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Aerospace series — Fibres and cables, optical, aircraft use — Test methods

Part 100: General

ICS 49.060

National foreword

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Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (EN 3745-100:2008) 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 standard defines terms for optical fibres and cable.

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.

IEC 50(731), *International Electrotechnical Vocabulary — Chapter 731: Optical fibre communication.*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
optical fibre
a dielectric waveguide whose core consists of optically transparent material of low attenuation and whose cladding consists of optical transparent material of lower refractive index than that of the core (see Figure 1)

NOTE In general the optical fibre is furnished with a primary coating (see Figure 1).

3.2
core
the central region of an optical fibre through which most of the optical power is transmitted (see Figure 1)

3.3
cladding
dielectric material surrounding the core of the optical fibre (see Figure 1)

3.4
fibre coating
the first protective coating directly applied to the fibre during its manufacture (see Figure 1)

NOTE Its purpose is to maintain original optical performance of the fibre and to provide minimum mechanical properties.

3.5
optical cable
an assembly consisting of optical fibre, inner sheath and where applicable strength members and jacket (see Figure 1)

3.6
multiple fibre cable
a construction in which a number of fibres are placed together in a cable

3.7
buffer
a material which surrounds and is immediately adjacent to a primary coating and provides mechanical protection (see Figure 1)

3.8
strength members
a protective envelope added to the inner sheath when necessary to improve the properties of mechanical resistance (see Figure 1)

3.9
jacket
a external protective covering (see Figure 1)

3.10
refractive index profile
the distribution of the refractive index along the diameter of an optical fibre

NOTE The refractive index profile for simple structures can be approximated by:

$$n(r) = n_1\sqrt{1-2\Delta(r/a)^g} \text{ for } r < a$$

$$n(r) = n_2 = n_1\sqrt{1-2\Delta} \text{ for } r \geq a$$

$$\text{with } \Delta = (n_1^2 - n_2^2) / 2\, n_1^2$$

where:

r is the radial distance from the centre of fibre,

n_1 is the maximum refractive index value of the core material,

n_2 is the refractive index value of the cladding material,

a is the core radius,

g is the profile parameter which defines the form of the profile:

$10 \leq g < \infty$ ➜ step index profile
$1 \leq g < 3$ ➜ graded index profile
$3 \leq g < 10$ ➜ quasi step index profile

3.11
core diameter
the core diameter ($\varnothing\ cr$) is the diameter of the circle which best fits the core area. For a cross section of an optical fibre the core area is that within which the refractive index everywhere (excluding any index dip) exceeds that of the innermost homogeneous cladding by a given fraction of the difference between the maximum of the refractive index of the core (n_1) and the refractive index of the innermost homogeneous cladding (n_2)

NOTE It is contained within the focus of points where the refractive index n_3 is given by:

n_3 $= n_2 + k\,(n_1 - n_2)$
n_1 = maximum refractive index value of core
n_2 = refractive index value of the innermost homogeneous cladding
k = a constant (unless otherwise specified a k value of 0,05 is assumed).

3.12
cladding diameter
the cladding diameter ($\varnothing\ cd$) is the physical diameter of the optical fibre

3.13
concentricity error core/cladding
the distance between the centre point of the core and the centre point of the cladding divided by the core diameter

3.14
non circularity of core
the difference between the longest and the shortest chords passing through the core centre, divided by the core diameter

3.15
non circularity of cladding
the difference between the longest and the shortest chords passing through the cladding centre, divided by the cladding diameter

3.16
attenuation
the attenuation A at the wavelength lambda between two cross sections 1 (input) and 2 (output) separated by the distance L of the fibre is defined by:

$A = 10 \log_{10} (P_1/P_2)$ (dB)

P_1 = optical power traversing the cross section 1

P_2 = optical power traversing the cross section 2

Attenuation coefficient:

α (alpha) = A/L (dB/unit length)

NOTE For practical use, generally, these parameters are given under modal equilibrium conditions (this is not normally the case in avionic applications where lengths are short).

3.17
numerical aperture
the numerical aperture NA is the maximum theoretical numerical aperture defined by:

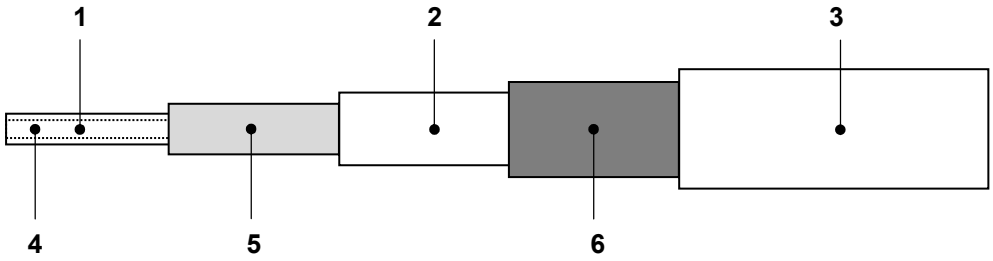
$$NA = \sqrt{{n_1}^2 - {n_2}^2}$$

where:

n_1 = maximum of the refractive index value of the core

n_2 = the refractive index value of the innermost homogeneous cladding

3.18
bandwidth
the value numerically equal to the lowest frequency at which the magnitude of the baseband transfer function of an optical fibre decreases to a specified fraction, generally to one half (3 dB), of the zero frequency value



Key

1 Cladding
2 Buffer (if present)
3 Jacket
4 Core } Optical fibre
5 Fibre coating } Optical fibre
6 Strength members (if present)

Figure 1 — Optical cable

4 Test conditions

Unless stated otherwise in the test methods, the technical specification or the product standard the test conditions shall be:

— Temperature: (20 ± 5) °C

— Atmospheric pressure: 86 KPa to 106 KPa

— Relative humidity: 45 % to 75 %

The temperature and humidity shall remain constant during a series of measurement.

5 List of test methods

Table 1 — General designation

EN 3745 part	Test designation
201	Visual examination
202	Fibre dimensions
203	Cable dimensions
204	—
205	Cable longitudinal dimensional stability

Table 2 — Optical tests

EN 3745 part	Test designation
301	Attenuation
302	Numerical aperture
303	Bandwidth
304	—
305	Immunity to ambient light coupling
306	Variation of attenuation during temperature cycling

Table 3 — Environmental tests

EN 3745 part	Test designation
401	Accelerated ageing
402	Temperature cycling
403	—
404	Thermal shock
405	Low/High temperature bend test
406	Cold bend test
407	Flammability
408	—
409	—
410	Thermal life
411	Resistance to fluids
412	Humidity resistance

Table 4 — Mechanical tests

EN 3745 part	Test designation
501	Optical fibre proof test
502	Tensile strength for short length of optical fibres
503	Scrape abrasion
504	Micro bending test
505	Cable tensile strength
506	Impact resistance
507	Cut-through
508	Torsion
509	Kink test
510	Bending test
511	Cable to cable abrasion
512	Flexure endurance
513	Crush resistance
514	Cable twist bend
515	Remove buffer
516	"Severe" cable bend test
517	Cable tie clamping test

Table 5 — Sundry tests

EN 3745 part	Test designation
601	Smoke density
602	Toxicity
603	Nuclear radiation

Table 6 — Handling tests

EN 3745 part	Test designation
701	Strippability
702	—
703	Durability of manufacturer's marking
704	—
705	Contrast measurement

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BSI Group
Headquarters 389
Chiswick High Road,
London, W4 4AL, UK
Tel +44 (0)20 8996 9001
Fax +44 (0)20 8996 7001
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