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Interface Practices Subcommittee

AMERICAN NATIONAL STANDARD

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# SCTE Recommended Optical Fiber Cable Types for Outside Plant Trunk and Distribution Applications

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# Document Types and Tags

Document Type: Specification

Document Tags:

| | | |
|---|---|---|
| ☒ Test or Measurement | ☐ Checklist | ☐ Facility |
| ☐ Architecture or Framework | ☐ Metric | ☐ Access Network |
| ☐ Procedure, Process or Method | ☐ Cloud | ☐ Customer Premises |

# Document Release History

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| SCTE 86 2003 | *2/24/2003* |
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Note: Standards that are released multiple times in the same year use: a, b, c, etc. to indicate normative balloted updates and/or r1, r2, r3, etc. to indicate editorial changes to a released document after the year.

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# 1. Introduction

## 1.1. Executive Summary

Optical fiber cable is a key component of any service provider's passive optical network for telecommunications applications. Optical fiber cables comprise a significant portion of Hybrid Fiber Coax (HFC) networks in service today and current MSO fiber to the home (FTTH) networks. Ensuring the long-term reliability of these assets is a key performance component to the service providers and network operators.

Optical cables are designed to protect the optical fibers from a variety of harmful effects that could degrade the ultimate service life of the network. The effects of mechanical stresses, such as those experienced during installation, must be considered. Environmental effects that typically manifest themselves post-installation, such as temperature changes and chemical exposure, should also be evaluated. In order to properly evaluate and compare different cable designs a test regime of standard performance requirements should be considered by network operators. Well-designed and properly installed cables will protect the optical fibers and ensure proper operation for 20 years or more.

## 1.2. Scope

The purpose of this document is to provide guidance in selection of a suitable outside plant (OSP) optical cable with respect to different application environments. This document will provide references to The International Electrotechnical Commission (IEC) and International Telecommunication Union (ITU-T) to provide recommended standards and procedures for outside plant optical fiber and cable.

## 1.3. Benefits

This document provides cross-references to industry wide accepted global standards

## 1.4. Intended Audience

This document is intended for engineers, technicians, systems engineers

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

None at this time.

# 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

No normative references are applicable.

## 2.2. Standards from Other Organizations

No normative references are applicable.

## 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

No informative references are applicable.

## 3.2. Standards from Other Organizations

No informative references are applicable.

## 3.3. Published Materials

No informative references are applicable.

# 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. |
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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. Abbreviations and Definitions

## 5.1. Abbreviations

| | |
|---|---|
| IEC | The International Electrotechnical Commission |
| ISBE | International Society of Broadband Experts |
| SCTE | Society of Cable Telecommunications Engineers |
| FTTH | Fiber to the Home |
| HFC | Hybrid Fiber Coax |
| IEC | The International Electrotechnical Commission |
| ISBE | International Society of Broadband Experts |
| ITU | International Telecommunication Union |
| OSP | Outside Plant |
| SCTE | Society of Cable Telecommunications Engineers |

## 5.2. Definitions

| | |
|---|---|
| IEC | The International Electrotechnical Commission is an international standards organization that prepares and publishes international standards for all electrical, electronic and related technologies – collectively known as "electrotechnology" |
| ITU-T | The International Telecommunication Union, is a specialized agency of the United Nations responsible for all matters related to information and communication technologies. |

# 6. Characteristics of optical fibres and cables

Optical fiber should be used as described in the following IEC and ITU-T documents. Guidance and recommendations should be provided on the following attributes:

- Transmission characteristics
- Fiber microbending
- Fiber macrobending

## 6.1. IEC and ITU-T fiber classifications

| IEC | ITU-T |
|---|---|
| IEC 60793-2-50, B-652.B(dispersion unshifted) | ITU-T G.652.B |
| IEC 60793-2-50,B-652.D(dispersion unshifted) | ITU-T G.652.D |
| IEC 60793-2-50, B-654.A/B/C (cut-off shifted) | ITU-T G.654.A/B/C |
| IEC 60793-2-50, B-654.D (cut-off shifted) | ITU-T G.654.D |
| IEC 60793-2-50, B-654.E (cut-off shifted) | ITU-T G.654.E |
| IEC 60793-2-50, B-653.A/B (dispersion shifted) | ITU-T G.653.A/B |
| IEC 60793-2-50, B-655.C/D/E (non-zero dispersion shifted) | ITU-T G.655.C/D/E |
| IEC 60793-2-50, B-656 (wideband non-zero dispersion shifted) | ITU-T G.656 |
| IEC 60793-2-50, B-657.A1/A2 (bending loss insensitive) | ITU-T G.657.A1/A2 |
| IEC 60793-2-50, B-657.B2/B3 (bending loss insensitive) | ITU-T G.657.B2/B3 |

