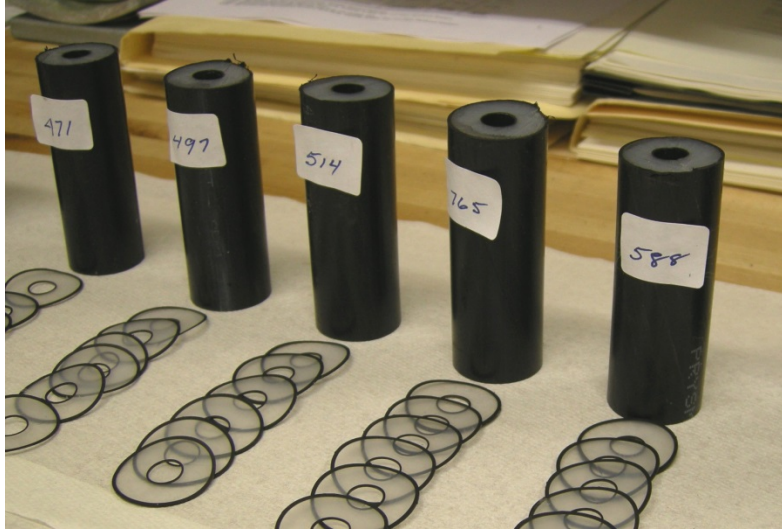


Medium Voltage Cable - General



1. Scope

This standard covers the general requirements for medium voltage (5–46 kV) cable, single- and three-conductor.

Specific requirements shall be according to the detailed material standard and purchase order issued subsequent to competitive solicitations.

2. Application

Cable is intended for use on the following three-phase, 60 Hz, systems:

- 13.8 kV, 3-wire, delta
- 26.4 kV, 4-wire, solidly-grounded, wye-connected

3. Industry Standards

Cable shall meet the applicable requirements of the following industry standards as referenced in this and the detailed material standard:

ANSI/ICEA S-97-682-2013 – Standard for Utility Shielded Power Cables
Rated 5 through 46 kV.

ASTM B231-04 – Standard Specification for Concentric-Lay-Stranded Aluminum
1350 Conductors

ASTM B233-03 – Standard Specification for Aluminum 1350 Drawing Stock for
Electrical Purposes

ASTM B3-01 – Standard Specification for Soft or Annealed Copper Wire

- ASTM B400-04** – Standard Specification for Compact Round Concentric-Lay-Stranded Aluminum 1350 Conductors
- ASTM B49-04** – Standard Specification for Copper Redraw Rod for Electrical Purposes
- ASTM B496-04** – Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors
- ASTM B609-04** – Standard Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes
- ASTM B8-04** – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- ICEA S-93-639-2000 (NEMA WC 74-2000)** – 5-46 kV Shielded Power Cable for Use in the Transmission & Distribution of Electric Energy (utilized only for its section on metallic and associated coverings)
- ANSI/ICEA S-94-649-2013** – Standard for Concentric Neutral Cables Rated 5,000-46,000 Volts
- NEMA WC 26-2008 (EEMAC 201-2008)** – Binational Wire and Cable Packaging Standard
-

4. Conflict

Where conflict exists, the following order of precedence shall apply:

1. Seattle City Light (SCL) purchase order
 2. SCL General Terms and Conditions
 3. SCL detailed material standard
 4. This standard
 5. ANSI/ICEA publications
 6. ICEA publications
 7. ASTM publications
 8. Other industry standards
-

5. Purchase Order Information

Purchase order will state the following minimum information:

- Cable description
 - SCL general material standard number including revision date
 - SCL detailed material standard number including revision date
 - SCL stock number
 - Total order quantity
 - Price
 - Delivery date
 - Quantity per reel
-

6. Construction and Ratings

6.1 General

Cable shall be suitable for aerial installations, direct burial, underground ducts, conduit risers, and wet or dry locations.

The manufacturer shall be responsible for ensuring the compatibility of all components used to assemble the cable.

