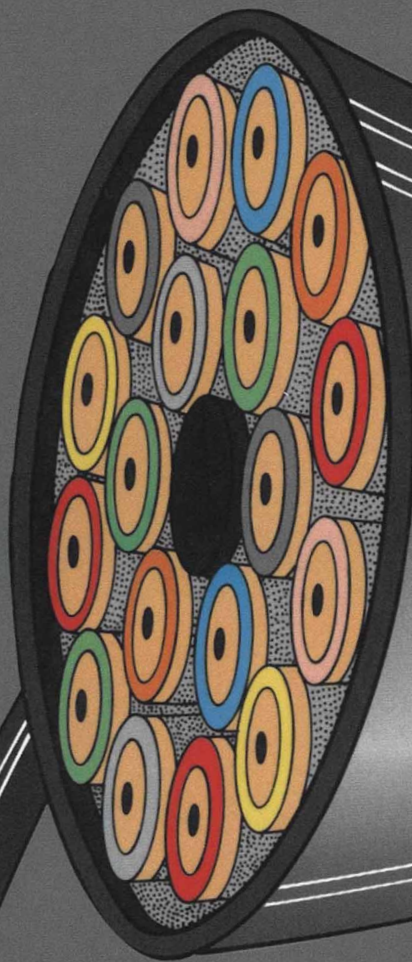


FIBER OPTICS STANDARD DICTIONARY

S E C O N D E D I T I O N



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Ex. 2008
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Fiber Optics Standard Dictionary

Second Edition

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SPRINGER-SCIENCE+BUSINESS MEDIA, LLC

Copyright ©1989 by Springer Science+Business Media New York
Originally published by Van Nostrand Reinhold in 1989
Library of Congress Catalog Card Number 89-30814
ISBN 978-0-442-23387-7 ISBN 978-1-4757-1177-6 (eBook)
DOI 10.1007/978-1-4757-1177-6

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Van Nostrand Reinhold
115 Fifth Avenue
New York, New York 10003

Van Nostrand Reinhold International Company Limited
11 New Fetter Lane
London EC4P 4EE, England

Van Nostrand Reinhold
480 La Trobe Street
Melbourne, Victoria 3000, Australia

Nelson Canada
1120 Birchmount Road
Scarborough, Ontario M1K 5G4, Canada

16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

Library of Congress Cataloging-in-Publication Data

Weik, Martin H.

Fiber optics standard dictionary / Martin H. Weik.—2nd ed.

p. cm.

Rev. ed. of: Fiber optics and lightwave communications standard
dictionary.

ISBN 978-0-442-23387-7

1. Optical communications—Dictionaries. 2. Fiber optics-
Dictionaries. I. Weik, Martin H. Fiber optics and lightwave
communications dictionary. II. Title.

TK5102.W45 1989

621.36'92'0321—dc19

89-30814

CIP

FDHM. *Full-duration half-maximum.*

FDM. *Frequency-division multiplexing.*

feature. *See optical cable interconnect feature.*

feed-through. *See fiber optic cable feed-through.*

femtosecond. A unit of time equal to 10^{-15} seconds.

Fermat's principle. A light ray follows the *path* that requires the least time to *propagate* from one point to another, including *reflections* and *refractions* that may occur. The *optical path length* is an extreme path in the terminology of the calculus of variations. Thus, if all rays starting from point *A* *propagate* via a *propagation medium* to the same point *B*, the optical paths from *A* to *B* are the same optical length, though their geometric lengths may be different. In *optical fibers*, different rays *launched* into the fiber at the same time take different paths. Thus, they arrive at the end at different points and different times, giving rise to *dispersion*.

ferrule. A mechanical device or fixture, generally a rigid tube, used to hold the stripped end of an *optical fiber* or *fiber bundle*. Typically, individual fibers of a bundle are cemented together within a ferrule that has a diameter designed to hold the fibers firmly with a maximum *packing fraction*. Nonrigid materials, such as shrink tubing, may also be used for ferrules. Generally, a ferrule provides a means of positioning fibers within a *connector* by performing the function of a bushing.

