BS EN 50377-4-4:2011

BSI Standards Publication

Connector sets and interconnect components to be used in optical fibre communication systems — Product specifications

Part 4-4: Type SC-PC simplex terminated on IEC 60793-2-50 category B1.1 and B1.3 singlemode fibre, with full zirconia ferrule category U

National foreword

This British Standard is the UK implementation of EN 50377-4-4:2011.

The UK participation in its preparation was entrusted to Technical Committee GEL/86/2, Fibre optic interconnecting devices and passive components.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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Amendments issued since publication

Date	Text affected

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English version

Connector sets and interconnect components to be used in optical fibre communication systems - Product specifications - Part 4-4: Type SC-PC simplex terminated on IEC 60793-2-50 category B1.1 and B1.3 singlemode fibre, with full zirconia ferrule category U

Jeux de connecteurs et composants d'interconnexion à utiliser dans les systèmes de communication par fibres optiques -
Spécifications de produits -
Partie 4-4: Type simplex SC-PC câblé sur une fibre unimodale des catégories B1.1 et B1.3 de la CEI 60793-2-50, avec férule en zircone, catégorie U

Steckverbindersätze und Verbindungsbauelemente für Lichtwellenleiter-Datenübertragungssysteme -
Produktnormen -
Teil 4-4: Bauart SC-PC-Simplex zum Anschluss an Einmodenfasern der Kategorie B1.1 und B1.3 nach IEC 60793-2-50 mit Zirkonium-Ferrule für die Kategorie U

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 86BXA, Fibre optic interconnect, passive and connectorised components.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50377-4-4 on 2011-01-02.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2012-01-02
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2014-01-02

Connector sets and interconnect components to be used in optical fibre communication systems – Product specifications

Part 4-4: Type SC-PC simplex terminated on IEC 60793-2-50 category B1.1 and B1.3 singlemode fibre, with full zirconia ferrule category U

Description		Performance	
Coupling mechanism:	Push-pull	Application:	For use in EN category U (Uncontrolled environment)
Configuration:	Plug/adaptor/plug	Attenuation grade: (random mate)	B: ≤ 0,12 dB mean ≤ 0,25 dB for > 97 % of measurements
Fibre category:	EN 60793-2-50, Types B1.1 and B1.3		C: ≤ 0,25 dB mean ≤ 0,50 dB for > 97 % of measurements
Cable type:	see Table 3	Return loss grades: (random mate)	2: ≥ 45 dB

Related documents:

EN 60794-2, *Optical fibre cables – Part 2: Indoor cables – Sectional specification* (IEC 60794-2)

EN 61300 series, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures* (IEC 61300 series)

EN 61753-1, *Fibre optic interconnecting devices and passive components performance standard – Part 1: General and guidance for performance standards* (IEC 61753-1)

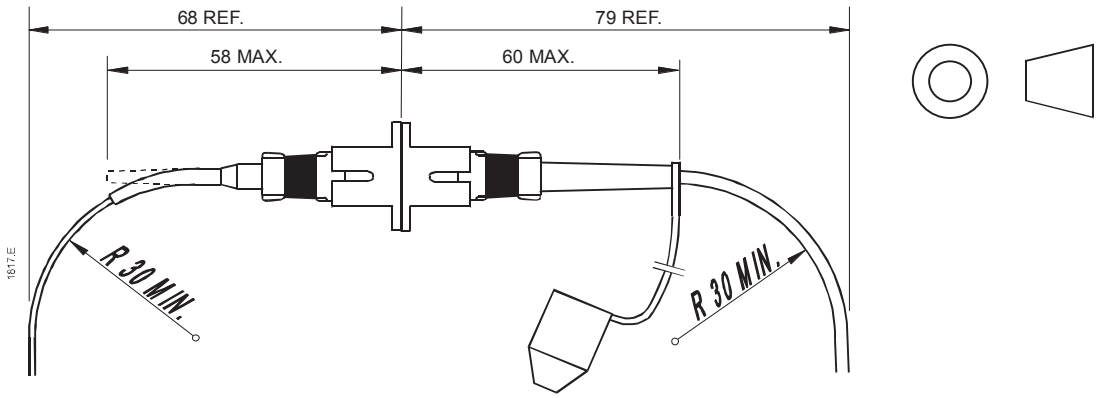
EN 61754-4, *Fibre optic connector interfaces – Part 4: Type SC connector family* (IEC 61754-4)

EN 61755-1, *Fibre optic connector optical interfaces – Part 1: Optical interfaces for single mode non-dispersion shifted fibres – General and guidance* (IEC 61755-1)

EN 61755-3-1, *Fibre optic connector optical interfaces – Part 3-1: Optical interface, 2,5 mm and 1,25 mm diameter cylindrical full zirconia PC ferrule, single mode fibre* (IEC 61755-3-1)

ETSI TS 100 671, *Transmission and Multiplexing (TM); Passive optical components; Optical fibre connectors for single mode optical fibre communication systems; Common requirements and conformance testing*

Outline and maximum dimensions:



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1 Scope

1.1 Product definition

This European Standard contains the initial, start of life dimensional, optical, mechanical and environmental performance requirements which a connector terminated with cylindrical zirconia PC ferrule and assembled singlemode resilient alignment sleeve SC-PC simplex connector set (plug/adaptor/plug), adaptor and patchcord must meet in order for it to be categorised as an EN standard product.

Since different variants and grades of performance are permitted, product marking details are given in 3.6.

1.2 Intermateability

Although all products conforming to the requirements of this European Standard will intermate, the resulting level of random attenuation performance will only be ensured in accordance with Table 1. The intention is that this will be true irrespective of the manufacturing source(s) of the product.

When intermating plug variants having different attenuation grades, the resulting level of attenuation cannot be assured to be any better than the worst attenuation grade.

The intermating of a Grade C plug with a Grade B plug will result in an uncertain level of random attenuation performance.

Table 1 – Ensured level of random attenuation

Plug attenuation grade	C	B
C	C	C
B	C	B

A simplex plug can be connected in a duplex adaptor without degrading its level of performance.

1.3 Operating environment

The tests selected combined with the severities and durations are representative of a category U environment described in EN 61753-1.

1.4 Reliability

Whilst the anticipated service life expectancy of the product in this environment is 20 years, compliance with this specification does not guarantee the reliability of the product. This should be predicted using a recognised reliability assessment programme.

