



BSI Standards Publication

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

Part 8-10: Type LSH-APC simplex terminated on IEC 60793-2-50 category B1.1 and B1.3 singlemode fibre with titanium composite ferrule for category C

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National foreword

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The UK participation in its preparation was entrusted by Technical Committee GEL/86, Fibre optics, to Subcommittee 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.

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**Connector sets and interconnect components to be used in optical fibre communication systems - Product specifications -
Part 8-10: Type LSH-APC simplex terminated on IEC 60793-2-50 category B1.1 and B1.3 singlemode fibre with titanium composite ferrule for category C**

Jeux de connecteurs et composants d'interconnexion à utiliser dans les systèmes de communication par fibres optiques - Spécifications de produits - Partie 8-10: Type LSH-APC simplex raccordé sur des fibres unimodales de catégorie B1.1 et B1.3 de la CEI 60793-2-50, avec fêrulle en composite de titane, pour utilisation en catégorie C

Steckverbindersätze und Verbindungsbaulemente für Lichtwellenleiter-Datenübertragungssysteme - Produktnormen - Teil 8-10: Bauart LSH-APC-Simplex zum Anschluss an Einmodenfasern der Typen B1.1 und B1.3 nach IEC 60793-2-50 mit Titanium-Komposit-Stift für die Kategorie C

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European Committee for Electrotechnical Standardization
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Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 86BXA, Fibre optic interconnect, passive and connectorised components. It was submitted to the formal vote and approved by CENELEC on 2010-04-01.

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with the EN have to be withdrawn (dow) 2013-04-01
-

Connector sets and interconnect components to be used in optical fibre communication systems – Product specifications			
Part 8-10: Type LSH-APC simplex terminated on IEC 60793-2-50 category B1.1 and B1.3 single mode fibre with titanium composite ferrule for Category C			
Description		Performance	
Coupling mechanism:	latched push-pull	Application:	For use in Category C (controlled environment)
Configuration:	plug/adaptor/plug	Attenuation grades: (random mate)	B: $\leq 0,12$ dB mean $\leq 0,25$ dB for > 97 % of measurements
Fibre category	EN 60793-2-50 type B1.1 & B1.3		C: $\leq 0,25$ dB mean $\leq 0,50$ dB for > 97 % of measurements
Cable type:	see Table 3	Return loss grade:	1: ≥ 60 dB (mated) ≥ 55 dB (unmated)
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 61754-15	Fibre optic interconnecting devices and passive components – Fibre optic connector interfaces – Part 15: Type LSH connector family (IEC 61754-15)		
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 61755-3-8	Fibre optic interconnecting devices and passive components – Fibre optic connector optical interfaces – Part 3-8: Optical interface, 2,5 mm and 1,25 mm diameter cylindrical 8 degrees angled-APC composite ferrule using titanium as fibre surrounding material, single mode fibre (IEC 61755-3-8)		
Outline and maximum dimensions:			

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1 Scope

1.1 Product definition

This standard contains the initial, start of life dimensional, optical, mechanical and environmental performance requirements which a terminated and assembled singlemode resilient alignment sleeve LSH-APC 8° 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 3.5.

1.2 Intermateability

Although all products conforming to the requirements of this 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 variant/Attenuation grade	C	B
C	C	C
B	C	B

1.3 Operating environment

The tests selected combined with the severities and durations are representative of a Category C environment as defined 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 standard 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 standard 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 61300-2-1 Fibre optic interconnecting devices and passive components – Basic test and measurement procedures –
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 61300-2-6	Part 2-6: Tests – Tensile strength of coupling mechanism (IEC 61300-2-6)
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 61300-2-19	Part 2-19: Tests – Damp heat (steady state) (IEC 61300-2-19)
EN 61300-2-22	Part 2-22: Tests – Change of temperature (IEC 61300-2-22)
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 61300-3-6	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: Examination 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)
ISO 8015	Technical drawings – Fundamental tolerancing principle

3 Description

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

3.1 Plug

The plug features a cylindrical composite ferrule using titanium as fibre surrounding material and a push-pull mechanism. It has a single male key which is used to limit and may be used to orientate, the relative rotation between mated connectors. The plug has mechanical and colour coding.

3.2 Adaptor

The adaptor has a zirconia ceramic resilient alignment sleeve. The mounting style can be:

- square flange – 2 hole fixing;
- square flange – side clip fixing;
- square flange – top bottom clip fixing.

Covers (dust caps) shall be provided to protect each port of the adaptor. The adaptor has a mechanical colour coding.

3.3 Materials

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

3.4 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.

3.5 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 following colour scheme is preferred:

Table 2 – Preferred colour scheme

Adaptor	Delatch housing
Green	Green
Preferred RAL number 6018.	

4 Variants

4.1 Terminated plug

The following variants are permitted:

Table 3 – Plug variants

E N 5 0 3 7 7 - 8 - 1 0 - * * * - * 1

No.	Fibre/Cable Ø mm	Structure
01	0,6 – 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

Mechanical code	Colour code for the latch	Note
0	Green	See NOTE, not coded
1	Red, RAL 3020	
2	Brown, RAL 8004	
3	Yellow, RAL 1016	
4	Orange, RAL 2003	
5	Violet, RAL 4008	
6	White, RAL 9010	

NOTE Universal, intermatable to all mechanical and colour coded adaptors.

Code	Attenuation grade
B	B
C	C

Code	Return loss grade
1	1

4.2 Adaptor

The following variants are permitted:

Table 4 – Adaptor variants

E N 5 0 3 7 7 - 8 - 1 0 - D * * *

No.	Format
01	Square flange 2 hole screw fixing
02	Square flange side clip fixing
03	Square flange top-bottom clip fixing

Mechanical code	Colour Code for the frame	Note
0	Green	See NOTE, not coded
1	Red, RAL 3020	
2	Brown, RAL 8004	
3	Yellow, RAL 1016	
4	Orange, RAL 2003	
5	Violet, RAL 4008	
6	White, RAL 9010	

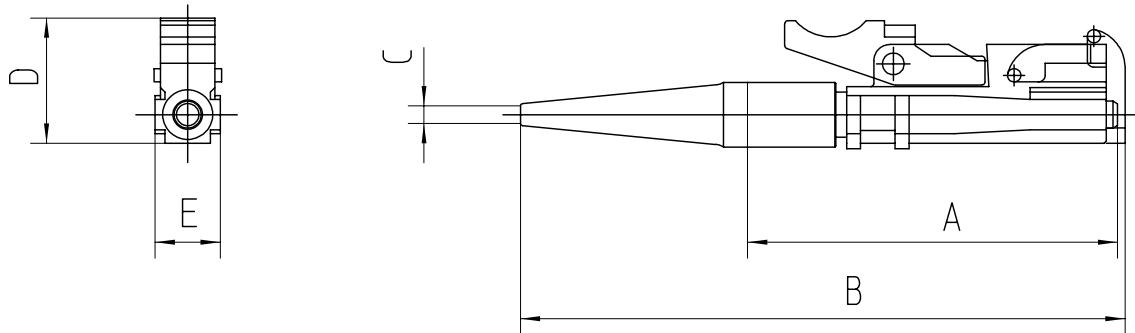
NOTE Universal, intermatable to all mechanical and colour coded plugs.

