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BSI Standards Publication

Aerospace series — Cables, optical 125 µm diameter cladding

Part 301: Tight structure 50/125 µm GI fibre nominal 1,8 mm outside diameter — Product standard

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Luft- und Raumfahrt - Lichtwellenleiterkabel, Claddingdurchmesser 125 µm - Teil 301: Festaderaufbau GI 50/125 µm, Faser Kabelaußendurchmesser 1,8 mm - Produktnorm

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Foreword

This document (EN 4641-301:2011) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2011, and conflicting national standards shall be withdrawn at the latest by November 2011.

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1 Scope

This product standard specifies the general characteristics, conditions for qualification, acceptance and quality assurance for a fibre optic cable with a 50/125 µm Graded Index fibre core, 1,8 mm outside diameter for non pull-proof contact designs.

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 2424, *Aerospace series — Marking of aerospace products*

EN 3475-601, *Aerospace series — Cables, electrical, aircraft use — Test methods — Part 601: Smoke density*

EN 3745 (all parts), *Aerospace series — Fibres and cables, optical, aircraft use — Test methods*

EN 3909, *Aerospace series — Test fluids and test methods for electric components and sub-assemblies*

EN 4641-001, *Aerospace series — Cables, optical, 125 µm diameter cladding — Part 001: Technical specification*

TR 4667, *Aerospace series — Termination procedure for EN 4639 optical contact* [1)]

3 Terms, definitions, symbols and abbreviations

For the purposes of this document, the terms, definitions, symbols and abbreviations detailed in EN 3745-100 apply.

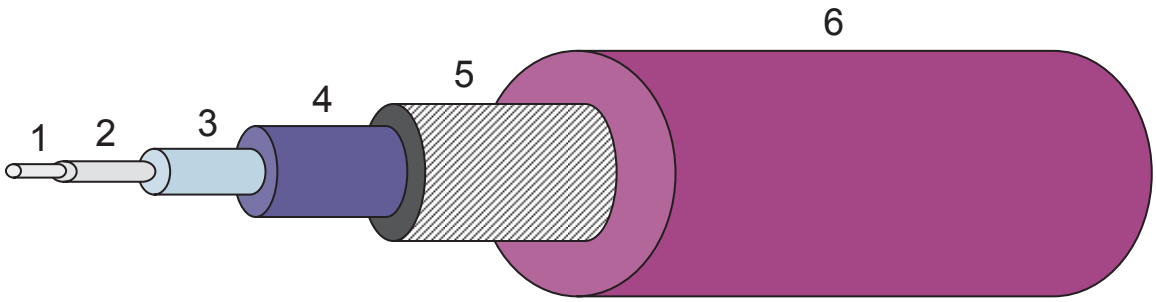
4 Required characteristics

The characteristics of the cables, tested according to the methods described hereafter shall comply with the values defined in this product standard.

1) Published as ASD-STAN Technical Report at the date of publication of this standard by Aerospace and Defence Industries Association of Europe-Standardization (ASD-STAN), (www.asd-stan.org).

5 Cable construction

See Figure 1 and Table 1.



Key

1 Core
2 Cladding
3 Primary buffer
4 Secondary buffer
5 Strength member
6 Outer jacket

Figure 1

Table 1

Property	Value
Core diameter	(50 ± 3,0) µm
Cladding diameter	(125 ± 2,0) µm
Core/cladding concentricity	≤ 3 µm
Core non circularity	≤ 5 %
Cladding non circularity	≤ 2 %
Primary buffer	(245 ± 15) µm
Attenuation at 850 nm (20 °C)	< 5 dB/km
Attenuation at 1300 nm (20 °C)	< 3 dB/ km
Finished cable diameter	(1,80 ± 0,1) mm
Cable mass	≤ 5 kg/km
Operating temperature	– 60 °C to 135 °C
Minimum bend radius (20 °C)	Installation: 20 mm (10 × outside diameter) Long term: 20 mm (10 × outside diameter) Storage: 40 mm (20 × outside diameter)
Strength member weave pitch	3 mm < p < 20 mm
Tensile strength	> 200 N

6 Materials

See Table 2.

