

Q4 XK

Consolidated Edison Company of New York, Inc. 4 Irving Place, New York, N.Y. 10003

**Purchase and Test
Manual No. 6, Sect. 3
All Districts**

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12/07/90**

**SPECIFICATION FOR
CROSS-LINKED POLYETHYLENE INSULATED
CABLES 5.000 TO 35 000 VOLTS**

SCOPE

1. This specification covers single and three-conductor cables insulated with cross-linked polyethylene for operation at voltages from 5,000 to 35,000 volts, inclusive. Unless otherwise specified, the latest revision of both ICEA Publication No. S-66-524 and AEIC No. CS5 Specification for Thermoplastic and Cross-Linked Polyethylene Insulated Shielded Power Cables Rated 5 through 35KV shall apply.

CONDUCTOR

2. The conductors specified for these cables shall conform to Part 2 of ICEA Publication No. S-66-524 with the following additions:
 - a. Copper conductors shall be annealed, uncoated and Class B stranded. When compact stranding is specified, the conductor shall conform to the number of wires and splices according to the requirements of ASTM B8. The copper conductors shall be annealed after stranding on all compact cables of sizes larger than 500 kcmil.
 - b. Aluminum conductors shall be aluminum alloy #1350 either half hard or three quarter hard in accordance with ASTM B609. The conductors shall conform to ASTM B231 for Class B, compressed stranding.

INSULATION

3. The insulation shall consist of chemically cross-linked thermosetting polyethylene which will meet the requirements of the referenced AEIC specification with the additional requirements listed below. Certified test reports showing conformance shall be furnished in accordance with paragraph 12 of this specification. The pellets used in the manufacture of the insulation shall be "extra-clean". The insulation shall be extruded in a closed system to insure maximum cleanliness.

a. Physical Properties

Original --- Tensile strength PSI (minimum) --- 1,800

Elongation percentage
(minimum) --- 350

After Aging- Air oven test (168 hours at 121 degrees centigrade)
- 75 minimum

Tensile strength
(percentage of original)
- 75 minimum

Elongation (percentage of original)- 75 minimum

After Aging- Air pressure test (80 psi 40 hours at 127 degrees centigrade)

Tensile strength (percentage of original)-75 minimum

Elongation (percentage of original) -- 75 minimum

INSULATION (Cont'd)

b. Electrical Properties

Insulation Resistance Constant (K) at 15.6 degrees centigrade ----- 25,000
minimum

Dielectric Constant at 75 degrees centigrade 3.0 maximum

Stability Factor after 14 days - 1.0 maximum

c. Moisture Resistance

Mechanical moisture absorption mg per square inch -----
5.0 maximum

Maximum percent change in Dielectric Constant (75 degree centigrade water)

1 to 14 days ----- 3.0 maximum

7 to 14 days ----- 1.5 maximum

d. Ozone Resistance (ICEA Publication S-19-81 Part 6.8)

.030 percent concentration at -- No cracks
room temperature and .005 after 24
percent concentration at 125 hours
degrees centigrade exposure

e. Cold Bend

No cracks at minus 30 degrees centigrade

ASSEMBLY

4. A semi-conducting shield shall be used for shielding the strands of the conductor and for shielding the insulation.

a. Strand Shielding

The strands shall be completely shielded with a layer of semi-conducting extruded cross-linked polyethylene of a material compatible with the insulation. The strand shielding shall be in intimate contact with the strands and shall be completely free stripping from the strands. No tape shall be applied under the

ASSEMBLY (Cont'd)

extruded shield without permission of the Distribution Equipment Engineer.

b. Semi-Conducting Insulation Shielding

Leaded Cables 13kV to 35kV

The insulation shall be completely shielded with a layer of semi-conducting extruded cross-linked polyethylene, compatible with the insulation, and have an average thickness of 30 mils. The legend "semi-conducting shielding, remove before splicing" shall be printed in white indelible non-conducting ink along its entire surface.

c. Semi-Conducting Insulation Shielding

Leaded Single Conductor Cable 5kV Only

The insulation shall be completely shielded with a layer of semi-conducting tape of a material compatible with the insulation. The tape shall be smoothly applied in intimate contact with the insulation. Minimum overlapping shall be 1/3 lap and maximum tape width shall be 1 1/2 inches. It shall be completely free stripping with no residue remaining on the insulation after removal. The legend "semi-conducting shielding, remove before splicing" shall be printed in white indelible non-conducting ink along its entire surface.