Cable shall be manufactured in a continuous triple-extrusion process. The conductor shield, insulation, and insulation shield layers shall be extruded over the core conductor in one continuous pass using true triple or triple tandem extruders.

Cable shall be capable of being safely handled and installed if not subjected to temperatures lower than minus 10° C in the preceding twenty four hours.

In-plant repairs of the cable core are prohibited unless specifically agreed to by the purchaser.

Failure to meet any of the requirements of this and referenced standards shall be cause for rejection.

Cable shall be designed and constructed to operate at conductor temperatures not exceeding those shown in Table 6.

Table 6. Insulation Material and Conductor Temperature Limits

Insulation Material	Normal Operation	Emergency Overload	Short Circuit
TRXLPE	90° C	130° C	250° C
EPR/EAM Class III	105° C	140° C	250° C

6.2 Conductor

If the detailed material standard requires sealant for stranded conductors the following clarifications apply: The requirements of ANSI/ICEA S-97-682, Section 2.2 or ANSI/ICEA S-94-649, Section 2.2 shall apply as appropriate.

6.3 Conductor Shield

ANSI/ICEA S-97-682, Part 3 shall apply to cable with a tape metallic shield.

ANSI/ICEA S-94-649, Part 3 shall apply to cable with a flat strap metallic shield or concentric neutral.

6.4 Insulation

Cable insulation material that may be specified in the detailed material standard includes:

- Tree retardant crosslinked polyethylene (TRXLPE)
- Ethylene propylene rubber (EPR) or ethylene alkene copolymer (EAM)

If **TRXLPE** is specified the following clarifications shall apply:

- Approved material formulations (no exceptions) include:
 - Dow HFDB-4202 NT EC
 - Dow HFDC-4202 EC
 - Borealis LE4212.
- Cable shall be dry cured. Steam curing is expressly prohibited.

If **EPR/EAM** is specified, the following clarifications shall apply:

- Material shall be Class III thermosetting type (for discharge-free designs).
- Cable may be steam cured or dry cured.

6.5 Extruded Insulation Shield

Extruded insulation shield shall be conspicuously marked "semiconducting."

6.6 Concentric Neutral Conductor and Metallic Shielding

ANSI/ICEA S-97-682 shall apply to cable with a tape metallic shield with the following clarifications:

- If single tape design, tape shall be helically applied and be uncoated copper at least 4.5 mils thick. Tape shall be overlapped at least 25%.
- If two tape design, tapes shall be overlapped, helically applied and intercalated. Individual tape shall be uncoated copper at least 3.0 mils thick. Tape shall be overlapped at least 25%.

ANSI/ICEA S-94-649 shall apply to cable with a flat strap metallic shield or a concentric neutral with the following clarifications - if the detailed material standard requires flat strap construction:

- Flat strap thickness shall be 19 mil +7, -0 mil
- Flat strap width shall be 175 mil +10, -35 mil

Suppliers please take note - in some cases, an SCL material standard will make reference to ANSI/ICEA S-94-649 (written for concentric neutral cable) even though the cable being manufactured is metallic shield type.

Refer to detailed material standard to determine if cable is metallic shield or concentric neutral type.

Suppliers should correctly apply the terms "metallic shield" or "concentric neutral" in all correspondence, bids, invoices, packing slips, and certified test reports to minimize confusion.

If the detailed material standard requires the option of water blocking components for the metallic shield or concentric neutral the following clarifications apply:

- The requirements of ANSI/ICEA S-97-682, Section 6.7 or ANSI/ICEA S-94-649, Section 6.6 shall apply as appropriate.
- The water blocking type shall be water swellable powder.

6.7 Jacket (Non-Metallic Covering)

If a jacket is required, the detailed material standard will identify it as one of the following types:

- Extruded-to-fill (encapsulated), or
- Overlaying (sleeved).

Cable jacket shall be free stripping.

6.8 Sheath (Continuous Metallic Covering)

Sheath, if required, shall not contain lead.