# 7. Cable construction

Since the first optical cable deployments in the 1970's a number of different optical cable designs have been developed. The basic aim of each of these designs is similar – to protect the optical fibers from damage during installation and over their useful service lifetime. Different application and considerations will determine specific preferences of one cable type over another. The cable designs in **Section 10** provide recommendations for the most commonly used cable in the telecommunication industry.

## 7.1. Cable mechanical characteristics

The ITU-T documents referenced in **Section 10** provide Guidance and recommendations on the following cable mechanical attributes:

- Bending
- Tensile strength
- Crush and impact
- Torsion

## 7.2. Cable environmental conditions

The ITU-T documents referenced in **Section 10** provide Guidance and recommendations on the following cable environmental attributes:

- Hydrogen gas
- Moisture permeation
- Water penetration
- Lightning
- Biotic damage
- Vibration
- Temperature variations

### 7.3. Fire Safety

In many countries, optical fiber cable for tunnel/duct installations are required to meet fire performance requirements or local government codes. Requirements for fire performance may differ in each country. Optical cables for tunnels/ducts should meet fire safety regulations in each country or in accordance with each telecommunication carrier or local government regulations. The following IEC documents can provide more information on fire safety testing recommendations

#### 7.3.1. IEC fire safety recommendations

| | |
|---|---|
| IEC 60331-25 | Tests for electric cables under fire conditions - Circuit integrity - Part 25: Procedures and requirements - Optical fibre cables |
| IEC 60332-1-2 | Tests on electric and optical fibre cables under fire conditions - Part 1-2: Test for vertical flame propagation for a single insulated wire or cable - Procedure for 1 kW pre-mixed flame |
| IEC 60332-3-24 | Tests on electric and optical fibre cables under fire conditions - Part 3-24: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category C |
| IEC 60754-1 | Test on gases evolved during combustion of materials from cables - Part 1: Determination of the halogen acid gas content |
| IEC 60754-2 | Test on gases evolved during combustion of materials from cables - Part 2: Determination of acidity (by pH measurement) and conductivity |
| IEC 61034-1 | Measurement of smoke density of cables burning under defined conditions - Part 1: Test apparatus |
| IEC 61034-2 | Measurement of smoke density of cables burning under defined conditions - Part 2: Test procedure and requirements |

## 8. Cable construction

### 8.1. Fiber coatings

The ITU-T documents referenced in **Section 10** provide guidance and recommendations on the following cable construction attributes for fiber coatings

- Primary coating
- Secondary or buffer coating
- Fiber identification
- Removability of coating

### 8.2. Cable elements

The ITU-T documents referenced in **Section 10** provide guidance and recommendations on the following cable construction attributes for cable elements, which make up the cable core

- Fiber ribbon
- Slotted core
- Tube
- Micro-module
- Strength member
- Water blocking material
- Pneumatic resistance

### 8.3. Sheath

The ITU-T documents referenced in **Section 10** provide guidance and recommendations on the following cable construction attributes for cable sheath which may be of a composite construction and may include strength members

### 8.4. Armor

The ITU-T documents referenced in **Section 10** provide guidance and recommendations on the following cable construction attributes for cable armor. When additional tensile strength or protection from external damage (e.g., crush, impact, rodents) is required armoring should be provided

### 8.5. Identification of cable

The ITU-T documents referenced in **Section 10** provide guidance and recommendations on the following cable construction attributes for cable identification. It is recommended to provide a visual identification of optical fiber cables

### 8.6. Cable sealing

The ITU-T documents referenced in **Section 10** provide guidance and recommendations on the following cable construction attributes for cable sealing. It is recommended that an optical fiber cable should be provided with cable end-sealing and protection

### 8.7. Considerations for installation

The ITU-T documents referenced in **Section 10** and **Section 11** provide guidance and recommendations on the following cable construction attributes for cable installation based on application area.