5 Dimensional requirements

5.1 Outline dimensions

5.1.1 Plug variants

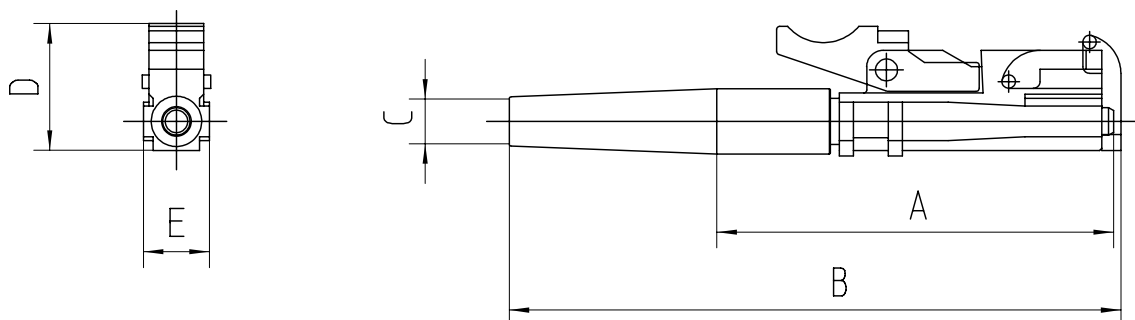
Variant No. 01* (*, third digit related to mechanical coding)



Ref.	Dimensions		Note	
	min.	mm		max.
A	-		34	See NOTE
B	-		60	
C	0,7		1,4	
D	-		13,05	
E	5,95		5,98	

NOTE Rigid length.

Variant No. 02*/03*/04*/05*/06*



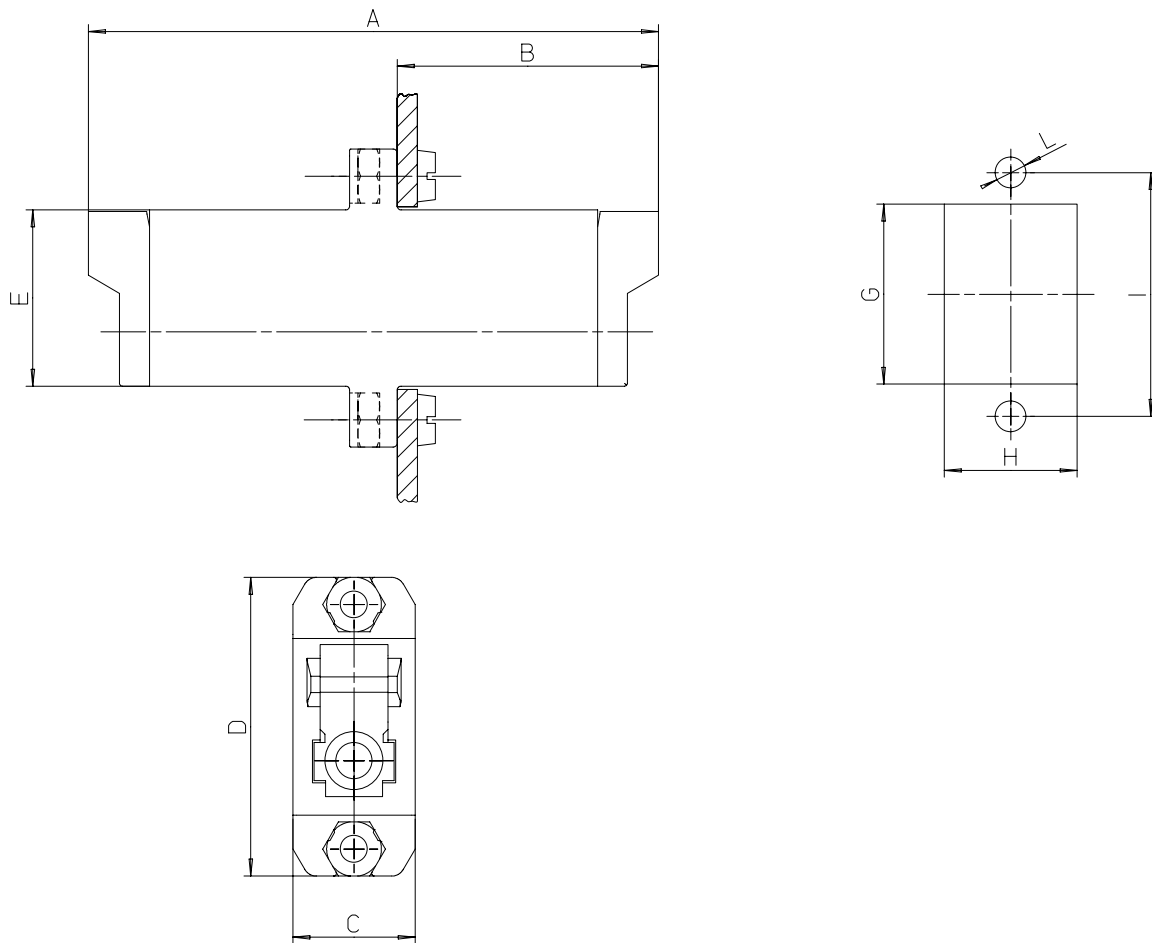
Ref.	Dimensions		Note	
	min.	mm		max.
A	-		38	See NOTE
B	-		60	
C	1,8		3,5	
D	-		13,05	
E	5,95		5,98	

NOTE Rigid length.

Figure 1 – Outline dimensions – Plug

5.1.2 Adaptor variants

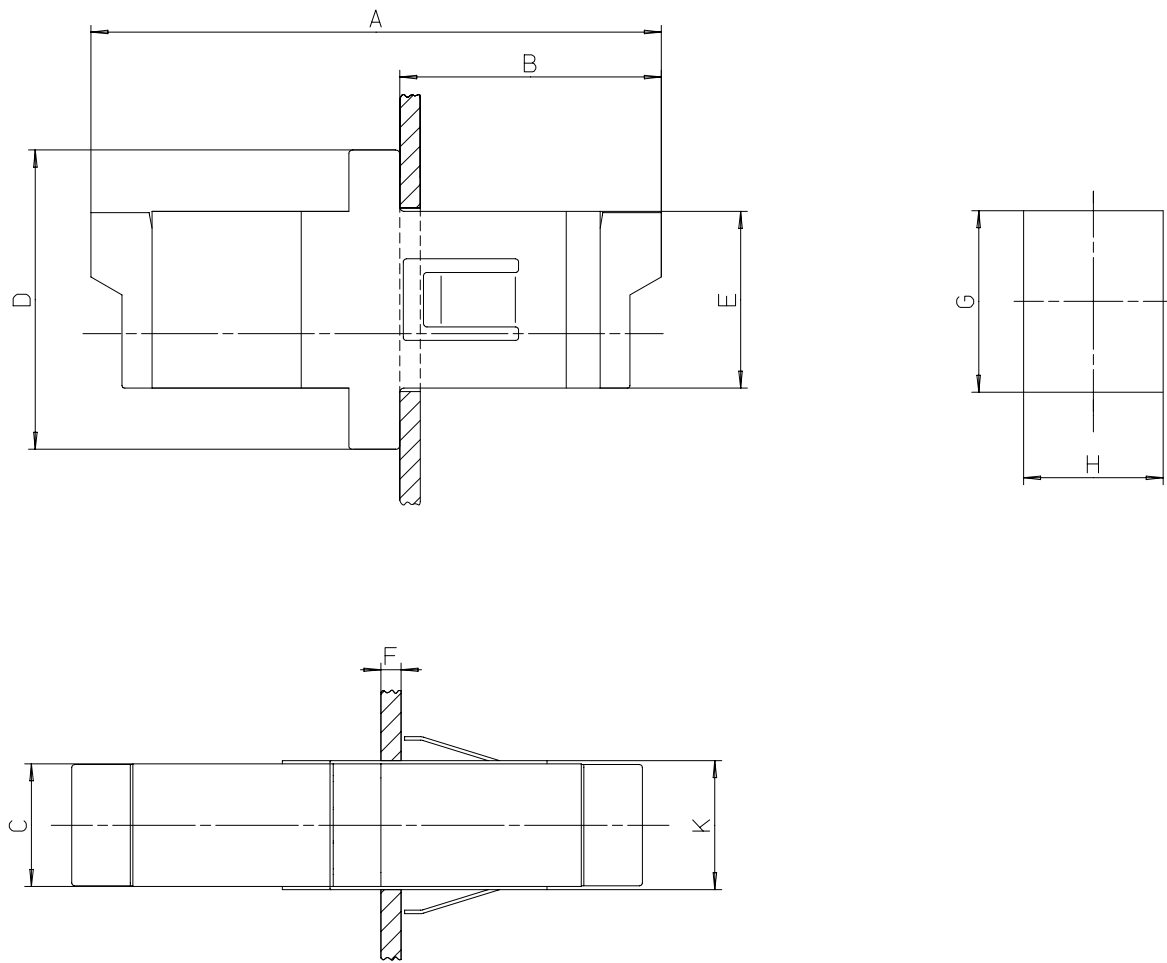
Variant No. D01* (*, fourth character related to mechanical coding)



