

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**Fibre optic interconnecting devices and passive components – Connector optical interfaces –**

**Part 6-2: Connection of 50  $\mu\text{m}$  core diameter multimode physically contacting fibres – Non-angled for reference connector application, at wavelength of 850 nm using selected A1a fibre only**

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**Dispositifs d'interconnexion et composants passifs fibroniques – Interfaces optiques de connecteurs –**

**Partie 6-2: Connexion de fibres multimodales en contact physique d'un diamètre de cœur de 50  $\mu\text{m}$  – Connecteurs de référence sans angle, à une longueur d'onde de 850 nm et en utilisant uniquement les fibres A1a choisies**



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IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

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**FIBRE OPTIC INTERCONNECTING  
DEVICES AND PASSIVE COMPONENTS –  
CONNECTOR OPTICAL INTERFACES –****Part 6-2: Connection of 50 µm core  
diameter multimode physically contacting fibres –  
Non-angled for reference connector application,  
at wavelength of 850 nm using selected A1a fibre only**

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

FDIS	Report on voting
86B/4124/FDIS	86B/4128/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.

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

A list of all parts in the IEC 61755 series, published under the general title *Fibre optic interconnecting devices and passive components – Connector optical interfaces*, can be found on the IEC website.

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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# FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – CONNECTOR OPTICAL INTERFACES –

## Part 6-2: Connection of 50 µm core diameter multimode physically contacting fibres – Non-angled for reference connector application, at wavelength of 850 nm using selected A1a fibre only

### 1 Scope

This part of the IEC 61755 defines the dimensional limits of an optical interface for reference connectors necessary to meet specific requirements for fibre-to-fibre interconnection of non-angled polished multimode reference connectors with cylindrical ferrules intended to be used for attenuation measurements in the field or factory.

One grade of reference connector is defined in this document. The reference connector is terminated to selected IEC 60793-2-10:2015 A1a fibre. The geometrical dimensions and tolerances of the specified reference connector have been developed primarily to limit the variation in measured attenuation between multiple sets of two reference connectors, and therefore to limit the variation in measured attenuation between randomly chosen reference connectors when mated with connectors in the field or factory.

### 2 Normative references

[IEC 61755-6-2:2018](https://standards.iteh.ai/catalog/standards/sist/93dd41cb-c954-4b3c-bf39-1d5e6443f17e/iec-61755-6-2-2018)

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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 60793-2-10:2015, *Optical fibres – Part 2-10: Product specifications – Sectional specification for category A1 multimode fibre*

IEC 61300-3-4, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-4: Examinations and measurements – Attenuation*

### 3 Terms and definitions

No terms and definitions are listed in this document.

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>

## 4 Performance grade

This document currently only specifies one performance grade. However, the construction of the document allows inclusion for other grades in the future, if necessary. The performance grade for physical contact (PC) non-angled polished reference connectors detailed in this document is listed in Table 1.

The specified attenuation for the grade is obtained when the reference plug is connected with other reference plugs in a reference adapter, and the attenuation is measured in accordance with IEC 61300-3-4 (insertion method B).

**Table 1 – Multimode attenuation grade at 850 nm**

Reference grade	Attenuation dB	Contribution to measurement uncertainty <sup>a</sup> dB
1	≤ 0,1	±0,071
<sup>a</sup> As described in Annex A, related to the measurement of the attenuation between any connector according to the IEC optical interface standards and a population of reference connectors.		

## 5 Description

Optical reference connectors are connectors manufactured with restricted dimensional tolerances on dimensions that contribute to lateral and angular offset of such optical connections. These connectors are mainly used for attenuation measurement purposes and shall be considered as part of the measurement setup. The goal is to strongly reduce the measurement uncertainty. The attenuation uncertainties due to the reference connectors are defined in this document, and are discussed in Annex A.

The performance of an optical interface is not only determined by the alignment accuracy of the optical datum targets of two mating fibres, but also by any fibre parameter mismatches. There are three conditions affecting the alignment of two optical datum targets: lateral offset, angular offset and longitudinal offset.

Parameters influencing the lateral and angular offset of the optical fibre axes include the following:

- ferrule outside diameter;
- fibre hole true position;
- fibre hole angle relative to ferrule axis;
- fibre cladding diameter to fibre hole inner diameter;
- alignment sleeve inside diameter;
- fibre core true position relative to the fibre cladding diameter.

