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**Optični spojni elementi in pasivne komponente - Vmesniki optičnih konektorjev za enorodovna vlakna - 2-2. del: Parametri konektorjev za disperzijsko nepremična, poševno fizično staknjena optična vlakna**

Fibre optic interconnecting devices and passive components - Connector optical interfaces for single-mode fibres - Part 2-2: Connection parameters of dispersion unshifted physically contacting fibres - angled

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# 86B/4536/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

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IEC SC 86B : FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS	
SECRETARIAT: Japan	SECRETARY: Mr Shigeru Tomita
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: <input type="checkbox"/> Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: <input type="checkbox"/> EMC <input type="checkbox"/> ENVIRONMENT <input type="checkbox"/> QUALITY ASSURANCE <input type="checkbox"/> SAFETY	
<input checked="" type="checkbox"/> SUBMITTED FOR CENELEC PARALLEL VOTING <input type="checkbox"/> NOT SUBMITTED FOR CENELEC PARALLEL VOTING	
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TITLE:

**Fibre optic interconnecting devices and passive components - Connector optical interfaces for single-mode fibres - Part 2-2: Connection parameters of dispersion unshifted physically contacting fibres – angled**

PROPOSED STABILITY DATE: 2032

NOTE FROM TC/SC OFFICERS:

## CONTENTS

1		
2		
3	FOREWORD .....	3
4	1 Scope .....	5
5	2 Normative references .....	5
6	3 Terms and definitions .....	5
7	4 Attenuation and return loss grades .....	6
8	5 Criteria for a fit within attenuation and return loss grades .....	6
9	5.1 General.....	6
10	5.2 Attenuation grades and criteria .....	6
11	5.3 Visual requirements for return loss grades .....	8
12	Annex A (informative) Return loss model on angled connections .....	9
13	Bibliography.....	10
14		
15	Figure 1 – Lateral offset and angular offset versus attenuation, $\eta_{\text{combined}}$ , for single-	
16	mode fibre with 8,9 $\mu\text{m}$ MFD at 1 310nm .....	7
17		
18	Table 1 – Single-mode random mate attenuation grades.....	6
19	Table 2 – Single-mode return loss grades for APC (8 degrees) .....	6
20	Table 3 – MFD and fibre core nominal index of refraction .....	7
21	Table 4 – Visual requirements for single-mode angle polished (APC) fibres .....	8

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS –  
CONNECTOR OPTICAL INTERFACES FOR SINGLE-MODE FIBRES –**

**Part 2-2: Connection parameters of dispersion unshifted physically  
contacting fibres – angled**

## FOREWORD

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International Standard IEC 61755-2-2 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 2006. It constitutes a technical revision. The changes with respect to the previous edition are,

- add normative references and visual requirements
- reconsider the whole parts of the text to avoid misuse of the standard.

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

FDIS	Report on voting
XX/XX/FDIS	XX/XX/RVD

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

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

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

- 80 • reconfirmed,
- 81 • withdrawn,
- 82 • replaced by a revised edition, or
- 83 • amended.

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# FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – CONNECTOR OPTICAL INTERFACES FOR SINGLE-MODE FIBRES –

## Part 2-2: Connection parameters of dispersion unshifted physically contacting fibres –angled

### 1 Scope

This part of IEC 61755 defines a set of prescribed conditions for a single-mode fibre optic connection that is maintained in order to satisfy the requirements of attenuation and return loss (RL) performance in a randomly mated pair of angled polished physically contacting (APC) fibres. The model uses a Gaussian distribution of light intensity over the specified mode field diameter (MFD) for determination of attenuation performance grades, based on MFD mismatch and the amount of lateral and angular fibre core offsets. Attenuation and RL performance grades are defined in IEC 61755-1.

### 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 60793-2-50, *Optical fibres – Part 2-50: Product specifications – Sectional specification for class B single-mode fibres*

IEC 61300-3-6, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-6: Examinations and measurements – Return loss*

IEC 61300-3-34, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-34: Examinations and measurements – Attenuation of random mated connectors*

IEC 61300-3-35, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-35: Examinations and measurements – Visual inspection of fibre optic connectors and fibre-stub transceivers*

IEC 61300-3-45, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-45: Examinations and measurements – Attenuation of random mated multi-fibre connectors*  
IEC 61755-1, *Fibre optic interconnecting devices and passive components – Fibre optic connector optical interfaces – Part 1: Optical interfaces for single-mode, non-dispersion shifted fibres – General and guidance*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61755-1 and the following apply.