Ref.	Dimensions		Note
	min.	max.	
A	41,7	42,5	
B	19,0	19,4	
C	-	9	
D	-	22,1	
E	-	13,05	
G	13,1	13,5	
H	9,6	10,0	
I	17,9	18,1	
L	2,2	2,4	Diameter

Figure 2 – Outline dimensions – Adaptor

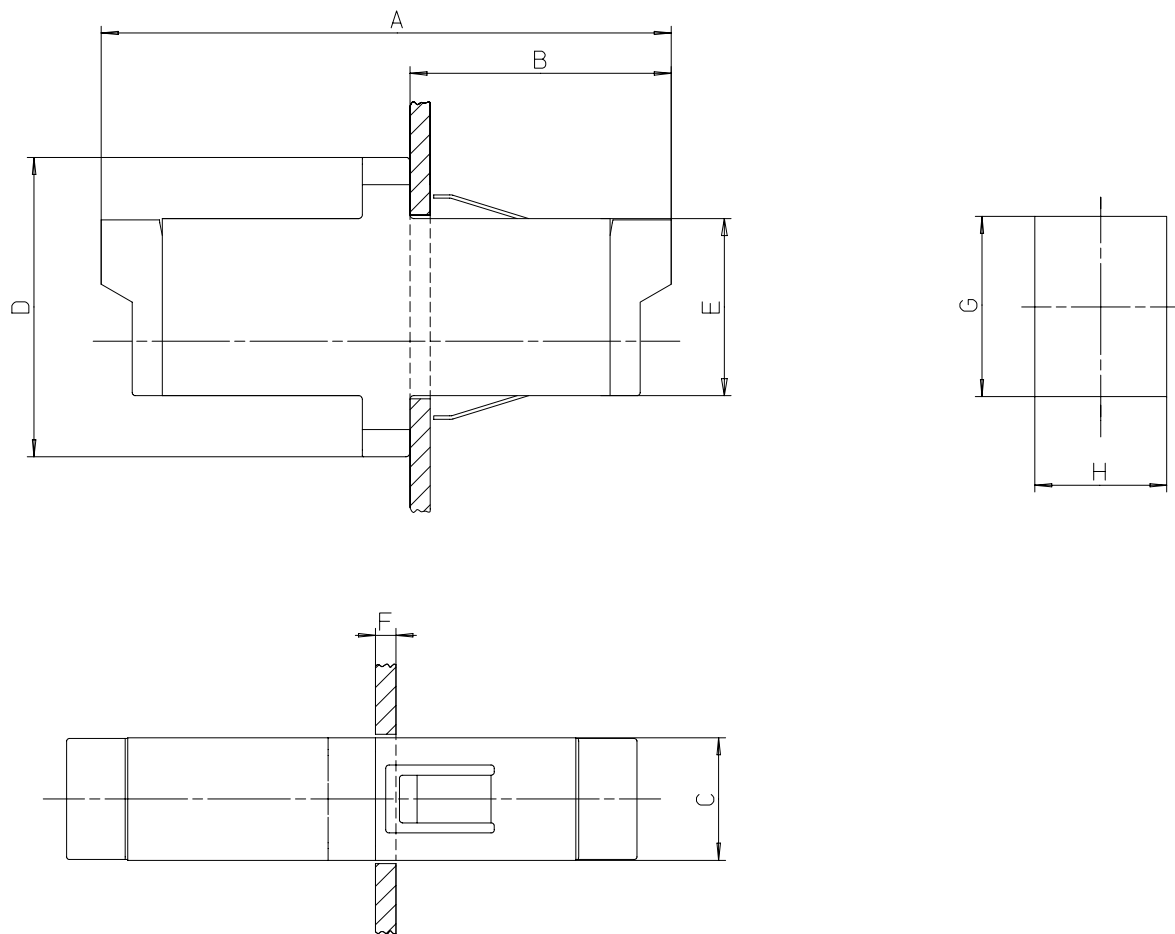
Variant No. D02*



Ref.	Dimensions		Note
	min.	mm	
A	41,7		42,5
B	19,0		19,4
C	-		9
D	-		22,2
E	-		13,1
F	1,3		1,6
G	13,1		13,5
H	9,6		10,0
K	-		9,6

Figure 2 – Outline dimensions – Adaptor (continued)

Variant No. D03*



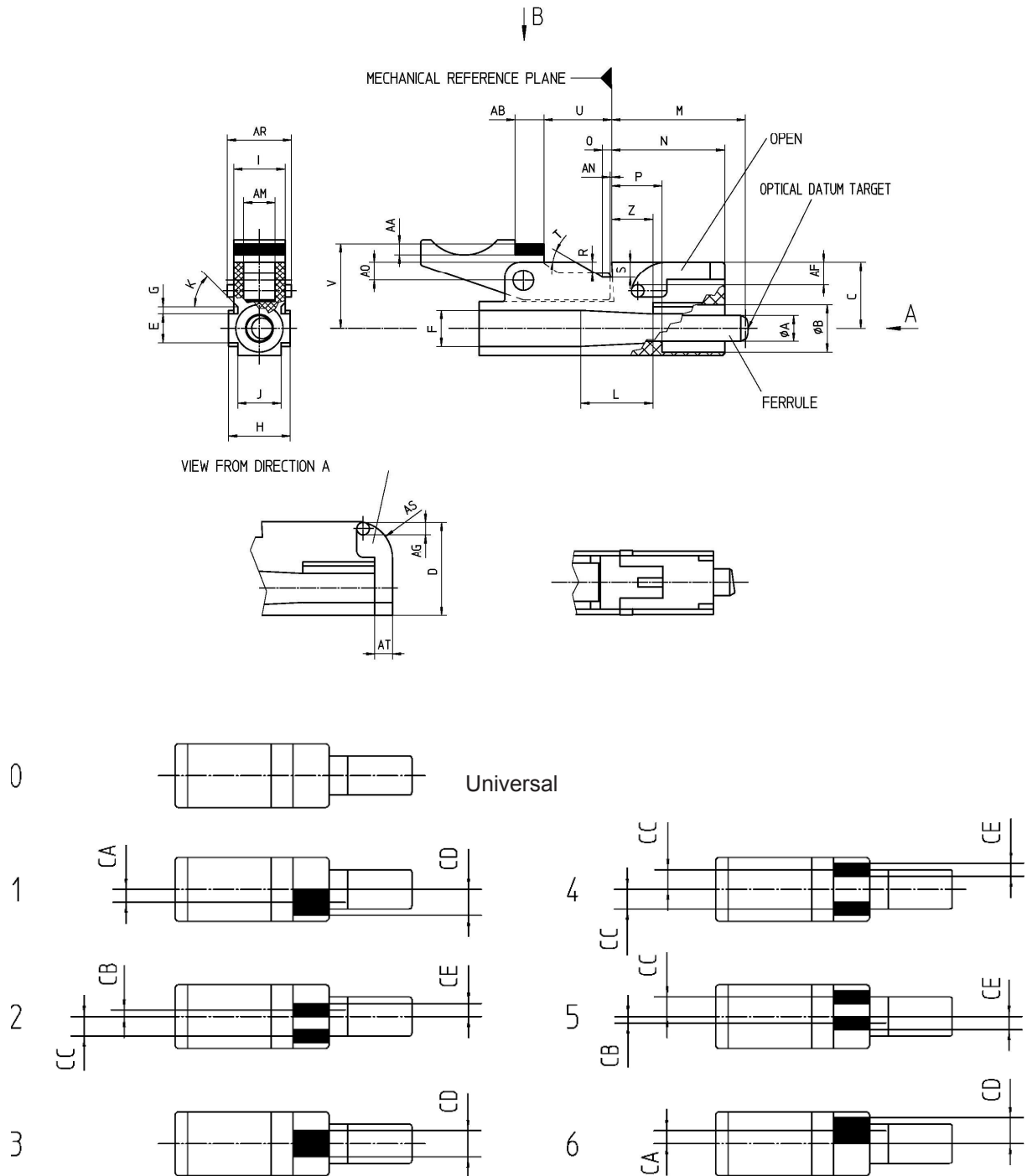
Ref.	Dimensions		Note
	min.	mm	
A	41,7		42,5
B	19,0		21,4
C	-		9
D	-		22,2
E	-		13,1
F	1,3		1,6
G	13,1		13,5
H	9,6		10,0

