

Edition 4.0 2020-04

## INTERNATIONAL STANDARD

## NORME INTERNATIONALE

Fibre optic interconnecting devices and passive components – Fibre optic fixed filters – Generic specification (standards.iteh.ai)

Dispositifs d'interconnexion et composants passifs fibroniques – Filtres fibroniques fixes – Spécification générique 1/41228219-adc4-437b-9163-

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#### INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

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This fourth edition cancels and replaces the third edition published in 2015. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous

- a) change of the title and the scope for the limitation to fibre optic fixed filters;
- b) addition of new terms and definitions reflecting new title;
- c) removal of terms and definitions duplicated in IEC TS 62627-09;
- d) harmonization of the vertical axis of Figures 1 to 5;
- e) restructuration of Clause 4 reflecting the latest technical and market situation.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
86B/4267/FDIS	86B/4286/RVD

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

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

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#### INTRODUCTION

There are two generic specifications for fibre optic filters: fibre optic fixed filters and fibre optic tuneable filters. This document focuses on fibre optic fixed filters. Fibre optic tuneable bandpass filter is standardized in IEC 63032.

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

#### 1 Scope

This document 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 cannot 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); https://standards.iteh.ai/catalog/standards/sist/41228219-adc4-437b-9163-
  - gain flattening (compensating the spectral profile of the device).

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

This document provides the generic information including terminology of IEC 61753-04x series documents. Published IEC 61753-04x series documents are listed in the Bibliography.

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

#### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 (IEV) – Part 731: Optical fibre communication (available at http://www.electropedia.org)

IEC 60617, Graphical symbols for diagrams (available at http://std.iec.ch/iec60617)

IEC 60825 (all parts), Safety of laser products

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

IEC TR 61930, Fibre optic graphical symbology

IEC TS 62627-09, Fibre optic interconnecting devices and passive components – Vocabulary for passive optical devices

ISO 129-1, Technical product documentation (TPD) – Presentation of dimensions and tolerances – Part 1: General principles

ISO 286-1, Geometrical product specifications (GPS) – ISO code system for tolerances on linear sizes – Part 1: Basis of tolerances, deviations and fits

ISO 1101, Geometrical product specifications (GPS) – Geometrical tolerancing – Tolerances of form, orientation, location and run-out

ISO 8601-1, Date and time – Representations for information interchange – Part 1: Basic rules

#### 3 Terms and definitions

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

#### 3.1 Component terms

#### 3.1.1

#### bandpass filter

**BPF** 

fibre optic filter designed to allow signals between two specific wavelengths to pass

Note 1 to entry: This note applies to the French language only.

#### 3.1.2

#### etalon

device consisting of a transparent plane-parallel plate with two reflecting surfaces, or two parallel reflecting mirrors

Note 1 to entry: The varying transmission function of an etalon is caused by interference between the multiple reflections of light between the two reflecting surfaces.

Note 2 to entry: Annex A describes the outline of etalon technology.

#### 3.1.3

#### fibre Bragg grating

**FBG** 

fibre optic device which has a short periodic variation to the refractive index of the fibre core along the fibre

Note 1 to entry: An FBG can reflect particular wavelengths of light and transmit other wavelengths.

Note 2 to entry: Annex B describes the outline of FBG technology.

Note 3 to entry: This note applies to the French language only.

#### 3.1.4

#### fibre optic filter

passive component used in fibre optic transmission system to modify the spectral intensity distribution of a signal in order to transmit or attenuate some wavelengths and block some others

Note 1 to entry: There are two types of fibre optic filters: fibre optic fixed filters and fibre optic tuneable filters.

Note 2 to entry: The wavelength band which transmits or attenuates the signal is called the passband. There may be more than one passband.

#### 3.1.5

#### fibre optic fixed filter

fibre optic filter which spectral profile is fixed

#### 3.1.6

#### fibre optic tuneable filter

fibre optic filter which spectral profile is changeable

Note 1 to entry: Fibre optic tuneable bandpass filter is standardized in IEC 63032.