1.5 Quality assurance

Compliance with this specification does not guarantee the manufacturing consistency of the product. This should be maintained using a recognised quality assurance programme.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 60793-2-50	Optical fibres – Part 2-50: Product specifications – Sectional specification for class B single-mode fibres (IEC 60793-2-50)
EN 61300 (series)	Fibre optic interconnecting devices and passive components – Basic test and measurement procedures (IEC 61300 series)
EN 61300-2-1	Part 2-1: Tests – Vibration (sinusoidal) (IEC 61300-2-1)
EN 61300-2-2	Part 2-2: Tests – Mating durability (IEC 61300-2-2)
EN 61300-2-4	Part 2-4: Tests – Fibre/cable retention (IEC 61300-2-4)
EN 61300-2-5	Part 2-5: Tests – Torsion/twist (IEC 61300-2-5)
EN 61300-2-6	Part 2-6: Tests – Tensile strength of coupling mechanism (IEC 61300-2-6)
EN 61300-2-7	Part 2-7: Tests – Bending moment (IEC 61300-2-7)
EN 61300-2-12	Part 2-12: Tests – Impact (IEC 61300-2-12)
EN 61300-2-17	Part 2-17: Tests – Cold (IEC 61300-2-17)
EN 61300-2-18	Part 2-18: Tests – Dry heat – High temperature endurance (IEC 61300-2-18)
EN 61300-2-22	Part 2-22: Tests – Change of temperature (IEC 61300-2-22)
EN 61300-2-26	Part 2-26: Tests – Salt mist (IEC 61300-2-26)
EN 61300-2-27	Part 2-27: Tests – Dust – Laminar flow (IEC 61300-2-27)
EN 61300-2-42	Part 2-42: Tests – Static side load for connectors (IEC 61300-2-42)
EN 61300-2-44	Part 2-44: Tests – Flexing of the strain relief of fibre optic devices (IEC 61300-2-44)
EN 61300-2-46	Part 2-46: Tests – Damp heat cyclic (IEC 61300-2-46)
EN 61300-3-6	Part 3-6: Examinations and measurements – Return loss (IEC 61300-3-6)
EN 61300-3-10	Part 3-10: Examinations and measurements – Gauge retention force (IEC 61300-3-10)
EN 61300-3-15	Part 3-15: Examinations and measurements – Dome eccentricity of a convex polished ferrule endface (IEC 61300-3-15)
EN 61300-3-16	Part 3-16: Examinations and measurements – Endface radius of spherically polished ferrules (IEC 61300-3-16)
EN 61300-3-23	Part 3-23: Examination and measurements – Fibre position relative to ferrule endface (IEC 61300-3-23)
EN 61300-3-28	Part 3-28: Examinations and measurements – Transient loss (IEC 61300-3-28)
EN 61300-3-34	Part 3-34: Examinations and measurements - Attenuation of random mated connectors (IEC 61300-3-34)
EN 61300-3-42	Part 3-42: Examinations and measurements - Attenuation of single mode alignment sleeves and or adaptors with resilient alignment sleeves (IEC 61300-3-42)
EN 61753-1	Fibre optic interconnecting devices and passive components performance standard – Part 1: General and guidance for performance standards (IEC 61753-1)
EN 61754-4	Fibre optic connector interfaces – Part 4: Type SC connector family (IEC 61754-4)
ISO 8015	Technical drawings – Fundamental tolerancing principle

3 Description

3.1 General

The SC-PC connector is a single position plug connector set of plug / adaptor / plug configuration characterised by a cylindrical, spring loaded butting ferrules of 2,5 mm nominal diameter and a push-pull coupling mechanism. The optical alignment mechanism of the connector is of a resilient sleeve style.

3.2 Plug

The plug features a cylindrical zirconia ceramic ferrule and a push-pull coupling mechanisms. The plug housing has a single male key, which is used to limit the relative rotation between mated plugs.

A cover (dust cap) to protect the ferrule end face when the connector is in the unmated condition shall be provided.

3.3 Adaptor

The adaptor has a zirconia ceramic resilient alignment sleeve. The mounting style is a rectangular flange – simplex.

Covers (dust caps) are provided to protect each port of the adaptor.

3.4 Materials

Materials which are not specified or which are not specifically described are left to the discretion of the manufacturer.

3.5 Dimensions

Outline dimensions and other dimensions necessary to ensure intermateability or which affect performance are specified. All other dimensions are left to the discretion of the manufacturer. Where the mating face limit dimensions are not in agreement with an EN Interface Standard this is clearly stated.

3.6 Colour and marking

Marking of the product shall be in the following order of precedence:

– identification of manufacturer;

– manufacturing date code: year/week;

– manufacturers part number;

– variant identification number.

The preferred colour scheme is given in Table 2.

Table 2 – Preferred colour scheme

Delatch housing plug	Adaptor
Blue, RAL 5015	Blue, RAL 5015

4 Variants

4.1 Terminated plug

The defined fibre/cable variants are given in Table 3.

Table 3 – Plug variants

Variant No.	Fibre/Cable ∅ mm	Structure
01	0,7 – 1,4	Buffered fibre
02	2,0 ± 0,2	Reinforced cable
03	2,5 ± 0,2	Reinforced cable
04	2,8 ± 0,2	Reinforced cable
05	3,0 ± 0,2	Reinforced cable
06	3,2 ± 0,2	Reinforced cable

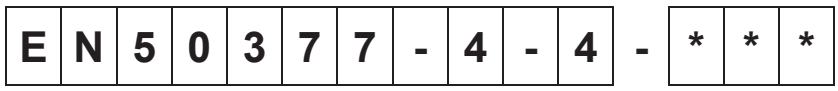
Variant	Attenuation grade
B	B
C	C

Variant	Return loss grade
2	2

4.2 Adaptor

The defined adaptor variants are given in Table 4.

Table 4 – Adaptor variants



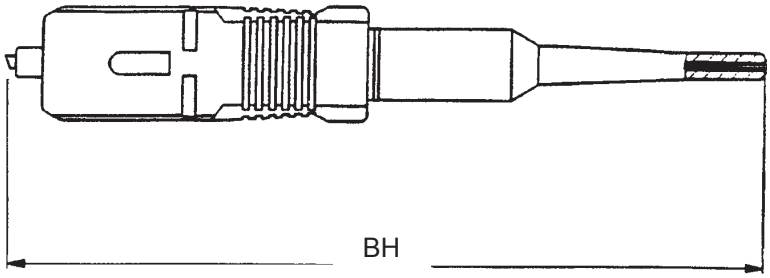
Variant number	Format
A01	Rectangular flange – simplex

5 Dimensional requirements

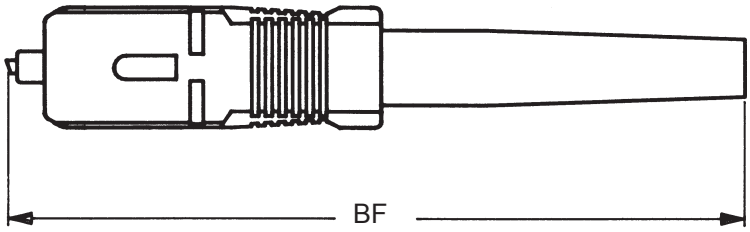
5.1 Outline dimensions

5.1.1 Plug

Variant No. 01



Variants No. 02 – 06

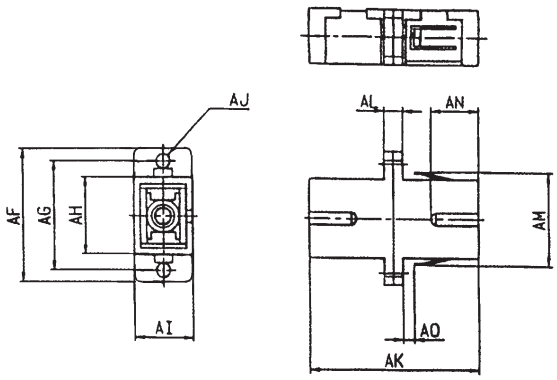


Reference	Dimensions			Notes
	min.	mm	max.	
BH			58	
BF			60	

Figure 1 – Outline dimensions – Plug

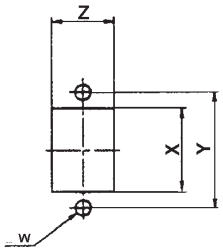
5.1.2 Adaptor

Variant No. A01. See Figure 2a).



Reference	Dimensions			Notes
	min.	mm	max.	
AF	21,5		22,5	
AG	17,9		18,1	
AH	12,6		13,0	
AI	9,2		9,4	
AJ	2,2		2,4	Diameter
AK	27,0		27,8	
AL	2,8		3,2	
AM	14,4		16,4	
AN	7,7		8,0	
AO	1,7		2,0	See Note
NOTE Panel thickness should be between 1,0 mm and 1,5 mm.				

a) Outline dimensions – Adaptor



Reference	Dimensions			Notes
	min.	mm	max.	
W	2,4		2,6	Diameter
X	13,1		13,5	
Y	17,9		18,1	
Z	9,5		10,0	

b) Outline dimensions – Panel cut out

Figure 2 – Outline dimensions – Adaptor and panel cut out

5.2 Mating face and other limit dimensions

5.2.1 Plug

The mating face dimensions are in accordance with EN 61754-4. See Figure 3.

