SMPTE 311-2009
Revision of
SMPTE 311M-2003

SMPTE STANDARD

Television — Hybrid Electrical and Fiber-Optic Camera Cable

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Approved
June 4, 2009

Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Recommended Practices and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given in Part XIII of its Administrative Practices.

SMPTE Standard 311 was prepared by Technology Committee 32NF.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Standard. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

1 Scope

This standard describes the minimum performance for a hybrid cable containing single-mode optical fibers and electrical conductors to convey signal and control in a variety of environments where moisture, weather, and ozone resistance are required. This document is not intended to be a cable manufacturing design standard. The cable described in this standard is intended to be used to interconnect cameras and base stations in conjunction with the connectors complying with SMPTE 304M; however, it may be used for other applications where appropriate.

2 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative" or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword “reserved” indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword “forbidden” indicates “reserved” and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

3 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

TIA-492B000-1988, Sectional Specification for Class IV Single-Mode Optical Waveguide Fibers

TIA-455-162A FOTP-162, Fiber Optic Cable Temperature-Humidity Cycling

TIA-455-61 FOTP-61, Measurement of Fiber or Cable Attenuation Using an OTDR

TIA-455-33-B FOTP-33, Optical Fiber Cable Tensile Loading and Bending Test

TIA-455-37-A FOTP-37, Low or High Temperature Bend Test for Fiber Optic Cable

TIA-455-104-A FOTP-104, Fiber Optic Cable Cyclic Flexing Test

TIA-455-25C FOTP-25, Impact Testing of Optical Fiber Cables

TIA-455-41A FOTP-41, Compressive Loading Resistance of Fiber Optic Cables

UL1581, sec 1582, Overall Cabling Flex Cycle Rating

ITU-T G.657, Characteristics of a Bending Loss Insensitive Single Mode Optical Fibre and Cable for the Access Network

4 Temperature and Humidity

The cable shall retain the optical and mechanical properties detailed within this standard, over the following conditions:

FOTP-162

Temperature: – 40°C to + 75°C for outdoor type cables
– 20°C to + 75°C for indoor and permanent installation type cables

Humidity: 0 to 95% at 40 C

5 Optical Fibers

5.1 Single-Mode Optical Fibers

There shall be two optical fibers. The optical fibers shall conform to TIA-492B000 requirements. Table 1 is shown as reference only.

Table 1 – Single-mode optical fibers

Item	Construction
Fiber type	Single-mode (SM) fiber, non-dispersion shifted or G.657-class A Bend Insensitive Single-mode fiber
Mode field diameter	8.9 ± .8 micron @ 1310nm
Cladding diameter	125 ± 1 micron
Concentricity error	≤ 1 micron
Coating material	Acrylate
Buffer material	Thermoplastic
Buffer diameter	0.90 ± 0.05 mm

Coating materials other than acrylate may be used. If other coating materials are used then this shall be clearly marked on the cable jacket at regular intervals. For instance, if silicone-coated fiber is used the cable jacket shall be marked “silicone coated fiber”.

5.2 Optical Characteristics

5.2.1 Single-mode optical fibers shall be as follows:

- Item: Attenuation
- Wavelength: 1250-1625 nm
- Characteristic: ≤ 0.8 dB/km
- Test method: FOTP-61

5.3 Color Coding

1) Blue
2) Yellow

6 Electrical Characteristics

6.1 Auxiliary Conductors

There shall be two or more auxiliary conductors (see Table 2). Section 9, Figures 1, 2, and 3 show cabling configurations for 2, 4, or 8 auxiliary conductors respectively.

Table 2 – Auxiliary conductors

Item	Conditions	Characteristics
DC loop resistance	20ºC	≤ 43 Ω/km
Insulation resistance	20ºC	≥ 10,000 MΩ × km
Dielectric strength	20ºC, 60 Hz, 1 min	1750 V_{RMS}

6.1.1 Color Coding

1) Black
2) White

6.2 Signal Conductors

There shall be two signal conductors (see Table 3).

Table 3 – Signal conductors

Item	Conditions	Characteristics
DC loop resistance	20ºC	≤ 184 Ω/km
Insulation resistance	20ºC	≥ 10,000 MΩ × km
Dielectric strength	20ºC, 60 Hz, 1 min	1750 V_{RMS}

6.2.1 Color Coding

1) Red

2) Gray

6.3 Overall Braid Shield

The overall braid shield shall be as follows:

– Item: DC resistance
– Conditions: 20°C
– Characteristics: ≤ 20 Ω/km
– Braid Coverage: > 70%

6.4 Central Strength Member

The central strength member shall be steel or a material with equivalent tensile and compressive properties.

– Diameter: 1.0mm – 1.8mm

7 Mechanical Characteristics

7.1 Operating Specifications

The mechanical characteristics shall be in accord with Table 4.

