SLOVENSKI STANDARD
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Aeronavtika - Električni in optični spojni elementi - Preskusne metode - 100. del: Splošno

Aerospace series - Elements of electrical and optical connection - Test methods - Part 100: General

Luft- und Raumfahrt - Elektrische und optische Verbindungselemente - Prüfverfahren - Teil 100: Allgemeines

Série aérospatiale - Organes de connexion électrique et optique - Méthodes d'essais - Partie 100 : Généralités

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Luft- und Raumfahrt - Elektrische und optische Verbindungselemente - Prüfverfahren - Teil 100: Allgemeines

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (prEN 2591-100:2022) 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 document 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 document is currently submitted to the CEN Enquiry.

1 Scope

This document specifies the general requirements for the methods of testing elements of electrical, optical and data transmission system connections used in aerospace applications.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 2083, *Aerospace series — Copper or copper alloys conductors for electrical cables — Product standard*

EN 2084, *Aerospace series — Cables, electrical, general purpose, with conductors in copper or copper alloy — Technical specification*

EN 2234, *Aerospace series — Cables, electrical, fire-resistant — Technical specification*

EN 2346,[1] *Aerospace series — Fire resistant electrical cables — Dimensions, conductor resistance and mass*

EN 3745-201, *Aerospace series — Fibres and cables, optical, aircraft use — Test methods — Part 201: Visual examination*

EN 4641-100, *Aerospace series — Cables, optical 125 µm diameter cladding — Part 100: Tight structure 62,5/125 µm core GI fibre 1,8 mm outside diameter — Product standard*

EN 4641-301,[2] *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*

EN 60512-1, *Connectors for electronic equipment — Tests and measurements — Part 1: General (IEC 60512-1:2001)*

EN 60793-43, *Optical fibres — Part 1-43: Measurement methods and test procedures — Numerical aperture measurement (IEC 60793-43)*

EN/IEC 60793-45, *Optical fibres — Part 1-45: Measurement methods and test procedures — Mode field diameter (IEC 60793-45)*

IEC 60050-581,[3] *International Electrotechnical Vocabulary — Chapter 581: Electromechanical components for electronic equipment*

IEC 61300-3-35,[4] *Fibre optic interconnecting devices and passive components — Basic test and measurement procedures — Part 3-35: Examinations and measurements — Visual inspection of fibre optic connectors and fibre-stub transceivers*

[1] Published as ASD-STAN Standard at the date of publication of this document by AeroSpace and Defence industries Association of Europe — Standardization (ASD-STAN), https://www.asd-stan.org/.

[2] Published as ASD-STAN Technical Report at the date of publication of this document by AeroSpace and Defence industries Association of Europe — Standardization (ASD-STAN), https://www.asd-stan.org/.

[3] Published by: IEC International Electrotechnical Commission https://www.iec.ch/.

[4] Published by: IEC International Electrotechnical Commission https://www.iec.ch/.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-581, EN 60512-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at https://www.iso.org/obp
- IEC Electropedia: available at https://www.electropedia.org/

3.1
element of electrical or optical connection [5)]
component such as connector, module, etc., the purpose of which is to ensure the connection of circuits

3.2
flight cover (or protective cover)
accessory designed to ensure, in flight, mechanical protection and sealing of front face of a non-coupled connector

3.3
connector with built-in protection of contacts
connector with characteristics such that male or female contacts, mounted in a plug or receptacle, cannot come into contact with the front of the connector to which it is coupled (scoop-proof) and in which, in the event of accidental coupling of two parts or the connector equipped with male contacts, no electrical contact can take place

3.4
contact pressure point
point at which a square ended gauge pin of the same basic diameter as the mating contact first engages the female contact spring member

3.5
initial measurement
examination or measurement of characteristics carried out to determine the magnitude of the variations produced by the stress or stresses applied

This examination or measurement is carried out at the end of pre-conditioning and under normal atmospheric conditions for measuring

3.6
final measurement
examination or measurement of characteristics carried out at the end of the recovery to assess the condition of the specimen after testing and to determine the magnitude of the variations in characteristics in relation to the values recorded at initial measuring

3.7
flammability
a product is considered to be “non-flammable” when combustion due to exposure for a given duration to a standard external flame remains localized and stops spontaneously after withdrawal of the flame

5) In test standards the term "element of connection" shall be used.

3.8
fire resistance
a product is considered to be “fire-resistant” when, subjected to a standard flame:

— it retains its electrical role for six minutes;

— the flame does not propagate to the other side of the support in the first twenty minutes

3.9
values of alternating voltage and current
unless otherwise indicated, alternating voltage and current are indicated in root mean square values

3.10
line data bus
pair of twisted wires, shielded, having a specified impedance, a matched impedance at its two ends and used for data transport

3.11
branch line
section of twisted wires, shielded, with a specified impedance, which connects equipment to a bus line

3.12
line coupler
element of electrical or optical connection the purpose of which is to shunt the transmission signals from a bus line to equipment

3.13
line coupler, single
coupler consisting of one line and one branch

3.14
line coupler, double
coupler consisting of one line and two branches

3.15
in-line splice
permanent element of electrical or optical connection for two-wire cables

3.16
line termination
end line component the purpose of which is to match the bus line to its characteristic impedance

3.17
branch termination
end branch termination the purpose of which is to eventually replace equipment

3.18
recovery
treatment of a specimen, after conditioning, so that the properties of the specimen may be stabilized before measuring

