



**STANDARD FOR
INDOOR OPTICAL FIBER CABLE**

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INSULATED CABLE ENGINEERS ASSOCIATION, Inc.

**ICEA STANDARD
FOR
INDOOR OPTICAL FIBER CABLE**

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FOREWORD

ICEA Standards are adopted in the public interest and are designed to eliminate misunderstanding between the manufacturer and user and to assist the user in selecting and obtaining proper products for his particular need. Existence of an ICEA Standard does not in any respect preclude the manufacture or use of products not conforming to the Standard.

The user of this Standard is cautioned to observe any applicable health or safety regulations and rules relative to the manufacture and use of cable made in conformity with this Standard. This Standard hereafter assumes that only properly trained personnel using suitable equipment will perform manufacture, testing, installation and maintenance of cables defined by this Standard.

Requests for interpretation of this ICEA Standard must be submitted in writing (hard copy, email, or fax) to the Secretary of the Insulated Cable Engineers Association. The mailing address of ICEA Headquarters and a *Contact* link are shown on the ICEA web site:

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An official written interpretation will be provided.

This revision to the Standard was approved by ICEA on June 3, 2015. The members of the ICEA Communications Cable Section, Working Group 596, who participated in this project, were:

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This issue replaces the previous issue, ANSI/ICEA S-83-596-2010, *ICEA Standard for Indoor Optical Fiber Cable*. Major changes in this revision include the following:

- Addition of new fiber types and reformatting of the fiber out-references
- Discussion of attributes and addition of tests for Bend Insensitive multimode and single-mode fibers.
- Inclusion of internationally-agreed criteria for long-term fiber strain.

NOTE – The format of the Tables of this issue of the document has been modified from the previous issue and generally follows that of IEC Directives Part 2.

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ICEA STANDARD FOR INDOOR OPTICAL FIBER CABLE

PART 1

INTRODUCTION

1.1 SCOPE

This Standard covers fiber optic communications cables intended for use in the buildings of communications users. Materials, constructions and performance requirements are included in the Standard, together with applicable test procedures. Refer to ICEA S-104-696 for optical fiber communications cables intended for indoor-outdoor use. ICEA 696 contains specific requirements for weatherized indoor cables in Annex B.

Refer to other ICEA optical cable product Standards which may have relevance to cables of this Standard:

- ICEA S-87-640 for optical fiber cables intended for general outside plant use
- ICEA S-104-696 for optical fiber cables intended for indoor/outdoor use.
- ICEA S-110-717 for optical fiber cables intended for aerial, duct, and buried outdoor and indoor/outdoor drop applications
- ICEA S-115-730 for optical fiber cables intended for Multiple Dwelling Unit (MDU) applications
Note that the MDU cable application space may overlap that of drop cables, including applications providing drops to single-family homes or businesses.
- ICEA S-120-742 for hybrid optical fiber cables intended for use in limited power circuits.

Products covered by this standard are intended only for operation under conditions normally found in communication systems. Typically, these products are installed both in exposed areas (surface mounted to walls or building baseboards or in non-stationary configurations) and in concealed areas (within walls, attics, etc.), with or without external protection (such as conduit), depending upon product type and specific use. These products normally convey communications signals (voice, video, data, etc.) from place to place within a building. Products covered by this Standard may be factory terminated with connectors or splicing modules.

When a hybrid cable (a cable with both optical fibers and metallic conductors) is required, the applicable metallic conductor requirements shall be defined by other standards. See Annex C for a list of applicable ICEA Standards. For power-limited hybrid cables, ICEA 742 defines the optical fiber and metallic conductor cable requirements. For other hybrid cables, the requirements shall be as established by agreement between the end user and the cable manufacturer.

In some cases, an indoor cable may be weatherized for indoor-outdoor use. These cables are covered in more detail in Annex B of ICEA 696 (Weatherized Indoor Cable Requirements), above.

MDU cabling is an emerging system topology for FTTX applications. Cables covered in this standard may be applicable for significant parts of the MDU topology. Please note ICEA 730, above.

