification —



## Appendix

## Appendix 1: Table of Compliance

Line	Criteria	Description	Pass/Fail (P / F)	Comments
1	Specification	The Proponent complies with the corresponding specification document 4350.160.		
2	Industry Standards	The Proponent complies with the industry standards established in the specification document. National Electrical Code (NEC), ASTM (B3, B8, B496), ICEA (S-94-649, T-31-610, T-34-664), AEIC CS-8, and UL 1072.		
3	Type	15kV, JCN cable		
4	Product Requirement	Maximum operating temperature: 90°C during normal operation.		
		Suitable for use in wet and dry locations.		
		Class B compressed or compact soft drawn bare copper conductor.		
		Water blocker compound for the conductor.		
		Conductor shield: conventional semi-conducting cross-linked copolymer with 12 mils minimum thickness.		
		Insulation: TRXLPE or EPR at 133%, 220 mils thickness.		
		Insulation Shield: strippable semi-conducting cross-linked copolymer with 40 mils minimum thickness (50 mils for cables ≥ 500 MCM).		
		One-third (1/3) concentric neutral soft drawn bare copper wires helically applied.		
		Water blocker compound over the concentric neutral.		
		Jacket: black with red extruded stripes LLDPE with 50 mils minimum thickness (80 Mil for cables ≥ 500 MCM).		
Jacket markings: "Property of PREPA", SFM, and all required as per the applicable standards and regulations.				











# 4350.160 15 kV Primary Copper Power Cable-Concentric Neutral (12-18-23)

Final Audit Report

2023-12-18

Created:	2023-12-18
By:	Miguel Rios (miguel.rioslopez@lumapr.com)
Status:	Signed
Transaction ID:	CBJCHBCAABAAFby_EzL8wA253qX8Xw5V-HWgGYllr4Vy

## "4350.160 15 kV Primary Copper Power Cable-Concentric Neutral (12-18-23)" History

-  Document created by Miguel Rios (miguel.rioslopez@lumapr.com)  
2023-12-18 - 7:39:09 PM GMT
-  Document e-signed by Miguel Rios (miguel.rioslopez@lumapr.com)  
Signature Date: 2023-12-18 - 7:43:41 PM GMT - Time Source: server
-  Document emailed to Rodolfo Flores (rodolfo.floresortiz@lumapr.com) for signature  
2023-12-18 - 7:43:42 PM GMT
-  Email viewed by Rodolfo Flores (rodolfo.floresortiz@lumapr.com)  
2023-12-18 - 8:01:08 PM GMT
-  Document e-signed by Rodolfo Flores (rodolfo.floresortiz@lumapr.com)  
Signature Date: 2023-12-18 - 8:05:15 PM GMT - Time Source: server
-  Document emailed to ricardo.castro@lumapr.com for signature  
2023-12-18 - 8:05:16 PM GMT
-  Email viewed by ricardo.castro@lumapr.com  
2023-12-18 - 8:20:16 PM GMT
-  Signer ricardo.castro@lumapr.com entered name at signing as Ricardo Castro Gómez  
2023-12-18 - 8:20:48 PM GMT
-  Document e-signed by Ricardo Castro Gómez (ricardo.castro@lumapr.com)  
Signature Date: 2023-12-18 - 8:20:50 PM GMT - Time Source: server
-  Agreement completed.  
2023-12-18 - 8:20:50 PM GMT