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Fibre optic interconnecting devices and passive components – Fibre optic filters – Generic specification

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – FIBRE OPTIC FILTERS – GENERIC SPECIFICATION

FOREWORD

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International Standard IEC 61977 has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

This second edition cancels and replaces the first edition published in 2001. It constitutes a technical revision. The changes with respect to the previous edition include having substantially increased the number of terms, added an informative annex for example of filtering technologies and deleted quality assessment procedures.

The text of this standard is based on the following documents:

FDIS	Report on voting
86B/2982/FDIS	86B/3015/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – FIBRE OPTIC FILTERS – GENERIC SPECIFICATION

1 Scope

This International Standard applies to the family of fibre optic filters. These components have all of the following general features:

– they are passive for the reason that they contain no optoelectronic or other transducing elements which can process the optical signal launched into the input port;

– they modify the spectral intensity distribution in order to select some wavelengths and inhibit others;

– they are fixed, i.e. the modification of the spectral intensity distribution is fixed and can not be tuned;

– they have input and output ports or a common port (having both functions of input and output) for the transmission of optical power; the ports are optical fibre or optical fibre connectors;

– they differ according to their characteristics. They can be divided into the following categories:

- short-wave pass (only wavelengths lower than or equal to a specified value are passed);
- long-wave pass (only wavelengths greater than or equal to a specified value are passed);
- band-pass (only an optical window is allowed);
- notch (only an optical window is inhibited).

It is also possible to have a combination of the above categories.

This standard establishes uniform requirements for optical, mechanical and environmental properties.

2 Normative references

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

IEC 60027 (all parts), *Letter symbols to be used in electrical technology*

IEC 60050(731), *International Electrotechnical Vocabulary – Chapter 731: Optical fibre communication*

IEC 61300 (all parts), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures*

IEC 60617-SN, *Graphical symbols for diagrams*

IEC 60695-11-5, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

IEC 60825-1, *Safety of laser products – Part 1: Equipment classification, requirements and user's guide*

IEC 61930, *Fibre optic graphic symbology*

IEC Guide 102, *Electronic components – Specification structures for quality assessment (Qualification approval and capability approval)*

IECQ 01, *IEC Quality Assessment System for Electronic Components (IECQ Scheme) – Basic Rules*

IECQ 001002-3, *IEC Quality Assessment System for Electronic Components (IECQ) – Rules of Procedure – Part 3: Approval procedures*

ISO 129-1, *Technical drawings – Indication of dimensions and tolerances – Part 1: General principles*

ISO 286-1, *ISO system of limits and fits – Part 1: Bases of tolerances, deviations and fits*

ISO 1101, *Geometrical Product Specifications (GPS) – Geometrical tolerancing – Tolerances of form, orientation, location and run-out*

ISO 8601, *Data elements and interchange formats – Information interchange – Representation of dates and times*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050(731) and the following apply.

3.1 Basic terms

3.1.1
port
an optical fibre or optical fibre connector attached to a passive component for the entry and/or exit of the optical power (input and/or output port)

3.2 Component terms

3.2.1
band pass filter
device designed to allow signals between two specific wavelengths to pass

3.2.2
etalon
device consisted of a transparent plane-parallel plate with two reflecting surfaces, or two parallel highly reflecting mirrors. The varying transmission function of an etalon is caused by interference between the multiple reflections of light between the two reflecting surfaces

3.2.3
fibre Bragg grating
FBG
device which can reflect particular wavelengths of light and transmit other wavelengths

3.2.4
fibre optic filter
passive component used in fibre optic transmission to modify the spectral intensity distribution of a signal in order to pass some wavelengths and block some others

3.2.5
gain flattening filter/ gain equalizer
GFF/ GEQ
device designed to have the inverse characteristic of an optical device which has an insertion loss wavelength characteristic

3.2.6
long wavelength pass filter
LWPF
filter that passes long wavelength signals but reduces the amplitude of short wavelength signals

3.2.7
notch filter
filter that passes all wavelength except those in a stop band centred on a centre wavelength

3.2.8
reflecting type fibre optic filter
fibre optic filter in which the input and output ports are coincident

3.2.9
short wavelength pass filter
SWPF
filter that passes short wavelength signals but reduces the amplitude of long wavelength signals

3.2.10
thin-film filter
TFF
optical filter which passes a particular wavelength band and reflecting all other wavelengths by using interference effect of thin-film

3.2.11
transmitting type fibre optic filter
fibre optic filter in which the input and output ports are different

3.3 Performance terms

3.3.1
insertion loss
reduction of optical power, when transmitted between the ports of a two-port fibre optic filter expressed in decibels. It is defined as:

$$a = -10 \log \left(P_{\text{out}} / P_{\text{in}} \right)$$

where

P_{in} is the optical power launched into one of the two ports;

P_{out} is the optical power received from the other port.