The normal temperature ranges for cables covered by this Standard are listed in Table 1-1:

Table 1-1

Temperature Ranges

	All Interconnect (Riser, Plenum, and General Purpose)		Horizontal and Backbone			
			Riser and General Purpose Fire Rated		Plenum Fire Rated	
	°C	(°F)	°C	(°F)	°C	(°F)
Operation	0 to +70	(32 to 158)	-20 to +70	(-4 to 158)	0 to +70	(32 to 158)
Storage and Shipping	-40 to +70	(-40 to 158)	-40 to +70	(-40 to 158)	-40 to +70	(-40 to 158)
Installation	0 to +60	(32 to 140)	-10 to +60	(14 to 140)	0 to +60	(32 to 140)

The standard installation tensile rating for cables is specified in section 7.22.

<u>Standard Minimum Bend Diameter</u>	<u>Interconnect</u>	<u>All Other Cables</u>
Unloaded Condition (Installed):	50 mm	20 x Cable OD
Loaded Condition (During Installation):	100 mm	40 x Cable OD

For cables utilizing bend insensitive fibers, as defined in Part 2, the minimum bend diameters may be reduced by agreement between manufacturer and user.

ICEA 730, the MDU cable Standard, addresses performance in FTTx applications where uncontrolled cable bends are allowed. Only single-mode fibers are included in that Standard; use of multimode fibers in such cables is referenced to ICEA 596. For rugged drop cables per ICEA 730 using multimode fiber, either a 10 mm or 15 mm minimum bend diameter specification should be used. It is understood that the cable may act as a self-bend-limiter to provide mechanical protection for the fiber.

For very small cables, manufacturers may specify a fixed cable minimum bend diameter (e.g., 300 mm) that is independent of the cable outer diameter (OD).

For cables not having a circular cross-section, bend diameter requirements are to be determined using the thickness (minor axis) as the cable diameter and bending in the direction of the preferential bend.

Products covered by this Standard shall comply with the pertinent Fire Resistance Code(s) described in Section 1.9.

1.2 GENERAL

This publication is arranged so that cables may be selected from numerous constructions covering a broad range of installation and service conditions.

Parts 2 and 3 designate the materials, material characteristics, dimensions and tests applicable to the particular component.

Part 4 covers assembly, cabling, and identification of the individual optical fiber.

Part 5 includes cable coverings.

Part 6 provides other pertinent requirements not otherwise addressed by Parts 1 through 5 or by Parts 7 and 8 of this Standard.

Part 7 describes the test methods and performance requirements applicable to the component materials and completed cables manufactured under this Standard. If there is a conflict between Parts 1 through 6 and Part 7, the provisions of Part 7 apply.

Part 8 contains routinely specified optical performance, test methods and requirements for finished cables.

Part 9 contains cross-references to other standards and publications.

Annex A Informative Ordering Information

Annex B Normative 1625 nm Cabled Fiber Performance Requirements

Annex C Informative ICEA Copper Telecommunications Cable Standards for Reference in Hybrid Cables

Annex D Informative ICEA Telecommunications Cable Standards

1.3 UNITS

In this Standard, metric (SI) units are used. Where approximate equivalents in alternate systems are included, they are provided for information only, and in most cases are rounded off for measurement convenience. Unless otherwise specified, the Rounding Method of ASTM E 29 shall be used. Rounding of U.S. customary units may be adjusted for measurement convenience. ICEA P-57-653 is a useful guide for metric units used in this publication.

1.4 DEFINITIONS

1.4.1 Cable Classification

Products covered in this Standard shall be classified according to their level of mechanical and thermal robustness, as declared by the manufacturer. The classification of a particular cable design, along with its fire rating (see 1.4.2),

determines the appropriate testing and acceptance requirements. Cable classifications are defined below.

1.4.1.1 Backbone Cables

Cables which consist of a plurality of optical fibers in designs having a higher degree of robustness as compared to interconnect cables. Backbone cables are suitable for connections between telecommunications rooms, equipment rooms and entrance facilities. Backbone cables, typically, are sufficiently robust for placement in riser shafts, cable racks, or cable trays. Backbone cables are further classified according to their fire rating (see section 1.4.2).

Backbone cable may be used in vertical applications where the weight of the cable substantially contributes to the cable environment. This cable may have a higher tensile rating than horizontal backbone cables.

- 1.4.1.2** Horizontal cable: A cable to be used primarily in horizontal applications. This cable may have a tensile rating which is dependent on its size or fiber count and may be lower than that of backbone cable. Cables installed in horizontal runs or horizontal air-handling spaces are common examples.