Figure 2 – Outline dimensions – Adaptor (continued)

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5.2 Mating face and other limit dimensions

5.2.1 Plug



View from direction B (mechanical colour coding according to Table 2) only latch.

Figure 3 – Mating face and other limit dimensions – Plug

Ref.	Dimensions		Note
	min.	max.	
A	-	-	Diameter See NOTES 2 and 3, Table in Figure 5
B	4,45	4,55	Diameter
C	6,25	6,29	
D	8,82	8,9	
E	2,75	2,79	
F	2,95	2,99	
G	0,67	1,0	
H	5,95	5,98	
I	4,93	4,98	
J	4,13	4,18	
K	45	60	Angle in degrees
L	6,1	6,5	
M (free)	12,05	-	See NOTE 1
M (mated)	11,9	-	See NOTE 1
N	10,9	11,1	
O	0,9	1,5	
P	4,5	5,1	
R	1,2	1,5	
S	1,25	1,35	
T	25	36	Angle in degrees
U	6,8	7,2	
V	8,2	8,4	
Z	3,9	4,1	
AA	0,95	-	
AB	2,5	2,8	
AF	2,2	2,3	
AG	1,15	1,2	
AM	3,0	3,2	
AN	0,1	0,3	
AO	1,5	2,0	
AR	-	6,2	
AS	2,8	3,5	
AT	1,65	1,8	
CA	0,99	1,01	
CB	0,49	0,51	
CC	1,49	1,51	
CD	1,96	2,04	
CE	0,95	1,05	

NOTE 1 Dimension M (free) refers to the plug in the unmated condition. Dimension M (mated) varies according to the axial compression generated when mated. The axial compression force shall be between 7,8 N and 11,8 N when dimension M (mated) is between 12,0 mm and 11,9 mm.

NOTE 2 Envelope condition in accordance with ISO 8015.

NOTE 3 Surface roughness $R_a \leq 0,1 \mu\text{m}$.