fiber. *See active optical fiber; all-glass fiber; all-plastic fiber; buffered fiber; compensated optical fiber; depressed-cladding fiber; dispersion-shifted fiber; dispersion-unshifted fiber; doubly clad fiber; drawn glass fiber; fully filled fiber; graded-index (GI) fiber; hard-clad silica fiber; launching fiber; Lorentzian fiber; medium-loss fiber; multimode fiber; optical fiber; overcompensated optical fiber; plastic-clad silica (PCS) fiber; polarization-maintaining optical fiber; quadruply clad fiber; single-mode fiber; step-index fiber; superfiber; tapered fiber; transition fiber; triangular-cored optical fiber; ultralow-loss fiber; undercompensated optical fiber; weakly guiding fiber; W-type fiber.*

fiber acoustic sensor. *See optical fiber acoustic sensor.*

fiber active connector. *See optical fiber active connector.*

fiber amplifier. An *optoelectronic* (optically pumped) *fiber laser* used as an amplifier to boost *optical signals*. The fiber amplifier can be used in lieu of an *optoelectronic repeater* in *local loops*, *LANs*, and *long-haul systems*, thus allowing more sequential switching stages between repeaters and an increased number of *nodes* for a single *transmitter* in a *network*. The fiber amplifier is a high gain, low noise, *wideband*,

fiber optic penetrator. A device that allows an *optical fiber* or *fiber optic cable* to pass from one compartment to another, such as through a wall, partition, bulkhead, hull, fuselage, or cabinet.

fiber optic phase modulator. See *optical phase modulator*.

fiber optic photodetector. A device capable of converting input *optical signals* into equivalent electronic output signals, usually consisting at least of an *optical fiber* signal-input *pigtail*; a light-sensitive element, such as a *photodiode*; an electrical signal output wire; and an electrical power input wire.

fiber optic polarizer. See *optical fiber polarizer*.

fiber optic preform. See *optical fiber preform*.

fiber optic receiver. An *optoelectronic* device that accepts *optical signals* from a *transmitter* or from a *propagation medium* and converts them into electronic signals for further processing.

fiber optic ribbon. *Optical fibers* arrayed side by side and held in place by tapes, adhesives, or plastic strips, for example, a cable consisting of optical fibers laminated within a flat plastic strip. Synonymous with *fiber ribbon*; *optical fiber ribbon*.

fiber optic rotary joint. A *passive optical device* made of *optical fibers* and *connectors* that allows signals from one or more fixed platforms to be *coupled* to one or more platforms that are rotating relative to the fixed platforms. Also see *optical rotor*.

fiber optics. 1. The branch of science and technology devoted to the *transmission of radiation*, that is, *radiant power*, through *optical fibers* made of *transparent materials*, such as glass, *fused silica*, and plastic. Optical fibers in fiber optic cables may be used for data transmission and for sensing, illumination, endoscopic, control, and display purposes, depending on their use in various geometric configurations, modes of excitation, and environmental conditions. The fibers usually may be wound and bound in various shapes and distributions singly or in bundles, which may be *aligned bundles* or *unaligned bundles*. The aligned bundles are used to transmit and display images as well as to scramble images. 2. In 1956, Kapany first defined fiber optics as the art of active and passive guidance of *light* as *rays* and *waveguide modes* in the *ultraviolet*, *visible*, and *infrared spectra* in *transparent fibers* along predetermined *paths*. See *woven fiber optics*; *ultraviolet fiber optics*.

fiber optic scrambler. Similar to a *fiberscope*, except that the center section of the *aligned bundle* has its *optical fibers* randomly distributed. When the randomized fibers are potted and sawed, each half is capable of coding a picture that can be readily decoded only by the other half.

fiber optic sensor. A device that responds to a physical, chemical, or *radiant field* input stimulus, such as heat, *light*, sound, pressure, temperature, strain, *magnetic*

field, and *electric field*, and *transmits* on an *optical fiber* a *pulse*, *signal*, or other representation indicating one or more characteristics of the stimulus, for example, a thermometer, tachometer, hydrophone, microphone, or barometer whose output lead is an optical fiber. See *Fabry-Perot fiber optic sensor*; *Mach-Zehnder fiber optic sensor*; *Michelson fiber optic sensor*; *Sagnac fiber optic sensor*. Also see *optical fiber sensor*.

fiber optic splice. An inseparable, that is, permanent, joint between one *dielectric waveguide*, such as an *optical fiber*, and another, with minimal power loss at the junction. The purpose of the splice is to *couple optical power* between the two waveguides. Synonymous with *optical splice*. Also see *optical fiber splice*.

