

SLOVENSKI STANDARD

SIST EN 3475-705:2022

01-april-2022

Nadomešča:

SIST EN 3475-705:2006

Aeronavtika - Električni kabli za uporabo v zračnih plovilih - Preskusne metode - 705. del: Meritev kontrasta

Aerospace series - Cables, electrical, aircraft use - Test methods - Part 705: Contrast measurement

Luft- und Raumfahrt - Elektrische Leitungen für Luftfahrtverwendung - Prüfverfahren - Teil 705: Kontrastmessung

Série aérospatiale - Câbles électriques à usage aéronautique - Méthodes d'essais - Partie 705: Mesure de contraste

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Ta slovenski standard je istoveten z: EN 3475-705:2022

ICS:

29.060.20	Kabli	Cables
49.060	Letalska in vesoljska električna oprema in sistemi	Aerospace electric equipment and systems

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en,fr,de

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 3475-705

February 2022

ICS 49.060

Supersedes EN 3475-705:2005

English Version

Aerospace series - Cables, electrical, aircraft use - Test
methods - Part 705: Contrast measurement

Série aérospatiale - Câbles électriques à usage
aéronautique - Méthodes d'essais - Partie 705: Mesure
de contraste

Luft- und Raumfahrt - Elektrische Leitungen für
Luftfahrtverwendung - Prüfverfahren - Teil 705:
Kontrastmessung

This European Standard was approved by CEN on 8 November 2021.

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 3475-705:2022) 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-STAN, prior to its presentation to CEN.

This document shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2022, and conflicting national standards shall be withdrawn at the latest by August 2022.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

[This document supersedes EN 3475-705:2005.]

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this document: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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Introduction

It is a requirement within the aerospace industry that all wires and cables within an aircraft electrical system are identified with a circuit identification code at regular intervals down the length of the wire. Various marking methods are used for marking these identification codes on to the surface of electrical wires or cables including ink-based and laser-based processes. The legibility of the markings is dependent upon the process used and the insulation medium. Minimum standards of contrast are required to facilitate reading back of the identity codes.

NOTE It has been reported that there are instances where the contrast of marks on tape wrap wires is non-uniform and can cause problems in the contrast measurement process which might lead to a non-conformance. Care needs to be taken in such cases to establish a good average value of the contrast. This issue will be assessed in the next revision of the document.

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1 Scope

This document specifies the process to be applied for measuring the contrast of wire and cable identification markings against the background of the unmarked wire insulation. It has been developed primarily to define a reproducible process of contrast value determination for use both to determine the intrinsic laser markability of wires at the time of manufacture or later, and to enable electrical wiring systems manufacturers to ensure that the whole process of wire marking is carried out to the required standard.

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 3475-706, *Aerospace series - Cables, electrical, aircraft use - Test methods - Part 706: Laser markability*

EN 4650, *Aerospace series — Wire and cable marking process, UV Laser*

CIE 15, *Colorimetry*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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/>
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3.1

contrast

ratio of the difference in luminance between the marked and unmarked areas of the insulation divided by the luminance of the unmarked insulation

3.2

luminance

quantitative measurement of the visible light reflected from a surface, in this case the wire or cable insulation

3.3

laser

acronym for Light Amplification by the Stimulated Emission of Radiation

Note 1 to entry: Lasers are a source of intense monochromatic light in the ultraviolet, visible or infrared region of the spectrum.

3.4

ultraviolet

UV

electromagnetic radiation in a wavelength range from approximately 200 nm to 400 nm

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3.5**UV laser**

laser that produces a beam of UV radiation

3.6**fluence**

energy density, measured in J/cm^{-2} (Joules per square cm) of a single pulse of the laser beam, which, for the purposes of this document, is taken at the surface of the wire insulation or cable jacket

Note 1 to entry: See also EN 4650 for further details.

3.7**wavelength**

λ

measured in nanometres, nm. $1 \text{ nm} = 10^{-9} \text{ m}$. $\lambda = c/f$ where c is the velocity of light and f is the frequency

4 Preparation of samples

The wire or cable samples shall be identified in accordance with the applicable manufacturing instructions for the marking equipment. Where samples are to be UV laser-marked, this shall be done using the fluence specified in EN 4650 or the relevant wire or aircraft manufacturer's process specification if different. When determining the laser markability of wires, this shall be in accordance with EN 3475-706.

Take a sample of the wire for marking. Before marking the wire ensure that the wire surface is clean and dry and free from dust and dirt, if necessary, wipe it clean using propan-2-ol (isopropyl alcohol). The surfaces of the samples shall be clean and without damage.

The identification markings to be measured shall be even in colour and characters shall have well defined edges.

Before starting measurements clean the surfaces with a soft, lint-free cloth, if required, to avoid distortion of test results by a roughened surface or "deposits".

5 Apparatus, measurement and process**5.1 Apparatus****5.1.1 Components of the measuring device**

The measuring device shall comprise, at a minimum, a photometer, an illumination system and a purpose designed sample holder suitable for wire and cable. The whole system shall be designed to ensure that test results are not falsified by external influences. The photometer shall be designed to be stable and free from vibrations and to exclude the influences of external light and reflections from scattered light.

