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S T A N D A R D S

Interface Practices Subcommittee

AMERICAN NATIONAL STANDARD

ANSI/SCTE 177 2018

**Specification for Braided 75 Ω , Mini-Series Quad
Shield Coaxial Cable for CMTS and SDI cables**

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1. Introduction

1.1. Executive Summary

This specification applies to flexible 75-ohm, braided, mini-series, quad shield coaxial cable for use in CMTS and SDI applications.

When reference to other regulations or specifications is made, the user should adhere to the latest revision of the regulation or specification.

1.2. Scope

This specification defines the required performance with regards to electrical and mechanical properties of 75-ohm, braided, mini-series quad shield coaxial cable for CMTS and SDI applications.

These cables are used in the transmission of RF signals and power for voice, data and video applications.

Cables meeting the requirements within this standard are for use with interior applications. Use within exterior applications is outside the scope and requirements of this document.

This document provides specifications or procedures for frequencies up to 1218 MHz. DOCSIS 3.1 specifications include operation at frequencies up to 1218 MHz, and optionally, to 1794 MHz. Specifications or procedures for frequencies above 1218 MHz should be considered in a future revision of this document.

2. Normative References

The following documents contain provisions, which, through reference in this text, constitute provisions of this document. At the time of Subcommittee approval, the editions indicated were valid. All documents are subject to revision; and while parties to any agreement based on this document are encouraged to investigate the possibility of applying the most recent editions of the documents listed below, they are reminded that newer editions of those documents might not be compatible with the referenced version.

2.1. SCTE References

- ANSI/SCTE 03 2008: Test Method for Coaxial Cable Structural Return Loss.
- ANSI/SCTE 31 2016: Test Method for Measuring Diameter Over Core.
- ANSI/SCTE 32 2016: Ampacity of Coaxial Telecommunications Cables.
- ANSI/SCTE 33 2016: Test Method for Diameter of Drop Cable.
- ANSI/SCTE 44 2010: Test Method for DC Loop Resistance
- ANSI/SCTE 47 2007: Test Method for Coaxial Cable Attenuation.
- ANSI/SCTE 48-3 2011: Test Procedure for Measuring Shielding Effectiveness of Braided Coaxial Drop Cable Using the GTEM Cell
- ANSI/SCTE 49 2011: Test Method for Velocity of Propagation.
- ANSI/SCTE 51 2018: Test Method for Determining Drop Cable Braid Coverage.
- SCTE 59 2018: Test Method for Drop Cable Center Conductor Bond to Dielectric
- ANSI/SCTE 66 2016: Test Method for Coaxial Cable Impedance.
- ANSI/SCTE 73 2018: Test Method for Insertion Force of Connector to Drop Cable Interface.
- ANSI/SCTE 88 2012: Test Method for Polyethylene Jacket Longitudinal Shrinkage.
- ANSI/SCTE 108 2018: Test Method for Dielectric Strength Withstand of Coaxial Cable.

2.2. Standards from Other Organizations

- ANSI/UL1581-2017: Reference Standard for Electrical Wires, Cables and Flexible Cords.
- ASTM D1248-05: Standard Specification for Polyethylene Plastics Extrusion Materials For Wire and Cable.
- ASTM D 4565-99(2004): Physical and Environmental Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable.
- ASTM B33-04: Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes

2.3. Published Materials

- IEC 61196-1-314: Coaxial communication cables - Part 1-314: Mechanical test methods - Test for bending
- IEC 62153-4-4: Metallic communication cable test methods - Part 4-4: Electromagnetic compatibility (EMC) - Shielded screening attenuation, test method for measuring of the screening attenuation as up to and above 3 GHz
- NFPA National Electric Code - NEC®-2017 Article 800: Communication Circuits.

3. Informative References

The following documents might provide valuable information to the reader but are not required when complying with this document.

3.1. SCTE References

- ANSI/SCTE 69 2007: Test Method for Moisture Inhibitor Corrosion Resistance.
- ANSI/SCTE 166 2010: Flexure Method for Drop Cable Conditioning

3.2. Standards from Other Organizations

- ASTM B1-01(2007): Standard Specification for Hard-Drawn Copper Wire.
- ASTM B193-02(2008): Resistivity of Electrical Conductive Materials.
- ASTM B3-01(2007): Standard Specification for Soft or Annealed Copper Wire.
- ASTM B566-04a: Standard Specification for Copper-Clad Aluminum Wire

3.3. Published Materials

- Jones Dictionary: Cable Television Terminology 3rd Edition.
- NFPA National Electric Code - NEC®-2017, Article 820: Community Antenna Television and Radio Distribution Systems.
- NFPA National Electric Code - NEC®-2017, Article 830: Network-Powered Broadband Communications Systems.
- IEEE: Standard Dictionary of Electrical and Electronic Terms