Table 4 – Mechanical characteristics

Item	Test method	Characteristics
Tensile strength	FOTP-33	700 N minimum
Bending radius	FOTP-37	7 × diameter @ 20°C
Flex	UL 1581, sec 1582 FOTP-104	15000 cycles, 10 × cable diameter maximum 1000 cycles, 10 × cable diameter maximum
Impact	FOTP-25	20 cycles @ 5.88 N
Crush (compression)	FOTP-41	180 kg over 10 cm

7.2 Diameter

The overall nominal diameter shall be 9.2 mm, 12 mm or 16 mm (16 mm consisting of 9.2-mm inner jacket with up-jacketed 16-mm outer jacket).

8 Cable Marking

8.1 Fiber Designation

The following information shall appear at regular intervals throughout the entire length of the finished cable. Other information may be added if it does not confuse or mislead.

- the wording "single-mode"
- the wording “SMPTE 311”
- the wording “G657A” for cables constructed with bend insensitive fiber
- If the fiber coating is not acrylate, a marking in accordance with Section 5.1

8.2 Cabling Orientation Designation

The following information should appear at regular intervals throughout the entire length of the finished cable

- arrow or similar directional marking together with the words “TO CAMERA”. The arrow should point to the plug end of the cable (see Section 9, Figures 1, 2 and 3).

9 Cable Layout

The cable should have one of the layouts shown in Figures 1, 2 and 3.

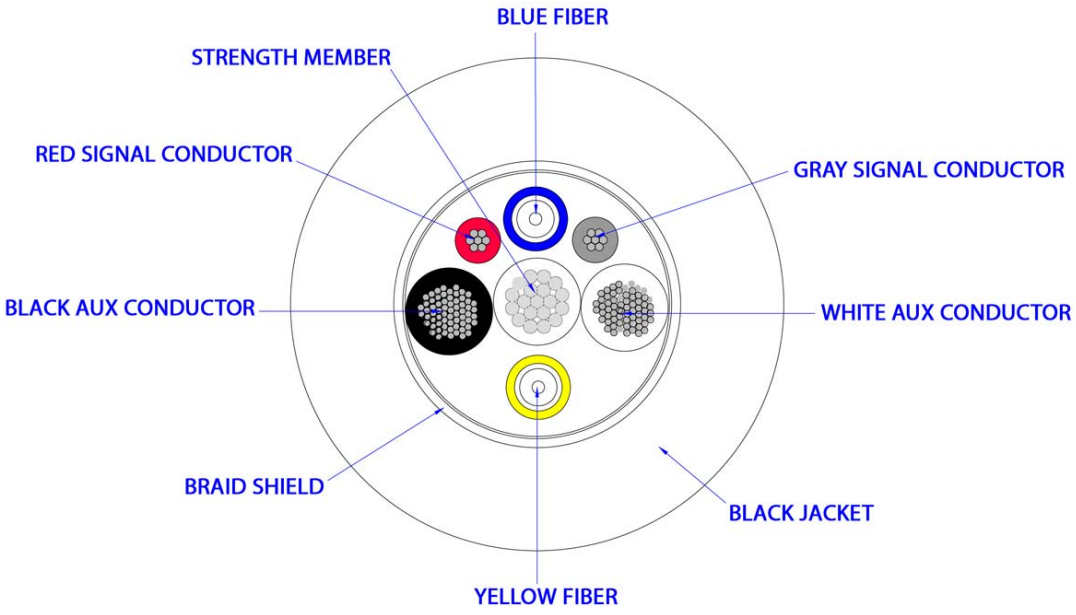

Figure 1 – Configuration for 2 auxiliary conductor cable types (Plug end)

