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oSIST prEN IEC 60793-1-40:2023
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Optična vlakna - 1-40. del: Metode merjenja slabljenja

Optical fibres - Part 1-40: Attenuation measurement methods

Lichtwellenleiter - Teil 1-40: Dämpfungsmessverfahren

Fibres optiques - Partie 1-40: Méthodes de mesure de l'affaiblissement

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TITLE:

Optical fibres - Part 1-40: Attenuation measurement methods

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NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

OPTICAL FIBRES –

Part 1-40: Attenuation measurement methods

FOREWORD

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International Standard IEC 60793-1-40 has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

This third edition cancels and replaces the second edition published in 2019. This edition constitutes a technical revision.

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

- a) modifying the definition of attenuation to be compatible with the definition in [electropedia.org](http://www.electropedia.org).

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

FDIS	Report on voting
86A/1909/FDIS	86A/1927/RVD

153
154 Full information on the voting for the approval of this International Standard can be found in the
155 report on voting indicated in the above table.

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

157 A list of all parts in the IEC 60793 series, published under the general title *Optical fibres*, can
158 be found on the IEC website.

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

- 162 • reconfirmed,
- 163 • withdrawn,
- 164 • replaced by a revised edition, or
- 165 • amended.

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iTeh STANDARD PREVIEW

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168 [b1769f6ffa04/osist-pren-iec-60793-1-40-2023](https://standards.iteh.ai/catalog/standards/sist/19279001-8a7c-49cd-90f0-b1769f6ffa04/osist-pren-iec-60793-1-40-2023)

OPTICAL FIBRES –

Part 1-40: Attenuation measurement methods

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175 **1. Scope**

176 This part of IEC 60793 establishes uniform requirements for measuring the attenuation of
177 optical fibre, thereby assisting in the inspection of fibres and cables for commercial purposes.

178 Four methods are described for measuring attenuation, one being that for modelling spectral
179 attenuation:

- 180 – method A: cut-back;
- 181 – method B: insertion loss;
- 182 – method C: backscattering;
- 183 – method D: modelling spectral attenuation.

184 Methods A to C apply to the measurement of attenuation for all categories of the following fibres:

- 185 – class A multimode fibres;
- 186 – class B single-mode fibres.

187 Method C, backscattering, also covers the location, losses and characterization of point
188 discontinuities.

189 Method D is applicable only to class B fibres.

190 Information common to all four methods appears in Clauses 1 to 11, and information pertaining
191 to each individual method appears in Annexes A, B, C, and D, respectively.

192 **2. Normative references**

193 The following documents are referred to in the text in such a way that some or all of their content
194 constitutes requirements of this document. For dated references, only the edition cited applies.
195 For undated references, the latest edition of the referenced document (including any
196 amendments) applies.

197 IEC 60793-1-1, *Optical fibres – Part 1-1: Measurement methods and test procedures – General*
198 *and guidance*

199 IEC 60793-1-22, *Optical fibres – Part 1-22: Measurement methods and test procedures –*
200 *Length measurement*

201 IEC 60793-1-43, *Optical fibres – Part 1-43: Measurement methods and test procedures –*
202 *Numerical aperture measurement*

203 IEC 61746-1, *Calibration of optical time-domain reflectometers (OTDR) – Part 1: OTDR for*
204 *single mode fibres*

205 IEC 61746-2, *Calibration of optical time-domain reflectometers (OTDR) – Part 2: OTDR for*
206 *multimode fibres*

207 3. Terms and definitions

208 For the purposes of this document, the terms and definitions given in IEC 60793-1-1 and the
209 following apply.

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

- 212 • IEC Electropedia: available at <http://www.electropedia.org/>
- 213 • ISO Online browsing platform: available at <http://www.iso.org/obp>

214 3.1

215 **attenuation**

216 attenuation of a fibre at wavelength λ between two cross-sections, 1 and 2, separated by a
217 distance and defined as

$$218 \quad A(\lambda) = 10 \log_{10} \frac{P_1(\lambda)}{P_2(\lambda)} \quad (1)$$

219 where

220 $A(\lambda)$ is the attenuation, in dB, at wavelength λ ;

221 $P_1(\lambda)$ is the optical power traversing the first cross-section;

222 $P_2(\lambda)$ is the optical power traversing the second cross-section.

223 Note 1 to entry: Attenuation is a measure of the decreasing optical power in a fibre at a given wavelength. It depends
224 on the nature and length of the fibre and is also affected by measurement conditions.