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

5.2.2 Ferrule endface geometry and fibre core position after termination

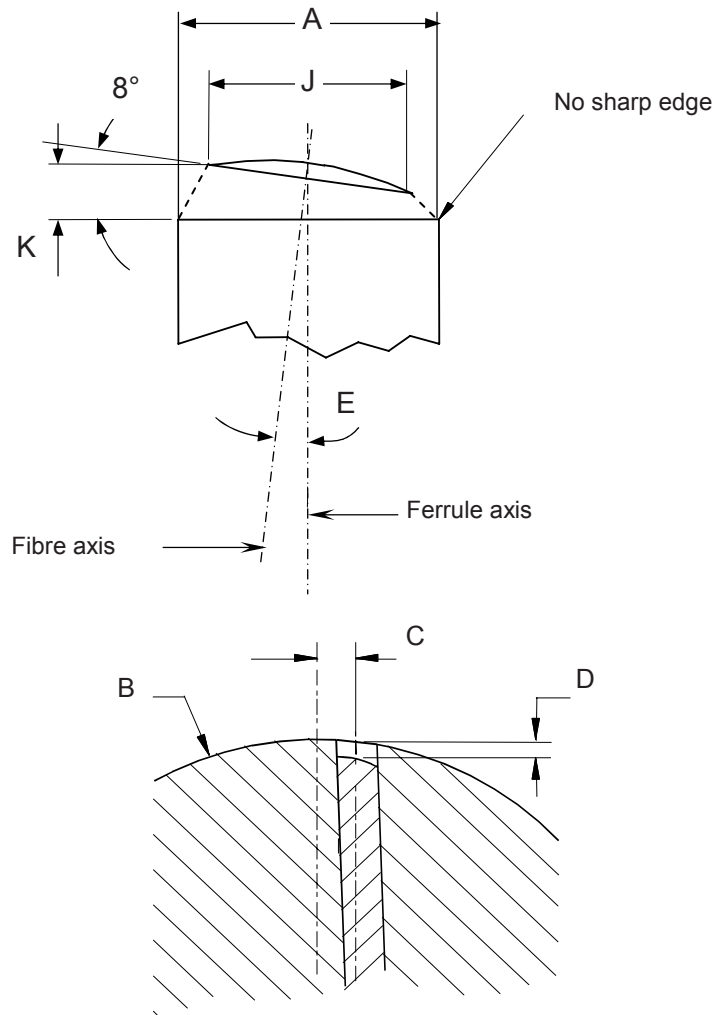


Figure 4 – Ferrule end face geometry – After termination

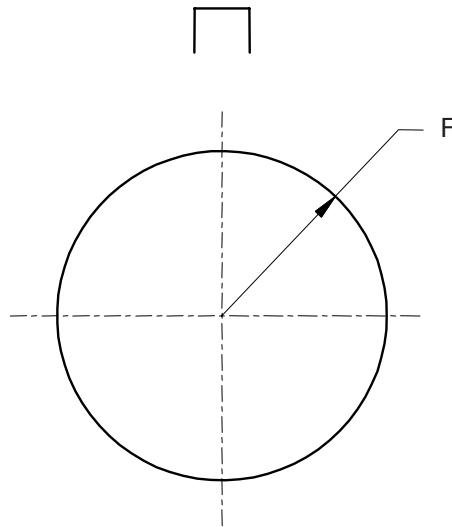


Figure 5 – Positioning of fibre core

Table 5 – Geometrical parameters

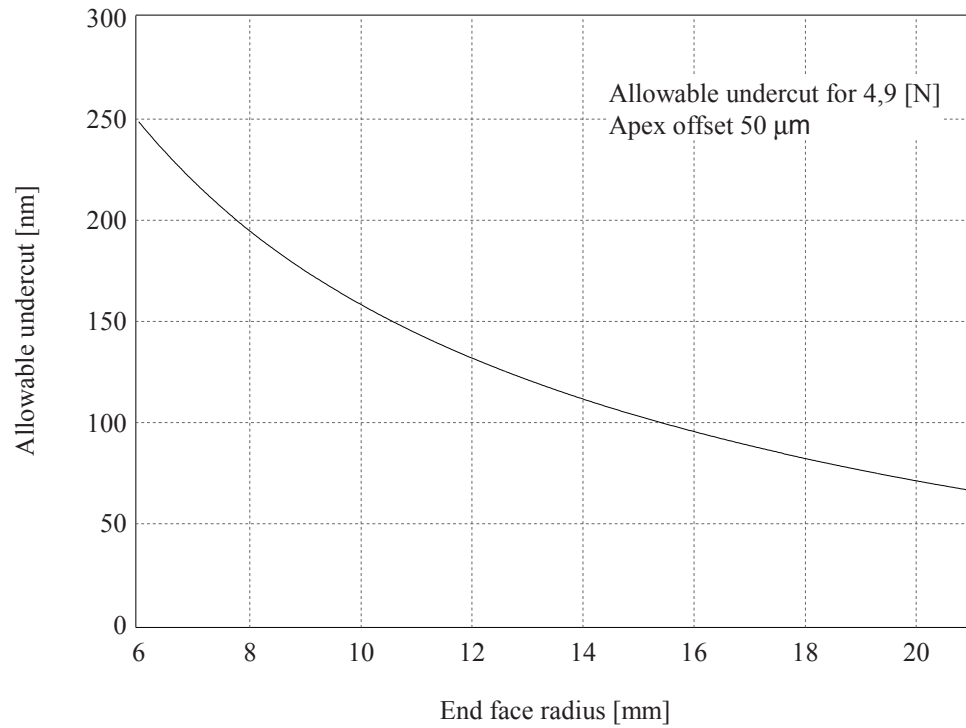
Ref.	Parameter values						Notes
	Grade B			Grade C			
	min.	mm	max.	min.	mm	max.	
A	2,499 0		2,499 5	2,498 5		2,499 5	Diameter
B	7		20	7		20	See NOTE 4, Radius
C	0		50	0		50	See NOTE 3, μm
D	- 200		see Figure 6	- 200		see Figure 6	See NOTES 1 and 2, nm
E	0		0,6	0		0,8	Degrees
F	0		0,000 15	0		0,000 3	Radius
J	0,8		-	0,8		-	
K	-		1,8	-		1,8	

NOTE 1 Contact force 4,9 N minimum. Ferrule material: titanium. Nominal material physical constant values: Young's Modulus, $E = 105 \text{ GPa}$, Poisson's Ratio, $\nu = 0,34$.

NOTE 2 A negative value indicates fibre protrusion.

NOTE 3 The dimension C shall be measured in both extreme positions of the ferrule when the ferrule is rotated in the connector.

NOTE 4 The radius and fibre undercut shall be measured in all directions over a diameter of 0,25 mm.



$$D_{\text{Maximum}} = 2\,115 \cdot B^{(-0,765)} - B \cdot 10^6 + \left(\sqrt{B^2 \cdot 10^6 - C^2} \right) \cdot 10^3 - 80$$

Figure 6 – Ferrule end face geometry – Allowable undercut

5.2.3 Control of fibre core position and axis

Figure 7 shows the relationship between the axis of the fibre and the position of the fibre core relative to the optical datum (see 5.2.2).

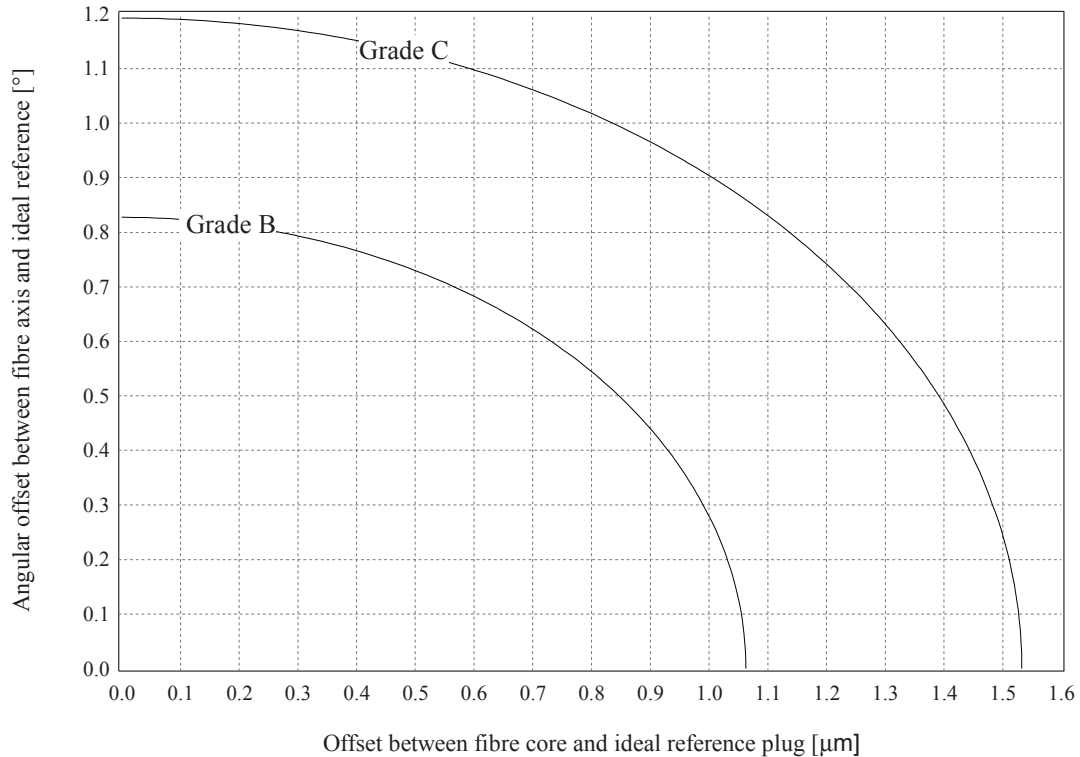


Figure 7 – Requirements for the attenuation grades for the plug fibre core connected to the ideal reference

