

Section: 3 – Conductors, Connectors, & Sleeves		Spec. #	02-153 FE
		Page #	1 of 6
		Date	02-24-2003
Group: Cable		Rev. Date	09-21-2022

**Cable, 15 - 46 kV, Aluminum Conductor,
Extruded Solid Dielectric Insulated
Jacketed Concentric Neutral**



I. SCOPE

This specification covers 15 kV through 46 kV cable consisting of an aluminum conductor with tree retardant cross-linked polyethylene (TRXLPE) or ethylene propylene rubber (EPR) insulation, a copper concentric neutral and a non-conducting jacket. This cable will be used for distribution circuits, either direct earth burial or in a conduit system.

II. REFERENCES

All cable supplied under this specification shall be in accordance with the latest version of the following standards, except where noted in this specification.

AEIC CS8	Specification for Extruded Dielectric, Shielded Power Cables Rated 5 through 46 kV
ICEA S-94-649	Concentric Neutral Cables Rated 5 through 46 kV
ASTM B 231/B 231M	Standard Specification for Concentric-Lay-Stranded Aluminum 1350 Conductors
ASTM B 609/B 609M	Specification for Aluminum 1350 Round Wire, Annealed, and Intermediate Tempers, for Electrical Conductors
NEMA WC 26	Binational Wire and Cable Packaging Standard

III. CHARACTERISTICS

The design and construction of the cable shall be suitable for operation in wet and dry locations at conductor temperatures not exceeding 90°C for normal continuous operation, 130°C for emergency operation, and 250°C for short circuit conditions. The dimensions of the extruded components shall be consistent with those in ICEA S-94-649.

A. Conductor

The conductor shall be 1350 aluminum Class B compressed or compressed unilay stranded in accordance with ASTM B 231 and H16/26 (3/4 hard) to H19 (full hard) temper in accordance with ASTM B 230/B 230M and ASTM B 609 as applicable. The conductor strands shall be filled with a water-blocking compound meeting all the requirements of ICEA S-94-649 Part 2.

B. Conductor Shielding

Conductor shielding shall consist of an extruded thermosetting material that is compatible with the conductor and insulation in accordance with Part 3 of ICEA S-94-649.

Section: 3 – Conductors, Connectors, & Sleeves		Spec. #	# 02-153 FE
Group: Cable		Page #	2 of 6
		Date:	02-24-2003
		Rev, Date:	09-21-2022

C. Primary Insulation

The primary insulation shall be tree retardant cross-linked polyethylene (TRXLPE) or Class II, Class III, or Class IV ethylene propylene rubber (EPR) and meet all the requirements of ICEA S-94-649 Part 4. Tree-retardant cross-linked polyethylene insulation systems shall be dry cured. The insulation thickness shall be as specified in ICEA S-94-649 Part 4 for the 100% insulation level.

D. Insulation Shield

The insulation shield shall be extruded semiconducting strippable material compatible with the insulation and the metallic shield/concentric neutral wires. The insulation shield shall meet all the requirements specified in ICEA S-94-649 Part 5.

E. Concentric Neutral Wires

The neutral shall consist of annealed uncoated solid round copper wires applied in accordance with ICEA S-94-649 Part 6 and sized as shown in Table 1 through Table 5 of this specification. The size and number of wires shall be the standard configurations for the specified capacity (full, ½, 1/3, 1/6, etc.) as specified in ICEA S-94-649 Part 6 or Appendix G. All concentric neutral wires shall be equally spaced and in intimate contact with the insulation shield after the cable is jacketed.

F. Water-Impeding Material

A water-impeding material shall be applied beneath the jacket of tree retardant cross-linked polyethylene (TRXLPE) cables in the interspatial area between the concentric neutral wires in such a way as to prevent the penetration of water along the conductor between the insulation shield and the jacket. This compound shall meet all the requirements of ICEA S-94-649 Part 6.

G. Nonconducting Jacket

The Extrude-To-Fill jacket shall be extruded black nonconducting light stabilized linear low-density polyethylene (LLDPE) providing a covering over the outer circumference of the concentric neutral wires. The jacket shall meet all the requirements of ICEA S-94-649 Part 7. The jacket material shall be fully compatible with the water-impeding material and applied in such a way as to fill the void spaces between adjacent concentric neutral wires. There shall be no air voids around individual concentric neutral wires.