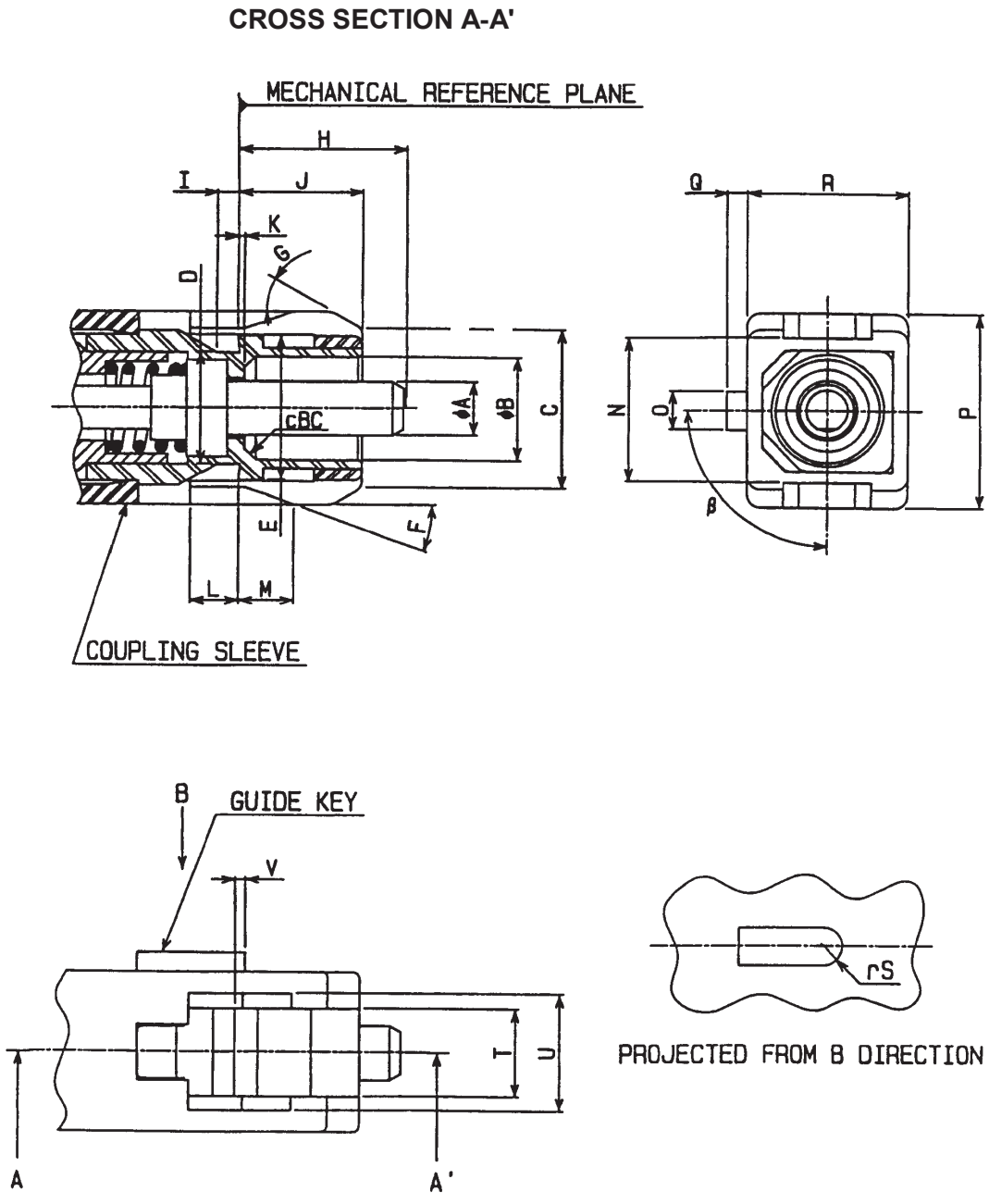


Figure 3 – Plug mating face and other limit dimensions

Reference	Dimensions		Notes
	min. mm	max.	
A	2,498 5	2,499 5	Diameter [d]
B	4,80	4,90	Diameter
C	6,80	7,40	
D	4,90	5,30	
E	6,70	6,80	
F	19	23	Degree
G	25	35	Degree
H	7,15	7,50	[a] [b]
β	89,5	90,5	Degree
I	0,80	1,20	
J	5,30	5,50	
K	-0,10	0,05	[c]
L	2,11	2,50	
M	2,00	2,80	
N	6,60	6,80	
O	1,60	1,80	
P	8,89	8,99	
Q	0,80	1,00	
R	7,29	7,39	
rS	0,80	0,90	Radius
T	4,05	4,15	
U	5,40	5,60	
V	0	0,50	
cBC	0	0,50	Chamfer

[a] Dimension H is given for a plug endface when not mated. The ferrule is movable by a certain axial compression force, with direct contacting endface, and therefore dimension H is variable. Ferrule compression force shall be 7,8 N to 11,8 N when the position of the optical datum target, dimension H is moved to the range 7,00 mm ± 0,10mm. Forces are for buffered fibre only. For different cord constructions allow higher forces of 7,8 to 12,8 N.

[b] This value shows the dimension after the ferrule is polished and in the unmated condition.

[c] The negative dimension refers to the position of the inside bottom plane in the direction towards the rear of the connector relative to the mechanical reference plane.

[d] Envelope condition in accordance with ISO 8015.

Figure 3 – Plug mating face and other limit dimensions *(continued)*

5.2.2 Adaptor

See Figure 4.