Table 2

Element		Material
Fibre	Core	Silica
	Cladding	
Primary buffer		High Temperature Polyacrylate
Secondary buffer		High Temperature Polymer(s)
Mechanical strength reinforcement		Aramid/Aramid-Fibreglass Woven Braid
Jacket(s)		High Temperature Polymer

7 Test methods and performances

7.1 Tests in accordance with EN 3745-100

7.1.1 Optical fibre

See Table 3.

Table 3 — Optical fibre performance requirements

Test method EN 3745-	Designation of test	Test conditions and results
201	Fibre visual examination	Pass
202	Fibre core dimension	Method A: core diameter = (50 ± 3) µm
501	Optical fibre proof test	> 1 %
202	Fibre cladding dimension	Cladding diameter: (125 ± 2) µm Method A or B Sample should be in accordance with test methods Number of sample: 1
203	Primary coating outside diameter	Not applicable
202	Fibre dimension core non circularity	Core non circularity : ≤ 5 % (3 µm) Number of sample: 1
202	Fibre dimension cladding non circularity	Cladding non circularity : ≤ 2 % (2,5 µm) Number of sample: 1

continued

Table 3 — Optical fibre performance requirements *(concluded)*

Test method EN 3745-	Designation of test	Test conditions and results
202	Fibre dimension concentricity error	Concentricity error ≤ 3 µm Number of sample: 1
301 Method A	Fibre attenuation	Maximum attenuation: ≤ 5 dB/km at 850 nm, ≤ 3 dB/km at 1 300 nm at 20 °C Minimum sample length: 100 m
302	Numerical aperture	Numerical aperture: 0,2 ± 0,015 at λ = (850 ± 20) nm Sample length: 2 m
303	Bandwidth	Bandwidth ≥ 500 MHz/km at 850 nm ≥ 500 MHz/km at 1 300 nm Number of sample: 1 Minimum sample length: 1 km Central wavelengths: (850 ± 10) nm (1 300 ± 10) nm Spectral width (– 3 dB): ≤ 10 nm for 850 nm

7.1.2 Fibre optic cable

See Table 4.

Table 4 — Fibre optic cable performance requirements

Test method EN 3745-	Designation of test	Test conditions and results
201	Visual Inspection	The outer jacket shall have the correct identification as specified in this standard. The jacket shall be continuous and free of visible defects such as lumps, abrasions, cracks, splits or blisters. Number of sample: 1 Sample length: 3 m.
203	Buffer diameter	(925 ± 75) µm
203	Outer jacket outside diameter	(1,80 ± 0,1) mm
205 Method A	Longitudinal stability	Visual examination in accordance with EN 3745-201 Shrinkage or elongation < 0,5 % Sample length: 5 m Number of samples: 1 Number of temperature cycles (EN 3745-402): 25.
301 Method A	Cable attenuation	Maximum attenuation: ≤ 5 dB/km at 850 nm, ≤ 3 dB/km at1 300 nm at 20 °C. Minimum sample length: 200 m.

continued

Table 4 — Fibre optic cable performance requirements *(continued)*

Test method EN 3745-	Designation of test	Test conditions and results
305	Cable immunity to ambient light	Level of optical power ≤ – 55 dBm Sample length exposed to light source: 10 m Diameter of the integration sphere: (10 ± 0,1) cm Spectral characteristics or colour temperature of the light source: solar spectrum Continuous spectrum between 250 nm and 1 600 nm Light temperature: 6 000 K Light intensity: 86 400 Lux Minimum authorized long term bend radius: (20 ± 0,1) mm
306/402	Attenuation during temperature cycling	Visual examination in accordance with EN 3745-201 Maximum variation of attenuation: ≤ 0,5 dB at 850 nm Test method EN 3745-402 – 10 cycles High temperature: 135 °C – Low temperature: – 60 °C Duration at extreme temperatures: 30 min Rate of change: 5 °C per min Number of samples: 3 – Sample length: 5 m
401	Cable accelerated aging	Visual examination in accordance with EN 3745-201 Variation in attenuation: ≤ 0,5 dB Variation in attenuation after 24 h: ≤ 0,3 dB Residual variation in attenuation: ≤ 0,2 dB Mandrel diameter: 250 mm – Number of turns: 1 Test temperature: 135 °C – Number of temperature cycles: 1 Number of samples: 1 – Sample length: (100 ± 0,05) m
404	Thermal shock	Visual examination in accordance with EN 3745-201 Permissible variation in attenuation during test sequence and after 24h: ≤ 0,7 dB High temperature: 135 °C Low temperature: – 60 °C Duration at extreme temperatures: 30 min Number of samples: 3 Sample length: 20 m Number of temperature cycles: 10

