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Fibre optic interconnecting devices and passive components - Fibre optic WDM devices - Part 1: Generic specification

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Dispositifs d'interconnexion et composants passifs à fibres optiques - Dispositifs WDM à fibres optiques - Partie 1: Spécification générique

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TITLE:

Fibre optic interconnecting devices and passive components - Fibre optic WDM devices - Part 1: Generic specification

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120 INTERNATIONAL ELECTROTECHNICAL COMMISSION

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**FIBRE OPTIC INTERCONNECTING DEVICES AND
PASSIVE COMPONENTS – FIBRE OPTIC WDM DEVICES –****Part 1: Generic specification****FOREWORD**

129

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161 International Standard IEC 62074-1 has been prepared by subcommittee SC 86B: Fibre optic

162 interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

162 This third edition cancels and replaces the second edition, published in 2014, and constitutes

163 a technical revision.

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

165 edition:

166 a) harmonization of terms and definitions with IEC TS 62627-09;

167 b) change of Clause 4 regarding requirements.

168

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

FDIS	Report on voting
86B/xxxx/FDIS	86B/xxxx/RVD

170
171 Full information on the voting for the approval of this standard can be found in the report on
172 voting indicated in the above table.

173 The French version of this standard has not been voted upon.

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

175 A list of all parts in the IEC 62074 series, published under the general title *Fibre optic*
176 *interconnecting devices and passive components – Fibre optic wdm devices*, can be found on
177 the IEC website.

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

- 181 • reconfirmed,
- 182 • withdrawn,
- 183 • replaced by a revised edition, or
- 184 • amended.

185

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FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – FIBRE OPTIC WDM DEVICES –

Part 1: Generic specification

1. Scope

This part of IEC 62074 applies to fibre optic wavelength division multiplexing (WDM) devices. These have all of the following general features:

- they are passive, in that they contain no optoelectronic or other transducing elements; however they can use temperature control only to stabilize the device characteristics; they exclude any optical switching functions;
- they have three or more ports for the entry and/or exit of optical power, and share optical power among these ports in a predetermined fashion depending on the wavelength;
- the ports are optical fibres, or optical fibre connectors.

This document establishes uniform requirements for the following:

- optical, mechanical and environmental properties.

2. Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 60695-11-5, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

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

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

ISO 286-1, *Geometrical product specifications (GPS) – ISO coding system for tolerances of linear sizes – Part 1: Bases of tolerances 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

For the purposes of this document, the terms and definitions given in IEC 60050-731 and IEC TS 62627-09, as well as the following, apply.

226 ISO and IEC maintain terminology databases for use in standardization at the following
227 addresses:

- 228 • IEC Electropedia: available at <https://www.electropedia.org/>
- 229 • ISO Online browsing platform: available at <https://www.iso.org/obp>

230 3.1 Device terms

231 3.1.1

232 wavelength-selective branching device

233 passive device with three or more ports that shares optical power among its ports in a
234 predetermined fashion, only depending on the wavelength, in the sense that at least two
235 different wavelength ranges are nominally transferred between two different pairs of ports

236 [SOURCE IEC TS 62627-09: 2016]

237 3.1.2

238 wavelength division multiplexing device

239 wavelength division multiplexer

240 WDM device

241 synonym for a wavelength-selective branching device

242 Note 1 to entry: The term of wavelength-selective device is the contrast with the term of non-wavelength-selective
243 branching device. The term of WDM device is frequently used.

244 3.1.3

245 dense wavelength division multiplexing device

246 DWDM device

247 WDM device which is intended to operate for a channel spacing equal or less than 1 000 GHz

248 Note 1 to entry: The channel spacing is approximately 8 nm at 1 550 nm and 5,7 nm at 1 310 nm.

249 3.1.4

250 coarse wavelength division multiplexing device

251 CWDM device

252 WDM device which is intended to operate for channel spacing less than 50 nm and greater than

253 1 000 GHz

254 3.1.5

255 wide WDM device

256 WWDM

257 WDM device which is intended to operate for channel spacing equal to or greater than 50 nm

258 3.1.6

259 wavelength multiplexer

260 MUX

261 WDM (DWDM, CWDM or WWDM) device which has n input ports and one output port, and
262 whose function is to combine n different optical signals differentiated by wavelength from n
263 corresponding input ports on to a single output port

264 3.1.7

265 wavelength demultiplexer

266 DEMUX

267 WDM (DWDM, CWDM or WWDM) device which has one input port and n output ports, and
268 whose function is to separate n different optical signals differentiated by wavelength from a
269 single input port to n corresponding output ports

270 **3.1.8**
 271 **interleaver**
 272 DWDM device which has three ports, and which function is to separate n different optical signals
 273 differentiated by wavelength from a common port and transmit an odd channel signal to one
 274 branching port and an even channel signal to the other branching port alternately

275 Note 1 to entry: An interleaver can operate as a wavelength multiplexer (OMUX) by reversing the demultiplexer.

276 3.2 Performance terms

277 **3.2.1**
 278 **operating wavelength**
 279 nominal wavelength λ_h at which a WDM device operates with the specified performance

280 Note 1 to entry: The term "operating wavelength" includes the wavelength to be nominally transmitting, designated
 281 attenuating and isolated.