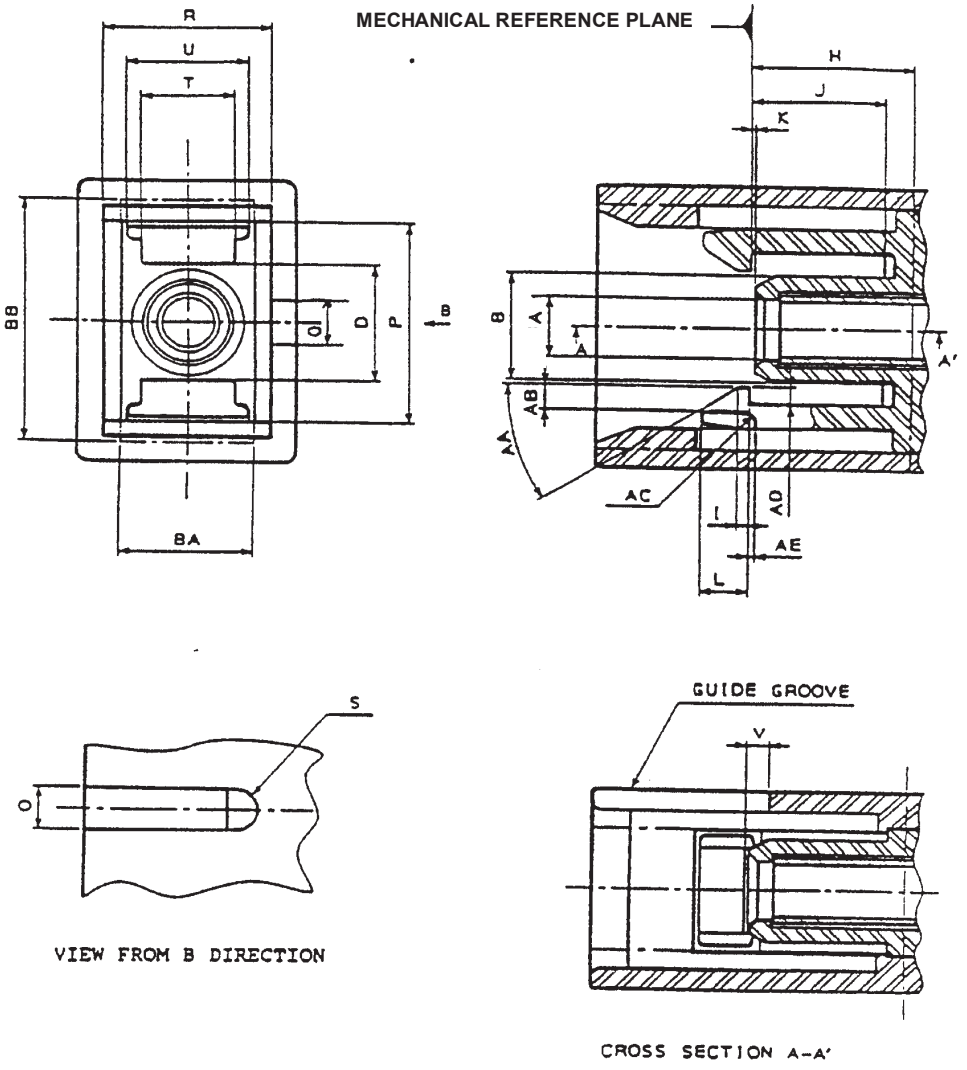


Figure 4 – Adaptor mating face and other limit dimensions

Reference	Dimensions		Notes
	min.	mm max.	
A			Diameter [a]
B	4,69	4,79	Diameter
D	4,9	5,5	
H	6,9	7,1	
I	0,4	0,8	
J	5,51	5,9	
K	0,06	1	
L	1,9	2,1	
O	2,0	2,2	
P	9,0	9,1	
R	7,4	7,5	
S	1,0	1,1	
T	3,8	4,04	
U	5,0	5,4	Degree
V	0,6	1,6	
AA	27	33	Degree
AB	0,8	1,0	
AC	0,4	0,6	
AD	0,7	0,8	
AE	0,4	0,6	
BA	5,4	5,6	
BB	10,8	11,2	

[a] The connector alignment feature is a zirconia ceramic resilient sleeve which is free to move in the adaptor. Alternative materials may be used for the sleeve that has directly compatible materials properties with zirconia. The gauge retention force shall be measured with 2 gauge pins, each inserted to the middle of the alignment feature. The gauge retention force shall be from 2,0 N to 5,9 N, for the extraction of one gauge. The surface roughness of the inside of the alignment sleeve shall be R_a < 0,3 µm.

Figure 4 – Adaptor mating face and other limit dimensions *(continued)*

5.2.3 Ferrule endface geometry after termination

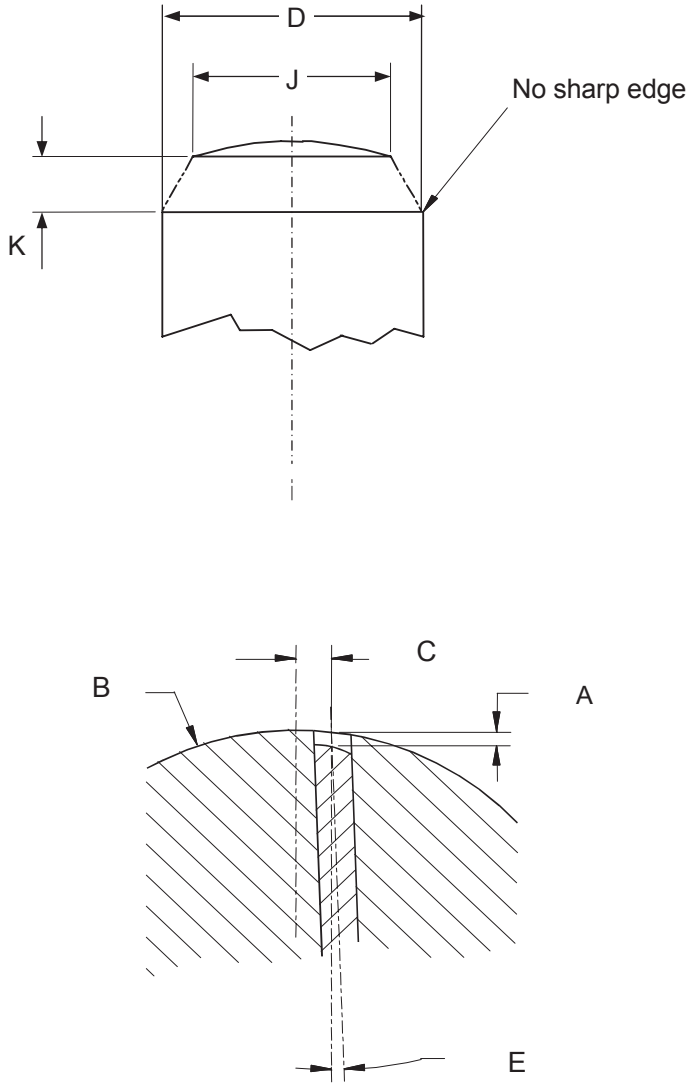


Figure 5 – Ferrule endface geometry after termination

Table 5 – Optical interface parameter values for PC ferrules

Reference	Parameter values		Notes
	min.	max.	
J	0,8	NA	Diameter
K	NA	1,8	

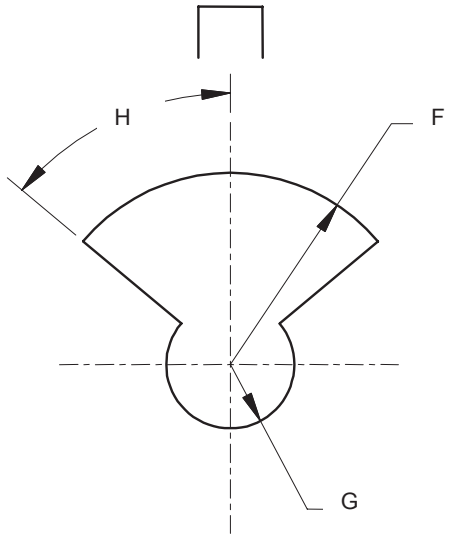


Figure 6 – Positioning of fibre core

Table 6 – Geometrical parameters

Reference	Parameter values				Notes
	Grade B		Grade C		
	min.	max.	min.	max.	
A	- 100	[a]	- 100	[a]	[c d], nm
B	5	30	5	30	See Radius [c], mm
C	0	50	0	50	See dome offset [b] µm
D	2,498 5	2,499 5	2,498 5	2,499 5	Diameter, mm
E	0	0,2	0	0,3	Degrees
F	0	0,001 2	0	0,001 5	Radius, mm
G	0	0,000 3	0	0,000 3	Radius, mm
H	0	50	0	50	Degrees
J	0,8	-	0,8	-	Diameter, mm
K	-	1,8	-	1,8	mm

[a] Contact force 4,9 N min. The given endface conditions are for 3 mol % Yttria stabilised Zirconia ZrO_2 ferrule with grain size < 0,35 µm, a Young's modulus between (200 ± 20) GPa and a Poisson ratio between 0,30 and 0,31 which is normative for this specification.

[b] The dome offset is defined as a distance between the ferrule centre and the vertex of the spherically polished endface.

[c] The radius and fibre undercut shall be measured in all directions over a diameter of 0,25 mm.

[d] The negative value refers to fibre protrusion.