1.4.1.3 Interconnect Cables

Interconnect cables are intended for relatively light duty use compared to backbone cables. Interconnect cables are typically not intended for placement in riser shafts, cable racks, or cable trays. Interconnect cables are suitable for use as intra-equipment jumpers or patch cords. Typical applications include patching active electronics to nearby patch panels, cable cross-connection on distribution frames, and connecting work area outlets to terminal equipment. Interconnect cables typically consist of one, two, or four loose tube or buffered fibers, or may contain higher fiber counts in ribbon or loose tube form. The fibers are reinforced and jacketed for use in short lengths. Interconnect cables are further classified according to their fire rating (see 1.4.2)

Simplex cable: An interconnect cable containing one fiber (typically buffered).

Duplex cable: An interconnect cable containing two fibers (typically buffered).

Small Form Factor: Small Form Factor interconnect cable is cable with an outside diameter ≤ 2.0 mm.

1.4.1.4 Distribution cables:

A cable design in which multiple fibers (typically buffered) are contained under one protective jacket.

1.4.1.5 Breakout cables:

A cable design in which each fiber (typically buffered) is individually reinforced and jacketed, all surrounded by one common overall jacket.

1.4.1.6 Composite Cables¹

Cables containing more than one type of optical fiber.

1.4.1.7 Dielectric Cables

Cables that contain no metallic members or other electrically conductive materials.

1.4.1.8 Hybrid Cables¹

Cables having both optical fibers and metallic conductors that are intended for communications use or powering.

1.4.1.9 Metallic Cables

Cables which contain conductive members, not normally intended to be current-carrying, such as metallic strength members, sheaths, shields, or armors.

1.4.2 Fire Rating of Cables²**1.4.2.1 Plenum Cables**

Optical fiber cables shall be listed as being suitable for use in ducts, plenums and other space used for environmental air and shall also be listed as having adequate fire-resistance and low smoke producing characteristics.

1.4.2.2 Riser Cables

Optical fiber cables shall be listed as being suitable for use in a vertical run in a shaft or from floor to floor and shall also be listed as having fire-resistant characteristics capable of preventing the carrying of fire from floor to floor.

¹ ICEA Standards prior to 2012 use definitions for *composite* and *hybrid* which are the exact opposite of those shown here. The change in definitions was made in the interest of harmonization with International documents and other National Standards. It must be noted that the definition of *composite* in the National Electrical Code, 2011 and earlier, are consistent with the older ICEA definition. Due to this change, users may see the terms used interchangeably. Regarding the definition for *hybrid*, as altered above: IEC uses a definition which encompasses metallic conductors used for all purposes – not just communication.

² The Fire Rating of Cables has been extracted from the National Electrical Code, (see section 1.9).

1.4.2.3 General Purpose

Optical fiber cables shall be listed as being suitable for general-purpose use, with the exception of risers, plenums, and other space used for environmental air, and shall be listed as being resistant to the spread of fire.

1.4.3 Jackets and Sheaths

In this Standard, the term "jacket" refers to a continuous non-metallic covering while the term "sheath" refers either to a continuous metallic covering or to a combination of jacket(s), together with metallic covering(s), strength member(s), or other components.

1.4.4 Ribbons:**1.4.4.1 Traditional Ribbon**

Ribbons designed to meet the full mechanical and environmental requirements as an intact unit but which may be dissected into individual units.

1.4.4.2 Unitized Ribbon

Ribbons designed to be divided into pre-designed individual units, i.e. 4, 6 or 12 fiber units. Sub units of the unitized units must meet the mechanical and environmental requirements of a traditional ribbon as stated in part 7 of this document.

1.4.6 Optical Fiber and Electric/Electronic Terms

Refer to TIA/EIA-440 and to IEEE-812 for definitions of other optical fiber terms. Refer to ANSI/IEEE Standard 100 for definitions of other electrical and electronic terms.

1.4.7 Detail Specification

The term "Detail Specification" refers to any requirement that is specific for the user's purchase. In case of conflict between a requirement called out in a Detail Specification and this Standard, the requirements of this Standard may be modified by agreement between the manufacturer and user. This definition does not apply to the Detail Specification referred to in Tables 2-1 and 2-2.

1.5 REFERENCES

All documents referenced herein are listed in Part 9.