282 Note 2 to entry: Operating frequency is also used for DWDM devices.

283 **3.2.2**
 284 **operating wavelength range**
 285 specified range of wavelengths including all operating wavelengths

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

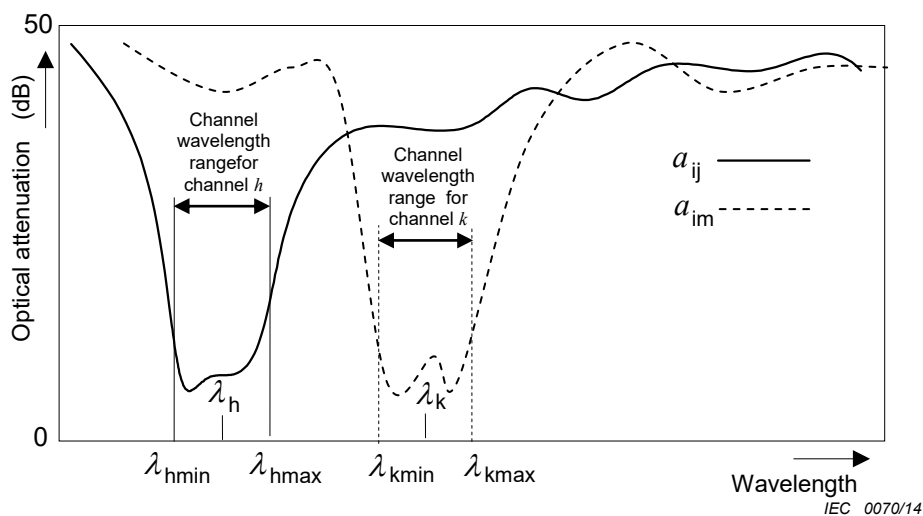
287 Note 2 to entry: The term "operating wavelength range" is defined for a WDM device, not for each channel or port.

288 **3.2.3**
 289 **channel wavelength range**
 290 range within which a CWDM or WWDM device operates with less than or equal to a specified
 291 optical attenuation for the conducting port pair

292 Note 1 to entry: For a particular nominal channel centre wavelength, λ_{nom} , this wavelength range from $\lambda_{imin} =$
 293 $(\lambda_{nom} - \Delta\lambda_{max})$ to $\lambda_{imax} = (\lambda_{nom} + \Delta\lambda_{max})$, where $\Delta\lambda_{max}$ is the maximum channel centre wavelength deviation.

294 Note 2 to entry: For CWDM devices, channel centre wavelengths and maximum channel centre wavelength
 295 deviations are defined as nominal central wavelengths and wavelength deviations in ITU-T G 694.2.

296 Note 3 to entry: An illustration of channel wavelength range is shown in Figure 1.



297

298

Figure 1 – Illustration of channel wavelength range

299 **3.2.4**300 **channel frequency range**

301 frequency range within which a DWDM device is required to operate with less than or equal to
 302 a specified optical attenuation for the conducting port pair

303 Note 1 to entry: For a particular nominal channel frequency, f_{nomi} , this frequency range is from $f_{\text{imin}} = (f_{\text{nomi}} - \Delta f_{\text{max}})$
 304 to $f_{\text{imax}} = (f_{\text{nomi}} + \Delta f_{\text{max}})$, where Δf_{max} is the maximum channel centre frequency deviation.

305 Note 2 to entry: Nominal channel centre frequency and maximum channel centre frequency deviation are defined
 306 in ITU-T G.694.1.

307 **3.2.5**308 **passband**

309 channel passband

310 synonym for channel wavelength range (channel frequency range)

311 Note 1 to entry: Passband is frequently used.

312 Note 2 to entry: There are two or more passbands for WDM devices. Each passband is defined corresponding to
 313 each channel.