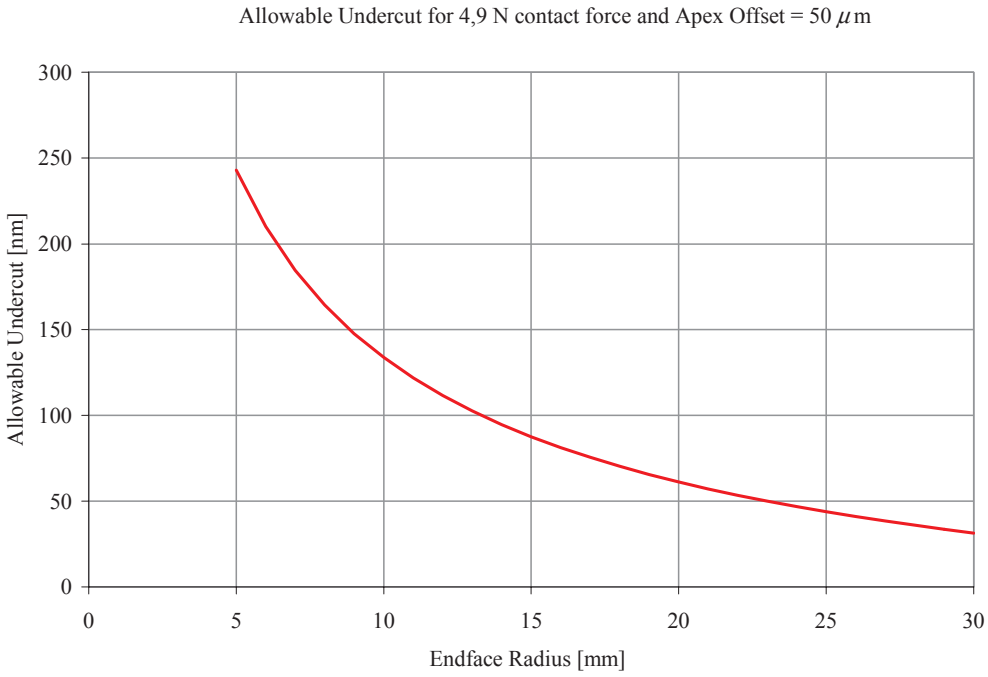


Figure 7 – Ferrule end face geometry – Allowable undercut

The figure and the values above define the parameters that must be met by each individual plug in order to ensure that the specified random attenuation performance grade will be met in any connection.

$$A_{Maximum} = 1\,988 \times B^{(-0,795)} - B \times 10^{6} + \left(\sqrt{B^{2} \times 10^{6} - C^{2}}\right) \times 10^{3} - 60$$

where

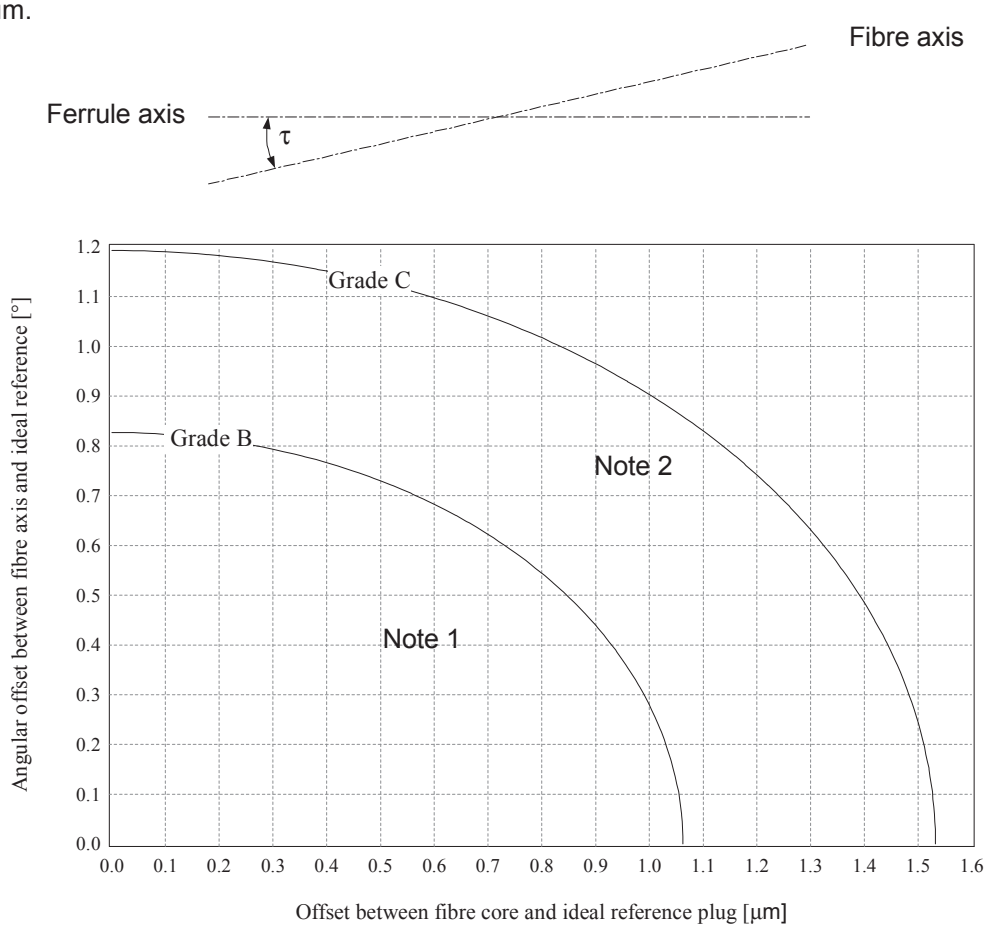
B is the radius of Zirconia ferrule [mm];

A is the fibre position relative to ferrule end face [nm];

C is the dome offset [µm].

5.2.4 Control of fibre core position and axis

Figure 8 shows the relationship between the axis of the fibre and the position of the fibre core relative to the optical datum.



The figure and the values above define the parameters that should be met by an individual plug after termination in order to ensure that the specified random attenuation performance grade will be met. The graph lines for grade B and C give the maximum value for the two parameters to be met by any plug after the manufacturing process. The specified random performance however can only be met with a Raleigh distribution of each of these parameters. The lines are based on a worst case mode field diameter mismatch.

$$\mathrm{IL\ (dB)} = -10\log\left(\frac{2W_1W_2}{\left(W_1^2+W_2^2\right)}\right)^2 * e^{-\left(\frac{2\left(\pi N_1 W_1 W_2 \hat{\tau}\right)^2}{\lambda^2\left(W_1^2+W_2^2\right)}+\frac{2a^2}{\left(W_1^2+W_2^2\right)}\right)}$$

where

W_i is the mode field radii (µm), i = 1,2
(calculation for the above curve is done with W_1 = 4,45 µm; W_2 = 4,75 µm);

N_1 is the refractive index between the endfaces
(in this case it is equal to the refractive index of the core);

a is the fibre core offset (µm);