5.1.2 Equipment colour

The device for holding samples and any accessories and the equipment in the vicinity of the measurement area shall be matt black in colour to absorb scattered light.

5.1.3 Photometer

The luminance shall be determined with a calibrated electrical photometer, which shall incorporate a photopic filter to simulate the response of the human eye. The manufacturer's instructions concerning the photometer working range and operating instructions shall be observed. The measurement sensitivity of the photometer shall be in conformity with CIE 15.

5.1.4 Illumination and viewing system

The illumination system shall consist of two light sources of equal intensity (see Figure 1). The two sources may be two separate lamps or, preferably, two fibre light guides fed from a single lamp. The light from the sources shall overlap to illuminate a central spot on the sample at an angle of 45° to the surface. The light cones shall illuminate the wire sample longitudinally along its length and in a manner to avoid the formation of shadows. The photometer shall be installed to view the sample along the normal to the surface, i.e. at 90°, and above the principal focus at a distance that depends on the objective's focal distance. It shall be adjusted during calibration and after every change of objective.

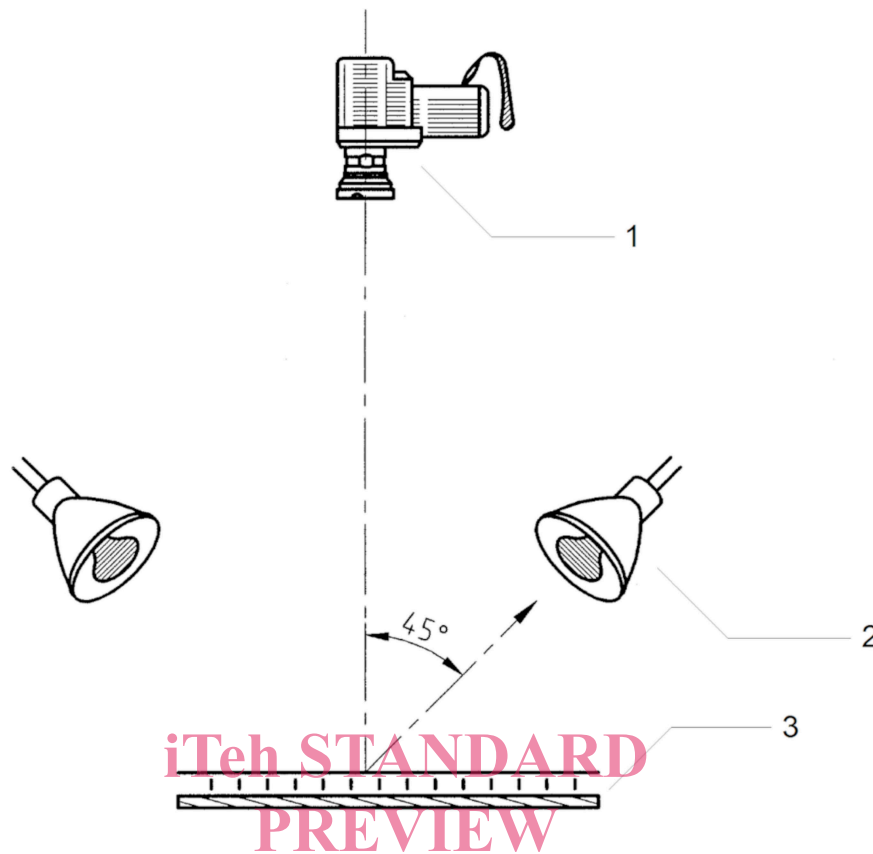
If two separate lamps are used, they shall be of identical power consumption and shall always be exchanged in pairs. The radiating light energy and colour temperature of the lamps shall be compatible with the working range of the photometer, according to the manufacturer's instructions. The spectral distribution of the light shall be close to artificial light specifications, e.g. according to light standard A, ISO 7724-1. Only gas-filled lamps with tungsten filaments shall be used. The colour temperature shall be $(3\,000 \pm 500)$ K.

The voltage supply for the lamps shall be insensitive to line fluctuations. A stabilized d.c. power unit shall be used.

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**Key**

- 1 Photometer
- 2 Source of light
- 3 Marked cable

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Figure 1 — Lighting equipment**5.2 Measurement****5.2.1 Equipment design and measurement methodology**

To determine the contrast, measurements shall be taken of the luminance from both marked and unmarked areas of the insulation. It is recommended that a photometer designed specifically for the task of making contrast measurements on wire and cable markings shall be used which takes a digital image of the mark and determines the contrast instantaneously by the simultaneous measurement of the luminance of all the sample points of an area of the sample.

Single point measurement systems typically have measurement spots which are large in comparison to the stroke width of the characters to be measured. Such single point systems shall not be used for the purposes of this standard unless the diameter of the measurement area is $\leq 50 \mu\text{m}$ in width. If such systems are used, sufficient points shall be sampled on both the marked and unmarked portion of the wire to ensure that a good average value of the reflectance of each is obtained.

5.2.2 Measurement spot size

The maximum admissible diameter of the photometer measurement spot shall be $\leq 50 \mu\text{m}$. This is particularly important if using a point measurement system where spot sizes are typically relatively large.