SLOVENSKI STANDARD
oSIST prEN 3475-408:2023

01-junij-2023

Aeronavtika - Električni kabli za uporabo v zračnih plovilih - Preskusne metode - 408. del: Požarna odpornost

Aerospace series - Cables, electrical, aircraft use - Test methods - Part 408: Fire resistance

Luft- und Raumfahrt - Elektrische Leitungen für Luftfahrtverwendung - Prüfverfahren - Teil 408: Feuerbeständigkeit

Série aérospatiale - Câbles électriques à usage aéronautique - Méthodes d'essais - Partie 408: Résistance au feu

Ta slovenski standard je istoveten z: **prEN 3475-408**

ICS:

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

oSIST prEN 3475-408:2023 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 3475-408

April 2023

ICS 49.060

Will supersede EN 3475-408:2005

English Version

Aerospace series - Cables, electrical, aircraft use - Test methods - Part 408: Fire resistance

Série aérospatiale - Câbles électriques à usage aéronautique - Méthodes d'essais - Partie 408: Résistance au feu

Luft- und Raumfahrt - Elektrische Leitungen für Luftfahrtverwendung - Prüfverfahren - Teil 408: Feuerbeständigkeit

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee ASD-STAN.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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, Türkiye and United Kingdom.

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.

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.

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

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

Ref. No. prEN 3475-408:2023 E

Contents

Page

European foreword

This document (prEN 3475-408:2023) 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 is currently submitted to the CEN Enquiry.

This document will supersede EN 3475-408:2005.

prEN 3475-408:2023 includes the following significant technical changes with respect to EN 3475-408:2005:

a) Introduction of liquid burner requirements with test setup configuration.

1 Scope

This document specifies a method of testing the fire resistance of "fire-proof" electrical cables.

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 3909, *Aerospace series — Test fluids and test methods for electrical and optical components and sub-assemblies*[1]

ISO 2685:1998, *Aircraft — Environmental test procedure for airborne equipment — Resistance to fire in designated fire zones*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminology 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/

4 Preparation of specimens

Six test specimens, 0,75 m minimum length, shall be selected at random from a quantity of cable.

5 Apparatus

5.1 List of apparatus

The following shall be required for this test: a burner, a burner calibration, a test fixture, and test fluids.

5.2 Burner

5.2.1 Method A – Liquid combustible (kerosene)

The burner shall be as described in ISO 2685:1998, Clause A.2 or any other burner or assembly of burners satisfying the following conditions:

— liquid combustible type of kerosene shall be in accordance with EN 3909;

— the burner outlet shall be equipped with an extension of 318 mm, 152 mm high and 280 mm width;

— cable length exposed to the flame: 152 mm;

— flame characteristics as per ISO 2685:

  — temperature: 1 100 °C ± 80 °C;

[1] Published as AECMA Prestandard at the date of publication of this standard.

— heat flux density received by the calorimeter described in ISO 2685:1998, Annex B: 116 kW/m² ± 10 kW/m².

5.2.2 Method B – Gas combustible

The burner shall be as described in ISO 2685:1998, Annex A or any other burner or assembly of burners satisfying the following conditions:

— cable length exposed to the flame: 152 mm;

— diameter or width of the flame at the base of the burner(s) ≥ 2 *D* (*D* diameter of the cable under test);

— Flame characteristics as per ISO 2685:

  — temperature: 1 100 °C ± 80 °C;

  — heat flux density received by the calorimeter described in ISO 2685:1998, Annex B: 116 kW/m² ± 10 kW/m².

5.2.3 Burner calibration

5.2.3.1 Temperature

5.2.3.1.1 Temperature measurement

The calibration in temperature of the burner consists of adjusting the mixing ratio of air and combustible, until the flame is delivering a standard flame. A flame is characterized by its temperature and its heat flux. As the quantitative value is directly dependent on the instrumentation, it is necessary to respect a common tool to ensure uniformity between tests.

Before calibrating the burner, allow the apparatus to run for at least 5 min for stabilizing the heating conditions.

During and after calibration, the burner shall not be extinguished until the end of the fire test.