continued

Table 4 — Fibre optic cable performance requirements *(continued)*

Test method EN 3745-	Designation of test	Test conditions and results
406	Cold bend	Permissible variation in attenuation: ≤ 0,3 dB at 850 nm Visual examination in accordance with EN 3745-201 1 hour soak at: – 60 °C Mandrel diameter: 30 mm Mandrel wraps: 10 Sample Length > 2 m Number of samples: 2
407	Flammability	No flaming particles shall fall from the sample during the test and the tissue paper shall not be ignited Period of flame application: 30 seconds Maximum burn length: 75 mm – Self extinguish after 5 sec Number of samples: 5 – Sample length: (1 ± 0,05) m
410	Thermal life	Test Sample: 100 m Maximum permissible variation in attenuation: < 2 dB Lifetime shall be ≥ 100 000 h
411 method 2	Resistance to fluids	See Table 3.
412	Humidity resistance	Visual examination in accordance with EN 3745-201 residual attenuation: ≤ 0,25 dB at 850 nm Radius of the cable: 15 mm – Number of cycles: 15 Number of samples: 1 – Sample length: 20 m
503	Scrape abrasion	Visual examination in accordance with EN 3745-201 Variation in attenuation: ≤ 1 dB at 850 nm Load: 10 N – Number of cycles : 100 Number of samples: 2 – Sample length: (0,75 ± 0,01) m
504	Micro-bending	Visual examination in accordance with EN 3745-201 Variation in attenuation: ≤1 dB at 850 nm Maximum residual attenuation 15 minutes after removing the load: < 0,1 dB at 850 nm Number of samples : 3 – Load: 50 N Rate load is applied: 50 N/min – Mandrel size = 5 mm
505 method B	Tensile strength	For F = 150 N, maximum permissible variation in attenuation : < 0,5 dB Visual examination in accordance with EN 3745-201 Breaking load for complete cable > 200 N Number of samples: 1

continued

Table 4 — Fibre optic cable performance requirements *(continued)*

Test method EN 3745-	Designation of test	Test conditions and results
506	Impact	Residual variation in attenuation: ≤ 0,3 dB at 850 nm Energy to be applied: 3 J – Radius intermediate piece :15 mm Mass of hammer: 800 g – Height: 400 mm Number of impacts: 5 – Sample length > 700 mm Number of samples: 5 – Distance between impacts : 0 mm
507	Cut-through	Visual Examination in accordance with EN 3745-201 Monitor attenuation to determine fibre breakage of the sample during testing at 20 °C and 150 °C Load to be applied: 20 N Duration of load application :1 min Number of samples: 3 – Sample length: (2 ± 0,01) m Rate of load application: (50 ± 10) N/min
508	Torsion	Variation of attenuation: ≤ 0,25 dB Number of samples: 1 – Sample length: (2 ± 0,01) m Load to be applied: 150 N – Number of cycles: 1 000 Distance between the rotating grip and the fixed grip: (0,25 ± 0,01) m
509	Kink	Permissible variation of attenuation: ≤ 3 dB Minimum loop diameter: 10 mm Number of samples: 3 – Sample length >10 times bend radius
510 method A	Bend	Visual examination in accordance with EN 3745-201 variation of attenuation: ≤ 0,2 dB Residual attenuation after removing the specimen from the test equipment: ≤ 0,1 dB Load to ensure contact between the cable and the mandrel: 20 N Mandrel diameter: 25 mm – Number of turns: 10 Number of sample: 1 – Sample length: (10 ± 0,01) m
511	Cable to cable abrasion	Visual examination in accordance with EN 3745-201 No exposure of first material under outer jacket Category A: 1 optical, 1 copper (16 AWG DR) Minimum number of cycles: 2 800 000 – Load: 10 N Category B: 2 optical cables Minimum number of cycles: 500 000 – Load = 10 N Number of samples: 3 – Sample length: 300 mm
512	Flexure endurance	Visual examination in accordance with EN 3745-201 Permissible variation in attenuation: ≤ 0,25 dB at 850 nm Load: 5 N – Mandrel diameter: 30 mm Number of cycles: 3 000 – Sample length: 5 m Number of samples: 3

