



BSI Standards Publication

# Aerospace series — Cables, optical 125 $\mu\text{m}$ diameter cladding

Part 103: Semi-loose, ruggedized simplex  
construction 62,5/125 $\mu\text{m}$  GI fibre  
nominal 2,74 mm, outside diameter —  
Product standard

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### National foreword

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The UK participation in its preparation was entrusted to Technical Committee ACE/6, Aerospace avionic electrical and fibre optic technology.

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

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English Version

**Aerospace series - Cables, optical 125  $\mu\text{m}$  diameter cladding -  
Part 103: Semi-loose, ruggedized simplex construction 62,5/125  
 $\mu\text{m}$  GI fibre nominal 2,74 mm, outside diameter - Product  
standard**

Série aérospatiale - Câble, optique, diamètre extérieur de la gaine optique 125  $\mu\text{m}$  - Partie 103 : Câble à structure semi libre, renforcée, monovoie fibre à gradient d'indice 62,5/125  $\mu\text{m}$ , diamètre extérieur 2,74 mm - Norme de produit

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This European Standard was approved by CEN on 2 July 2010.

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## Foreword

This document (EN 4641-103:2010) 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.

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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 62,5/125  $\mu\text{m}$  single mode fibre core, 2,74 mm outside cable diameter and of semi-loose construction. The basic construction is the cable defined in EN 4641-102 with added sheaths for ruggedized usages.

## 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 2812, *Aerospace series — Stripping of electrical cables*<sup>1)</sup>

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

EN 3475-602, *Aerospace series — Cables, electrical, aircraft use — Test methods — Part 602: Toxicity*

EN 3745-100, *Aerospace series — Fibres and cables, optical, aircraft use — Test methods — Part 100: General*

EN 3838, *Aerospace series — Requirements and tests on user-applied markings on aircraft electrical cables*<sup>1)</sup>

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

EN 4641-102, *Aerospace series — Cables, optical 125  $\mu\text{m}$  outside diameter cladding — Part 102: Semi-loose 62,5/125  $\mu\text{m}$  GI fibre nominal 1,8 mm outside diameter — Product standard*

EN 9133, *Aerospace series — Quality management systems — Qualification procedure for aerospace standard parts*

TR 4647, *Aerospace series — Termination procedure for EN 4639 optical contact*<sup>2)</sup>

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given 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.

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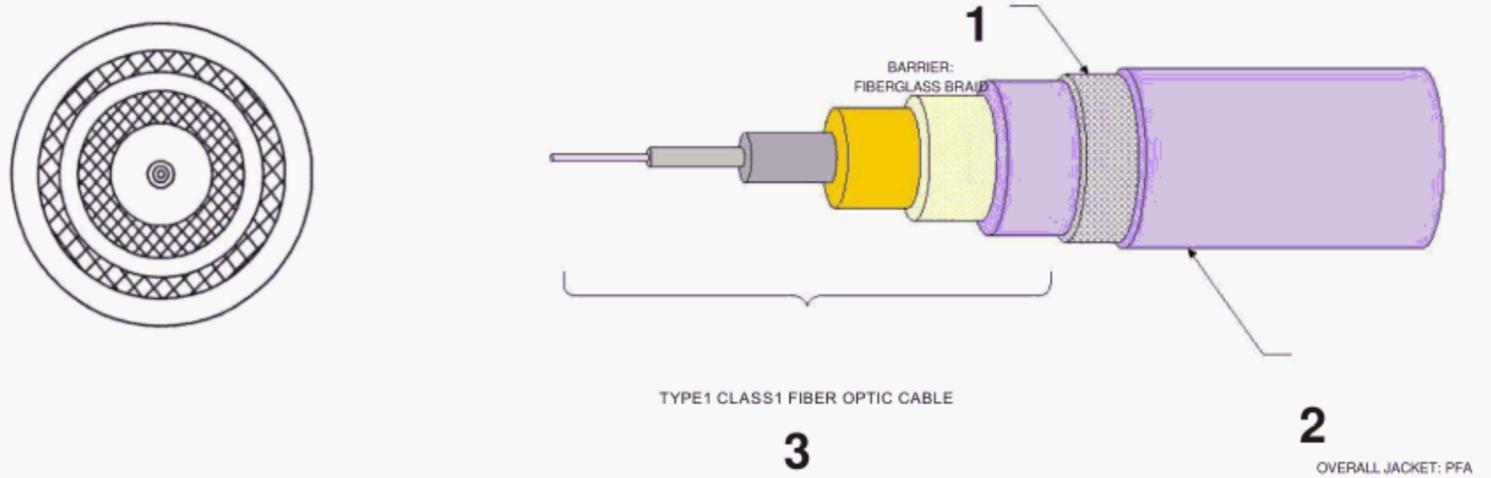
1) Published as ASD-STAN Prestandard at the date of publication of this standard by Aerospace and Defence Industries Association of Europe-Standardization (ASD-STAN), ([www.asd-stan.org](http://www.asd-stan.org)).