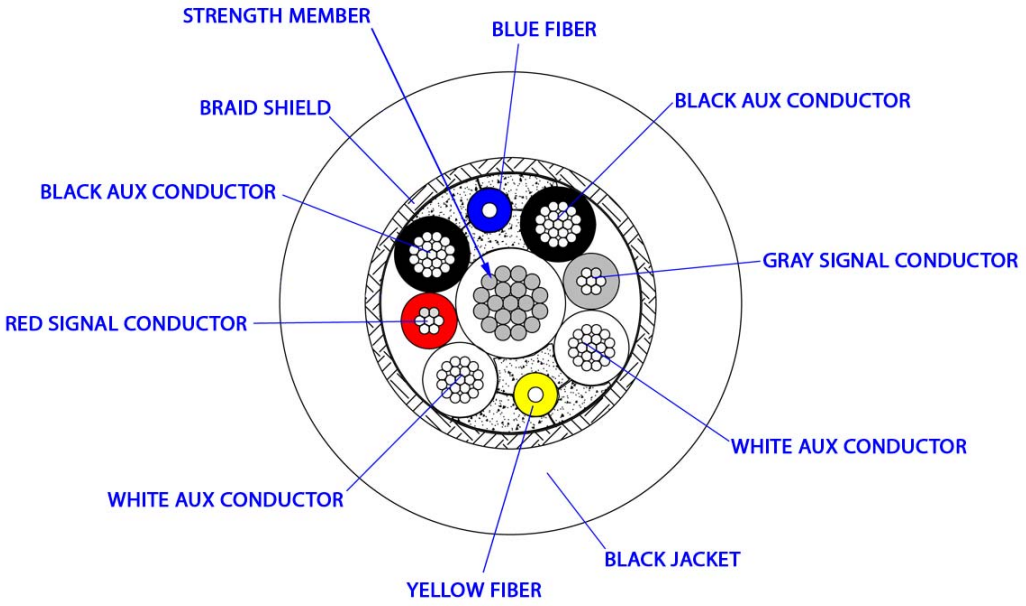

Figure 2 – Configuration for 4 auxiliary conductor cable types (Plug end)

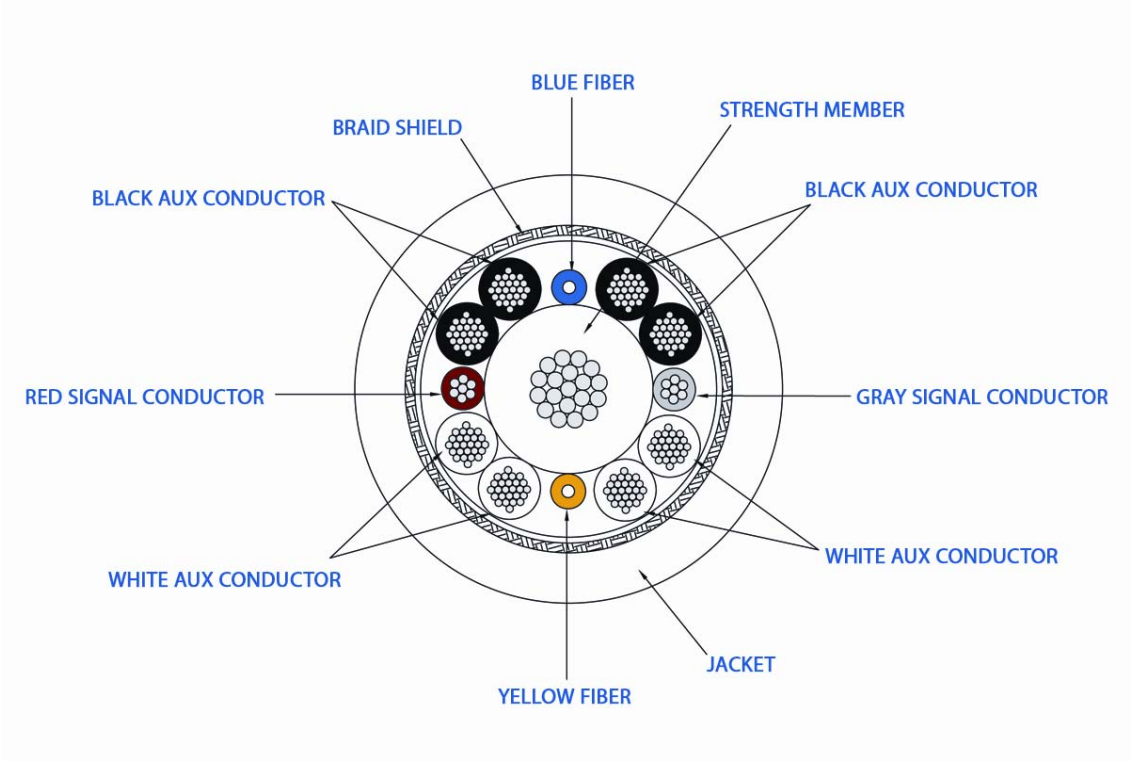

Figure 3 – Configuration for 8 auxiliary conductor cable types (Plug end)

Annex A (Informative)
Bibliography

SMPTE 304-2009, Television — Broadcast Cameras — Hybrid Electrical and Fiber-Optic Connector

NFPA 70-2008, National Electrical Code

UL 62-2001, Flexible Cord and Fixture Wire

UL 444-2002, Communications Cables

UL AWM 20907, Professional Video Interconnecting Cable

Annex B (Informative)
Safety and Cable Marking

This cable may require certification, classification, or listing, under the requirements of the NEC, CEC, UL, CSA or similar authorities, appropriate to the intended application. Such requirements may include, but are not limited to, voltage, current, flammability, and environment.

This cable may require marking with the applicable UL, CSA or other authorities' designations.