314 **3.2.6**315 **insertion loss**

316 maximum value of a_{ij} (where $i \neq j$) within the passband for conducting port pair

317 Note 1 to entry: It is the optical attenuation from a given port to a port which is another port of conducting port pair
 318 of the given port of a WDM device. Insertion loss is a positive value in decibels. It is calculated as:

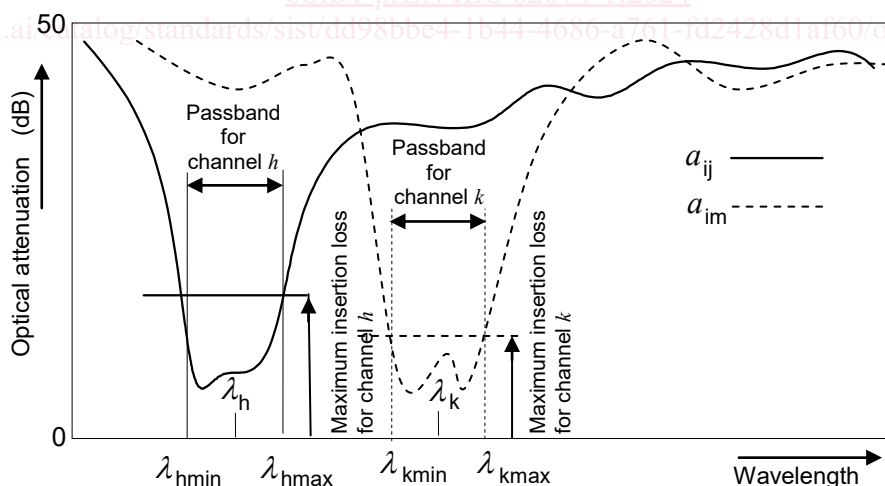
$$319 \quad IL = -10 \times \log_{10} \left(\frac{P_{\text{out}}}{P_{\text{in}}} \right)$$

320 where

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

322 P_{out} is the optical power received from the other port of the conducting port pair.

323 Note 2 to entry: An illustration of insertion loss is shown in Figure 2.



324

IEC 0071/14

325 **Figure 2– Illustration of insertion loss**

326 Note 3 to entry: For a WDM device, the insertion loss shall be specified as a maximum value of the insertion losses
 327 of all channels

328 **3.2.7**329 **channel insertion loss**

330 insertion loss of the specific channel

331 Note 1 to entry: The term of insertion loss is used both for a WDM device and channel insertion loss.

332 3.2.8

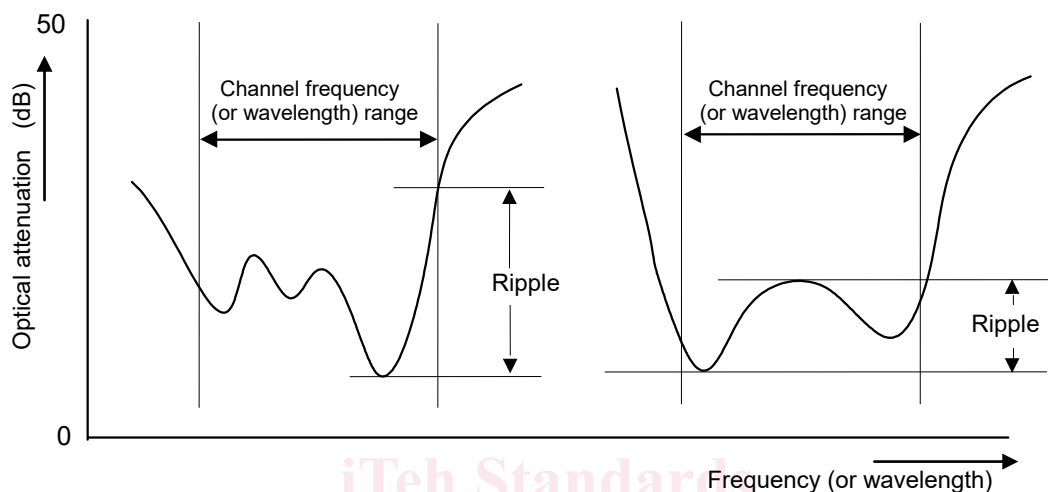
333 passband ripple

334 maximum peak-to-peak variation of the insertion loss over the passband

335 Note 1 to entry: Insertion loss is expressed as a positive value.

336 Note 2 to entry: The term of passband is applied both for the unit of wavelength (WWDM and CWDM) and the unit of
337 frequency (DWDM).