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

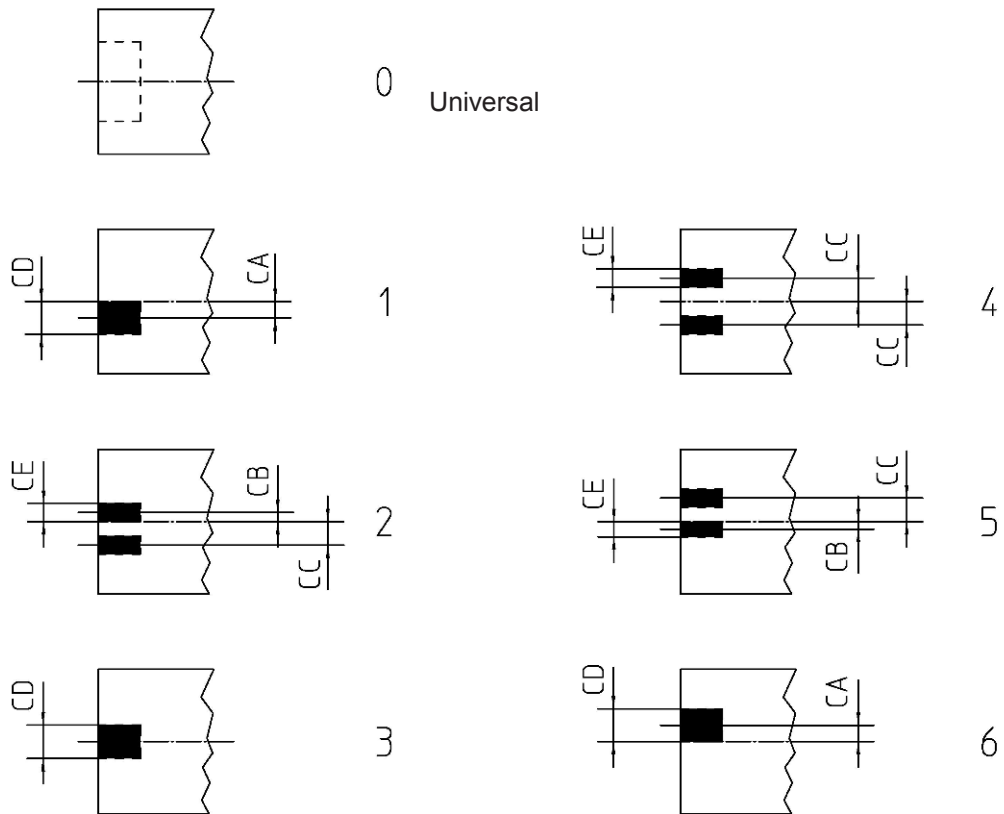
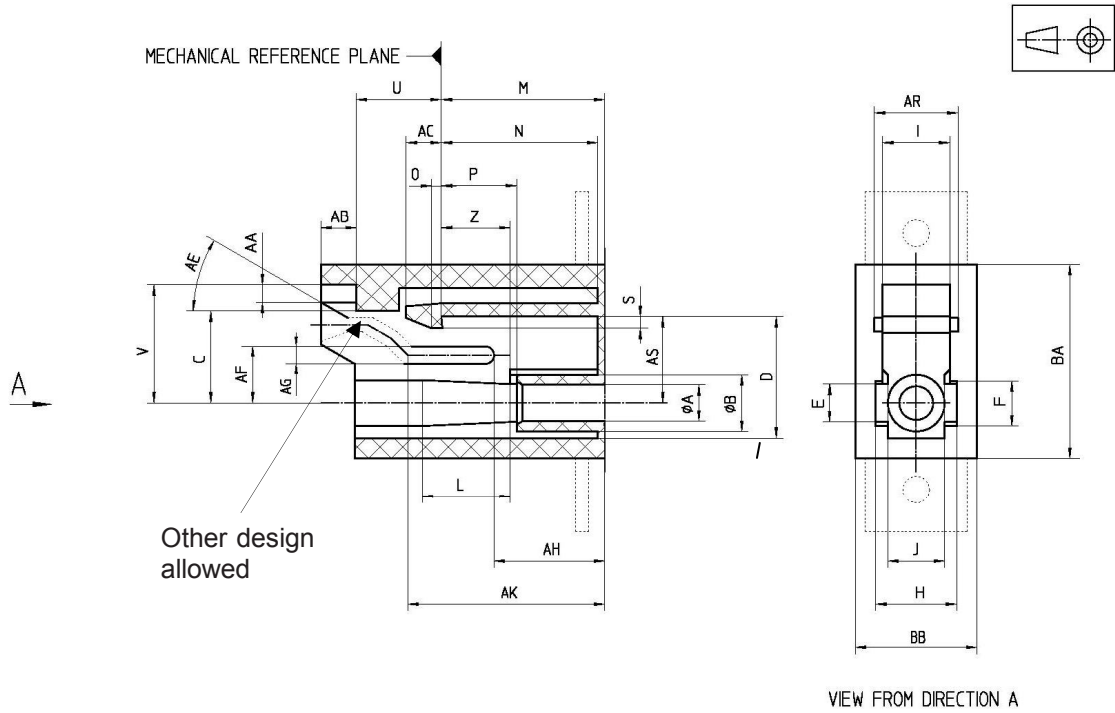
The figure and the values above define the parameters that should be met by an individual plug after termination in order to ensure that the specified random attenuation performance grade will be met. The graph lines for grade B and C give the maximum value for the two parameters to be met by any plug 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.

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

where

- W_i : mode field radii (μm), $i = 1, 2$
 (calculation for the above curve is done with worst case mode field diameter mismatch
 $W_1 = 4,45 \mu\text{m}$; $W_2 = 4,75 \mu\text{m}$);
- N_1 : refractive index between the end faces (in this case it's equal with the refractive index of the core);
- a : fibre core eccentricity (μm);
- $\bar{\tau}$: fibre angle (radians);
- λ : wavelength
 (calculation for the above curve is done with 1 310 nm).

5.2.4 Adaptor



View from direction B (mechanical colour coding according to Table 3)

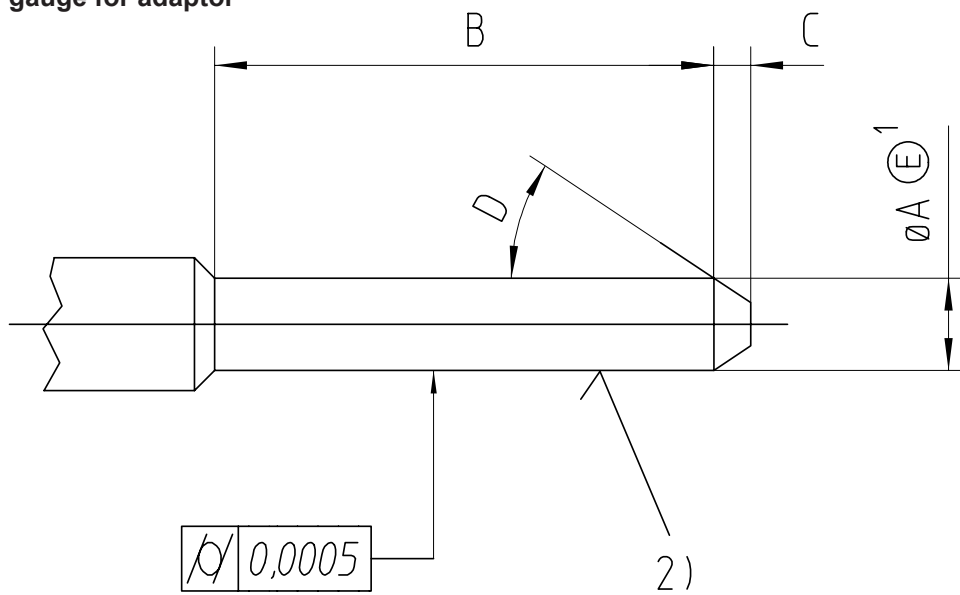
Figure 8 – Mating face and other dimensions – Adaptor

Ref.	Dimensions		Note
	min.	mm max.	
A	-	-	See NOTE, diameter Diameter
B	4,2	4,4	
C	6,31	-	
D	8,93	8,97	
E	2,81	2,85	
F	3,02	3,05	
H	6,0	6,05	
I	5,0	5,05	
J	4,2	4,25	
L	-	6,5	
M	11,9	12,0	
N	11,15	11,5	
O	0,75	0,85	
P	5,1	-	
S	-	1,2	
U	6,5	6,7	
V	8,45	8,65	
Z	4,8	5,2	
AA	-	0,9	
AB	2,4	2,6	
AC	-	2,9	
AE	30	40	Angle in degrees
AF	4,11	4,2	
AG	1,25	-	
AH	-	8,65	
AK	14,8	-	
AR	6,3	-	
AS	6,31	6,35	
BA	-	13,05	
BB	-	9	
CA	0,99	1,01	
CB	0,49	0,51	
CC	1,49	1,51	
CD	2,06	2,14	
CE	1,1	1,2	

NOTE The connector alignment feature is a resilient sleeve. The feature must accept a gauge pin to the centre of the adaptor with a force of 2,0 N to 5,9 N under the condition that another gauge pin is inserted into the feature from the other side. The centre of the adaptor is defined by the right side position of the dimension M. The surface roughness of the inside of the alignment sleeve shall be $Ra < 0,3 \mu\text{m}$.