SHEATH

5. Where a lead sheath is specified for cables listed in Table I, the cables shall be covered with an extruded sheath of copper bearing lead or its approved equivalent. The average sheath thickness shall be not less than the value indicated in the detailed specifications for the individual cable. The minimum thickness shall be not less than 90 percent of this value.

POLYETHYLENE COVERING

6. Unless otherwise specified in the individual cable specifications of Table I, the jacket applied over the lead sheath on leaded cables shall be high density black polyethylene, Type 3, Class C, Grade J4 of ASTM Designation D1248.

PRODUCTION SAMPLING TEST

7. The following tests shall be run on all orders of single and three-conductor cable of 50,000 feet and larger and shall be reported in certified test reports. Samples shall be tested throughout the order at the frequency specified in the AEIC specification.

a. Structural Stability Test

The structural stability test described in the referenced AEIC specification shall be applied to all samples. The corona values shall conform to paragraph 8a of this specification.

b. High Voltage Time Test

After passing the structural stability test above, the samples shall be given the high voltage time test described in the referenced AEIC specification.

c. Witnessing

Con Edison reserves the right to inspect a manufacturer's facility during the time of cable manufacture and to pick out the samples for testing if deemed necessary.

TEST ON COMPLETED CABLES

8. The following tests shall be run on all completed cables.

a. Corona Test

The following corona level test must be made on completed shielded single conductor cable after triplexing and on completed three-conductor cable on long length factory reels. Certified test reports shall be submitted only for cut lengths although the actual values reported are those for the completed long lengths.

The corona values shall comply with the maximum discharge in picocoulombs specified in the following tables with a detection sensitivity of 5 pc and using the method specified in the referenced AEIC specification.

Cables With Semi-Conducting Tape Insulation Shield

Rated Circuit Voltage Phase-To-Phase (Volts)	Insulation Thickness (Mils)	Discharge In Picocoulombs At Percent of Rated Voltage To Ground			
		125	150	175	200
		5,000	90	5	5

Cables With Extruded Semi-Conducting Insulation Shield

Rated Circuit Voltage Phase-To-Phase (Volts)	Insulation Thickness (Mils)	Discharge In Picocoulombs At Percent of Rated Voltage To Ground			
		150	200	300	400
		15,000	175	5	5
27,000	275	5	5	5	5
35,000	345	5	5	5	5

TEST ON COMPLETED CABLES (Cont'd)

b. AC-DC Voltage Tests

Completed cables on shipping reels shall be tested at the AC and DC voltages specified in the individual cable specifications and in the referenced AEIC specification.

c. Solderability Test

A three-foot sample from the leading end of single conductor leaded cable on all long factory reels before triplexing in an order shall be tested for solderability. A standard joint wipe of appropriate diameter shall be made on the sample. No bubbling or blistering of the lead shall occur during wiping. When the wipe is cool enough, it shall be removed and the semi-conducting insulating shield shall be examined. No blistering or bubbling shall occur. The results of these tests shall be included in the certified test reports. Failure of this test is grounds for rejection of the cable.

MOISTURE

9. There shall be no water in the strands and between the jacket and insulation of the cable when shipped. Each end of each conductor shall be made watertight with a pulling bolt or end seal or a thick wall heat shrinkable cap as per paragraph 11. Free water present anywhere in the cable is grounds for rejection of the cable.

MARKING

10. The following shall apply:

a. All cables shall have the following stamped in legible indelible ink along the lead sheath or outer jacket at approximately one foot intervals:

1. A sequential footage number on single conductor cables; on duplex or triplexed cables, one leg is to be marked.

MARKING (Cont'd)

10. (Cont'd)
 2. The words, "Property of Consolidated Edison".
 3. The size of the conductor, the voltage rating and the type of insulation.
- b. All cables shall contain a laminated mylar marker tape containing sequential footage, the name of the manufacturer, the facility in which the cable core was made, the year in which the cable was manufactured and the identification "for C.E.", all to appear at intervals of approximately one foot.
- c. On lead covered cables, the tape shall be placed along the core and immediately under the lead sheath conductor cable.
- d. All non-compact conductors larger than #6 AWG shall have the center strand stamped with the following marking at approximately one foot intervals.
 1. Manufacturer's name
 2. Year of manufacture
 3. The words, "For C.E."