2) 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](http://www.asd-stan.org)).



## 5 Cable construction

See Figure 1 and Table 1.



### Key

- 1 Glass braid
- 2 Jacket – Extruded fluoropolymer
- 3 EN 4641-102 fibre cable

Figure 1

Table 1	
Property	Value
EN 4641-102 — Fibre optic cable	(1,80 ± 0,12) mm
Finished cable diameter	(2,74 ± 0,25) mm
Cable mass	10,7 g/m
Operating temperature	– 65 °C to 150 °C
Attenuation at 850 nm (20 °C)	≤ 4,0 dB/km
Attenuation at 1 300 nm (20 °C)	≤ 2,0 dB/km
Numerical aperture	0,275 ± 0,015
Minimum bend radius (20 °C)	Installation: 27 mm (10 × outside diameter) Long term: 27 mm (10 × outside diameter) Storage: 54 mm (20 × cable outside diameter)

## 6 Materials

See Table 2.

Table 2	
Element	Material
Fibre cable component	EN 4641-102 — Fibre optic cable
Overall braid	Fibre glass woven braid
Outer jacket	Extruded fluoropolymer



## 7 Test methods and performances in accordance with EN 3745-100

### 7.1 Optical fibre tests

In accordance with EN 4641-102.

### 7.2 Fibre optic component cable tests

In accordance with EN 4641-102.

### 7.3 Ruggedized fibre optic cable

Tests in accordance with Table 3.

**Table 3 — Ruggedized fibre optic cable test methods**

Test	Test method <del>EN 3745</del>	Test conditions and results
Visual examination	201	The outer jacket shall have the correct identification as specified in this standard. The coating shall be continuous and free of visible defects such as lumps, abrasions, cracks, splits or blisters. Sample length : 3 m
Outer jacket outside diameter	203	(2,74 ± 0,25) mm
Outer jacket wall thickness	203	Minimum wall ≥ 0,20 mm
Longitudinal stability	205	The change in longitudinal dimensions between A and B shall not exceed the maximum value of ≤ 5 mm. Number of samples: 3 – Sample Length: (3,5 ± 0,03) m <del>Test Method EN 3745-402 – 25 cycles</del>
Fibre attenuation	301 Method D	Maximum attenuation ≤ 4 dB/km at 850 nm, ≤ 2 dB/km at 1 300 nm at 20 °C Minimum sample length: ≥ 100 m
Cable immunity to ambient light	305	Not applicable. This is a EN 4641-102 component test.
Cable accelerated aging	401	Not applicable if jacket materials are the same. This is a EN 4641-102 component test.
Attenuation during temperature cycling	306	Visual examination in accordance with EN 3745-201 Maximum variation of attenuation: $\alpha \leq 0,25$ dB at 850 nm and 1 300 nm Test Method EN 3745-402 – 10 cycles High temperature : 150 °C – Low temperature: 65 °C – Duration at extreme temperatures: 30 minutes Rate of change: 5 °C per minute Number of samples: 3 – Sample Length: 20 m ≥

continued



Table 3 — Ruggedized fibre optic cable test methods (continued)

