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IEEE Guide for Installation Methods for Fiber-Optic Cables in Electric Power Generating Stations and in Industrial Facilities

IEEE Power Engineering Society

Sponsored by the
Insulated Conductors Committee



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Abstract: This guide is intended for cables designed for use in power generating stations and industrial facilities, in both the outside plant environment and indoor applications—the latter with adequate consideration for requirements of the National Electrical Code® (NEC®.)

Keywords: cable construction, electric power generating stations, fiber-optic cables, index of refraction, local area network connections, multimode fibers, numerical aperture, optical cable designs, optical performance, reflectometer, singlemode fibers, telecommunication

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Introduction

This introduction is not part of IEEE Std 1428-2004, IEEE Guide for Installation Methods for Fiber-Optic Cables in Electric Power Generating Stations and in Industrial Facilities.

This guide was prepared by the Task Group D6 of Subcommittee D, Station, Control, and Utilization Cables, of the Insulated Conductors Committee within the Power Engineering Society.

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1. Overview

1.1 Scope

This guide is intended for cables designed for use in power generating stations and industrial facilities, in both the outside plant environment and indoor applications—the latter with adequate consideration for requirements of the National Electrical Code[®] (NEC[®]) (NFPA 70¹).

It is not the intention of this guide to establish requirements for cables designed for installation in a high-voltage environment, such as optical ground wire and all-dielectric, self supporting. These applications are covered by other IEEE documents (IEEE Std 1138TM and IEEE Std 1222TM).

1.2 Purpose

This document is intended to provide guidance for the selection, application, and installation of fiber-optic cable in power generating plants and industrial facilities. The selection and application of fiber-optic cable in these facilities differ in many respects from conventional telecommunications and local area network (LAN) installations. Those issues, which require special consideration, are identified and discussed.

2. Normative references

The following referenced documents are indispensable for the application of this guide. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

IEEE Std 1222TM, IEEE Standard for All-Dielectric Self-Supporting Fiber Optic Cable.²

NFPA 70, National Electrical Code[®] (NEC[®]).³

¹ For information on references, see Clause 2.

² IEEE publications are available from the Institute of Electrical and Electronics Engineers, Inc., 445 Hoes Lane, Piscataway, NJ 08854, USA (<http://standards.ieee.org/>).

NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.⁴

UL 1581, Reference Standard for Electrical Wires, Cables, and Flexible Cords.⁵

3. Definitions

For the purposes of this guide, the following terms and definitions apply. *The Authoritative Dictionary of IEEE Standards Terms* [B9]⁶ should be referenced for terms not defined in this clause.

3.1 all-dielectric: An optical fiber cable construction having no metallic or conductive components.

3.2 blown fiber: A term describing a system that uses the force of moving compressed gas to carry bare or specially coated fibers or fiber bundles into small, flexible tubes. Long installed lengths are possible without the need for splices or lubricants and without the need to apply pulling tension to the fiber. Such systems provide a high degree of flexibility. Installed fibers can be blown out and new fibers blown in. Tube raceways can be reconfigured to facilitate modifications.

3.3 chromatic dispersion: The process by which a pulse traveling in a fiber is distorted (broadened) as it travels along the fiber core.

3.4 critical angle: The maximum angle of travel in the core of an optical fiber, which will result in continued propagation of light through the core. Light that strikes the core at an angle greater than the critical angle will pass into the fiber's cladding structure and be dissipated.

3.5 equilibrium modes distribution (EMD): The modal distribution of light transmission in a fiber that exists after high order modes and cladding modes have been attenuated. EMD is naturally achieved in long cables but can be artificially achieved to improve the accuracy of loss measurements through use of a tight coil of fiber or a mode stripper at the output of the light source.

3.6 innerduct: A smooth or corrugated, tubular raceway system used to protect fiber-optic cables in ducts, conduits, cable trays, air plenums, and panels.

3.7 loose tube cable: A style of optical cable construction for which the fiber is loosely encased in a buffer tube to isolate the fiber from external environmental and installation forces.

3.8 microbending: Sharp curvatures of the fiber resulting in axial displacements on the order of a few micrometers. Such bends can cause significant loss of signal into the cladding and are typically the result of improperly applied coatings, cabling, jacketing, and installation.

3.9 modal dispersion: The process by which a pulse traveling along the core of a multimode fiber is distorted (broadened) as a result of the differing path (mode) lengths.

3.10 mode: A distinct path of light in The number of paths that can exist within a fiber are a function of the size of the core and the wavelength of the light source of interest. Singlemode cables support only one path while multimode fibers may support thousands of paths. The differing path lengths of each mode result in signal distortion known as modal dispersion.

³ The NEC is published by the National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269-9101, USA (<http://www.nfpa.org>). Copies are also available from the Institute of Electrical and Electronics Engineers, Inc., 445 Hoes Lane, Piscataway, NJ 08854, USA (<http://standards.ieee.org/>).

⁴ NFPA publications are available from Publication Sales, National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269-9101, USA (<http://www.nfpa.org/>).

⁵ UL standards are available from Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112, USA (<http://global.ihs.com/>).

⁶ The numbers in brackets correspond to those of the bibliography in Annex A.