#### 3.1.7

#### gain flattening filter

gain equalizer

ĞFF

#### iTeh STANDARD PREVIEW

**GEQ** 

fibre optic filter designed to have the inverse characteristic of the wavelength dependent loss of an optical device

#### IEC 61977:2020

Note 1 to entry: A GFFi (GEQ) is used for the purpose of minimizing the wavelength dependent loss of a fibre optic device.

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Note 2 to entry: A GFF (GEQ) is typically used with (in) an optical amplifier.

Note 3 to entry: This note applies to the French language only.

Note 4 to entry: This note applies to the French language only.

#### 3.1.8

#### long wavelength pass filter

**LWPF** 

fibre optic filter that passes long wavelength signals but reduces the amplitude of short wavelength signals

Note 1 to entry: This note applies to the French language only.

#### 3.1.9

#### notch filter

fibre optic filter that passes all wavelengths except those in a stop band centred on a particular wavelength

#### 3.1.10

#### reflecting type fibre optic filter

wavelength selective reflecting device having two ports that reflects back the light to the launch port at different wavelength range (OTDR monitoring range)

#### 3.1.11

#### short wavelength pass filter

**SWPF** 

fibre optic filter that passes short wavelength signals but reduces the amplitude of long wavelength signals

Note 1 to entry: This note applies to the French language only.

#### 3.1.12

#### thin-film filter

**TFF** 

fibre optic filter which passes particular wavelength band(s) and reflects all other wavelengths by using the interference effect of thin-film

Note 1 to entry: One of the typical TFF is a dielectric multi-layer film filter. Annex C describes the outline of TFF technology.

Note 2 to entry: This note applies to the French language only.

#### 3.1.13

#### transmitting type fibre optic filter

fibre optic filter in which the input and output ports are separated

#### 3.2 Performance terms

#### 3.2.1

#### operating wavelength

nominal wavelength  $\lambda_{\rm h}$ , at which a fibre optic filter operates with the specified performances

Note 1 to entry: The term "operating wavelength" includes the nominally transmitting wavelength, and designated attenuation/isolation wavelength.

#### 3.2.2 iTeh STANDARD PREVIEW

#### operating wavelength range

specified range of wavelengths including all operating wavelengths

Note 1 to entry: It includes all passbands and isolation wavelength ranges.

**3.2.3** https://standards.iteh.ai/catalog/standards/sist/41228219-adc4-437b-9163-

#### passband

wavelength range within which a passive optical component is required to operate with optical attenuation less than or equal to a specified optical attenuation value

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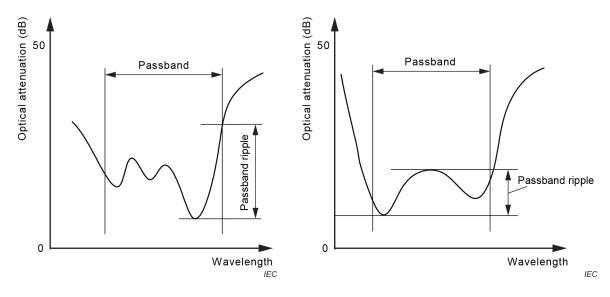
Note 1 to entry: There may be one or more passbands for a fibre optic filter.

#### 3.2.4

#### passband ripple

maximum peak-to-peak variation of the insertion loss (absolute value) over the passband

Note 1 to entry: See Figure 1.



a) Passband ripple at band edges

b) Passband ripple in band

Figure 1 - Illustration of passband ripple

Note 2 to entry: For a wide wavelength division multiplexing (WWDM) fibre optic filter which has only one passband, the term "spectral ripple" or "flatness" is used instead of "passband ripple".

### 3.2.5

(standards.iteh.ai)

insertion loss attenuation

IEC 61977:2020

reduction of optical power in a passband, when transmitted through a fibre optic filter 6cef4b583d10/iec-61977-2020

Note 1 to entry: The insertion loss is expressed in decibels and defined as:

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

where

 $P_{\mathsf{in}}$ is the optical power launched into the fibre optic filter;

is the optical power received out of the fibre optic filter.