Test	Test method <del>EN 3745</del>	Test conditions and results
Thermal shock	404	Visual examination in accordance with EN 3745-201 Maximum permissible variation in attenuation during test sequence and after 24 h: $\Delta\alpha \leq 0,25$ dB at 850 nm and 1 300 nm. High temperature: 150 °C – Low temperature: – 65 °C Duration at extreme temperatures: 30 minutes Number of samples: 3 – Sample Length: $\geq 20$ m Number of temperature cycles: 10
Cold bend	406	Maximum permissible variation in attenuation: $\Delta\alpha \leq 0,25$ dB at 850 nm and 1 300 nm. Visual examination in accordance with EN 3745-201. 1 hour soak at: – 65 °C – Mandrel size: $(50 \pm 1)$ mm Mandrel wraps: 10
Flammability	407	Number of samples: 1 – Sample Length: $\geq 10$ m 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 seconds
Thermal life	410	Number of samples: 3 – Sample length: $(1 \pm 0,05)$ m Not applicable if jacket materials are the same. This is a EN 4641-102 component test.
Resistance to fluids	411	Not applicable if jacket materials are the same. This is a EN 4641-102 component test.
Humidity resistance	Method 2 412	Not applicable if jacket materials are the same. This is a EN 4641-102 component test.
Scrape abrasion	503	Maximum variation in attenuation: $\Delta\alpha \leq 0,25$ dB at 850 nm and 1 300 nm. Visual examination in accordance with EN 3745-201 Number of samples: 3 – Sample length: $\geq 3,0$ m Test at ambient temperature: 20 °C Load: 7 N – Number of cycles: 500 Test at high temperature: 150 °C
Tensile strength	505	Load: 2,2 N – Number of cycles: 500 Maximum variation in attenuation: $\Delta\alpha \leq 0,25$ dB at 850 nm and 1 300 nm. Tensile Strength: 50 N Mandrel diameter: 28 mm Pulling speed: $(50 \pm 10)$ mm/min Number of samples: 3 – Sample length: $\geq 5$ m

continued



**Table 3 — Ruggedized fibre optic cable test methods (continued)**

Test	Test method <del>EN 3745</del>	Test conditions and results
Impact resistance	506	Maximum variation in attenuation: $\Delta\alpha \leq 0,25$ dB at 850 nm and 1 300 nm. No Jacket cracks/splits Test temperature: 20 °C Load to be applied: 15 N – Radius intermediate piece: 12 mm Drop height: 150 mm – Number of impacts: 2 Number of samples: 3 – Sample length: $\geq 700$ mm
Cut-through	507	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. Loads to be applied: Ambient (20 °C): 330 N – High temperature (150 °C): 85 N Duration of load application: 1 min Number of samples: 3 – Sample length: $\geq 3$ m
Torsion	508	Added to test criterion: No cracking or splitting of cable jacket Maximum variation of attenuation at 850 nm and 1 300 nm. For one cycle: $\leq 0,10$ dB – For 1 000 cycles: $\leq 0,10$ dB Number of samples: 3 – Sample length: $\geq 3,0$ m Load to be applied: 150 N – Number of cycles: 1 000 Distance between the rotating grip and the fixed grip: (0,25 $\pm$ 0,05) m
Kink	509	No kink shall occur at a diameter greater than minimum loop diameter. Maximum permissible variation of attenuation: $\leq 0,10$ dB at 1,310 nm Minimum loop diameter: 20 mm
Bend	510 Method B	Number of samples: 3 – Sample length: $\geq 10$ times bend radius Maximum variation of attenuation: $\leq 0,25$ dB at 850 nm and 1 300 nm. equipment: $\leq 0,10$ dB at 850 nm and 1 300 nm. Visual examination in accordance with EN 3745-201 Mandrel diameter: 25 mm – Number of turns: 10
		Number of samples: 1 – Sample length: (10 $\pm$ 0,05) m Residual attenuation after removing the specimen from the test

Cable to cable abrasion

511

Not applicable if jacket materials are the same. This is a EN 4641-102 component test.

continued



Table 3 — Ruggedized fibre optic cable test methods (continued)