338 Note 3 to entry: Refer to Figure 3.



IEC 0072/14

339

a) – Ripple at band edges

b) – Ripple in band

340

Figure 3 – Illustration of ripple

341 3.2.9

342 maximum channel insertion loss deviation within the passband

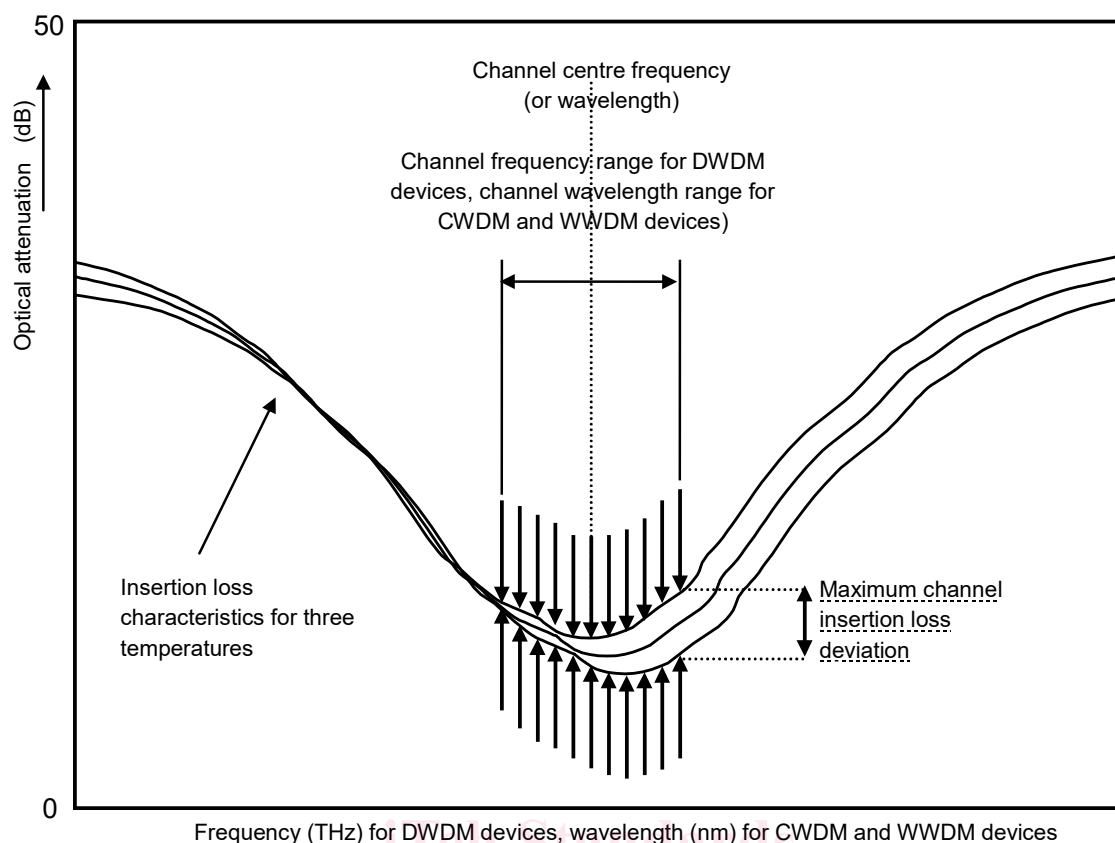
343 maximum variation of the insertion loss

344 Note 1 to entry: Insertion loss is a positive value.

345 Note 2 to entry: The channel frequency range for a DWDM device or channel wavelength range for a coarse WDM
346 (CWDM) and a wide WDM (WWDM) device can be used for passband.

347 Note 3 to entry: See Figure 4.

348 Note 4 to entry: Channel insertion loss deviation should not to be confused with ripple defined in Figure 3 below.



349

350

Figure 4 – Illustration of channel insertion loss variation

3.2.10

channel non-uniformity

insertion loss channel non-uniformity

difference between the maximum and the minimum insertion loss at the common port for a specified set of branching ports

Note 1 to entry: Channel non-uniformity is defined for a MUX ($N \times 1$ WDM device) and a DEMUX ($1 \times N$ WDM device). Channel non-uniformity is a positive value, and expressed in dB.

Note 2 to entry: For CWDM and DWDM devices, channel non-uniformity should be defined as the differences between the maximum and the minimum insertion loss at nominal wavelengths (frequencies) of all channels.

3.2.11

centre wavelength deviation

difference between the centre wavelength and nominal wavelength (frequency) of the specified channel for DWDM devices

Note 1 to entry: The centre wavelength is defined as the centre of the wavelength range which is x dB less than the minimum optical attenuation for the specified passband (channel).

Note 2 to entry: 0,5, 1 or 3 are generally used for x .

3.2.12

crosstalk

ratio of the noise power in the specified channel(s) versus the signal power in the specified channel

Note 1 to entry: Crosstalk is a negative value given in dB. The crosstalk is defined for each output port. Crosstalk for WDM devices is defined for a DEMUX ($1 \times N$ WDM device). The crosstalk for port o to port j is subtraction from the insertion loss of port i to o (conducting port pair) to the isolation of port j to o (isolated port pair). Crosstalk for

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