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STANDARDS

Interface Practices Subcommittee

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Specification for Braided 75 Ω, Micro-Series Quad Shield Coaxial Cable for Connectivity and Dense CCAP/Edge QAM Applications

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1. Introduction

1.1. Executive Summary

This specification applies to flexible 75-ohm, braided, micro-series, quad shield coaxial cable ***(for example MMCX)*** for connectivity and dense CCAP/Edge QAM 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

1.2.1. This specification defines the required performance with regards to electrical and mechanical properties of 75-ohm, braided micro-series quad shield coaxial cable for connectivity and dense CCAP/Edge QAM applications.

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

1.2.3. 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.

1.3. Benefits

Specification for Braided 75 Ω Micro-Series Quad Shield Coaxial Cable for Connectivity and Dense CCAP/Edge QAM Applications, is provided to ensure accurate and consistent micro-series coax for high density applications in today's broadband applications. As fiber is deployed deeper into the system, and with Remote PHY technologies, the need for even smaller coax assemblies is realized. This specification is a logical step to ensure the interoperability and performance for these cables and assemblies, the customer demands.

1.4. Intended Audience

The intended audience for this specification are manufacturers, evaluation laboratories, and end-users with proper laboratories and equipment to perform this test described therein.

1.5. Areas for Further Investigation or to be Added in Future Versions

At this time, there are no considerations being giving for further investigation.

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 2012: Test Method for Determining Drop Cable Braid Coverage.
- ANSI/SCTE 59 2012: Test Method for Drop Cable Center Conductor Bond to Dielectric
- ANSI/SCTE 66 2016: Test Method for Coaxial Cable Impedance.
- ANSI/SCTE 73 2012: 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 2012: Test Method for Dielectric Strength Withstand of Coaxial Cable.
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2.2. Standards from Other Organizations

- ANSI/UL1581-2017: Reference Standard for Electrical Wires, Cables and Flexible Cords.
- ASTM D1248-12: 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
- 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 a_s up to and above 3 GHz
- NEC®-2017 Article 800: Communication Circuits.

2.3. Published Materials

- No normative references are applicable.

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 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.
- Jones Dictionary: Cable Television Terminology 3rd Edition.
- NEC®-2017 Article 820: Community Antenna Television and Radio Distribution Systems.
- NEC®-2017 Article 800: Communications Circuits.
- IEEE: Standard Dictionary of Electrical and Electronic Terms

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

shall	This word or the adjective "***required***" means that the item is an absolute requirement of this document.
shall not	This phrase means that the item is an absolute prohibition of this document.
forbidden	This word means the value specified shall never be used.
should	This word or the adjective "*recommended*" 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.
should not	This phrase means that there may exist valid reasons in particular circumstances when the listed behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
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deprecated	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. 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.
CMTS	Cable Modem Termination System
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 Z.
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.
SDI	Serial Digital Interface

6. Center Conductor

6.1. Center conductor dimension shall be 0.0118 ± 1% inches (0.30 mm ± 1%).

6.2. Solid-Copper, Silver-Plated Copper, Silver-Plated Copper-Clad Steel or Copper-Clad Steel shall be specified. Copper based center conductors shall be of soft drawn temper.

6.3. Minimum break strength (MBS) of the Solid-Copper center conductor shall be determined by multiplying the minimum cross sectional area by 30,000 psi (207 MPa). MBS for 0.0118" Solid-Copper conductor equals 3.28 lbf (14.6 N).

6.4. Minimum break strength (MBS) of the Silver-Plated, Copper-Clad Steel center conductor shall be determined by multiplying the minimum cross sectional area by 95,000 psi (655 MPa). MBS for 0.0118" Silver-Plated, Copper-Clad Steel conductor equals 10.4 lbf (46.2 N).

6.5. The center conductor electrical conductivity shall be 96 percent IACS minimum, for copper based conductors, and shall be 40 percent IACS minimum, for copper-clad steel conductors.

6.6. Maximum DC resistance shall be measured per ANSI/SCTE 44, and shall not exceed 79.6 ohms/1000 feet (261.2 ohms/km) for solid-copper center conductors. Maximum DC resistance shall not exceed 190 ohms/1000 feet (623.4 ohms/km) for, copper-clad steel conductors. All values are at 68°F (20°C) reference.

7. Dielectric

7.1. The dielectric shall be a cross-linked, gas-injected foamed Polyethylene (PE), or Polypropylene (PP), and shall meet the requirements of a 105ºC operating temperature.

7.2. The dielectric shall contain a stabilization package to meet the requirements of section 10.1.3 Thermal Oxidative Stability (TOS).