6.9 Assembly and Identification

Cable jacket (or extruded insulation shield, as appropriate) shall be manufactured with sequential length marking according to the requirements of ANSI/ICEA S-97-682, Section 8.2.4 or ANSI/ICEA S-94-649, Section 8.2.4 as appropriate, with the following clarification: Sequential length marking numbers shall be non-repeating and extend the entire core extruder run.

If the detailed material standard requires the option of red stripe (three stripes) identification, the following clarifications apply: The requirements of ANSI/ICEA S-97-682, Section 8.2.1.1 or ANSI/ICEA S-94-649, Section 8.2.1.1 shall apply as appropriate.

For 3/C and 3-1/C type cable, at least two of the three conductors shall be uniquely identifiable throughout their length.

For 3/C cable, fillers shall be applied to the interstices of the cable to attain a substantially circular cross section.

For 3/C cable, filler material shall be jute or polypropylene rove. Alternate filler materials may be considered.

7. Packaging

Reels shall be returnable, fluted type steel.

Reels and their corresponding capacities shall be according to the requirements of NEMA WC 26.

Cable shall be dry when shipped.

Cable ends shall be sealed to prevent the entrance of moisture.

The inner end of the cable shall be securely fastened to the reel drum or inner flange surface. This method of securement shall be designed and constructed to withstand long-term, outside storage.

The inner end of the cable shall not extend beyond the outside plane of the reel flange.

The outer end shall be securely fastened to the inner side of the flange.

Each reel shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- Shipping length of cable on reel
- Outer and inner end sequence length marking numbers
- Gross weight
- Tare weight
- Net weight
- Date of manufacture
- Reel identification according to NEMA WC-26, Section 5
- SCL purchase order number
- SCL stock number.

Reels shall be protected for shipment according to WC 26, Section 4, and Table 7 of this standard.

Table 7. Reel Covering

Plant Location	WC 26 Reel Covering
US	Level 2 (Weather Protector)
Canada	
Mexico	
All other	Level 5 (Export)

8. Testing and Test Methods

Testing and test methods shall be performed according to the requirements ANSI/ICEA S-97-682, Part 9 or ANSI/ICEA S-94-649, Part 9 as appropriate.

Cable shall not be tested with high voltage DC.

9. Terminology

This section defines certain terms unique to SCL for the purpose of reducing confusion between customer and supplier.

Table 9. Definition of Terms

Term	Definition
Two-conductor cable	A single-conductor cable with a full concentric neutral, abbreviated 2/C. Common industry convention abbreviates this cable type as 1/C+1N.
CR	Any compressed (-3%) class B concentric round conductor as defined by ASTM B8, Section 6.3.
CCR	Stands for compact concentric round. Any compact (-9%) concentric round conductor as defined by ASTM B496 for copper or ASTM B400 for aluminum.
CS	Stands for compact sector, a very rare 3/C cable that is outside the scope of this material standard.

10. Documentation

10.1 General

Documentation shall be in English and use customary inch-pound units.

Documentation shall utilize common industry terminology and well-understood abbreviations.

10.2 Bidder's Data

Bidder shall identify all exceptions to SCL requirements with reference to the requirement to which exception is taken; indicate if no exceptions taken.

10.3 Certified (Production) Test Reports

For each shipment a certified production test report (CTR) shall be emailed to: standards.scl@seattle.gov

Certified production test report shall include:

- A unique certified test report number
- SCL purchase order number
- Manufacturer's name
- Manufacturing plant location
- Basic cable description
- Manufacturer's order number
- Shipping reel information or serial numbers and shipment footage
- Conductor metal, stranding type, class, stranding subtype, number of strands, temper, and lay
- Conductor shield manufacturer and compound number
- Insulation compound and manufacturer
- Extruded insulation shield manufacturer and compound number
- Metallic insulation shield dimensional information
- Nominal dimensions and number of flat straps, if specified
- Filler material description and properties, if specified

- Jacket compound and manufacturer
- Bedding material description and properties, if specified
- Armor and band serving details, if specified
- Red stripe compound and manufacturer, if specified
- Results of the testing required under Section 8 of this material standard
- Cable core extruder line identification
- Jacket extruder line identification
- List of shipping reels in the sequential order in which they came off the core extruder
- The sequential order of the shipping reels in which they came off the jacket extruder
- Outside (top) and inside (bottom) jacket sequential footage numbers for each shipping reel.