H. Identification

1. The outer surface of each cable shall be durably marked in accordance with ICEA S-94-649. The cable's outer jacket shall be identified with three (3) longitudinal extruded red stripes spaced at 120° around the cable.
2. The cable shall also include a durable sequential footage marking on the jacket surface at a maximum interval of three (3) feet between markings. When cables are paralleled, footage makers are required on at least one of the phases (footage marking is acceptable on all three cables).

Section: 3 – Conductors, Connectors, & Sleeves		Spec. #	# 02-153 FE
Group: Cable		Page #	3 of 6
		Date:	02-24-2003
		Rev, Date:	09-21-2022

3. Each phase of a parallel cable assembly shall be uniquely identified, such as:

- “A”, “B”, “C”
- “1”, “2”, “3”
- “1”, “2”, Blank
- Other FirstEnergy approved method.

I. Cable-in-Conduit

If a cable-in-conduit (CIC) assembly is identified in the FirstEnergy material description, the conduit shall be EPEC-40, black, high-density polyethylene (HDPE) per NEMA TC 7. The conduit shall be marked with three extruded red stripes approximately 120 degrees apart.

IV. PRODUCTION TESTS / CERTIFIED TEST REPORTS

- A. Production tests shall be performed in accordance with AEIC and ICEA requirements.
- B. Certified test reports shall be on file with the manufacturer and be available upon request.
- C. Upon request, the manufacturer shall send a three-foot sample of cable, selected by an FE approved sampling procedure, for FirstEnergy analysis.

V. SHIPMENTS & REELS

- A. All cable packaging shall conform to AEIC CS8, Section 12, unless otherwise noted.
- B. No reel covering is required (NEMA WC 26 Level 1 Reel Covering).
- C. The manufacturer shall specify the preferred method of shipping and storage for the cable reels (upright or flat):
 - 1. Reels that are shipped upright shall rest on both flanges, properly chocked and tied/strapped down. The tie downs/straps shall be applied to the reel and not to the wire/cable loaded on the reel.
 - 2. Reels that are shipped lying on the flange (pancake mode) shall be stacked no more than three high. If stacked, blocks/separators shall be provided under the flanges of each reel to allow for 2-inch minimum vertical opening for lift forks.
- D. Each shipping reel shall have a minimum of two inches in clearance between the cable and the outside edge of the flange.
- ▶ E. Package size (length) tolerance shall be $\pm 10\%$ of the specified length.

VI. PRODUCT / PLANT / MANUFACTURER MODIFICATIONS

The ED Distribution Design Standards Section of the Energy Delivery Operations Services Department shall be notified in writing of all changes in manufacturer status including, but not limited to, a change in design, material, or components.

Section: 3 – Conductors, Connectors, & Sleeves		Spec. #	# 02-153 FE
Group: Cable		Page #	4 of 6
		Date:	02-24-2003
		Rev, Date:	09-21-2022

Specification Revision Log

Revision Date	Revision Description
09-02-2003	Added "Extrude-To-Fill" to jacket description; corrected material number for 15 kV 1000 kcmil AL single on reel.
06-24-2004	Removed old material numbers for #2 15 kV cable; changed package size of material number 18434 to 3000 ft from 4500 ft; corrected number of strands for material number 32779282; removed requirement for reels to be on both flanges during shipment.
07-26-2007	Added the option of filled-strand conductors; clarified footage marker requirement; listed tactile marking on jacket as acceptable phase marking method; added conduit requirements for CIC assembly; changed abbreviation for circuit feet CKF to match the SAP unit of measure; redefined cable min. OD to be with twice the neutral wire indent & made a few corrections in other dimensions; added material number 10012924 for #2 15 kV CIC to Table 1; added material number for 750 kcmil 15 kV single on a reel; added reel sizes for 500 through 1000 kcmil 15kV cables.
10-23-2007	Clarified dimension requirements in III on page 1.
12-11-2007	Added wording to require strand fill; inserted new III. F covering water-blocking compound beneath the jacket; relabeled paragraphs F through H due to above addition.
03-27-2012	Added single and parallel reels of 750 kcmil AL 25 kV and 35 kV cable to Table 2.
02-23-2015	Updated scope, updated references, removed national standard redundancies, removed dimensional requirements, and referenced national standard dimensions, updated reel and shipping requirements, removed bid information requirements, updated conduit requirements for CIC, revised neutral requirements to comply with industry standard, revised neutral to 1/3 for parallel conductors 500 kcmil and below, revised neutral to 1/6 for conductors 750 kcmil and larger. Split Table 1 into Tables 1 & 2 (15 kV), split. Table 2 into Tables 3 (25kV) & 4 (35kV) and renamed Table 3 to Table 5 (46 kV).
06-03-2019	Revised the title, scope, and insulation requirements to include both EPR and TRXLPE insulation, reworded the conductor shield requirements, reworded the insulation shield requirements for both EPR & TRXLPE, changed the requirements for the concentric neutral to size and number as specified in ICEA S-94-649 and changed the water blocking requirement for TRXLPE cables only. Revised Tables to exclude dimensions and other requirements covered in ICEA S-94-649.
11-16-2021	Change the put-up reel length from 1000 ft to 2000 ft for 15 kV AL 750 JCN 1/6 Neut. 1/C (SAP # 100037201).
12-14-2021	Corrected SAP# 100012924 description from 1/3 Neutral to Full Neutral.
09-21-2022	Added cable length tolerance to the spec. See paragraph V.E.