Test	Test method EN 3745-	Test conditions and results
Flexure endurance	512	Examination of test specimen for damage in accordance with EN 3745-201 (visual examination). Maximum permissible variation of attenuation: ≤ 0,25 dB at 850 nm and 1 300 nm. Number of samples: 3 – Length of the sample: ≥ 5 m Load to be applied: 11,5 N – Diameter of mandrel: 28 mm Number of cycles: 100 000
Crush resistance	513	Maximum variation of attenuation: ≤ 0,05 dB at 850 nm and 1 300 nm. No cracking or splitting of cable jacket Load: 445 N – Area of load: 100 mm <sup>2</sup> Number of samples: 3 – Sample length: ≥ 3 m
Severe cable bend	516	Examination of test specimen for damage in accordance with EN 3745-201 (visual examination). No fibre breakage. Load to be applied : 45 N Maximum edge radius: 127 µm Number of cycles: One bend in each direction Number of samples: 3 – Length of the sample: ≥ 3 m
Cable clamping	517	Typical requirements: Maximum transmittance change: ≤ 0,05 dB at 850 nm. Mandrel diameter: (13 ± 1) mm Number of cable ties applied: 6 – Cable tie tension setting: #1 Cable tie spacing: ≥ 90 mm Number of samples: 3 – Sample length: ≥ 4 m
Smoke	601	Test method: EN 3475-601 Specific optical smoke density (average) D <sub>s</sub> ≤ 200 within 4 minutes test duration under both the flaming and non-flaming conditions.
Toxicity	602	Value must be measured at the end of the test. EN 3475-602 HF < 300 ppm HCL < 150 ppm HCN < 150 ppm SO <sub>2</sub> < 100 ppm H <sub>2</sub> S < 100 ppm NO < 100 ppm NO <sub>2</sub> < 100 ppm CO < 1 000 ppm

continued

**Table 3 — Ruggedized fibre optic cable test methods (concluded)**

Test	Test method	Test conditions and results
	<del>EN 3745</del>	
Nuclear radiation	603	Not applicable
Cable stripping	701	Jacket: < 5 N per 30 mm Blade design (see EN 2812) Pulling speed 25 mm/min to 50 mm/min
Durability of manufacturers identity markings	703	Examine marking in accordance with EN 3745-201 visual examination. Number of samples: 3 – Sample length: (2 ± 0,05) m Load: 1,5 N – Number of cycles: 125 Not applicable if marker tape used under outer jacket.
Contrast measurement	705	≥ 40 % for UV laser marked cable. Not applicable if marker tape used under outer jacket.
Durability of user identification markings	706 EN 3838	Not applicable
General test conditions: The tests shall be performed with the following launch condition: 70/70 %		

## 8 Tooling

See TR 4647 termination processes.

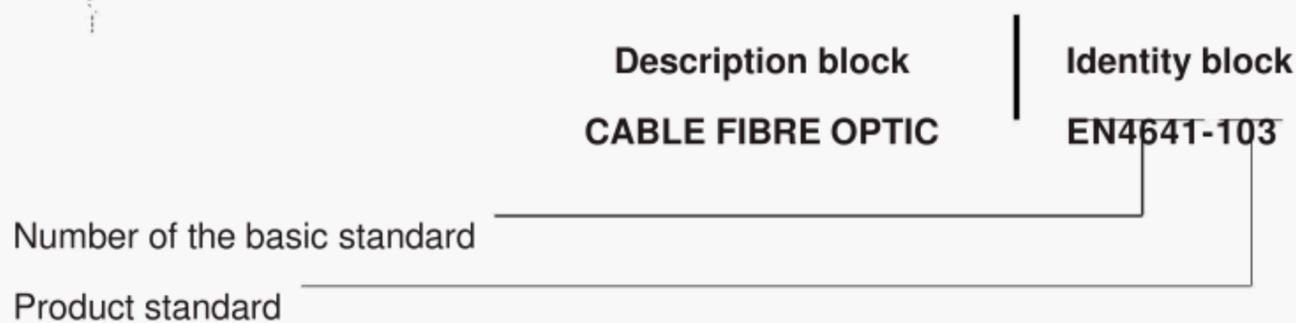
## 9 Quality assurance

See EN 9133.

## 10 Designation, marking and colours

### 10.1 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 cable shall use marker tape under the outer jacket or the outer jacket shall be marked with a UV laser.

**Hot stamping is forbidden.**

## 10.3 Colours

The colour of the outer jacket will be light purple or as specified by customer.

## 11 Delivery conditions

### 11.1 Packaging

See EN 4641-001.

### 11.2 Labelling

See EN 4641-001.

### 11.3 Delivery lengths

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: – 65 °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

Tensile strength on cable < 30 N.

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