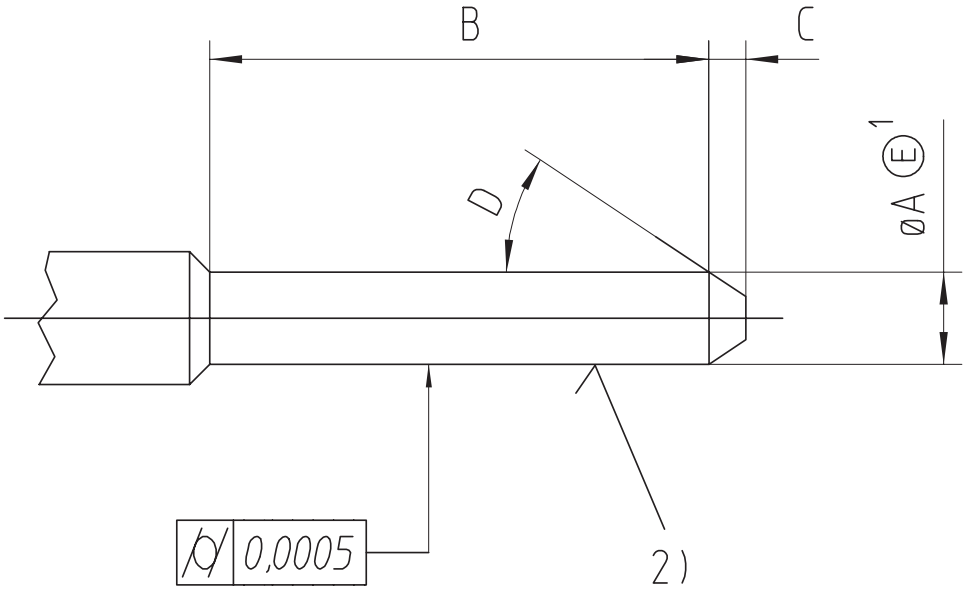
$\hat{\tau}$ is the fibre angle in radians;

λ is the wavelength (calculation for the above curve is done with 1 310 nm).

NOTE Ideal reference plug has zero angular offset and zero lateral offset.

Figure 8 – Requirements for the attenuation grades for the plug fibre core connected to the ideal reference

5.2.5 Pin gauge for adaptor



Reference	Dimensions		Notes
	min.	mm max.	
A	2,499 3	2,499 5	See Note 1, diameter
B	12,5	13,5	
C	1,0	1,5	
D	28	32	Angle in degrees
NOTE 1 Envelope condition in accordance with ISO 8015.			
NOTE 2 Surface roughness $R_a \leq 0{,}1$ µm.			

Figure 9 – Pin gauge for adaptor

6 Tests

6.1 Sample size

All samples shall be randomly selected. For the purposes of this European Standard, a sample is defined as a plug connector set.

All samples shall be randomly selected.

The sample size and product sourcing requirements are given in Annex C.

The length of cable (or fibre) on each side of the connector set shall be at least 2,0 m.

6.2 Test and measurement methods

All tests and measurements have been selected from EN 61300 series.

Unless otherwise stated in the individual test details all attenuation measurements shall be performed at both (1 310 ± 30) nm and (1 550 ± 30) nm, all return loss measurements shall be performed at (1 550 ± 30) nm.

Attenuation change is defined as the difference between the maximum and minimum values of attenuation measured during the test.

No deviation from the specified test method is allowed.

6.3 Test sequence

All products shall be subjected to Tests 1 to 3 (see Annex C) following which there is no defined sequence in which Tests 3 to 19 must be run.

6.4 Pass/fail criteria

A product will have met the requirements of this European Standard provided no failures occur in the sample group for any test.

In the event of a failure occurring, the test shall be re run using a sample size double that of the original.

7 Test report

A fully documented test report and supporting data shall be prepared and must be available for inspection as evidence that the tests described in Clause 8 have been carried out in accordance with this European Standard.

8 Performance requirements

8.1 Dimensional and marking requirements

Dimensions and marking of the product, including any associated spring force, shall be in accordance with the requirements of 3.6 and Clause 5, and shall be measured and inspected using the appropriate EN test method.

End face geometry shall be measured before and after the completion of climatic testing and shall meet the requirements as stated in 5.2.3.

The methods to be used are EN 61300-3-15, EN 61300-3-16 and EN 61300-3-23.

8.2 Optical performance requirements

Table 7 – Optical performance requirements

No.	Test	Requirement	Details	
1	Adaptor performance (between matched reference connectors) [a]	< 0,10 dB	Method:	EN 61300-3-42 Place the slit of the sleeve at the positions 12, 3, 6 and 9 o'clock and measure the attenuation of the adaptor between 2 matched reference connectors. Reverse the adaptor between the connectors and measure the attenuation again with the slit at the positions 12, 3, 6 and 9 o'clock.
			Source type:	LED
			Peak wavelength:	(1 310 ± 30) nm
			Source stability:	≤ ± 0,01 dB over the measuring period or at least 1 h
			Detector linearity:	Within ± 0,01 dB over the dynamic range to be measured
			Launch fibre length:	> 2 m. Only the fundamental mode shall propagate at the connector interface to be tested and at the detector.
			Pre-conditioning procedure:	Clean plug and adaptor according to manufacturer's instructions.
2	Attenuation (random mate) [b]	Grade B ≤ 0,12 dB mean ≤ 0,25 dB for ≥ 97 % of measurements Grade C ≤ 0,25 dB mean ≤ 0,50 dB for ≥ 97 % of measurements 20 randomly mated plugs. For plug / adaptor / plug connector sets, 10 adaptors, randomly selected shall be used (100 randomly mated connector sets).	Method:	EN 61300-3-34
			Source type:	LED
			Peak wavelength:	(1 310 ± 30) nm
			Source stability:	Source output shall not vary more than ± 0,05 dB from its initial power over the measuring period of time or at least 1 h.
			Detector linearity:	Within ± 0,05 dB over the dynamic range to be measured
			Launch fibre length:	> 2 m. Only the fundamental mode shall propagate at the connector interface to be tested and at the detector.
			Pre-conditioning procedure:	Clean plug and adaptor according to manufacturer's instructions.

Table 7 – Optical performance requirements *(continued)*

No.	Test	Requirement	Details	
3	Return loss (random mate)	Grade 2 ≥ 45 dB 20 randomly mated connectors. For plug / adaptor / plug connector sets, 10 adaptors, randomly selected shall be used (100 randomly mated connector sets).	Method:	EN 61300-3-6, Method 1
			Source type:	LED
			Peak wavelength:	(1 310 ± 30) nm.
			Source stability:	Source output shall not vary more than ± 0,05 dB from its initial power over the measuring period of time or at least 1 h.
			Detector linearity:	Within ± 0,05 dB over the dynamic range to be measured
			Launch fibre length:	> 2 m. Only the fundamental mode shall propagate at the connector interface to be tested and at the detector.
			Directivity:	> 70 dB
			Method:	EN 61300-3-6, Method 2
			Pre-conditioning procedure:	Clean plug and adaptor in accordance to manufacturer's instructions.

[a] Matched reference connector definition is given in Annex B.

[b] Attenuation measurement tests against reference connectors (EN 61300-3-4) are intended to be used should quality conformance be required (see Annex A). Random mating attenuation test (EN 61300-3-34) is to be used during qualification to ensure that the requirements of the appropriate grade are met.

8.3 Mechanical performance requirements

Table 8 – Mechanical performance requirements

No.	Test	Requirement	Details	
4	Vibration (sinusoidal)	Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (Initial and final attenuation must be ≤ specified value for the class) Return loss: (initial and final) ≥ 45 dB	Method:	EN 61300-2-1
			Frequency range:	10 Hz to 55 Hz at 1 octave/min
			Vibration amplitude:	0,75 mm
			Duration/axis:	30 min
			No. of axes:	3
			Specimen optically functioning:	Yes
			Measurements required:	Before, during and after test (max. sampling interval shall be 2 ms, according to EN 61300-3-28.)
			Attenuation:	According to Table 7
			Return loss:	According to Table 7
			Pre-conditioning procedure:	Clean plug and adaptor according to manufacturer's instructions.