Parameters influencing the longitudinal offset of the optical fibre axes include the following:

- end face spherical radius;
- end face spherical radius apex offset;
- fibre undercut relative to the spherical ferrule radius;
- axial force on ferrule end face;
- ferrule and fibre material physical constraints;
- alignment sleeve frictional force.



Parameters influencing the fibre to fibre intrinsic attenuation include the following:

- core diameter (CD) mismatch;
- numerical aperture (NA) mismatch;
- core non circularity;
- alpha profile mismatch;
- refractive index mismatch.

The last three parameters are not considered in this document.

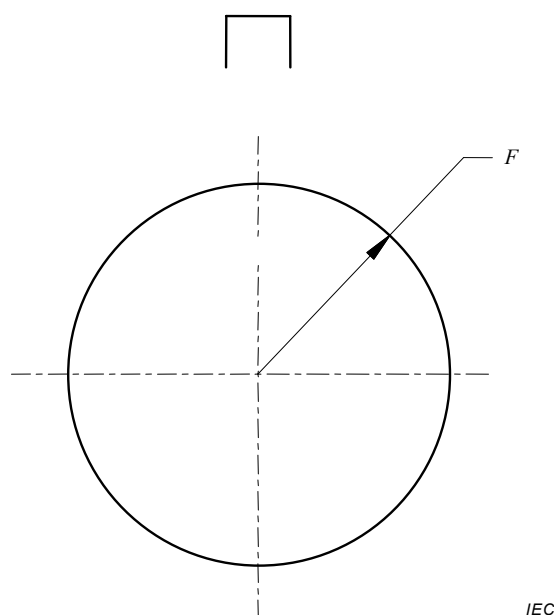
Parameters that govern the connector end face deformation, and control the physical contact of two mated connectors include the following:

- end face spherical radius;
- end face spherical radius apex offset;
- fibre undercut;
- axial force on ferrule end face;
- ferrule and fibre material physical constraints;
- alignment sleeve frictional force.

## 6 Criteria for a fit within the performance grade

Figure 1 and Table 2 give the criteria for meeting the performance grade as listed in Table 1. The parameters that are selected for the criteria definition are based on their degree of significance in affecting the performance.

Multimode reference connectors shall be terminated on multimode (MM) A1a 50 µm fibre, as specified in IEC 60793-2-10.



**Key**

*F* ferrule

**Figure 1 – Geometrical requirements for fibre core location after termination relative to the ferrule axis and the connector plug key**

**Table 2 – Optical interface parameter values for 1,25 mm and 2,5 mm diameter PC ferrules for MM reference connectors**

Parameters	Reference Grade 1		Unit	Remarks
	Minimum	Maximum		
<i>F</i>	0	0,5	µm	Eccentricity

**7 Use of selected fibre in reference-grade connectors**

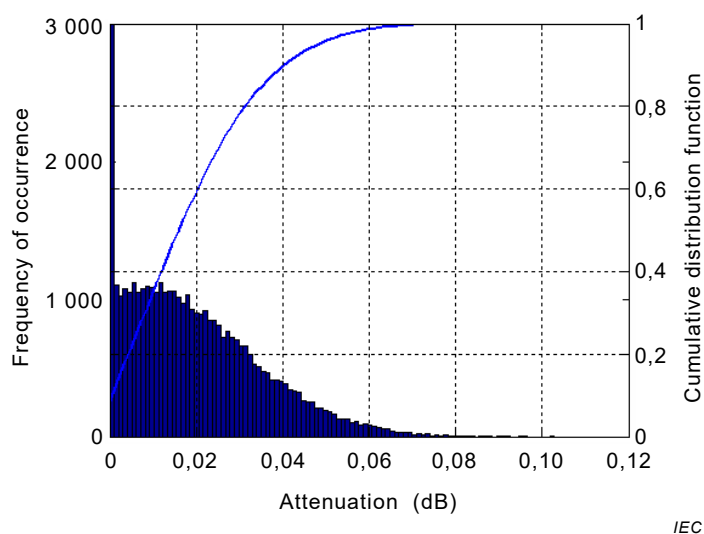
Selected fibre shall be used with a core diameter of  $50 \mu\text{m} \pm 0,5 \mu\text{m}$  and a numerical aperture of  $0,200 \pm 0,002$  to restrict the variability of attenuation measurements using reference connectors.

**8 Calculated attenuation of random mated grade 1 reference connectors**

The attenuation of a MM grade 1 reference connector for 1,25 and 2,5 mm PC ferrules is expected to be lower than 0,1 dB, when measured using a reference adapter against another randomly chosen reference connector according to this document (see Figure 2).