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>

128 **3.1**  
 129 **Defect size**  
 130 diameter of the smallest circle that can encompass the entire defect

#### 131 **4 Attenuation and return loss grades**

132 As defined in IEC 61755-1, attenuation and return loss grades for APC polished connections  
 133 are given in Tables 1 and 2. The return loss grade is for angled contacting fibres only. The  
 134 grades for non-angled polished PC connections are given separately in IEC 61755-2-1.

135 **Table 1 – Single-mode random mate attenuation grades**

Attenuation grade	Mean [dB]	Attenuation [dB] <sup>a</sup> ≥ 97 % <sup>b</sup>	Notes
A			Reserved for future application
B	≤ 0,12	≤ 0,25	
C	≤ 0,25	≤ 0,50	
D	≤ 0,50	≤ 1,0	

<sup>a</sup> Attenuation shall be measured by IEC 61300-3-34 for single-fibre connectors and IEC 61300-3-45 for multi-fibre connectors.

<sup>b</sup> The probability of a randomly mated connection set meeting the specified attenuation requirement will be ≥ 97 %. This performance is reached by means of a statistical distribution of connection parameters (MFD mismatch, lateral offset and angular offset) using a nominal value for wavelength of 1 310 nm.

136

137 **Table 2 – Single-mode return loss grades for APC (8 degrees)**

Return loss grade	Return loss (mated) <sup>a</sup> [dB]	Return loss (unmated) [dB]
1	≥ 60	≥ 55

<sup>a</sup> The test shall be carried out according to IEC 61300-3-6.

138

139 Single-mode attenuation and return loss grades are applicable for the wavelengths from 1 310  
 140 nm to 1 625 nm.

## 141 **5 Criteria for a fit within attenuation and return loss grades**

### 142 **5.1 General**

143 The following figures and tables give the criteria for meeting the attenuation and return loss  
 144 grades listed in Table 1 and Table 2. The parameters chosen for the criteria definition are based  
 145 on the degree of significance by which they affect the performance under test. The criteria  
 146 selected are based on the theoretical model in 5.2 and 5.3 as well as experimental results.

### 147 **5.2 Attenuation grades and criteria**

148 Using a Gaussian distribution for the incident light, the attenuation of the joint between two  
 149 dispersion unshifted single-mode optical fibres defined by IEC 60793-2-50 category B is given  
 150 by Formula (1). Attenuation is also referred to as insertion loss (IL), or coupling efficiency of  
 151 the fibres.

152 The range of the nominal MFD and index of refraction ( $n_0$ ) of the fibre cores are given in Table  
 153 3.



154

**Table 3 – MFD and fibre core nominal index of refraction**

Fibre Sub-Category	Nominal wavelength [nm]	Nominal MFD [ $\mu\text{m}$ ]	$n_0$ (core)
IEC 60793-2-50 fibres	1 310	8,6 to 9,2	1,452 0

