SLOVENSKI STANDARD
oSIST prEN 50399:2020

01-junij-2020

Skupne preskusne metode za ognjevzdržnost kablov - Meritve oddajanja toplote in nastajanja dima na kablih med preskusom z razpršenim plamenom - Preskusna naprava, postopki, rezultati

Common test methods for cables under fire conditions - Heat release and smoke production measurement on cables during flame spread test - Test apparatus, procedures, results

Allgemeine Prüfverfahren für das Verhalten von Kabeln und isolierten Leitungen im Brandfall - Messung der Wärmefreisetzung und Raucherzeugung während der Prüfung der Flammenausbreitung - Prüfeinrichtung, Prüfverfahren und Prüfergebnis

Méthodes d'essai communes aux câbles soumis au feu - Mesure de la chaleur et de la fumée dégagées par les câbles au cours de l'essai de propagation de la flamme - Appareillage d'essai, procédure et résultats

Ta slovenski standard je istoveten z: **prEN 50399**

ICS:

13.220.40	Sposobnost vžiga in obnašanje materialov in proizvodov pri gorenju	Ignitability and burning behaviour of materials and products
29.060.20	Kabli	Cables

oSIST prEN 50399:2020 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 50399

March 2020

ICS 13.220.40; 29.060.20

Will supersede EN 50399:2011 and all of its amendments and corrigenda (if any)

English Version

Common test methods for cables under fire conditions - Heat release and smoke production measurement on cables during flame spread test - Test apparatus, procedures, results

Méthodes d'essai communes aux câbles soumis au feu - Mesure de la chaleur et de la fumée dégagées par les câbles au cours de l'essai de propagation de la flamme - Appareillage d'essai, procédure et résultats

Allgemeine Prüfverfahren für das Verhalten von Kabeln und isolierten Leitungen im Brandfall - Messung der Wärmefreisetzung und Raucherzeugung während der Prüfung der Flammenausbreitung - Prüfeinrichtung, Prüfverfahren und Prüfergebnis

This draft European Standard is submitted to CENELEC members for enquiry.
Deadline for CENELEC: 2020-06-05.

It has been drawn up by CLC/TC 20.

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

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the 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 Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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

Contents

Page

166

European foreword

This document (prEN 50399:2020) has been prepared by CLC/TC 20, “Electric cables”.

This document is currently submitted to the Enquiry.

The following dates are proposed:

• latest date by which the existence of this document has to be announced at national level	(doa)	dor + 6 months
• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	dor + 12 months
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	dor + 36 months (to be confirmed or modified when voting)

This document will supersede EN 50399:2011 and all of its amendments and corrigenda (if any).

prEN 50399:2020 includes the following significant technical changes with respect to EN 50399:2011:

— inclusion of the test apparatus in this document, not only by reference to EN 60332-3-10 (see 4.1);

— improvements of the test apparatus (see 4.2 to 4.7), including the obligatory use of mass flow controllers for the feeding of gases to the burner;

— several improvements of the qualification of the test equipment, including a check of the flame shape (5.6) and repeatability and reproducibility of the equipment (5.7);

— additions for testing of flat cables incl. mounting (6.4, 6.5);

— inclusion of normative Annex K (Check of the flame shape for nominal heat input of 20,5 kW) and Annex L (Repeatability and reproducibility of test results).

Introduction

EN 50399 specifies the test apparatus and test procedures for the assessment of the reaction to fire performance of cables to enable classification under the Construction Products Regulation [1, 2] to be achieved.

The test method describes an intermediate scale fire test of multiple cables mounted on a vertical cable ladder and is carried out with a specified ignition source to evaluate the burning behaviour of such cables and enable a direct declaration of performance. The test provides data for the early stages of a cable fire from ignition of cables. It addresses the hazard of propagation of flames along the cable, the potential, by the measurement of the heat release rate, for the fire to affect areas adjacent to the compartment of origin, and the hazard, by the measurement of production of light obstructing smoke, of reduced visibility in the room of origin and surrounding enclosures.