Table 8 – Mechanical performance requirements *(continued)*

No.	Test	Requirement	Details	
5	Mating durability	Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (Initial and final attenuation must be ≤ specified value for the class) Return loss: (initial and final) ≥ 45 dB	Method: Mechanism to be cycled: Number of cycles: Specimen optically functioning: Measurements required: Attenuation: Return loss: Pre-conditioning procedure:	EN 61300-2-2 Plug-adaptor 500 Yes After every mating According to Table 7 According to Table 7 Clean plug and adaptor according to manufacturer's instructions as necessary but not more than 25 times.
6	Fibre/cable retention	Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (Initial and final attenuation must be ≤ specified value for the class) Return loss: (initial and final) ≥ 45 dB	Method: Magnitude and rate of application of the tensile force: Point of application of the load: Duration of max. load: Specimen optically functioning: Measurements required: Sampling rate: Pre-conditioning procedure:	EN 61300-2-4 Var. 01*: (5 ± 0,5) N at 0,5 N/s Var. 02*: (70 ± 2) N at 5 N/s Var. 03* - 06*: (100 ± 2) N at 5 N/s Var. *01: 0,3 m from plug Var. *02 / *06: On strength member 0,3 m from plug. The connector shall be rigidly mounted such that the load is applied to the fibre/cable retention mechanism and not to the coupling mechanism. 2 min at 100 N 1 min at 5 N Yes Before, during (continuous) and after the test (5 min recovery period) Measurements shall be made after the load has been maintained at its maximum level for at least 30 s. Clean plug and adaptor according to manufacturer's instructions.

Table 8 – Mechanical performance requirements *(continued)*

No.	Test	Requirement	Details	
7	Strength of coupling mechanism	Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (Initial and final attenuation must be ≤ specified value for the class) Return loss: (initial and final) ≥ 45 dB	Method: Magnitude of load: Duration of the load: Rate of application of the load: Point of application of the load: Specimen optically functioning: Measurements required: Sampling rate: Pre-conditioning procedure	EN 61300-2-6 40 N 2 min max. 2 N/s Var.*02 / *06 0,2 m from rear of plug Yes Before during and after the test (5 min recovery period) Measurements shall be made after the load has been maintained at its maximum level for at least 30 s. Clean plug and adaptor according to manufacturer's instructions.
8	Impact	Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (Initial and final attenuation must be ≤ specified value for the class) Return loss: (initial and final) ≥ 45 dB	Method: Number of drops: Drop height: Specimen optically functioning: Measurements required: Pre-conditioning procedure: Recovery procedure:	EN 61300-2-12, Method A 5 1,5 m No (Specimen shall be unmated during impact test.) Before and after the test Fit dust cap Clean plug and adaptor according to manufacturer's instructions.
9	Torsion	Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (Initial and final attenuation must be ≤ specified value for the class) Return loss: (initial and final) ≥ 45 dB	Method: Magnitude and rate of application of the torsional load: Duration of application of the load: Point of application of the load: Specimen optically functioning: Measurements required: Sampling rate: Pre-conditioning procedure: Recovery procedure:	EN 61300-2-5 Var. *01: 2 N at 0,1 N/s Var. *02 / *06: 15 N at 1 N/s 25 cycles ± 180° (not to exceed cable specification) 0,2 m from rear of plug body Yes Before, during (continuous) and after the test Measurements shall be made after the load has been maintained at its maximum level for at least 30 s. Clean plugs and adaptors in accordance to manufacturer's instructions. 5 min recovery period

Table 8 – Mechanical performance requirements *(continued)*

No.	Test	Requirement	Details	
10	Flexing of the strain relief	Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change before and after test ≤ 0,30 dB change during test (Initial and final attenuation must be within specified grade.) Return loss: ≥ 45 dB	Method: Magnitude of the load: No. of cycles: Point of application of the load: Specimen optically functioning: Measurements required: Sampling rate: Pre-conditioning procedure: Recovery procedure:	EN 61300-2-44 Var. 02*- 06*: 5 N 100 cycles (± 90°) 0,2 m from rear of plug body Yes Before, during and after test (Max. sampling interval shall be 2 ms, according to EN 61300-3-28.) Max. sampling interval shall be 2 ms. Clean plug and adaptor according to manufacturer's instructions. 5 min recovery period.
11	Static side load	Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (Initial and final attenuation must be ≤ specified value for the class) Return loss: (initial and final) ≥ 45 dB	Method: Magnitude of the load: Point of application of the load: Method of mounting: Duration of load: Specimen optically functioning: Measurements required: Sampling rate: Attenuation: Return loss: Pre-conditioning procedure:	EN 61300-2-42 Var. *01: 0,2 N (90° to plug axis) Var. *02 / *06: 1 N (90° to plug axis) 0,5 m from rear of plug An adaptor shall be mounted rigidly to the mounting. Var. *01: 5 min Var. *02 / *06: 1 h Yes Before, during (continuous) and after the test Max interval: 3 min According to Table 7 According to Table 7 Clean plug and adaptor according to manufacturer's instructions.

Table 8 – Mechanical performance requirements *(continued)*

No.	Test	Requirement	Details	
12	Bending Moment	Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (Initial and final attenuation must be ≤ specified value for the class) Return loss: (initial and final) ≥ 45 dB	Method:	EN 61300-2-7
			Magnitude of the load:	Var. *02 - *06: 10 N smoothly applied.
			Point of application of the load:	25 mm from the centreline of the ferrule axis as shown in Figure 3
			Duration of the load:	25 s
			Method of mounting:	An adaptor shall be mounted rigidly to the mounting fixture.
			Specimen optically functioning:	Yes
			Measurements required:	Before, during (continuous) and after the test
			Sampling rate:	Measurements shall be made after the load has been maintained at its maximum level for at least 15 s.
			Attenuation:	According to Table 7
			Return loss:	According to Table 7
			Pre-conditioning procedure:	Clean adaptors and plugs in accordance to manufacturer's instructions.
13	Gauge retention force	Allowable gauge retention force: Max. 5,9 N Min. 2,0 N	Method:	EN 61300-3-10
			Gauge dimensions and characteristics:	See Figure 9
			Pre-conditioning procedure:	Clean adaptors and plugs in accordance to manufacturer's instructions.

8.4 Environmental performance requirements

Table 9 – Environmental performance requirements

No.	Test	Requirement	Details	
14	Cold	Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (Initial and final attenuation must be ≤ specified value for the class) Return loss: (initial and final) ≥ 45 dB	Method: Temperature: Duration of cycle: Specimen optically functioning: Measurements required: Attenuation: Return loss: Pre-conditioning procedure: Recovery procedure:	EN 61300-2-17 - 25 °C 96 h Yes Before, during (max. interval 1 h) and after the test According to Table 7 According to Table 7 Clean plug and adaptor according to manufacturer's instructions. 2 h at normal ambient conditions
15	Dry heat – High temperature endurance	Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (Initial and final attenuation must be ≤ specified value for the class) Return loss: (initial and final) ≥ 45 dB	Method: Temperature: Duration of cycle: Specimen optically functioning: Measurements required: Pre-conditioning procedure: Recovery procedure: Recovery procedure:	EN 61300-2-18 + 70 °C 96 h Yes Before, during (max. interval 1 h) and after the test Clean plug and adaptor according to manufacturer's instructions. 2 h at normal ambient conditions 2 h at normal ambient conditions
16	Change of temperature	Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (Initial and final attenuation must be ≤ specified value for the class) Return loss: (initial and final) ≥ 45 dB	Method: Low temperature: High temperature: Duration at temperature extreme: Rate of change of temperature: Number of cycles: Specimen optically functioning: Measurements required: Attenuation: Return loss: Pre-conditioning procedure: Recovery procedure:	EN 61300-2-22 - 25 °C + 70 °C 1 h 1 °C/min 12 Yes Before, during (max. interval 10 min) and after the test According to Table 7 According to Table 7 Clean plug and adaptor according to manufacturer's instructions. 2 h at normal ambient conditions