PULLING BOLTS AND END SEALS

11. All lead covered copper cables shall be equipped with a pulling bolt on the leading end, in accordance with EO-1440-B (wipe type), or an equivalent approved by the Distribution Equipment Engineer. The trailing end of all leaded cables shall be sealed in accordance with EO-1592-D. Lead covered cables with aluminum conductors shall be equipped with a compression type pulling bolt on the leading end in accordance with EO-15503-B.

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CERTIFIED TEST REPORTS

12. One set of certified test reports showing corona values and the high voltage test shall be sent to the Distribution Equipment Engineer within one week after the cable has been shipped. The reports regarding to production tests of paragraph 7 and all other required tests shall be sent within two weeks after shipment.


Frank Doherty
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T. Hui/ar
Attachment: Table I

<p><u>REVISION 9:</u> General Revision. Removed non-leaded cable construction from Table I. To be revised by 12/93.</p>	<p><u>FILE:</u> Purchase and Test Manual No. 6, Section 3 Cable and Wire</p>
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TABLE I
SPECIFICATIONS FOR CROSS-LINKED
POLYETHYLENE (XLPE) INSULATED CABLES
5,000 TO 35,000 VOLTS

Specification Number	Number of Conductors	Size of Conductor (AWG Or kcmil)	Stranding Number And Diameter (Mils)	Conductor Insulation (Mils)	Lead Thickness (Mils)	Covering (Mils)	Maximum O.D. (Mils)	Approx. Weight Lb/Ft	Cond-Grd HV Test 5 Min KV-AC	Minimum Insulation Resistance Megohm/M'	Remarks
Rating - 5,000 Volts - Between Conductors											
EO-430X-2	1-Cu	#2	7/97.4	90	65	--	750	1.0	18.0	5,400	-
EO-430XJ-3	1-Cu	#2	7/97.4	90	65	50	865	1.1	18.0	5,400	CA
EO-451X-2	1-Cu	#2/0	19/83.7	90	65	--	885	1.3	18.0	4,200	-
EO-451XJ-3	1-Cu	#2/0	19/83.7	90	65	65	1,035	1.4	18.0	4,200	CA
EO-432X-2	1-Cu	#4/0	19/105.5	90	80	--	1,035	2.0	18.0	3,600	-
EO-432XJ-3	1-Cu	#4/0	19/105.5	90	80	65	1,185	2.1	18.0	3,600	CA
EO-427X-2	1-Cu	350	37/97.3	90	80	--	1,200	2.7	18.0	3,000	-
EO-427XJ-2	1-Cu	350	37/97.3	90	80	65	1,355	2.8	18.0	3,000	CA
EO-7627XJ-2	3-Cu	350	37/97.3	90	95	65	2,910	9.1	18.0	3,000	-
	1-Cu	#4/0	19/105.5	78 EPR	--	45N			5.5	2,350	NOTE B
EO-466XJ-3	1-Cu	500	37/116.2	90	95	65	1,535	3.8	18.0	2,659	CA
EO-7628XJ-2	3-Cu	500	37/116.2	90	95	65	3,300	13.0	18.0	2,650	-
	1-Cu	#4/0	19/105.5	78 EPR	--	45N			5.5	2,350	NOTE B
Rating - 15,000 Volts - Between Conductors											
EO-7403X-2	1-Cu	#2/0	19/83.7	175	80	--	1,100	1.9	35.0	6,800	-
EO-7403XJ-3	1-Cu	#2/0	19/83.7	175	80	65	1,250	2.0	35.0	6,800	CA
EO-7401X-4	1-Cu	300	37/90.0	175	80	--	1,330	2.8	35.0	5,150	-
EO-7401XJ-3	1-Cu	300	37/90.0	175	80	65	1,490	2.9	35.0	5,150	CA
EO-7445X-2	1-CuCR	350	37	175	95	110	4,000	19.0	35.0	5,180	NOTE A
EO-7402X-2	1-CuCR	750	61	175	95	--	1,640	5.0	35.0	3,980	-
EO-7402XJ-2	1-CuCR	750	61	175	95	80	1,855	5.2	35.0	3,980	CA
EO-74446X-1	3-CuCR	750	61	175	125	110	4,800	25.0	35.0	3,960	NOTE A
EO-7405XJ-5	1-Cu	1000	61/128.0	175	100	60	2,090	6.9	35.0	3,350	CA