The following parameters may be determined under defined conditions during the test:

a) flame spread;

b) heat release rate;

c) total heat release;

d) smoke production rate;

e) total smoke production;

f) fire growth rate index;

g) occurrence of flaming droplets/particles.

The apparatus is derived from that of EN 60332-3-10 [3] but with modifications and with additional instrumentation to measure heat release and smoke production during the test. It has been demonstrated [4] that the utilization of these additional measurement techniques, proven for other standard tests, e.g. for other building products, are appropriate for assessing the reaction to fire performance of electric cables. These techniques include heat release and smoke production measurements. Compared with the test methods described in the EN 60332-3 series, they enable a more comprehensive assessment system, which is both more precise and sensitive, and enables a wider range of fire performance levels.

Care should be exercised in relating the parameters measured to different safety levels in actual cable installations as the actual installed configuration of the cables could be a major determinant in the level of flame spread, heat release and smoke production occurring in an actual fire. These parameters depend upon a number of features, such as:

h) the volume of combustible material exposed to the fire and to any flaming or heat which could be produced by the combustion of the cables;

i) the geometrical configuration of the cables and their relationship to an enclosure;

j) the temperature at which it is possible to ignite the gases emitted from the cables;

k) the quantity of combustible gas released from the cables for a given temperature rise;

l) the volume of air passing through the cable installation;

m) the construction of the cable, e.g. armoured or unarmoured, multi or single core.

All of the foregoing assumes that the cables are able to be ignited when involved in an external fire.

The conditions of cable mounting, including volume of material exposed and geometrical configuration of the cables on the test ladder, and volume of airflow through the chamber have been chosen to be in accordance with that required by the Commission Decision 2006/751/EC [5]. CENELEC has not been

involved in the definition of these parameters. These standardized conditions provide the basis for classification, as detailed in EN 13501-6 [6] and EN 50575 [2], but do not necessarily correspond to conditions found in a particular cable installation.

EN 50399 gives the detailed description of the test apparatus and details of the test procedures, which are used.

1 Scope

EN 50399 specifies the apparatus and methods of test for the assessment of vertical flame spread, heat release, smoke production and occurrence of flaming droplets/particles of vertically-mounted electric cables under defined conditions.

NOTE For the purpose of this standard, the term “electric cable” covers all power, control and communication cables, including optical fibre cables and hybrid cables used for the conveyance of energy and/or signals.

EN 50399 details the apparatus for the fire propagation testing and the arrangement and calibration of the instrumentation to be installed in order to measure the heat release and the smoke production during the test. The combustion gases are collected in a hood above the test chamber and conveyed through an exhaust system, which allows the measurement of heat release rate and smoke production. Test procedures to be used for type approval testing for classification of cables in classes [2, 6] $B1_{ca}$, $B2_{ca}$, C_{ca} and D_{ca} are given. Cable installation on the test ladder and the volume of air passing through the chamber are in accordance with the Commission Decision 2006/751/EC [5], which is reflected in the requirements of this 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 60584-1, *Thermocouples — Part 1: EMF specifications and tolerances (IEC 60584-1)*

EN 60811-203, *Electric and optical fibre cables — Test methods for non-metallic materials — Part 203: General tests — Measurement of overall dimensions (IEC 60811-203)*

EN ISO 13943, *Fire safety — Vocabulary (ISO 13943)*

3 Terms and definitions

For the purpose of this document, the terms and definitions given in EN ISO 13943 and the following apply.

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

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

3.1
heat release rate
HRR
thermal energy released per unit time by an item during combustion under specified conditions

3.2
total heat release
THR
integrated value of the heat release rate over a defined period

3.3
smoke production rate
SPR
smoke production per unit time

3.4
total smoke production
TSP
integrated value of the smoke production rate over a defined period

3.5
flame spread
FS
propagation of a flame front

Note 1 to entry: In this standard the extent of flame spread is determined as the extent of damage measured by the onset of char.

3.6
fire growth rate index
FIGRA
highest value of the quotient between *HRR* and time

Note 1 to entry: In this standard *FIGRA* is expressed in W/s.