Note 2 to entry: The insertion loss (attenuation) is a function of wavelength.

#### 3.2.6

#### free spectral range

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

Note 1 to entry: This note applies to the French language only.

#### 3.2.7

#### isolation wavelength

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

#### 3.2.8 isolation wavelength range stopband

specified range of wavelengths from  $\lambda_{kmin}$  to  $\lambda_{kmax}$  around the isolation wavelength  $\lambda_k$ , that are nominally suppressed by a fibre optic filter

Note 1 to entry: There may be one or more isolation wavelength ranges (stopbands) for a fibre optic filter.

Note 2 to entry: The term "stopband" is an antonym of the term passband.

Note 3 to entry: See Figure 2.

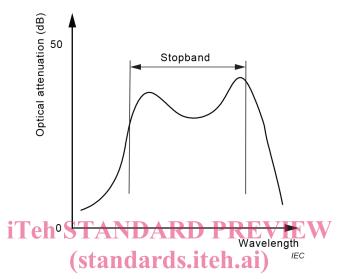


Figure 2 - Illustration of a stopband

https://standards.iteh.ai/catalog/standards/sist/41228219-adc4-437b-9163-3.2.9 maximum insertion loss within a passband

maximum attenuation within a passband

maximum value of the optical attenuation within a passband

Note 1 to entry: Figure 3 shows passband and maximum insertion loss within a passband.

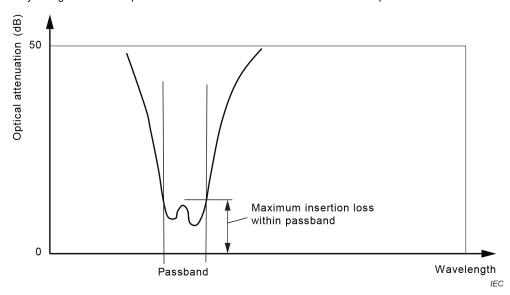


Figure 3 - Illustration of maximum insertion loss within a passband

#### 3.2.10

#### maximum slope of passband ripple

maximum value in fibre optic filter 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 passband

#### 3.2.11

### minimum insertion loss within a passband minimum attenuation within a passband

minimum value of the optical attenuation within a passband

Note 1 to entry: Figure 4 shows passband and minimum insertion loss within a passband.

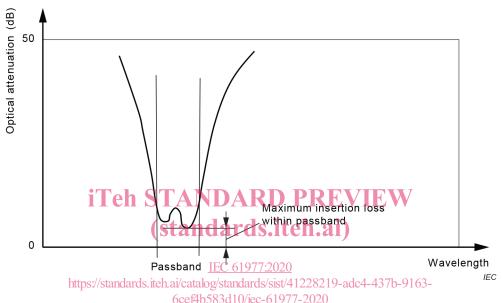


Figure 4 – Illustration of minimum insertion loss within a passband

### 3.2.12 return loss

 $a_{RL}$ 

fraction of input power that is returned from a port of a fibre optic filter

Note 1 to entry: The return loss is expressed in decibels and defined as:

$$a_{\text{RL}} = -10\log_{10}\left(\frac{P_{\text{refl}}}{P_{\text{in}}}\right)$$

#### where

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

 $P_{\rm refl}$   $\;\;$  is the optical power received back from the same port.

Note 2 to entry: The return loss is a function of wavelength.

#### 3.2.13

#### wavelength dependent loss

variation of insertion loss of a fibre optic filter within passband(s)

Note 1 to entry: When there are two or more passbands, the wavelength dependent loss is generally defined as the maximum value of passband ripples.

Note 2 to entry: The term "wavelength dependent loss" is generally used for LWPFs, SWPFs or relatively wide passband filters. For BPF especially narrow passband filters, for example WDM application, passband ripple is generally used.