Figure 8 – Mating face and other dimensions – Adaptor (continued)

5.2.5 Pin gauge for adaptor



Ref.	Dimensions		Note
	min.	max.	
A	2,499 3	2,499 5	See NOTE 1, diameter
B	12,5	13,5	
C	1,0	1,5	Angle in degrees
D	28	32	

NOTE 1 Envelope condition in accordance with ISO 8015.
NOTE 2 Surface roughness $Ra \leq 0,1 \mu\text{m}$.

Figure 9 – Pin gauge for adaptor

6 Tests

6.1 Sample size

For the purpose of this specification a sample is defined as a plug-adaptor-plug connector set or a patch cord.

All samples shall be randomly selected.

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

The length of cable (or fibre) on each side of the connector set shall be 2 m minimum.

The length of the patchcord samples which shall be included in the test chamber together with the two attached connectors is 3 m – 5 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 $(1\ 310 \pm 30)$ nm and $(1\ 550 \pm 30)$ nm, all return loss measurements shall be performed at $(1\ 550 \pm 30)$ 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.

Attenuation measurement against reference (EN 61300-3-4) is intended to be performed should quality conformance be required. Random attenuation (EN 61300-3-34) is to be used during qualification only to ensure the requirements of the appropriate grade are met.

Reference connector requirements are specified in Annex C.

6.3 Test sequence

All products shall be subjected to Test 1 following which there is no defined sequence in which Tests 2 – 15 must be run. However the end face geometry of each batch of connectors shall be measured before and after the test or tests to which they are subjected.

6.4 Pass/fail criteria

A product will have met the requirements of this 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 standard.

8 Product qualification 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 3.5 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 5.2.2.

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 6 – 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 position 12, 3, 6 and 9 o'clock.
			Source type:	LED
			Peak wavelength:	1 300 nm ± 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 manufacturers instructions.
^a Matched reference connector definition is given in Annex A.				

Table 6 – Optical performance requirements (continued)

No.	Test	Requirement	Details	
2	Attenuation (random mate)	<p>Grade C $\leq 0,25$ dB mean $\leq 0,50$ dB (for > 97 % of measurements)</p> <p>Grade B $\leq 0,12$ dB mean $\leq 0,25$ dB (for > 97 % of measurements)</p> <p>20 randomly mated plugs. For plug/adaptor/plug connector sets, 10 adaptor randomly selected shall be used (100 randomly mated connector sets). Total number of measurements 100 times the number of fibres in each plug.</p>	<p>Method:</p> <p>Source type:</p> <p>Peak wavelength:</p> <p>Source stability:</p> <p>Detector linearity:</p> <p>Launch fibre length:</p> <p>Pre-conditioning procedure:</p>	<p>EN 61300-3-34</p> <p>LED/LD</p> <p>(1 310 ± 30) nm</p> <p>< ± 0,01 dB over the measuring period or at least 1 h.</p> <p>Within < ± 0,01 dB over the dynamic range to be measured.</p> <p>> 2 m. Only the fundamental mode shall propagate at the connector interface to be tested and at the detector.</p> <p>Clean plug and adaptor according to manufacturers instructions.</p>
3	Return loss (random mate)	<p>> 60 dB</p> <p>20 randomly mated plugs. For plug/adaptor/plug connector sets, 10 adaptors randomly selected shall be used (100 randomly mated connector sets). Total number of measurements 100 times the number of fibres in each plug.</p>	<p>Method:</p> <p>Source type:</p> <p>Peak wavelength:</p> <p>Source stability:</p> <p>Detector linearity:</p> <p>Launch fibre length:</p> <p>Directional coupler: Type:</p> <p>Directivity:</p> <p>Method:</p> <p>Pre-conditioning procedure:</p>	<p>EN 61300-3-6, Method 1</p> <p>LD</p> <p>(1 310 ± 30) nm</p> <p>< ± 0,05 dB over the measuring period or at least 1 h.</p> <p>Within ± 0,05 dB over the dynamic range to be measured.</p> <p>> 2 m. Only the fundamental mode shall propagate at the connector interface to be tested and at the detector.</p> <p>50/50 fused.</p> <p>> 60 dB</p> <p>EN 61300-3-6, Method 1</p> <p>Clean plug and adaptor according to manufacturers instructions.</p>

8.3 Mechanical performance requirements

Table 7 – 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 for grade) Return loss: > 60 dB mated	Method: Frequency range: Vibration amplitude: Number of sweeps: No. of axes: Specimen optically functioning: Measurements required: Pre-conditioning procedure:	EN 61300-2-1 10 Hz - 55 Hz - 10 Hz at 1 octave/min 0,75 mm 15 sweeps (10 - 55 - 10) 3 Yes Before, during and after test (max. sampling interval shall be 2 ms). According to EN 61300-3-28. Clean plug and adaptor according to manufacturers instructions.
5	Mating durability	Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (initial and final attenuation must be ≤ specified for grade) Return loss: > 60 dB mated In the event that the attenuation increases above the allowable limit the connector may be cleaned as necessary but not more than 25 times during the course of the test. (The measurement at which the cleaning takes place shall be discounted from the test results.)	Method: Mechanism to be cycled: Number of cycles: Mating speed: Specimen optically functioning: Measurements required: Pre-conditioning procedure:	EN 61300-2-2 Plug-Adaptor 500 (only one plug is subjected to successive engagement and separation) Not less than 3 s between engagements. Yes After every mating. Clean plug and adaptor according to manufacturers instructions.

Table 7 – Mechanical performance requirements (continued)

No.	Test	Requirement	Details	
6	Fibre/cable retention	<p>Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (initial and final attenuation must be ≤ specified for grade)</p> <p>Return loss: > 60 dB mated</p>	<p>Method: Magnitude and rate of application of the tensile force: Point of application of the load: Duration of maximum load: Specimen optically functioning: Measurements required: Sampling rate: Pre-conditioning procedure:</p>	<p>EN 61300-2-4 Var. 01*: 5 N ± 0,5 N at 0,5 N/s Var. 02* – 06*: 50 N ± 3 N at 5 N/s. > 0,3 m from plug. 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 50 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 manufacturers instructions.</p>
7	Strength of coupling mechanism	<p>Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (initial and final attenuation must be ≤ specified for grade)</p> <p>Return loss: > 60 dB mated</p>	<p>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:</p>	<p>EN 61300-2-6 40 N 60 s 2 N/s max. 0,3 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 manufacturers instructions.</p>

Table 7 – Mechanical performance requirements (continued)

No.	Test	Requirement	Details	
8	Impact	Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (initial and final attenuation must be ≤ specified for class) Return loss: > 60 dB mated	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 manufacturers instructions.
9	Static side load	Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (initial and final attenuation must be ≤ specified for grade) Return loss: > 60 dB mated	Method: Magnitude of the load (90° to plug axis) Point of application of the load: Method of mounting: Duration of load: Specimen optically functioning: Measurements required: Sampling rate: Pre-conditioning procedure:	EN 61300-2-42 Var. 02* – 06*: 1 N 0,2 m from rear of plug. An adaptor shall be mounted rigidly to the mounting fixture. 1 h Yes Before, during (continuous) and after the test. 3 min max. interval Clean plug and adaptor according to manufacturers instructions.
10	Flexing strain relief of fibre optic devices	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 ≤ specified for grade) Return loss: > 60 dB mated	Method: Magnitude of the load (90° to plug axis) Point of application of the load: Method of mounting: Number of cycles: Specimen optically functioning: Measurements required: Sampling rate:	EN 61300-2-44 Var. 02* – 06*: 2 N 0,2 m from rear of plug. An adaptor shall be mounted rigidly to the mounting fixture. 100 (± 90°) Yes Before, during (continuous) and after the test. (max. sampling interval shall be 2 ms). According to EN 61300-3-28.