4. Compliance Notation

<i>shall</i>	This word or the adjective “ <i>required</i> ” means that the item is an absolute requirement of this document.
<i>shall not</i>	This phrase means that the item is an absolute prohibition of this document.
<i>forbidden</i>	This word means the value specified shall never be used.
<i>should</i>	This word or the adjective “ <i>recommended</i> ” means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighted before choosing a different course.
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<i>may</i>	This word or the adjective “ <i>optional</i> ” means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.
<i>deprecated</i>	Use is permissible for legacy purposes only. Deprecated features may be removed from future versions of this document. Implementations should avoid use of deprecated features.

5. Abbreviations and Definitions

5.1. Abbreviations

CMTS	Cable Modem Termination System
SDI	Serial Digital Interface

5.2. Definitions

Attenuation	The decrease in magnitude of a wave as it travels through any transmitting medium, such as cable or circuitry. It is the difference between transmitted and received power.
Coaxial Cable	A type of cable used for broadband data and cable systems, composed of a center conductor, insulating dielectric, conductive shield and optional protective covering.
Conductivity	The ability of a material to allow electrons to flow, measured by the current per unit of voltage applied. It is the reciprocal of resistivity.
Core Ovality	The difference between the minimum and maximum dimensions over the first laminated shield tape.
DC Resistance	The opposition a conductive material offers to current flow, measured in ohms.
DC Loop Resistance	A resistance measurement of the center conductor and outer conductor when connected in series (measured in ohms/1000 feet or ohms/km).
Dielectric	A nonconductive insulator material between the center conductor and outer conductor of coaxial cable.

Dielectric Withstand	The ability of the drop cable insulation to withstand a minimum specified voltage.
Impedance	The total opposition a circuit, cable or component offers to alternating current flow. It includes both resistance and reactance and is generally expressed in ohms and designated by the symbol <i>Z</i> .
IACS	International Annealed Copper Standard (IACS) set the conductivity of copper at 100% in 1913 and was adopted by the International Electro-Technical Commission (IEC). The conductivity of an electrical conductor is expressed in units of a percentage of IACS.

6. Center Conductor

Center conductor dimension shall be 0.0226±1% inches (0.574 mm ± 1%).

Solid copper or copper clad steel shall be specified.

Minimum break strength (MBS) of the solid copper center conductor shall be determined by multiplying the minimum cross-sectional area by 32,000 psi (221 MPa). MBS for 0.0226" solid copper conductor equals 13 lbf (57 N).

Minimum break strength (MBS) of the copper clad steel center conductor shall be determined by multiplying the minimum cross-sectional area by 95,000 psi (655 MPa). MBS for 0.0226" copper clad steel conductor equals 38 lbf (169 N).

The center conductor electrical conductivity shall be 40 percent IACS minimum.

Maximum DC resistance shall be measured per ANSI/SCTE 44 2010 and shall be 51.0 ohms/1000 ft (167 ohms/km).

7. Dielectric

The dielectric shall contain a stabilization package to meet the requirements of section 10.2 Thermal Oxidative Stability (TOS).

Unless otherwise specified, polyethylene materials for the dielectric shall meet all applicable requirements of ASTM D 1248 and requirements of this document.

Nominal Dielectric Diameter – 0.100 inch (2.54 mm).

8. Shield Construction

8.1. Quadshield

8.1.1. Inner Laminated Shielding Tape (LST)

The first outer conductor shall be a LST bonded to the dielectric and to itself at the tape overlap.

On the finished product, the LST shall overlap the dielectric circumference by a minimum of 18 percent.

The LST shall be applied longitudinally to the dielectric and shall be free of creases or twists over the entire length.

The average core diameter shall be determined by measuring the diameter over the LST in the finished product as described in ANSI/SCTE 31 2016. Average core diameter – 0.107 ± 0.003 inches (2.72 ± 0.08 mm)

Core ovality shall be determined by subtracting the measured minimum diameter from the measured maximum diameter over the LST in the finished product. Core ovality maximum – 0.010 inches (0.254 mm)

8.1.2. Inner Braid Wires

The braiding wire shall be tin copper wire consisting of 36 AWG (0.005 ± 0.0003 inches, 0.13 ± 0.08 mm) maximum.

Minimum tensile strength for individual strands of tinned copper braid wire shall comply with ASTM B33 latest revision.

Braid coverage over the first outer conductor shall be a minimum of 64 percent. The braid coverage shall be determined by SCTE 51 2018.

8.1.3. Outer Laminated Shielding Tape (LST)

A LST shall be applied over the braid wires specified in section 8.1.2.