Certified production test reports shall not contain information for more than one cable order or more than one stock number at a time.

Supplier shall provide certified production test report according to Table 12 of this material standard.

10.4 Certified Qualification Test Reports

Cable shall meet the qualification test requirements of ANSI/ICEA S-97-682, Part 10 or ANSI/ICEA S-94-649, Part 10 as appropriate.

Upon request, supplier shall provide copies of ICEA certified qualification test reports.

10.5 Plant QA Processes

Upon request, supplier shall provide information describing their plant's quality assurance processes.

11. Cable Samples

For each shipment, manufacturer shall provide cable samples for SCL to evaluate for compliance according to Tables 11 and 12 of this material standard.

Cable samples shall be taken from the top of each shipping reel.

Each cable sample shall include at least one complete identification string and at least one sequential length marking number.

For each shipment, cable samples shall be express mailed to:

Seattle City Light
3613 – 4th Avenue South
Seattle, WA 98134
Attention: Quality Assurance

Each cable sample shall be marked at one end with the following information:

- Manufacturer's name
- Shipping reel number
- Reel length
- CTR number
- SCL purchase order number
- SCL stock number

Table 11. Sample Requirements by Cable Type

Cable Type	Sample Requirements
1/C	One 2-ft sample per shipping reel
1/C + 1 N	One 2-ft sample per shipping reel
3/C	One 2-ft sample per shipping reel
3/C + 3 N	One 2-ft sample per shipping reel
3-1/C	One 2-ft sample per phase per shipping reel
3-1/C + 2 N	One 2-ft sample per phase per shipping reel

12. Product Evaluation

SCL Quality Assurance and Standards will evaluate the certified production test report and cable samples for compliance.

Following the internal evaluation, SCL Material Control will inform the supplier if cable shipment is in compliance, or not.

SCL Material Control will release reels for shipment and receive cable according to Table 12.

Table 12. Cable Release Process

	Plant Location	
	US and Canada	All Other
Certified Test Reports (CTR)	Email as soon as available.	Email as soon as available.
Cable Samples	Express mail as soon as available. Cable samples may be shipped with the reels, if the address is the same as in Section 11.	Express mail as soon as available.
Release Reels for Shipment	As soon as available	Following verification of compliance by SCL
Receive Cable	Following verification of compliance by SCL	Following matching of reels with CTR and check for visible shipping damage

13. Plant Inspections

Upon request, supplier shall provide sufficient notice for SCL or an SCL representative to inspect the cable during any stage of manufacture or testing.

14. Shipping

Reels shall be shipped and delivered in the upright position (on the flange edges) on open flatbed trucks suitable for side unloading by forklift. Reels shall not be strapped or palletted.

15. Approved Manufacturers

Approved manufacturers and plant locations are identified in the detailed material standard.

16. Sources

ANSI/ICEA P-45-482-2007; “Short Circuit Performance of Metallic Shields and Sheaths on Insulated Cables”; Insulated Cable Engineers Association, Inc.; 2007

General Cable, MTC Report No. 09-111-Q; Revision 2 Core Qualification Report on 5–46 kV Rated Power Cable, LS-571-E/EI-4000-LF/LS-766-B, May 9, 2011

Oki, Todd; SCL Quality Inspector and subject matter expert for 6015.00
(todd.oki@seattle.gov)

SCL Design Standard 9660.04, “Properties of Medium Voltage Cables”

Shipek, John; SCL Standards Engineer, subject matter expert and originator of 6015.00
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