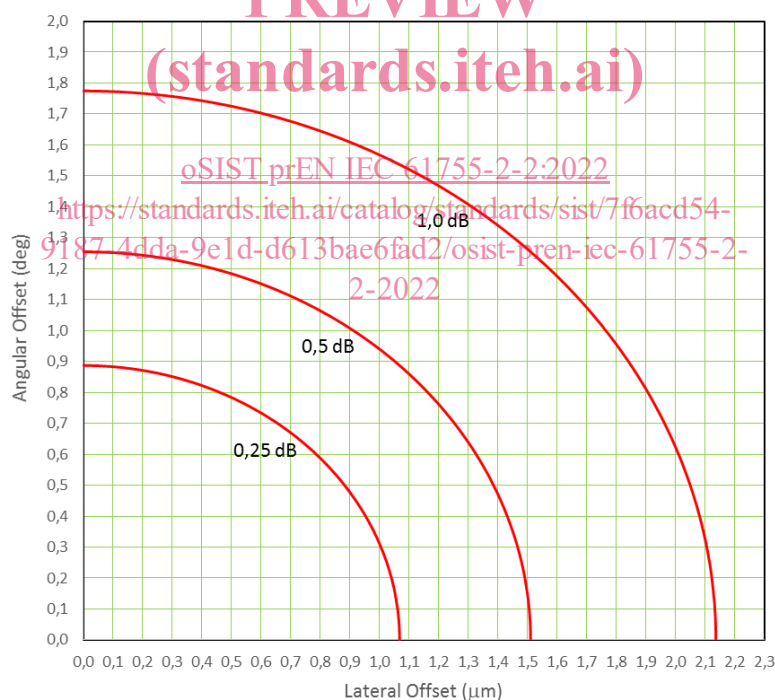
155

156 These attenuation grades are based on a statistical approach defining parameter values of  
 157 connection populations to reach the attenuation to be less than or equal to the given value in  
 158 97 % of the connections. This performance is assumed at the nominal wavelength with fibre  
 159 MFD in the range defined in IEC 60793-2-50 family specification for single-mode dispersion  
 160 unshifted fibres category B.

161 Populations of lateral and angular offset of the random mated connections are assumed to be  
 162 statistically distributed within the specific ranges of parameter values  $d$  and  $\theta$  in Formula (1).

163 Each curve given in Figure 1 represents maximum allowable combinations of lateral offset and  
 164 angular offset so as not to exceed the specified attenuation of any single connection, without  
 165 the contribution from fibre MFD mismatch. Additional attenuation due to mismatch of the MFD  
 166 from the randomly selected fibres is included in Formula (1).

167 Formula (1) is applicable to wavelengths from the range between 1 310 nm and 1 625 nm, using  
 168 the parameters for these wavelengths. The curves in Figure 1 are only shown at 1 310 nm  
 169 wavelength.



170

171 **Figure 1 – Lateral offset and angular offset versus attenuation,  $\eta_{\text{combined}}$ , for single-mode**  
 172 **fibre with 8,9  $\mu\text{m}$  MFD at 1 310nm**

173

174 Attenuation  $\eta_{\text{combined}}$  is expressed in Formula (1) below:

$$175 \eta_{\text{combined}} = -10 \log_{10} \left[ \frac{(2\omega_2\omega_1)^2}{(\omega_2^2 + \omega_1^2)^2} \exp \left[ \frac{-2 \cdot d^2}{\omega_2^2 + \omega_1^2} - 2\pi^2 \frac{n_0^2}{\lambda^2} \frac{(\omega_2^2 \omega_1^2)}{(\omega_2^2 + \omega_1^2)} \sin^2(\theta) \right] \right] \quad (1)$$

176 where

- 177  $d$  is the total lateral offset between two fibres;  
 178  $\theta$  is the angular offset between fibre core axes;  
 179  $\lambda$  is the wavelength of transmitted light in vacuum;  
 180  $n_0$  is the index of refraction of the fibre core;  
 181  $\omega_1$  is the transmit fibre mode field radius;  
 182  $\omega_2$  is the receive fibre mode field radius.

183

### 184 5.3 Visual requirements for return loss grades

185 Without considering any contamination or defect on the end face, the intrinsic return loss for  
 186 angled polished physical contacting fibres is primarily governed by the polishing angle (see  
 187 Annex A). The appropriate polishing method shall be applied to obtain the return loss grade in  
 188 Table 2. The quality of the end face shall be inspected using IEC 61300-3-35. The visual  
 189 requirements for single-mode APC polished end faces in fibre core zone (Zone A), and fibre  
 190 cladding zone (Zone B) are shown in Table 4.

191 **Table 4 – Visual requirements for single-mode angle polished (APC) fibres**

192

<b>SM APC (RL ≥ 60 dB)</b>		
Zone (Diameter)	Defects (diameter)	Scratches (width)
A: core 25 µm	No limit < 2 µm Maximum 1 ≥ 2 µm and ≤ 3 µm None > 3 µm	No limit < 3 µm Maximum 4 ≥ 3 µm and ≤ 4 µm None > 4 µm
B: cladding 25 µm to 110 µm	No limit ≤ 25 µm None > 25 µm	No limit

193

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