Section: 3 – Conductors, Connectors, & Sleeves		Spec. #	# 02-153 FE
Group: Cable		Page #	5 of 6
		Date:	02-24-2003
		Rev, Date:	09-21-2022

Table 1 - 15 kV Cables (Small)

Volts Between Phases	15,000 Volts						
SAP #	19101243	19101283	100012924	19101323	19101363	19101333	19101383
<u>Central Conductor:</u> Size (AWG or kcmil)	#2 AL	#2 AL	#2 AL	1/0 AL	1/0 AL	3/0 AL	3/0 AL
<u>Copper Wire Shield:</u> % Neutral	Full	1/3	Full	Full	1/3	Full	1/3
<u>Conduit: (CIC only)</u>	---	---	1.50" HDPE	---	---	---	---
<u>Package:</u> Length	Single 4000 ft	3-Parallel 1000 CKF	Cable-in- Conduit 2000 ft	Single 3500 ft	3-Parallel 1000 CKF	Single 3000 ft	3-Parallel 1000 CKF

Table 2 - 15 kV Cables (Large)

Volts Between Phases	15,000 Volts				
SAP #	32411142	100037201	31823002	12610106	19101393
<u>Central Conductor:</u> Size (AWG or kcmil)	500 AL	750 AL	750 AL	1000 AL	1000 AL
<u>Copper Wire Shield:</u> % Neutral	1/3	1/6	1/6	1/6	1/6
<u>Package:</u> Length	3-Parallel 1000 CKF	Single 2000 ft	3-Parallel 750 CKF	Single 1000 ft	3-Parallel 750 CKF

Table 3 - 25 kV Cables

Voltage Between Phases	25,000 Volts					
SAP #	18434	19101403	19101503	18435	100072888	100073358
<u>Central Conductor:</u> Size (AWG or kcmil)	#1 AL	1/0 AL	1/0 AL	4/0 AL	750 AL	750 AL
<u>Copper Wire Shield:</u> Neutral	Full	Full	1/3	1/3	1/6	1/6
<u>Package:</u> Length	Single 3000 ft	Single 2500 ft	3-Parallel 1000 CKF	Single 3000 ft	Single 1000 ft	3-Parallel 750 CKF

Section: 3 – Conductors, Connectors, & Sleeves		Spec. #	# 02-153 FE
Group: Cable		Page #	6 of 6
		Date:	02-24-2003
		Rev, Date:	09-21-2022

Table 4 - 35 kV Cables

Voltage Between Phases	35,000 Volts					
SAP #	19101673	100034950	2057	100072889	100073359	2058**
<u>Central Conductor:</u> Size (AWG or kcmil)	1/0 AL	1/0 AL	4/0 AL	750 AL	750 AL	1000 AL**
<u>Copper Wire Shield:</u> Neutral	Full	1/3	1/3	1/6	1/6	1/6
<u>Package:</u> Length	Single 1800 ft	3-Parallel 1000 CKF	Single 2500 ft	Single 1000 ft	3-Parallel 750 CKF	Single 2500 ft

** - This cable shall be supplied with EPR insulation only.

Table 5 - 46 kV Cables

Voltage Between Phases	46,000 Volts				
SAP #	32778032	32778292	494365	32778602	32779282
<u>Central Conductor:</u> Size (AWG or kcmil)	4/0 AL	4/0 AL	750 AL	1000 AL	1500 AL
<u>Copper Wire Shield:</u> Neutral	1/3	1/3	1/6	1/6	1/6
<u>Package:</u> Length	Single 1000 ft	3-parallel 750 CKF	Single 1000 ft	Single 1000 ft	Single 1000 ft

Note: CKF – circuit feet