1.6 INFORMATION TO BE SUPPLIED BY THE USER

When requesting proposals from cable manufacturers, the prospective user should describe the cable by reference to pertinent sections of this Standard. To help avoid misunderstandings and possible misapplication of cable, the user should also provide pertinent information concerning the intended application. Recommended ordering information is summarized in Annex A.

1.7 MODIFICATION OF THIS STANDARD

Any part of this Standard may be modified by agreement between the manufacturer and user, but such modifications shall be clearly denoted as exceptions to the Standard. In this Standard, requirements which are recognized to have various options, but for which preferred values are given, have been introduced by phrases such as, "Unless otherwise specified ", or "Unless otherwise modified by manufacturer and user." Requirements which must be determined in each case are introduced by phrases such as, "established by agreement between manufacturer and user" or "as mutually agreed upon."

1.8 QUALITY ASSURANCE

It is the responsibility of the manufacturer to establish a quality assurance system consistent with TL-9000® or an alternate system acceptable to the user. This will assure conformance with the requirements of this Standard. When the user wishes to require a specific quality assurance program or special testing procedures, agreement between the user and the manufacturer should be reached before the order is placed.

1.9 FIRE RESISTANCE CODE REQUIREMENTS

Cable type designations and safety performance requirements are determined by the following Codes:

- For the United States the Fire Resistance Codes are:
 1. NFPA 70 National Electrical Code (NEC)
 2. Local Codes
- For Canada the Fire Resistance Codes are:
 1. C22.2 No. 232, Canadian Standards Association (CSA)
 2. Local Codes
- For Mexico the Fire Resistance Codes are:
 1. Telecommunications - Cables - Optical Fiber Cables for Premises Applications (NMX-J-237-2008-NYCE)
 2. Local Codes

1.10 SAFETY CONSIDERATIONS

Materials in the cable shall present no dermal or environmental hazards as defined by current industry standards or applicable federal, state or local laws and regulations.

The manufacturer and user of cables made in accordance with this Standard are cautioned to observe any applicable health or safety rules and regulations relative to their manufacture and use. This Standard hereafter assumes that manufacture, testing, installation and maintenance of cables defined herein will be performed only by properly trained personnel using suitable equipment and employing appropriate safety precautions. Cable materials shall comply with the requirements of the

European Union Restriction on Hazardous Substances (RoHS) directive, EU Directive 2002/95/EC for electrical and electronic components.

Cable materials shall not contain more than the maximum concentrations as prescribed by the latest RoHS Directive (see Note, below) of the substances listed below:

- Cadmium
- Hexavalent Chromium
- Lead
- Mercury
- Polybrominated Biphenyls
- Polybrominated Diphenyl Ethers.

NOTE - Use of certain potentially hazardous substances above allowed limits in electrical and electronic materials was banned in the European Union by the Restriction on Hazardous Substances (RoHS) Directive (EU Directive 2002/95/EC) as amended by the Commission Decision of 18 August 2005 (2005/618/EC). Although use of these substances has not been banned throughout the United States at the time this document has been issued, many other nations and jurisdictions, including the People's Republic of China and the state of California, have adopted similar legislation banning use of these substances above allowed limits in electrical and electronic materials.

The European Union has issued an updated RoHS Directive 2011/65/EU, commonly referred to as "RoHS 2", which went into effect on 2 January 2013. This recast directive superseded the original RoHS directive, which was officially repealed 3 January 2013. RoHS 2 is applicable to all equipment that has at least one intended function dependent on electrical or electromagnetic fields.

The EU Frequently Asked Questions document on RoHS2 explicitly notes that optical cables are exempt from RoHS 2 (refer to section Q7.2 of http://ec.europa.eu/environment/waste/rohs_eee/pdf/fag.pdf). Although the restrictions of RoHS 2 are not applicable to optical cable, it is best practice to avoid use of these potentially hazardous materials.

In addition compliance may be required with Article 33 of the European REACH Directive 2006/1907/EC (Registration, Evaluation, Authorization and Restriction of Chemicals), which obligates manufacturers to notify customers in the EU of the presence of cable materials or components that are classified as substances of very high concern (SVHC). A list of current and candidate SVHC can be viewed on the European Chemical Agency (ECHA) website to help determine compliance with the REACH Directive (refer to http://echa.europa.eu/chem_data_en.asp).