## 9. Test methods

### 9.1. IEC Test methods for cable elements

Tests to characterize the different types of cable elements for handling purposes can be referenced in the following IEC documents. IEC 60794-1-3xx series. The test methods include the following test procedures and can be referenced when needed.

| | |
|---|---|
| IEC 60794-1-301 | Bend test for cable elements |
| IEC 60794-1-302 | Ribbon dimensions and geometry – Visual method |
| IEC 60794-1-303 | Ribbon dimensions – Aperture gauge |

| | |
|---|---|
| IEC 60794-1-305 | Ribbon tear (separability) |
| IEC 60794-1-306 | Ribbon torsion |
| IEC 60794-1-307 | Tube kinking |
| IEC 60794-1-308 | Ribbon residual twist test |
| IEC 60794-1-309 | Bleeding and evaporation |
| IEC 60794-1-310 | Stripping |
| | Stripping force stability of cabled optical fibres |
| | Strippability of optical fibre ribbons |
| | Strippability of buffered optical fibres |
| IEC 60794-1-311 | Tensile strength and elongation at break of buffer tubes |
| IEC 60794-1-312 | Elongation of buffer tubes at low temperature |

## 9.2. IEC Test methods for cable mechanical characteristics

The mechanical characteristics of optical fiber cable can be referenced in the following IEC documents. IEC 60794-1-1xx series. The test methods include the following test procedures and can be referenced when needed.

| | |
|---|---|
| IEC 60794-1-101 | Tensile performance |
| IEC 60794-1-102 | Abrasion |
| | *Method A: Abrasion resistance of optical fibre cable sheaths* |
| | *Method B: Abrasion resistance of optical fibre cable markings* |
| IEC 60794-1-103 | Crush |
| | *Method A: Plate/plate* |
| | *Method B: Mandrel/plate* |
| IEC 60794-1-104 | Impact |
| IEC 60794-1-105 | Stripping force stability of cabled optical fibres |
| IEC 60794-1-106 | Repeated bending |
| IEC 60794-1-107 | Torsion |
| IEC 60794-1-108 | Flexing |
| - | Snatch (deleted) |
| IEC 60794-1-110 | Kink |
| IEC 60794-1-111 | Bend |
| | *Method A: Standard test procedure* |
| | *Method B: Alternative test procedure* |
| - | Cut-through resistance (deleted) |
| IEC 60794-1-113 | Shotgun damage |
| | *Method A: Shotgun test* |
| | *Method B: Shotgun simulation* |
| - | [Title unknown] (deleted) |

| | |
|---|---|
| IEC 60794-1-117 | Bending stiffness |
| | *Method A: Three-point bend* |
| | *Method B: Cantilever bend* |
| | *Method C: Buckling bend* |
| IEC 60794-1-118 | Bending under tension |
| IEC 60794-1-119 | Aeolian vibration |
| IEC 60794-1-120 | Cable coiling performance |
| IEC 60794-1-121 | Sheath pull-off force for optical fibre cable for use in patch cords |
| IEC 60794-1-122 | Buffered fibre movement under compression in optical fibre cables for use in patch cords |
| IEC 60794-1-123 | Microduct route verification test |
| IEC 60794-1-124 | Installation test for microduct cabling |
| IEC 60794-1-125 | Rip cord functional test |
| IEC 60794-1-126 | Galloping |
| IEC 60794-1-127 | Indoor simulated installation test |
| IEC 60794-1-128 | Cable and fibre mechanical reliability test |
| IEC 60794-1-129 | Straight midspan access to optical elements |
| IEC 60794-1-130 | Coefficient of friction between cables |
| IEC 60794-1-131 | Microduct inner clearance test |
| IEC 60794-1-132 | Creep Test (for ADSS) |
| IEC 60794-1-133 | Multiple cable coiling and uncoiling performance |
| IEC 60794-1-134 | Coefficient of dynamic friction between cables |
| IEC 60794-1-135 | Sheave test (primarily for OPGW and OPAC) |