Table 7 – Mechanical performance requirements (continued)

No.	Test	Requirement	Details	
			Pre-conditioning procedure:	Clean plug and adaptor according to manufacturers instructions.
11	Gauge retention force Measured on sleeve or adaptor	Allowable gauge retention force: max. 5,9 N min. 2,0 N	Method: Gauge dimensions and characteristics: Pre-conditioning procedure:	EN 61300-3-10 See Figure 9 The gauge and adaptor shall be cleaned according to manufacturers instructions.

8.4 Environmental performance requirements

Table 8 – Environmental performance requirements

No.	Test	Requirements	Details	
12	Cold	Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (initial and final attenuation must be ≤ specified for grade) Return loss: > 60 dB mated	Method: Temperature: Duration of exposure: Specimen optically functioning: Measurements required: Pre-conditioning procedure: Recovery Procedure:	EN 61300-2-17 -10 °C 96 h Yes Before, during (max. interval 1 h) and after the test. Clean plug and adaptor according to manufacturers instructions. 2 h at normal ambient conditions.
13	Damp heat (steady state)	Attenuation at (1 550 ± 30) nm: ≤ 0,20 dB change (initial and final attenuation must be ≤ specified for grade) Return loss: > 60 dB mated	Method: Temperature: Relative humidity: Duration of exposure: Specimen optically functioning: Measurements required: Pre-conditioning procedure: Recovery procedure:	EN 61300-2-19 +40 °C (93 ± 2) % 96 h Yes Before, during (max. interval 1 h) and after the test. Clean plug and adaptor according to manufacturers instructions 2 h at normal ambient conditions.

Table 8 – Environmental performance requirements (continued)

14	Change of temperature for connectors and patchcords	<p>Monitoring change of attenuation at (1 550 ± 30) nm:</p> <p>≤ 0,2 dB change for pigtails /connectors during and after</p> <p>≤ 0,5 dB during and ≤ 0,4 after the test for 3 m – 5 m patchcords with both connectors and the cable in the climatic chamber.</p> <p>Cable coil inside the chamber not smaller than 30 cm.</p> <p>Return loss:</p> <p>> 60 dB mated</p>	<p>Method:</p> <p>Low temperature:</p> <p>High temperature:</p> <p>Duration at temperature extreme:</p> <p>Rate of change of temperature:</p> <p>Number of cycles:</p> <p>Specimen optically functioning:</p> <p>Measurements required:</p> <p>Pre-conditioning procedure:</p> <p>Recovery Procedure:</p>	<p>EN 61300-2-22</p> <p>-10 °C</p> <p>+60 °C</p> <p>1 h</p> <p>1 °C/min</p> <p>5</p> <p>Yes</p> <p>Before, during (max. interval 10 min) and after the test.</p> <p>2 h at normal ambient conditions. The plug and adaptor shall be cleaned with dry lint free material.</p> <p>2 h at normal ambient conditions.</p>
15	Dry heat	<p>Attenuation at (1 550 ± 30) nm:</p> <p>≤ 0,20 dB change (initial and final attenuation must be ≤ specified for grade)</p> <p>Return loss:</p> <p>> 60 dB mated</p> <p>Strength of coupling mechanism (Test 7) shall be performed on completion of test after recovery procedure.</p>	<p>Method:</p> <p>Temperature:</p> <p>Duration of exposure:</p> <p>Specimen optically functioning:</p> <p>Measurements required:</p> <p>Pre-conditioning procedure:</p> <p>Recovery procedure:</p>	<p>EN 61300-2-18</p> <p>+60 °C</p> <p>96 h</p> <p>Yes</p> <p>Before, during (max. interval 1 h) and after the test.</p> <p>Clean plug and adaptor according to manufacturers instructions.</p> <p>2 h at normal ambient conditions.</p>

Annex A
(normative)

Adaptor matched reference plug details

Table A.1

Ferrule outer diameter	2,499 0 mm – 2,499 5 mm
Eccentricity of spherically polished ferrule end face	≤ 30 μm
Visual examination of fibre end face with ≥ 200 magnification	No defects in core zone
Attenuation between two matched reference plugs in a reference adaptor in all 8 positions at 1 310 nm	≤ 0,03 dB
Visual examination	Every 50 mating

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 C.

The visual examination shall be repeated every 50 matings.

Annex B (normative)

Sample size and product sourcing requirements

Table B.1

No.	Test	Sample size		Source
		Plug	Adaptor	
n/a	Dimensional	25	25	New
1	Adaptor attenuation (between matched reference)	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	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	Static side load	4	2	Test 2
10	Flexing of strain relief of fibre optic devices	4	2	Test 2
11	Gauge retention force	4	2	Test 2
12	Cold pigtails	2 × 4	4	Test 2
13	Damp heat (steady state) pigtails	2 × 4	4	Test 2
14	Change of temperature pigtails patch cords	2 × 4 4	4 2 × 4	Test 2
15	Dry heat	2 × 4	4	Test 2

The above tests are intended to be performed individually in any order on product sourced as defined, although product from a previous test may be used, in which case the number of samples for Test 1 will be reduced.

Annex C (informative)

Reference connector details

C.1 Reference plug

Table C.1

Ferrule outer diameter	2,499 0 mm – 2,499 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 degree
Eccentricity of spherically polished ferrule end face	< 30 µm
Visual examination of fibre end surface 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

C.2 Test details

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 C.2

Attenuation (against reference connector)	Grade C: ≤ 0,5 dB	Method: Source type: Peak wavelength: Source stability: Detector linearity: Launch fibre length: Pre-conditioning procedure:	EN 61300-3-4, Method B LED/LD (1 310 ± 30) nm and (1 550 ± 30) nm < ± 0,01 dB over the measuring period or at least 1 h. Within ± 0,05 dB over the dynamic range to be measured. > 2 m. Only the fundamental mode shall propagate at the connector interface to be tested and at the detector. Clean plug and adaptor according to manufacturers instructions.
	Grade B: ≤ 0,25 dB		

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- 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 (series) Fibre optic interconnecting devices and passive components – Basic test
and measurement procedures (IEC 61300 series)
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Part 3-4: Examinations and measurements – Attenuation (IEC 61300-3-4)
- EN 61754-15 Fibre optic interconnecting devices and passive components – Fibre optic connector
interfaces –
Part 15: Type LSH connector family (IEC 61754-15)
- 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 61755-2-2 Fibre optic connector optical interfaces –
Part 2-2: Optical interface standard single mode angled physically contacting
fibres (IEC 61755-2-2)
- EN 61755-3-8 Fibre optic interconnecting devices and passive components – Fibre optic connector
optical interfaces –
Part 3-8: Optical interface, 2,5 mm and 1,25 mm diameter cylindrical 8 degrees
angled-APC composite ferrule using titanium as fibre surrounding material, single
mode fibre (IEC 61755-3-8)

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