The surface calibrated is only valid as long as the burner settings was not changed or turned off.

The temperature of each thermocouple shall be recorded at least every 5 s intervals during minimum 2 min.

5.2.3.1.2 Temperature measuring equipment

It is important that the temperature measuring equipment (including the thermocouple and the acquisition tools) ensures an accuracy and compatible reactivity with the values sought.

The temperature-measuring tool is composed of thermal sensors placed in a manner that it ensures a good overview of the flame temperature distribution without disturbing it.

The temperature measuring equipment shall have an allowable overall error of 1 % at 1 100 °C and shall have a temperature range between at least from 900 °C to 1 200 °C.

The diameter of the thermocouple wire shall be between 0,6 mm and 1 mm.

The thermocouple shall have an exposed junction over at least 10 mm.

A thermocouple type K or N, unshielded (exposed probe) and non-aspirated, with a wire between 0,6 mm and 1 mm, is compliant with this requirement.

5.2.3.2 Heat flux

5.2.3.2.1 Heat flux measurement

The heat flux, also known as the thermal flux, is defined as the rate of heat transfer per unit cross-sectional area (kW/m²), and quoted “q”.

As the heat flux measured is directly dependent on the measuring tool, the measuring apparatus and heat flux burner calibration shall be as described per ISO 2685:1998, Clause B.4.

5.2.3.2.2 Heat flux measuring equipment

A heat transfer tube device (also known as a continues flow calorimeter) shall be in copper and it is used to measure the flame in heat flux.

The tube shall be in copper, the copper tube shall be set up without any type of backing plate behind it.

Prior each measurement, the exposed surface of the copper tubing shall be cleaned with a fine steel wool. Inspect the tubing bore for corrosion and remove any scale of accumulation.

Since the temperature rise across the heat-transfer tube is small, it is necessary to have an accurate thermocouple. The water temperature sensor shall be capable of measuring at least a delta of 0,1 °C.

Minimum segment length of calorimeter tube to be exposed to the flame during its calibration shall be 12 mm to control thermal flux density calibration “q” in kW/m² as per the formula:

The heat flux density is to be calculated using the following method:

$$q = \frac{q_V \rho_c \left(T_2 - T_1\right)}{37,7 \times 10^{-3} \times L}$$

where

q_V is the water volume flow rate in cubic meters per second;

r is the density of water in kilograms per cubic meter, at mean temperature $(T_1 + T_2)/2$, or approximately 1 000 kg/m3;

c is the specific heat capacity of water in kilojoules per kilogram Kelvin at the mean temperature $(T_1 + T_2)/2$, i.e. approximately 4,185 kJ/(kg·K);

T_1 is the temperature of the water in degrees Celsius, averaged over time, at the entrance of the heat transfer tube;

T_2 is the temperature of the water in degrees Celsius, averaged over time, at the outlet of the heat transfer tube;

L is the length in meters, of the portion of the tube exposed to the flame.

5.2.3.3 Burner calibrated distance

5.2.3.3.1 Burner for liquid combustible (kerosene)

Minimum axial distance “h” between the burner extension outlet extremity and the surface calibration of device (calorimeter and thermocouple) shall 100 mm ± 10 % as per ISO 2685.

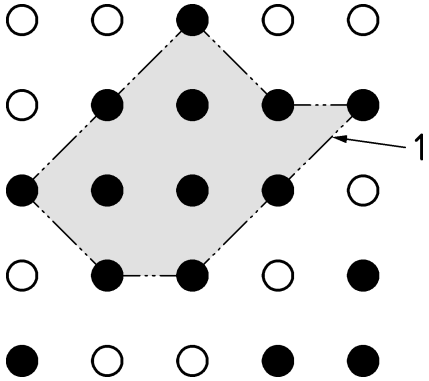
5.2.3.3.2 Burner for gas combustible

Minimum axial distance “h” between the burner extension outlet extremity and the surface calibration of device (calorimeter and thermocouple) shall 75 mm. (−0; +5 mm to include tolerance Max) as per ISO 2685.