Note 2 to entry: Details of the calculation of *FIGRA* are given in Annex G.

3.7
flaming droplets/particles
material separating from the specimen during the test and continuing to flame for a minimum period as described in this test method

3.8
E-value
heat release per unit volume of oxygen consumed

3.9
electric cable
all power, control and communication cables, including optical fibre cables and hybrid cables which are a combination of two or more of these cable types

4 Test apparatus

4.1 General

The test apparatus, as represented in Figure 1, is derived from the equipment defined in IEC 60332-3-10. It shall be installed inside a building fully protected from the possible influences of the elements (such as wind, temperature and rain). The test shall not be carried out if the ambient temperature in the test chamber and in the building where the test chamber is located is below 5 °C or above 40 °C. The ambient temperature is measured (0,30 ± 0,05) m from an outer sidewall of the test chamber at a height of 1,50 m. In addition, prior to the start of a test the back wall temperature of the test chamber, measured at a point on the back wall (1,50 ± 0,05) m from the floor and (0,50 ± 0,05) m from a side-wall (so centred on the backwall) shall be below 40 °C.

The size of the room where the test apparatus is located shall be large enough to sustain an ambient temperature between 5 °C and 40 °C and a stable flow of the air through the test equipment during the entire duration of the test.

Other equipment having an influence on the oxygen and carbon dioxide concentration levels and/or the airflow in the test room shall not be operated simultaneously with the EN 50399 equipment as that could disturb the test.

The test apparatus shall consist of the test chamber, ladder, ignition source (burner), air supply equipment, hood, exhaust duct, extracting ventilator, smoke measuring equipment and combustion gas equipment to determine heat release; these parts are specified in the following paragraphs.

WARNING: Care should be taken in monitoring and extinguishing cable fires once the test specimen has started to propagate fire. Some specimens could have a very high capacity to generate high heat release levels that could damage the test equipment and instrumentation. It is important that testing staff are sufficiently trained in dealing with such fires and have adequate firefighting facilities at their disposal during testing.

It is recommended that indicative temperature measurements are taken through the use of thermocouples installed along the cable bunch being tested at 1,5 m and 2,5 m above the burner and at the top of the chamber or in the duct. Such measurements can give an early indication of any excessive temperature or burning condition that could require the test to be aborted in order to prevent damage to the test equipment.

4.2 Test chamber

The test chamber (see Figure 2) shall have a width of (1 000 ± 100) mm, a depth of (2 000 ± 100) mm and a height of (4 000 ± 100) mm; the floor of the chamber shall be raised above ground level. The test chamber shall be airtight along its sides, air being admitted at the base of the test chamber through an aperture of (800 ± 20) mm × (400 ± 10) mm situated (150 ± 10) mm from the front wall of the test chamber and centred relative to the with (1000 ± 100) mm of the chamber.

An outlet (300 ± 30) mm x (1 000 ± 100) mm shall be made at the rear edge of the top of the test chamber. The back, sides and door of the test chamber shall be thermally insulated to give a coefficient of heat transfer of approximately 0,7 $W \cdot m^{-2} \cdot K^{-1}$. For example, a steel plate 1,5 mm to 2,0 mm thick covered with 65 mm of mineral wool with a suitable external cladding is satisfactory (see also Figure 4). The distance between the ladder and the rear wall of the chamber is (150 ± 10) mm, and between the bottom rung of the ladder and the floor (400 ± 5) mm (see Figure 5).

All other openings in the test chamber through the chamber walls, for example openings needed to feed the gas supply tube(s) to the burner and connection of thermocouples, shall be carefully sealed. Any other leakage such as insufficient sealing of the chamber door shall be avoided. The door of the test chamber shall be closed throughout the test.

NOTE The tightness of the door sealing can easily be checked during operation by using a “candle” flame (on the outside of the chamber) as a sensor for an air flow into or out of the chamber through the door sealing. A flame which bends towards or away from the door gap indicates insufficient sealing. The candle flame check is performed with the exhaust air flow set at 1 ± 0,05 m^3/s, the inlet air flow into the chamber set to 8000 ± 400 l/min and the burner set at 20,5 kW.