continued

Table 4 — Fibre optic cable performance requirements *(concluded)*

Test method EN 3745-	Designation of test	Test conditions and results
513	Crush resistance	Variation of attenuation: ≤ 1dB Load: 500 N during 10 s – Mandrel diameter: 10 mm Number of samples: 5 – Sample length: 5 m
514	Bend twist	Not applicable
515	Buffer insertion force	Not applicable
516	Severe bend	Not applicable
517	Cable tie clamping	Maximum transmittance change: ≤ 0,05 dB Mandrel diameter: (13 ± 1) mm Number of cable ties applied: 6 – Cable tension setting: #1 Number of samples: 3 – Sample length: ≥ 4 m
601	Smoke density	Test method: EN 3475-601 Specific optical smoke density (average) Dm < 200 within 4 minutes test duration under both the flaming and non-flaming conditions. Value must be measured at the end of the test. Number of samples: 8 – Sample length: 3,1 m
602	Toxicity	Not applicable
603	Nuclear radiation	Not applicable
701	Cable stripping	Visual examination in accordance with EN 3745-201 Strip force < 20 N – Sample length: 50 mm
703	Durability of manufacturers identity markings	Examine marking in accordance with EN 3745-201 visual inspection Number of samples: 1 – Length of strokes: 10 mm Stroke rate: (55 ± 5) cycles/min – Number of strokes: 125 Needle size: 0,5 mm – Weight on needle: 150 g
705	Contrast measurement	≥ 50 %

7.2 Fluids test

See Table 5.

Table 5 — List of fluids

Fluids family	Type	Fluid number see EN 3909	Test temperature ± 2 °C Duration 24 h
Fuel	Kerosene	2	70
	Gasoline	1	40
Oil	Mineral	7	70
	Synthetic	9	—
Hydraulic Fluid	Mineral	5	80
	Phosphate Ester	3	70
De-icer	Runway	14	25
	Aircraft	15	25
Solvent	IPA	10	25
	MEK	12	25
	White Spirit	11	25
Cleaner	Aqueous Alkali	13	25
Sullage	Formaldehyde	16	25
Fire Extinguishant	Hepta-fluoropropane	17	25

8 Tooling

See TR 4667 for termination process.

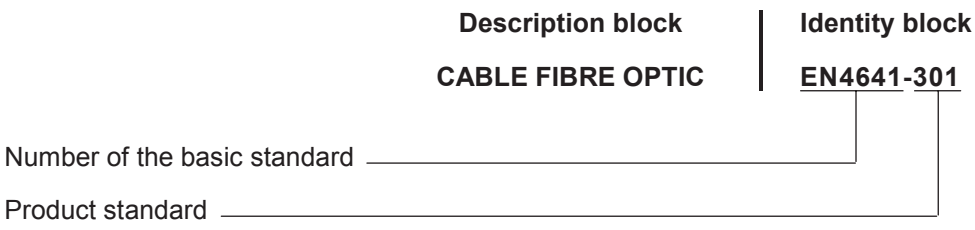
9 Quality assurance

See EN 4641-001.

10 Designation and marking

10.1 General principle of designation

EXAMPLE



10.2 Marking

The marking shall comprise of the cable reference, the manufacturer code and the last two digits of the year of manufacture shall conform to EN 2424.

The marking may be done wholly or partially in code by agreement with the user.

The outer jacket of the cable shall accept marking with UV laser. **Hot stamping is forbidden.**

10.3 Colours

The colour of the outer jacket will be light purple.

11 Delivery conditions

11.1 Packaging

See EN 4641-001.

11.2 Labelling

See EN 4641-001.

11.3 Delivery lengths

See EN 4641-001.

The minimum delivery length of a fibre or cable is by agreement between customer and supplier.

12 Storage

Fibre optic cables shall be stored as described hereunder:

— Humidity: < 90 %

— Temperatures: – 60 °C to 85 °C

CAUTION — Let cable warm up prior to handling if fibre optic cable has been stored for prolonged periods of time below 0 °C.

13 Technical specification

See EN 4641-001.

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