fiber optic splice tray. A flat, usually rectangular, pan-shaped device for holding and protecting the individual *optical fibers* from two *fiber optic cables* that have been *spliced*. The tray holds the fibers even though they may not be sheathed, *jacketed*, or otherwise covered as a group, although the fiber optic splices may be individually covered.

fiber optic splitter. A device that extracts a portion of the *optical signal power propagating* in a *dielectric waveguide*, such as an *optical tap* or a *partial mirror*, and diverts that power to a destination different from that of the remaining portion.

fiber optic spot illumination. Illumination of a relatively small area with a narrow beam of *light* emanating from the end of an *optical fiber* or *bundle* of fibers.

fiber optic station cable. See *optical station cable*.

fiber optic station facility. See *optical station facility*.

fiber optic station/regenerator section. See *optical station/regenerator section*.

fiber optic supporting structures. Structures that are used to fasten, guide, and hold *fiber optic* components in place in operational systems, for example, *bend limiters*, raceways, harnesses, hangars, ducts, and housings, without which a fiber optic system cannot be installed, held in place, and operated.

fiber optic switch. A device that can selectively transfer *optical signals* from one *optical fiber* to another depending upon the application of external stimuli, such as a force or an applied *electric*, *magnetic*, *electromagnetic*, acoustic, gravitational, or other force *field*. The switch may be *latching* or *nonlatching*.

fiber optic system. See *integrated fiber optic system*.

fiber optic telemetry system. A telemetry system in which *fiber optic* components, such as *fiber optic sensors*, *data links*, *light sources*, *photodetectors*, and related components, are used to gather and distribute *data* originating from a sensor.

$$\lambda = v/f$$

where v is the *propagation velocity* and f is the *frequency*. 2. For any periodic type of wave, the distance between corresponding points, such as positive-peak values, in two consecutive cycles of the wave. If the propagation velocity and repetition rate of the wave are known, the wavelength can be calculated from the relation:

$$\delta = s/r$$

where s is the speed and r is the repetition rate. See *cable cutoff wavelength*; *cutoff wavelength*; *long wavelength*; *nominal central wavelength*; *peak spectral wavelength*; *short wavelength*; *zero-dispersion wavelength*; *zero-material-dispersion wavelength*.

wavelength-dependent attenuation rate characteristic. A plot of the variation of the *attenuation rate* (dB/km) of *optical fiber* as a function of the *wavelength* λ of the energizing *light source*. The plot usually also shows the minimum, nominal, and maximum wavelength in the *spectral width* of the source. The characteristic is used to determine the increase in *attenuation rate* that has to be allowed for in the design of an *optical station/regenerator section*. The increase in attenuation rate to be used in the design is the maximum value, which may occur at the minimum or maximum wavelength, or anywhere in between, relative to the *nominal central wavelength*.

wavelength-division multiplexing (WDM). In *fiber optics* when referring to *light-waves*, multiplexing that is similar to *frequency-division multiplexing*, a multiplexing system in which the available *transmission wavelength* range is divided into narrow *bands* and each is used as a separate channel. Because an *optical fiber* can transmit more than one wavelength of *light* at the same time, each wavelength can be separately *modulated* and used as a separate transmission *channel* as long as a combination of dispersive components, such as prisms, and *photodetectors* on the receiving end are wavelength-sensitive or spatially distributed for demultiplexing. In *fiber optics*, such frequency-division multiplexing (FDM) is called wavelength-division multiplexing (WDM), because *lightwaves* are more often described and measured in terms of wavelength rather than *frequency*, and perhaps more importantly, because the use of the term WDM also avoids confusion with the possible use of FDM in assembling *baseband signals*, such as FDM-pulse patterns, that are to be transmitted over an *optical link* at each of the operating optical wavelengths. Because optical frequencies are so high, these multiplexing schemes can be accomplished during assigned time slots. Thus, *time-division multiplexing (TDM)*, along with *space-division multiplexing (SDM)*, can take place concurrently on an optical link. Thus, WDM, FDM, TDM, and SDM can all be used concurrently. (See Figs W-1 and W-2.)

wavelength measurement. See *central wavelength measurement*.

wavelength range. See *transmitter central wavelength range*.