Additional installations in the chamber, other than those required by this standard, are not allowed since they can influence the distribution of the air flow. Therefore for instance covers on top of the burner - (to avoid material falling down on the burner during the test)- should be avoided and the flow around the ladder shall not be substantially affected by brackets, rails or bars for positioning ladders or reinforcement of the chamber. The size of the support of the burner shall also be kept small to minimize the influence on the distribution of the air flow.

4.3 Ignition source

4.3.1 Type

The ignition source shall be a ribbon-type propane gas burner complete with a venturi mixer, and a set of mass flow controllers. The distance between venturi mixer and burner shall be between 0,15 m and 5,0 m. Bends between venturi mixer and burner shall be minimized. When the venturi is mounted inside the chamber the inner diameter of the tubing (piping or braided flexible hose) between the venturi mixer and burner shall be at least equal to 20 mm. When the venturi is mounted outside of the chamber, the inner diameter of all the tubing (piping or braided flexible hose) supplying gases to the burner inside the chamber shall be at least equal to 20 mm.The propane gas shall have a purity of at least 95 % purity of propane. The flame-producing surface of the burner shall consist of a flat metal plate through which 242 holes of 1,32 mm in diameter are drilled on 3,2 mm centres in three staggered rows of 81, 80 and 81 holes each to form an array having the nominal dimensions 257 mm × 4,5 mm. As the burner plate may be drilled without the use of a drilling jig, the spacing of the holes could vary slightly. Additionally, rows of small holes on each side of the burner plate serve as pilot holes with the function of keeping the flame burning. In order to

prevent clogging of pilot holes as much as possible the burner shall be run for 5 min with low air flow, after or separate from a test.

The diameter of the main burner holes has an influence on the burner flame. Thus the main burner holes need to be measured and inspected on a regular basis and they shall be kept free from any obstructions. Cleaning with a brass brush or a 1,2 mm drill bit held in a pin vice is recommended; care should be taken that the holes do not change shape or size. The diameter of the burner holes shall be between 1,30 and 1,40 mm. In case the holes in the burner are measured to be larger than 1,40 mm the burner needs to be replaced.

The burner is shown in Figure 6, and the placement of the holes in Figure 7.

To ensure reproducibility between results from different testing equipment, a burner, which is readily available, shall be used; for details, see Annex H. If a burner is used different from the one prescribed in this standard, the laboratory shall demonstrate full equivalence. Correctness of the burner can be checked by applying the procedures described in Annexes K and L.

The burner shall be fitted with suitable accurate mass flow controllers for both propane and air. It is recommended to use digital mass flow controllers with an accuracy (including linearity) of ± 0,5 % reading plus ± 0,1 % of full scale. Mass flow controllers having a display or data output - to see in real time the gas consumption- are recommended.

The mass flow controllers shall be designed to be used at the operating pressures; their calibration shall be done at the operating pressure.

Figure 8 shows an example of a burner control system.

The calibration of the mass flow controllers for the propane and air flows can be checked by weighing the gas consumption during at least 5 min. at operating flow rates. For weighing propane, use a balance having a scale resolution of 1 g, and a time of 20 min. For the check of the air flow, a 10 l air bottle and a time of no more than 5 min is advised as problems caused by condensation and/or ice formation are then avoided.

The accuracy of the mass flow controllers shall be determined at the initial commissioning stage, after replacement and at least every year by weighing the gas consumption. The data should be recorded.

Rotameter-type flow meters can additionally be installed, but are optional and only for visualization of the flow of the gases during a test.

The piping between the mass flow controllers and the burner shall be checked regularly for leakages. Special care shall be taken when checking for leaks from the propane supply line as part of that line can be under negative pressure due to the venturi mixer.

For the purposes of this test, the air shall have a dew-point not higher than 0 °C.

The flow rates for the test shall be as given in Clause 6.7 of this document.

WARNING: The following precautions are recommended to ensure safe operation of the ignition source:

— the gas supply system should be equipped with flashback arresters;

— a flame failure protection device should be used;

— safe sequencing of the propane and air supply should be employed during ignition and extinguishing.