## 9.3. IEC Test methods for cable environmental characteristics

The environmental characteristics of optical fiber cable can be referenced in the following IEC documents. IEC 60794-1-1xx series. The test methods include the following test procedures and can be referenced when needed

| | |
|---|---|
| IEC 60794-1-201 | Temperature cycling |
| IEC 60794-1-205 | Water penetration |
| | *Method A: (circumferential) Water penetration* |
| | *Method B: Water penetration (end-on)* |
| | *Method C: Water penetration (end-on, for cables with swellable water blocking material)* |
| - | Deleted |
| IEC 60794-1-207 | Nuclear radiation |
| IEC 60794-1-208 | Pneumatic resistance |
| IEC 60794-1-209 | Ageing |

| | |
|---|---|
| IEC 60794-1-210 | Underwater cable resistance to hydrostatic pressure |
| IEC 60794-1-211 | Sheath shrinkage (cables intended for patch cords) |
| IEC 60794-1-212 | Temperature cycling of cables used for patch cords) |
| IEC 60794-1-213 | Microduct pressure-withstand |
| IEC 60794-1-214 | Cable UV resistance test |
| IEC 60794-1-215 | Cable external freezing test |
| IEC 60794-1-216 | Compound flow (Drip) |
| IEC 60794-1-217 | Cable shrinkage test (Fibre protrusion) |
| IEC 60794-1-218 | Mid-span temperature cycling test for exposed buffer tubes |
| IEC 60794-1-219 | Material compatibility |

### 9.4. IEC Test methods for cable electrical characteristics

When electrical conductors or other metallic elements are incorporated in an optical fiber cable, verification of various electrical characteristics may be necessary. The electrical characteristics of optical fiber cable containing metallic elements can be referenced in the following IEC documents. IEC 60794-1-4xx series. The test methods include the following test procedures and can be referenced when needed

| | |
|---|---|
| IEC 60794-1-401 | Short-circuit test (for OPGW and OPAC) |
| IEC 60794-1-402 | Lightning test method for optical aerial cables along electric power lines (OPGW and OPAC |
| IEC 60794-1-403 | Electrical continuity test of cable metallic elements |

## 10. Cable types and applications

The following recommendations from the ITU-T describes characteristics, construction and test methods of optical fiber cables based on different application areas. The methods of examining whether the cables have these required characteristics are found in the following list of ITU-T recommendations. Each recommendation will cover:

- Characteristics of the optical fiber and cables required for the application area
- Cable construction based on application area
- Test methods recommended for each cable type based on IEC test procedures

### 10.1. ITU-T Optical cable reference recomendations

| | |
|---|---|
| ITU-T L.100 | Optical fiber cables for duct and tunnel application |
| ITU-T L.101 | Optical fiber cables for buried application |
| ITU-T L.102 | Optical fiber cables for aerial application |
| ITU-T L.103 | Optical fiber cables for indoor applications |
| ITU-T L.104 | Small count optical fiber cables for indoor applications |

| | |
|---|---|
| ITU-T L.105 | Optical fiber cables for drop applications |
| ITU-T L.106 | Optical fiber cables: Special needs for access network |
| ITU-T L.107 | Optical fiber cable construction for sewer duct applications |
| ITU-T L.108 | Optical fiber cable elements for microduct blowing-installation application |
| ITU-T L.109 | Construction of optical/metallic hybrid cables |
| ITU-T L.110 | Optical fiber cables for direct surface application |
| ITU-T L.111 | Optical fiber cables for in-home applications |

# 11. Guidance and installation techniques

The ITU-T following Recommendations gives information about the methodologies recommended to install fiber optic cables in various types of installation procedures. nine countries on this matter.

## 11.1. ITU-T Optical cable installation reference recomendations

| | |
|---|---|
| ITU-T L.150 | Installation of optical fibre cables in the access network – Aerial, Duct, Direct Buried |
| ITU-T L.151 | Installation of Optical Fibre Ground Wire (OPGW) cable |
| ITU-T L.152 | Use of trenchless techniques for the construction of underground infrastructures for telecommunication cable installation |
| ITU-T L.153 | Mini-trench installation technique |
| ITU-T L.154 | Micro-trench installation technique |
| ITU-T L.155 | Low impact trenching technique for FTTx networks |
| ITU-T L.156 | Air-assisted installation of optical fibre cables |
| ITU-T L.157 | Optical fibre cable installation by floating technique |
| ITU-T L.158 | Installation of optical fibre cables along railways |
| ITU-T L.159 | Installation of optical fibre cables inside sewer ducts |
| ITU-T L.160 | Optical cabling shared with multiple operators in buildings |
| ITU-T L.161 | Protection of telecommunication cables and plant from biological attack |
| ITU-T L.162 | Microduct technology and its applications |
| ITU-T L.163 | Criteria for optical cable installation with minimal existing infrastructure |