The LST shall be constructed of two aluminum foils laminated to a central strength member.

The outer LST shall be applied longitudinally over the second outer conductor with an overlap of 18% minimum to 35% maximum and shall be free of creases, twists and discontinuities over the entire length.

8.1.4. Outer Braid Wires

The braiding wire shall be tin copper wire consisting of 36 AWG (0.005 ± 0.0003 inches, 0.13 ± 0.08 mm) maximum.

The individual strands of tinned copper braid wire shall conform to ASTM B33 latest revision.

Braid coverage over the LST shall be sufficient to comply with screen attenuation requirements specified in section 10.3.

9. Jacket

Flame retardant polyvinyl chloride (PVC) compound shall be used in the composition of the jacket.

The jacket material shall be UV stable after 720 hours, as defined in UL 2556, Section 4.2.

The diameter over the jacket shall be 0.184 ± 0.005 inches (4.67 ± 0.18 mm) when measured as described in ANSI/SCTE 33 2016.

10. Finished Product Tests

10.1. Mechanical

The cable shall be flex tested in accordance with IEC 61196-1-314 and pass all electrical requirements outlined in section 10.3.

- Cable shall be subjected to 5 cycles.
- Diameter of pulleys shall be 3.750 inches (95.25 mm) maximum.
- Cycle speed shall be ≤ 3.281 ft/s (1 m/s).
- Test temperature shall be 68 degrees Fahrenheit (20 degrees Celsius).
- Cable length shall be 72 inches (182.9 cm).
- There shall be a minimum 2.2 lb (1 kg) tension applied to each end of the cable while undergoing testing.
- Jacket longitudinal shrinkage shall be no more than 5 percent of the length under test and tested per ANSI/SCTE 88.
- If required, the insertion force to install a connector onto a cable may be measured as described in ANSI/SCTE 73 2018.
- Center conductor to dielectric bond strength shall be a minimum of 3 lbs (1.36 kg) and measured per SCTE 59 2018.

10.2. Thermal Oxidative Stability

To ensure the desired life expectancy of the dielectric insulation, determine its Oxidative Induction Time (OIT) before and after aging at 90°C for 14 days by measuring OIT according to IPS TP119. The test utilizes insulation removed from the completed cable and tested at 180 ± 0.3 °C. Requirements for OIT – Initial: 20 minutes minimum, after aging: 70 percent of initial value.

10.3. Electrical

Velocity of Propagation (Vp) shall be 82 percent minimum when measured per ANSI/SCTE 49 2011.

Impedance shall be 75 ± 3 ohms per ANSI/SCTE 66 2016.

The cable minimum ampacity in both conductors shall be 3 ampere at 140°F (60°C) when determined per ANSI/SCTE 32 2016.

Minimum structural return loss shall be 20 dB in the frequency range 5-2250 MHz and 15 dB in the frequency range 2.25-3 GHz per ANSI/SCTE 03 2008 when measured on 200 ft sections. Performance is irrespective of packaging.

When tested in accordance with ANSI/SCTE 44 2010, at 68°F (20°C), the maximum DC loop resistance shall be 58.2 Ohms per 1000 ft (191 Ohms per km).

The cable shall be tested for screen attenuation (shielding effectiveness) in accordance with IEC 62153-4-4. The cable shall meet a minimum of 95 dB in the frequency range of 5-1002 MHz, shall meet a minimum of 85 dB in the frequency range of 1-2 GHz, and shall meet a minimum of 75 dB in the frequency range of 2-3 GHz. Alternate test method maybe used per ANSI/SCTE 48-3.

The maximum attenuation for all construction types shall be as specified in Table 1 per ANSI/SCTE 47 2007.

Table 1 - Maximum Attenuation at 68°F (20°C)

Frequency (MHz)	dB/100ft	dB/100m
5	1.00	3.28
55	2.82	9.25
211	5.30	17.39
250	5.72	18.77
270	5.94	19.49
300	6.26	20.54
330	6.56	21.52
350	6.75	22.15
400	7.25	23.79
450	7.70	25.26
500	8.11	26.61
550	8.54	28.02
600	8.92	29.27
750	10.01	32.84
870	10.79	35.40
1000	11.62	38.13
1218	12.89	42.29
1500	14.37	47.15
2000	16.73	54.89
2250	17.82	58.46
3000	20.78	68.18

The dielectric between inner conductor and outer conductor of the cable shall withstand without breakdown, for one minute, a voltage of 1000V rms at a frequency of 60 Hz, or the equivalent DC voltage at 1 milliamp/100 ft leakage detection when tested at 68° F (20 C°) per ANSI/SCTE 108 2018.

The finished cable shall be listed as being suitable for use in NEC Article 800 CMR locations and marked accordingly.