The insertion loss is a function of wavelength

3.3.2
chromatic dispersion
group delay between two closely spaced wavelengths (or frequencies) inside an optical signal going through a pair of conducting ports of a WDM device. It corresponds to the difference between the arrival times of these two closely spaced wavelengths (or frequencies). Chromatic dispersion is defined as the variation (first order derivative) of this group delay over a range of wavelengths (or frequencies) especially over the channel operating wavelength (or frequency) range at a given time, temperature, pressure and humidity. It is expressed as D in terms of units of ps/nm or ps/GHz and it is a predictor of the broadening of a pulse transmitted through the device

3.3.3
free spectral range
in the case of a periodic spectral response of a fibre optic filter, the difference between two adjacent operating wavelengths

3.3.4
isolation wavelength
nominal wavelength λ_k (where $\lambda_h \neq \lambda_k$), that is nominally suppressed by a fibre optic filter

3.3.5
isolation wavelength range, stopband
specified range of wavelengths from λ_{kmin} to λ_{kmax} around the isolation wavelength λ_k, that are nominally suppressed by a fibre optic filter

3.3.6
maximum insertion loss within pass band
maximum value of the insertion loss within pass band. Figure 1 shows pass band and maximum insertion loss within pass band

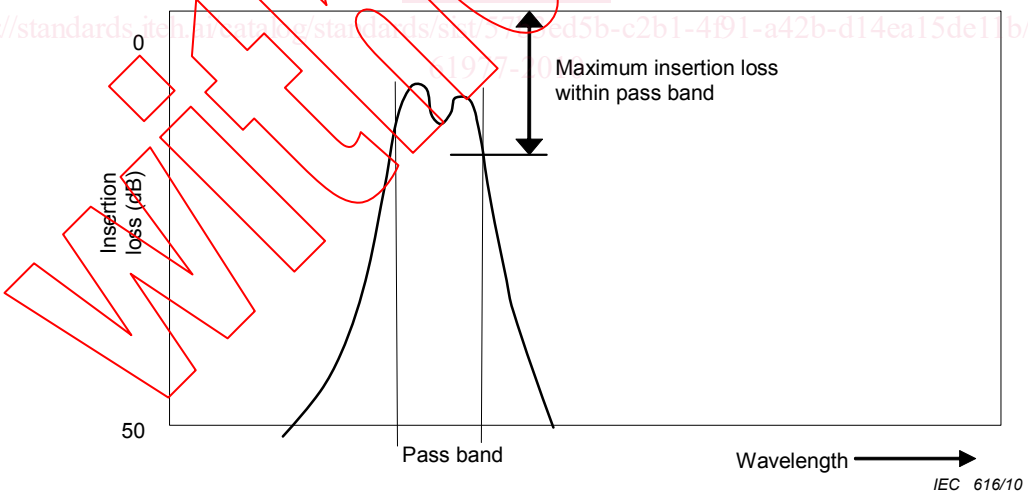

Figure 1 – Illustration of maximum insertion loss within pass band

3.3.7
maximum slope of spectral ripple
maximum value in module of the derivative of the insertion loss (for transmitting-type fibre optic filter) or return loss (for reflecting-type fibre optic filter) as a function of wavelength over the bandpass

3.3.8
minimum insertion loss within pass band
minimum value of the insertion loss within pass band. Figure 2 shows pass band and minimum insertion loss within pass band

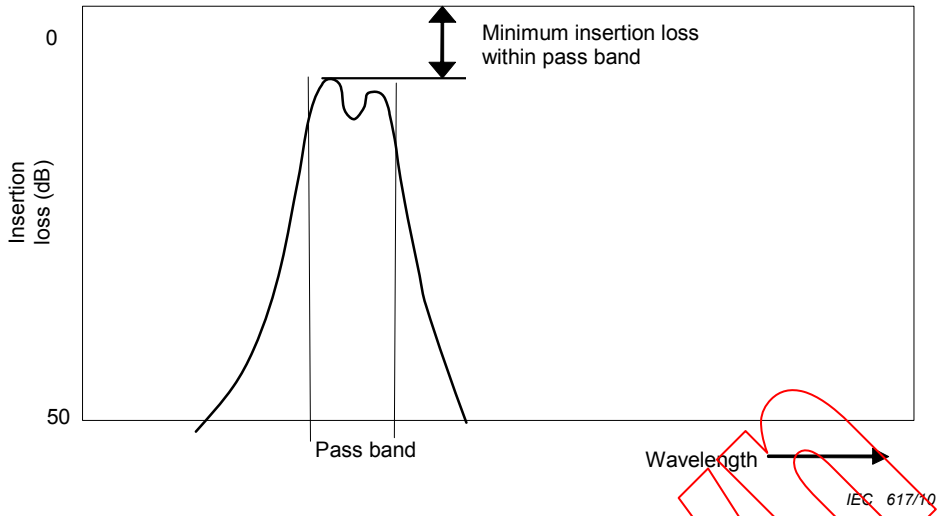

Figure 2 – Illustration of minimum insertion loss within pass band

3.3.9
operating wavelength
nominal wavelength λ_h, at which a fibre optic filter operates with the specified performances

3.3.10
operating wavelength range, bandpass
specified range of wavelengths from λ_{hmin} to λ_{hmax} around the operating wavelength λ_h, within which a fibre optic filter operates with the specified performances

3.3.11
polarization dependent loss
PDL
maximum variation of insertion loss over all the polarization states

3.3.12
polarization mode dispersion
PMD
when an optical signal passes through an optical fibre, component or subsystem, such as going through a pair of conducting ports of a WDM device, the change in the shape and rms width of the pulse due to the average delay of the travelling time between the two principal states of polarization (PSP), differential group delay (DGD), and/or to the waveform distortion for each PSP, is called PMD. PMD, together with polarization dependent loss (PDL) and polarization dependent gain (PDG), when applicable, may introduce waveform distortion leading to unacceptable bit error rate increase

3.3.13
reflectance
percentage of optical power reflected by the filter at the operating wavelength

3.3.14
return loss
fraction of input power that is returned from a port of a fibre optic filter, expressed in decibels. It is defined as:

$$RL = -10 \log \left(P_{refl} / P_{in} \right)$$

where

P_{in} is the optical power launched into the port;

P_{refl} is the optical power received back from the same port.