The selected fibre geometry parameters numerical aperture (NA) and core diameter (CD) and the eccentricity of the fibre core in the reference plug are assumed to be uniformly distributed.

Limiting the fibre core/cladding eccentricity may be required to achieve the required eccentricity of the fibre core in the ferrule.



**Figure 2 – Calculated attenuation of random mated grade 1 reference connectors**

## 9 Reference adapter

To qualify reference adapters, it is recommended to use reference connector plugs as defined in this document and measure the attenuation of the adapter in accordance with IEC 61300-3-42 with an attenuation variation smaller than 0,03 dB.

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Although the title of IEC 61300-3-42 refers to single mode alignment sleeves, the method also applies to MM types.

## 10 Attenuation measurement uncertainty contribution

Using the prescribed fibre geometry, including the tolerance parameters mentioned in Clause 6, it is possible to achieve measurements using grade 1 reference connectors that have an uncertainty of  $\pm 0,071$  dB, where reference connectors and adapters are randomly varied and the target encircled flux (EF) launch is satisfied (see Annex A).

## Annex A (informative)

### Multimode attenuation measurement uncertainty contribution

#### A.1 General

The attenuation of a multimode connectorised component (or connector) is measured against a reference connector in a reference adapter. Since reference connector parts vary within the tolerances allowed in this document, the variability has to be considered as a contribution to the attenuation measurement uncertainty of the setup.

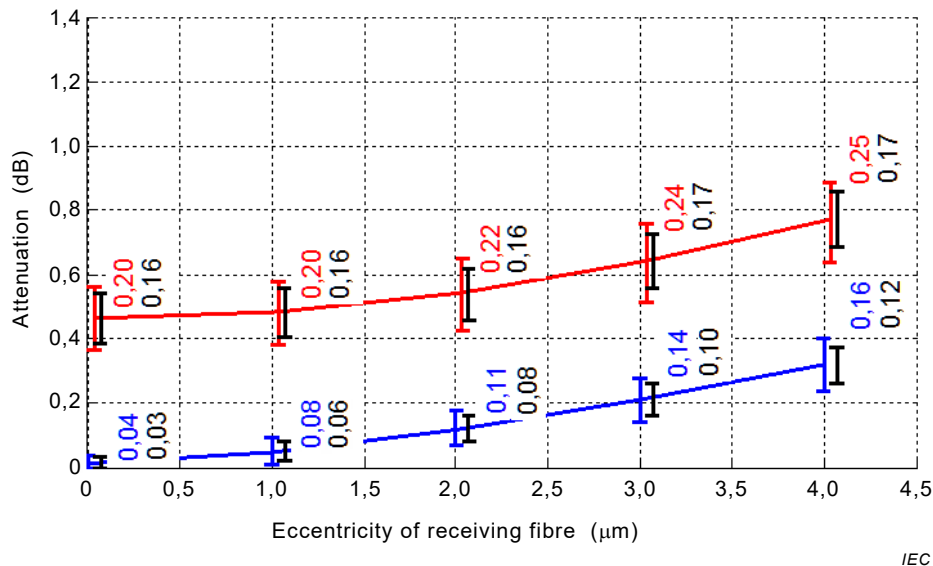
#### A.2 Sources of variability

##### A.2.1 Measurement condition and setup

This is the variability caused by factors such as power meter calibration, finite display resolution, linearity and connector/detector coupling repeatability, source stability and launch conditions. IEC TR 62627-04 gives a more detailed explanation of how to determine this uncertainty for single mode fibres.

##### A.2.2 Geometry mismatch

Another factor causing variability is the mismatch between the fibre geometry parameters of the reference connector and the DUT connector such as the core diameter (CD), the numerical aperture (NA), and the lateral offset. For the calculation, worst case mismatch is used assuming that the DUT fibre has a CD of 47,5 µm and a NA of 0,185. The calculated uncertainty also depends on the offset between the fibre cores of reference and DUT plugs. See Figure A.1.



**Figure A.1 – Attenuation measurement uncertainty contribution for grade 1 reference connectors resulting from lateral offset, NA and CD mismatch**

The red line presents the averaged result of a Monte Carlo simulation (MCS) of the calculated attenuation of a DUT plug with a worst case minimal CD and NA (47,5 µm and 0,185 NA) mated to 6 000 grade 1 reference connectors.