225 3.2

226 **attenuation coefficient**

227 attenuation per unit length for a uniform fibre under steady-state conditions

228 Note 1 to entry: It is possible to define the attenuation per unit length or the attenuation coefficient as follows:

$$229 \quad \alpha(\lambda) = \frac{A(\lambda)}{L} \quad (2)$$

230 which is independent of the chosen length of the fibre,

231 where

232 $\alpha(\lambda)$ is the attenuation coefficient;

233 $A(\lambda)$ is the attenuation at wavelength λ ;

234 L is the length, in kilometres.

235 Note 2 to entry: Uncontrolled launching conditions normally excite higher order lossy modes that produce transient
236 losses and result in attenuation that is not proportional to the length of the fibre. A controlled, steady-state launching
237 condition yields attenuation that is proportional to the fibre's length. Under steady-state conditions, an attenuation
238 coefficient of a fibre can be determined and the attenuation of concatenated fibres added linearly.

239 3.3

240 **spectral attenuation modelling**

241 technique that predicts the attenuation coefficients across a spectrum of wavelengths from a
242 small number (three to five) of discrete values measured directly at different wavelengths

243 3.4

244 **point discontinuity**

245 temporary or permanent local deviation of the continuous optical time-domain reflectometer
246 (OTDR) signal in the upward or downward direction

247 Note 1 to entry: The nature of the deviation can vary with test conditions (e.g. pulse duration, wavelength, and
248 direction of the OTDR signal). Although a point discontinuity can have a length greater than the corresponding

249 displayed pulse duration (including transmitter and receiver effects), the length is usually about equal to the pulse
250 duration. For a correct interpretation, the guidelines in IEC 60793-1-22 should be followed for measuring length.

251 **4. Calibration requirements**

252 See Annexes A, B, and C for methods A, B, and C, respectively.

253 **5. Reference test method**

254 Method A, cut-back, is the reference test method (RTM), which shall be the one used to settle
255 disputes.

256 **6. Apparatus**

257 Annexes A, B, C, and D include layout drawings and other equipment requirements for each of
258 the methods, respectively.

259 **7. Sample Preparation**

260 **7.1 Sample length**

261 The sample shall be a known length of fibre on a reel, or within a cable, as specified in the
262 relevant specification.

263 **7.2 Sample end face**

264 Prepare a flat end face, orthogonal to the fibre axis, at the input and output ends of each sample.

265 **8. Procedure**

266 See Annexes A, B, C and D for methods A, B, C and D, respectively.

267 **9 Calculations**

268 **9.1 Methods A and B**

269 Methods A and B, cut-back and insertion loss use Equations (1) and (2) respectively, which
270 appear in 3.1 and 3.2.

271 **9.2 Method C**

272 See Annex C.

273 **9.3 Method D**

274 See Annex D.

275 **10 Results**

276 **10.1 Information available with each measurement**

277 Report the following information with each measurement:

278 – date and title of measurement;

- 279 – identification of specimen;
- 280 – optical source wavelength;
- 281 – specimen length;
- 282 – spectral attenuation, in dB, or attenuation coefficient, in dB/km, versus wavelength or at
- 283 specific wavelength(s), as required by the relevant specification.

284 **10.2 Information available upon request**

285 The following information shall be available upon request:

- 286 – measurement method used: A, B, C, or D;
- 287 – type of optical source used: centroidal wavelength(s) and spectral width(s);
- 288 – launching technique and conditions used;
- 289 – indication if a dead-zone fibre was used (for method C only);
- 290 – description of all key equipment;
- 291 – for type B fibres – dimensions and number of turns of the mode filter or mode scrambler;
- 292 – pulse duration(s), scale range(s), and signal-averaging details;
- 293 – details of computation technique (calculation method);
- 294 – any deviations to the procedure that were made;
- 295 – date of latest calibration of measurement equipment.

296 **10.3 Method-specific additional information**

297 For methods C and D, see the additional requirements in Clauses C.6 and D.6, respectively.
298 This particularly applies when using method C for measuring point discontinuities.

299 **11 Specification information**

300 The relevant specification shall specify the following information:

- 301 – type of fibre (or cable) to be measured;
- 302 – failure or acceptance criteria at the wavelength or wavelength range;
- 303 – any deviations to the procedure that apply;
- 304 – information to be reported.

305