TABLE I CONTINUED

SPECIFICATIONS FOR CROSS-LINKED
POLYETHYLENE (XLP) INSULATED CABLES
5,000 TO 35,000 VOLTS

Specification Number	Number of Conductors	Size of Conductor (AWG Or kcmil)	Stranding Number And Diameter (Mils)	Conductor Insulation (Mils)	Lead Thickness (Mils)	Covering (Mils)	Maximum O.D. (Mils)	Approx. Weight (Lb/Ft)	Cond-Grd HV Test 5 Min KV-AC	Minimum Insulation Resistance Megohm/M'	Remarks
Rating - 27,000 Volts - Between Conductors											
EO-7404X-2	1-Cu	#2/0	19/83.7	275	95	--	1,350	2.6	55.0	9,225	-
EO-7404XJ-3	1-Cu	#2/0	19/83.7	275	95	65	1,480	2.8	55.0	9,225	CA
EO-7400X-5	1-CuCR	500	37	275	95	--	1,640	4.3	55.0	6,400	-
EO-7400XJ-4	1-CuCR	500	37	275	95	80	1,850	4.6	55.0	6,400	CA
EO-7434X-2	3-CuCR	500	37	275	140	95	4,845	25.0	55.0	6,400	NOTE A
EO-7406XJ-3	1-Cu	750	61/110.9	275	95	60	2,100	6.5	55.0	5,190	CA
EO-7407X-2	1-CuCR	1000	61	275	110	--	2,065	7.1	55.0	4,970	-
Rating - 35,000 Volts - Between Conductors											
EO-7409X-1	1-Cu	#2/0	19/83.7	345	95	--	1,490	3.0	69.0	10,700	-
EO-7409XJ-1	1-Cu	#2/0	19/83.7	345	95	80	1,685	3.2	69.0	10,700	CA
EO-7425X-1	1-Cu	#4/0	19/105.5	345	95	--	1,610	3.4	69.0	9,290	-
EO-7425XJ-1	1-Cu	#4/0	19/105.5	345	95	80	1,805	3.7	69.0	9,290	CA
EO-7410X-1	1-Cu	350	37/97.3	345	95	--	1,775	4.2	69.0	7,915	-
EO-7410XJ-1	1-Cu	350	37/97.3	345	95	80	1,975	4.4	69.0	7,915	CA
EO-7411X-2	1-CuCR	500	37	345	110	--	1,875	5.1	69.0	7,455	-
EO-7411XJ-2	1-CuCR	500	37	345	110	80	2,080	5.4	69.0	7,455	CA
EO-7414XJ-1	1-EC	750	61/110.9	345	110	80	2,355	5.3	69.0	6,125	CA
EO-7439XJ-1	1-Cu	1000	61/128.0	345	110	80	2,525	8.1	69.0	5,540	CA

TABLE I (CONTINUED)

SPECIFICATIONS FOR CROSS-LINKED
POLYETHYLENE (XLP) INSULATED CABLES
5 000 TO 35.000 VOLTS

CA	=	Cable shall be used for direct burial, station legs and corrosive areas.
CU	=	Round copper conductor.
CUCR	=	Compact round copper conductor.
EC	=	EC aluminum conductor
N	=	Non-conducting neoprene in accordance with ASTM Designation D752.
EPR	=	Ethylene propylene rubber in accordance with specification EO-18.

NOTE A = This submarine cable shall be provided with the following:

1. 95 mils jute bedding over the polyethylene jacket.
2. #4 AWG galvanized steel armor wires over the jute bedding.
3. 100 mils of asphalt covering overall.

NOTE B = The neutral conductor shall be laid in the interstices of the three insulated conductors and cabled with a left hand lay, approximately 60 inches long.