3.19
optical fibre cable
certain number of optical fibres or bundles, coated separately and joined inside a common sheath

3.20
beam splitter
device for dividing an optical beam into two separate beams

3.21
insertion loss (of an optical element)
extra optical attenuation caused by the insertion of an extra optical element into an optical system

3.22
launch angle
angle between the wave propagation vector of the incoming light and the normal vector of an optic fibre end face

3.23
mode conditioner
device for adapting the light output from a source to produce a defined launch condition for testing an optical system

3.24
multimode fibre
optical fibre having a large core diameter dimension in relation to the wavelength of the light, and in which a large number of modes can propagate

3.25
optical port
port which radiates or accepts optical power at the interface

3.26
fibre optic branching device
device possessing three or more optical ports which shares optical power among its ports in a predetermined fashion

3.27
patch cord
assembly where the cable or fibre is terminated at each end with either a plug or socket connector

3.28
pigtail
short length of fibre between a component and a transmission fibre, often permanently secured to the component (LED, coupler, connection elements, ...)

3.29
power meter
device for measuring the optical power in a fibre optic system. Power measurements are usually made in Watts or dBm. Relative power measurements are made in dB

3.30
single mode fibre
optical fibre in which only one mode can propagate

3.31
passive coupler
passive branching device in which power from one or more incoming optical ports is distributed to one or more outgoing optical ports

3.32
tee coupler
an optical fibre tee coupler is a passive coupler or combiner with three optical ports

3.33
return loss
light energy reflected back from discontinuities in a fibre optic link

3.34
light launch system
LLS
device designed to create defined and repeatable light coupling conditions in a test setup

3.35
light detection system
LDS
device designed to take repeatable measurements of light transmitted by a test setup

3.36
temporary joint
non-permanent optical fibre connecting devices for use on equipment

3.37
terminator
non-reflective termination of an optical fibre

3.38
test cord
terminated optical fibre cord used to connect the test equipment to the optical span, or to provide a suitable interfaces to the cabling under test

3.39
for the following terms, see EN 3745-100
optical fibre – Core – Cladding – Primary coating – Refractive index profile – Step index fibre – Graded index fibre – Quasi-step index fibre – Core diameter – Cladding diameter – Concentricity error core/cladding – Non circularity of core – Non circularity of cladding – Attenuation – Numerical aperture – Bandwidth

4 Standard test conditions

4.1 The test methods are written so that the test may be carried out either individually or included in a test sequence.

4.2 Unless otherwise indicated in the test method, technical specification or product standard, the test conditions shall be as follows:

— temperature: (23 ± 5) °C;

— atmospheric pressure: 86 kPa to 106 kPa (860 mbar to 1 060 mbar);

— relative humidity: 45 % to 75 %.

The temperature and humidity shall remain constant throughout a series of measurements.

Unless otherwise indicated in the technical specification, the cables used for tests shall be in accordance with EN 2083 and EN 2084 or EN 2234 and EN 2346.

5 Test main requirements

5.1 Fibre end preparation

5.1.1 General

The aim of this section is to give recommendations on the acceptable end condition of fibres, whether terminated or not. It is not intended to describe a precise method for fibre end preparation; instead it gives the information necessary to describe and quantify fibre end quality.

This paragraph is applicable therefore to all tests which require the use of at least one optical interface of this type. It applies to all types of fibre, silica, plastic or a combination of these and other materials, generally up to a diameter of 125 µm. Comments are made for some other fibre sizes.

5.1.2 Parameters

The quality of a fibre end can be described in terms of the end face profile and the surface condition. These terms are now described in more detail.

5.1.2.1 End face profile

If terminated in a connector ferrule or contact, the fibre/ferrule end-face will be required to have a particular profile depending on the application.

The most common connector profiles are listed below:

The connector end face profile will determine the connector insertion loss and return loss (back reflection). Minimizing back reflection is of great importance in certain high-speed and analogue fibre optic links to prevent instability at the source.

Flat Polish — As the name suggests the fibre interface is essentially flat. Usually produced with a very hard backing material during polishing. A flat polish of the connector surface will result in a back reflection of about −16 dB (4 %).

PC Polish — A Physical Contact (PC) polish results in a slightly curved connector surface, forcing the fibre ends of mating connector pairs into physical contact with each other. This produces much lower back reflection of −30 dB to −40 dB. The PC polish is the most prevalent connector end face in most applications.

SPC and UPC Polish — Super PC (SPC) and Ultra PC (UPC) polished connectors are also curved and physically contact. An extended polishing process enhances the surface quality of the connector, resulting in back reflections of −40 dB to −55 dB and < −55 dB, respectively. These polish types are used in high-speed, digital fibre optic transmission systems.

APC Polish — The Angled PC (APC) polish uses an 8 degree angle to the connector end face. Back reflections of < −60 dB can routinely be accomplished with this type of polish.

For cases where the fibre is not terminated into a connector ferrule, it may be prepared as a nominally flat interface. This may require cleaving to produce an acceptable end although polishing to a flat profile is also possible (within a suitable bare fibre adapter). For cases where a ‘flat’ fibre end is to be produced the flatness of the end-face should be good. In quantitative terms this can be defined in terms of end face angle (see 5.1.2.2).

It is useful to describe the industry standard parameters for a PC (Physical Contact) profile. These are shown in Figure 1. This profile is characterized typically by three key parameters namely, (1) fibre/ferrule radius of curvature, (2) fibre height (undercut or protrusion with respect to the