Table 9 – Environmental performance requirements *(continued)*

No.	Test	Requirement	Details	
17	Dust	Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (Initial and final attenuation must be ≤ specified value for the class) Return loss: (initial and final) ≥ 45 dB	Method: Dust type: Dust particle size: Dust concentration: Temperature: Relative humidity: Duration of exposure: Specimen optically functioning: Measurements required: Preconditioning procedure: Recovery procedure:	EN 61300-2-27 Talc d < 150 µm (10,6 ± 7) g/m³ + 35 °C 30 % 10 min No Before and after the test Clean adaptors and plugs in accordance to manufacturer's instructions. 2 h at normal ambient conditions
18	Salt mist	Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (Initial and final attenuation must be ≤ specified value for the class) Return loss: (initial and final) ≥ 45 dB	Method: Atmosphere: Temperature: Duration of exposure: Specimen optically functioning: Measurements required: Preconditioning procedure: Recovery procedure:	EN 61300-2-26 Salt solution 5 % NaCl pH 6,5 – 7,2 + 35 °C 96 h No Before and after the test Clean adaptors and plugs in accordance to manufacturer's instructions. 2 h at normal ambient conditions
19	Damp heat cyclic	Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (Initial and final attenuation must be ≤ specified value for the class) Return loss: (initial and final) ≥ 45 dB	Method: High temperature: Low temperature: Duration of cycle: Specimen optically functioning: Number of cycles: Measurements required: Pre-conditioning procedure: Recovery procedure:	EN 61300-2-46 + 55 °C + 25 °C 24 h Yes 6 Before, during (max. interval 1 h) and after the test. Clean plug and adaptor according to manufacturer's instructions. 2 h at normal ambient conditions

Annex A
(informative)

Attenuation against reference

Attenuation measurement tests against reference connectors (EN 61300-3-4) are intended to be performed should quality conformance be required. When these measurements are required the following test details are valid.

Table A.1

Attenuation (against reference connector)	Grade B: ≤ 0,25 dB Grade C: ≤ 0,5 dB	Method:	EN 61300-3-4, Method B
		Source type:	LED/LD
		Peak wavelength:	(1 310 ± 30) nm and (1 550 ± 30) nm
		Source stability:	≤ ± 0,01 dB over the measuring period or at least 1 h
		Detector linearity:	Within ± 0,01 dB over the dynamic range to be measured
		Launch fibre length:	> 2 m – Only the fundamental mode shall propagate at the connector interface to be tested and at the detector.
		Pre-conditioning procedure:	Clean plug and adaptor according to manufacturer's instructions.

Table A.2 – Reference connector details

Ferrule outer diameter	(2,499 ± 0,000 5) mm
Eccentricity of fibre core centre to ferrule centre	≤ 0,000 3 mm
Deviation of axis of fibre to axis of ferrule	≤ 0,2°
Dome offset of spherically polished ferrule endface	≤ 30 µm
Visual examination of fibre endface with ×200 magnification	No defects in core zone
Attenuation between two reference plugs at 1 310 nm	≤ 0,10 dB
Visual examination	Every 50 matings

Annex B
(normative)

Adaptor matched reference plug details

Table B.1

Ferrule outer diameter	(2,499 ± 0,000 5) mm
Eccentricity of fibre core centre to ferrule centre	≤ 0,000 3 mm
Deviation of axis of fibre to axis of ferrule	≤ 0,2°
Dome offset of spherically polished ferrule endface	≤ 30 µm
Visual examination of fibre endface with ×200 magnification	No defects in core zone
Attenuation between two matched reference plugs in a reference adaptor in all 8 measuring positions	≤ 0,03 dB
Visual examination	Every 50 matings

The matched reference plug shall have the same geometrical characteristics as the plug under test and is selected from products meeting the requirements from Annex A.

The visual examination shall be repeated every 50 matings.

Annex C
(normative)

Sample size and product sourcing requirements

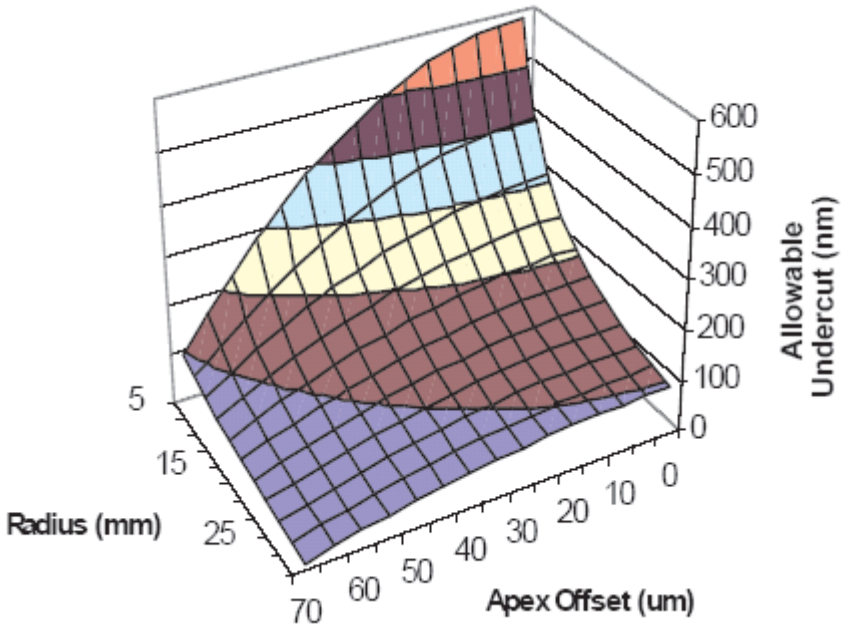
Table C.1

No.	Test	Sample size		Source
		Plug	Adaptor	
NA	Endface geometry	all	NA	New and after all tests are completed
NA	Dimensional	5	5	New
1	Adaptor performance (between matched reference plugs)	NA	20	New
2	Attenuation (random mate)	20	10	New
3	Return loss (random mate)	10	10	Test 2
4	Vibration (sinusoidal)	4	2	Test 2
5	Mating durability	4	2	Test 2
6	Fibre/cable retention	4	2	Test 2
7	Strength of coupling mechanism	4	2	Test 15
8	Impact	4	2	Test 2
9	Torsion	4	2	Test 2
10	Flexing	4	2	Test 2
11	Static side load	4	2	Test 2
12	Bending moment	4	2	Test 2
13	Gauge retention force	NA	4	Test 2
14	Cold	8	4	Test 2
15	Dry heat	8	4	Test 2
16	Change of temperature pigtail patchcord	8 4	4 8	Test 2
17	Dust	8	4	Test 2
18	Salt mist	8	4	Test 2
19	Damp heat (cyclic)	8	4	Test 2

The above tests are intended to be performed individually in any order on products sourced as defined. Products from previous tests may be used.

Annex D
(informative)

Zirconia ferrule response surface



NOTE This graph is a qualitative representation only.

Figure D.1 – Radius vs. undercut and apex offset

Bibliography

EN 60794-2	Optical fibre cables – Part 2: Indoor cables – Sectional specification (IEC 60794-2)
EN 60794-2-50	Optical fibre cables – Part 2-50: Indoor cables – Family specification for simplex and duplex cables for use in terminated cable assemblies (IEC 60794-2-50)
EN 61300-3-4	Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-4: Examinations and measurements – Attenuation (IEC 61300-3-4)
EN 61300-3-35	Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-35: Examinations and measurements – Fibre optic connector endface visual and automated inspection (IEC 61300-3-35)
EN 61755-1	Fibre optic connector optical interfaces – Part 1: Optical interfaces for single mode non-dispersion shifted fibres – General and guidance (IEC 61755-1)
EN 61755-2-1	Fibre optic connector optical interfaces – Part 2-1: Optical interface standard single mode non-angled physically contacting fibres (IEC 61755-2-1)
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