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

7.4. A precoat over the inner conductor is optional.

7.5. Nominal Dielectric Diameter – 0.056 inch (1.42 mm).

8. Shield Construction

8.1. Quadshield

8.1.1. Inner Laminated Shielding Tape (LST)

8.1.1.1. The first outer conductor (LST) shall be an aluminum-polyester foil tape (AP) bonded to the dielectric and to itself at the tape overlap. The minimum Aluminum thickness shall be 9 microns

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

8.1.1.3. On the finished product, the LST shall overlap the dielectric circumference by a minimum of 18 percent, and 35% maximum, when applied longitudinally.

8.1.1.4. The average core diameter shall be determined by measuring the diameter over the LST in the finished product as described in ANSI/SCTE 31. Average core diameter – 0.064 ± 0.002 inches (1.62 ± 0.05 mm)

8.1.1.5. 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 – 0.003 inches (0.076 mm)

8.1.2. Inner Braid Wires

8.1.2.1. The braiding wire shall be tin copper wire consisting of 38 AWG (0.004±0.0003 inches, 0.10±0.007 mm.)

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

8.1.2.3. Braid coverage over the first outer conductor shall be a minimum of 89 percent. The braid coverage shall be determined by ANSI/SCTE 51.

8.1.3. Outer Laminated Shielding Tape (LST)

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

8.1.3.2. The LST shall be constructed of one, aluminum foil laminated to a strength member.

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

8.1.4. Outer Braid Wires

8.1.4.1. The braiding wire shall be tin copper wire consisting of 38 AWG (0.004±0.0003 inches, 0.10±0.007 mm).

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

8.1.4.3. Braid coverage over the LST shall be sufficient to comply with screen attenuation requirements specified in section 10.2.5. Typical outer braid coverage is 90 percent.

9. Jacket

9.1. Flame retardant polyvinyl chloride (PVC) compound shall be used in the composition of the jacket. Jacket material shall be rated 105°C, and comply with applicable safety standards and listings.

9.2. The jacket material shall be UV stable after 720 hours, as defined in UL 1581, paragraph 1200, Reference Standard for Electric Wire, Cables and Flexible Cords.

9.3. The diameter over the jacket shall be 0.125 ± 0.003 inches (3.20±0.076 mm) when measured as described in ANSI/SCTE 33.

10. Finished Product Tests

10.1. Mechanical

10.1.1. The cable shall be flex tested in accordance with IEC 61196-1-314 and pass all electrical requirements outlined in section 10.2.

10.1.1.1. Cable shall be subjected to 5 cycles.

10.1.1.2. Diameter of pulleys shall be 3.750 inches (95.25 mm) maximum.

10.1.1.3. Cycle speed shall be ≤3.281 ft/s (1 m/s).

10.1.1.4. Test temperature shall be 68 degrees Fahrenheit (20 degrees Celsius).

10.1.1.5. Cable length shall be 72 inches (182.9 cm).

10.1.1.6. There shall be a minimum 2.2 lb (1 kg) tension applied to each end of the cable while undergoing testing.

10.1.2. Jacket longitudinal shrinkage shall be no more than 5 percent of the length under test and tested per ANSI/SCTE 88.

10.1.3. Thermal Oxidative Stability

To ensure the desired life expectancy of the dielectric insulation, determine its Oxidative Induction Time (OIT) before and after aging at 194°F (90°C) for 14 days by measuring OIT according to ASTM D 4565, Section 17. The test utilizes insulation removed from the completed cable and tested at 356°F ± 0.5°F (180°C ± 0.3°C). Requirements for OIT – Initial: 20 minutes minimum, after aging: 70 percent of initial value.

10.1.4. Center conductor to dielectric bond strength shall be a minimum of 1.5 lbf (0.68 kgf) and measured per ANSI/SCTE 59.

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

10.2. Electrical

10.2.1. Velocity of Propagation (Vp) shall be 80 percent minimum when measured per ANSI/SCTE 49.

10.2.2. Impedance shall be 75 ± 2 ohms per ANSI/SCTE 66.

10.2.3. Minimum structural return loss shall be 23 dB in the frequency range 5 MHz to 1002 MHz and 20 dB in the frequency range 1 GHz to 3 GHz per ANSI/SCTE 03 when measured on 200 ft sections. Performance is irrespective of packaging.

10.2.4. When tested in accordance with ANSI/SCTE 44, at 68°F (20°C), the maximum DC loop resistance shall be 103 ohms per 1000 ft (338 Ohms per km) for cable with solid copper inner conductor. For cables utilizing silver-plated, copper-clad steel inner conductor, the maximum DC loop resistance shall be 201 ohms per 1000 ft (659 Ohms per km).

10.2.5. 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 MHz to 1002 MHz, shall meet a minimum of 85 dB in the frequency range of 1 GHz to 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.

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

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

Frequency (MHz)	dB/100ft	dB/100m
5	1.62	5.31
55	5.43	17.8
211	10.6	34.9
400	14.8	48.5
500	16.6	54.5
750	20.3	66.7
870	21.9	71.9
1000	23.6	77.3
2000	33.3	109.4
3000	40.8	133.9

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