Temperature measurement:

The calibration shall be a free burning calibration (i.e.: In the vicinity of the sensor, nothing shall perturb the flame measurement).

From the temperature-measured points, it is possible to draw the biggest dimension surface enclosing only valid sensors, see Figure 1.



Key

1	Calibrated Zone
○	Non-Valid sensor for calibration
●	Valid sensor for calibration

Figure 1 — Valid calibration zone surface example

A sensor is declared valid if the temperature measurement recorded are within 1 100°C ± 80 °C during 2 min minimum.

A calibrated surface is the area covered by the smallest triangle meshes where the nodes are the sensors that recorded a temperature of 1 100 °C ± 80 °C during minimum 2 min, without any recorded value outside the tolerances.

The calibrated surface in temperature shall be superior of the foreseen impinging surface for the test. And the condition A < 2B is fulfilled, where A is the major cross-section of the equipment/specimen in square metres, and B is the area of the flame at the nozzle of the burner, in square metres.

The surface calibrated in temperature shall be at least 25 % of the burner face.

5.3 Test fixture

The test rig shall ensure that the orientation and disposition will guaranty that the specimen will see the required test conditions as specified below:

— the burner shall be in:

  — vertical position for gas combustible, see Figure 2;

  — horizontal position for liquid combustible, see Figure 3;

— the frame of the test fixture shall be vibrated during flame exposition;

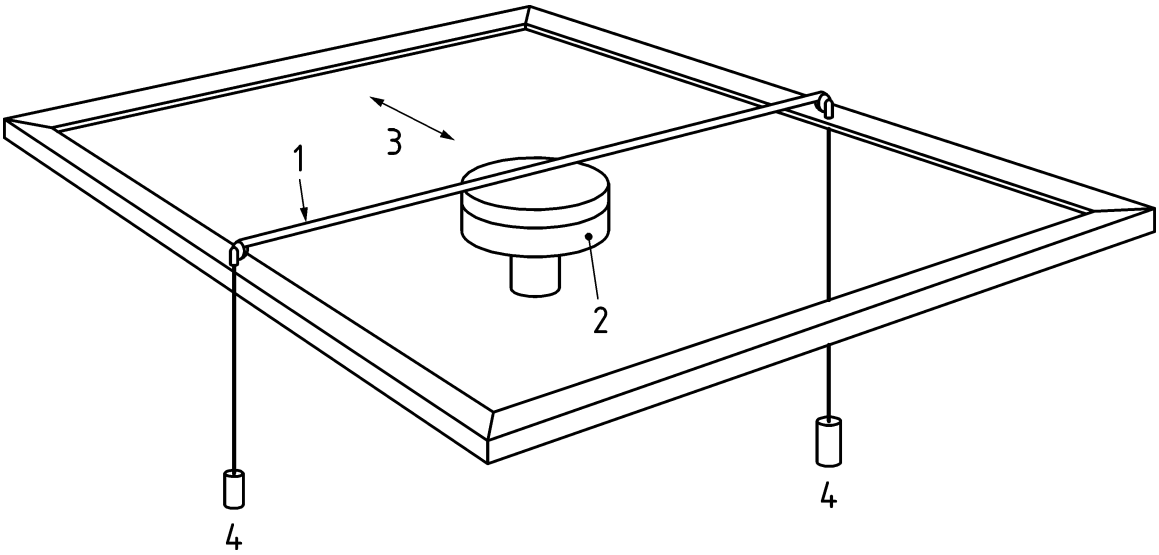
— frame definition and dimensions holding the cable shall be square shape of 500 mm × 500 mm;

— the vibration direction shall be perpendicular to the axis of the cable; and perpendicular to the axis of the burner. (no vibration longitudinal to the cable axis is acceptable);

— the vibration characteristics:

  — frequency: 30 Hz ± 5 Hz;

  — minimum acceleration: 4 g.



Key

1 Cable test specimen
2 Test burner
3 Vibration axis
4 Weights: cables 004 to 030: 170 g (to be reviewed)
cables 050 to 220: 340 g (to be reviewed)

Figure 2 — Test fixture burner vertically