4.3.2 Positioning

For the test, the burner shall be arranged horizontally at a distance of (75 ± 5) mm from the front surface of the cable sample, (600 ± 5) mm above the floor of the test chamber and symmetrical with the vertical axis of the ladder. The point of application of the burner flame shall also lie in between two rungs of the ladder (see Figure 4 and Figure 5).

An auxiliary template may be used for the correct positioning of the burner versus the front surface of the cable sample.

Adjustment of air and gas flows prior to the test may be carried out away from the test position.

4.4 Ladder

A steel ladder of (500 ± 5) mm width shall be used; details of the ladder are given in Figure 9.

4.5 Inlet air supply

A means of supplying a controlled air flow through the chamber shall be used. Air shall be introduced to the test chamber through a plenum box fitted directly underneath, and of approximately the same dimensions as, the air inlet aperture. The depth of the plenum box shall be (150 ± 10) mm. Air shall be blown into the plenum box from a suitable fan through a rectangular straight section of duct of constant cross section of (300 ± 10) mm width and (80 ± 5) mm height and a minimum length of 800 mm, which shall be parallel to the floor and along the burner centre line as shown in Figure 2 and Figure 3. The ducting between the fan and the rectangular straight section of duct shall enter from the rear of the chamber. The duct shall be arranged to inlet air to the plenum box through an aperture in the longest side closest to the rear of the chamber. A grid shall be fitted in the air inlet aperture to achieve uniform flow of the air. The grid shall be constructed of steel plate approximately 2 mm thick with holes of approximately 5 mm diameter drilled at approximately 8 mm spacing between centres.

A grille may be placed over the air inlet aperture underneath or on top of the steel plate grid to facilitate accessing the test chamber, but shall be removed before the start of a test.

The airflow shall be set prior to a test at (8 000 ± 400) l / min at a temperature between 5 and 40 °C. The airflow rate shall be measured in a circular duct prior to the rectangular cross section duct. It shall be measured by a gas flow measuring device located at a straight section of the circular duct. The minimum length of straight circular section before and after the measuring device shall be selected according to the technical specification of the measuring device. It is recommended to use a fluid flow measuring system according to either EN ISO 5167-2 (orifice plate) or EN ISO 5167-4 (venturi tube), but another measuring device with similar or better accuracy can be used (such as a gas mass flowmeter or an ultrasound system) . A pitot tube may be used when the readings are calibrated by taking multiple samples across the inlet duct in accordance with Annex D.

The airflow shall be checked throughout the test and shall not vary by more than 10 % of the set value. A suitable automatic air supply control to ensure a constant flow may be used.

The airflow distribution in the test chamber shall not be disturbed (for instance by objects not specified in this standard), since a disturbed airflow distribution can significantly affect the flame spread. A disturbed airflow could, for instance, result in an asymmetrical combustion pattern on the test specimen; the combustion pattern can be monitored in conjunction with the “Check of the flame shape” (see 5.6 and Annex K).

In order to remove noxious gases, it is recommended to maintain the air flow for some minutes after the end of the test, before entering the test chamber.

4.6 Hood

A hood, see Figure 10, having a truncated shape, and where the base has a minimum length of 1,50 m and a minimum width of 1,00 m, shall be centred above the outlet of the test chamber. The maximum size of the hood shall be 2,5 m by 2,5 m. The base of the hood shall be raised above the top of the test chamber, with the largest side of the hood (if any) parallel to the largest side of the outlet of the chamber. A gap between the top of the test chamber and the base of the hood shall be between 200 mm to 400 mm, the recommended gap should be as close to 300mm as possible. There shall be a chamber above the hood to allow a connection to the exhaust duct. The exhaust duct should leave the chamber horizontally (as shown in Figure 1 and 9). Plates/baffles shall be installed in the hood to improve mixing of the air and effluents. The system shall be designed to collect all the combustion products leaving the test chamber through the outlet during the test. There shall be no leakage of flames or smoke.

Objects not specified in this standard (for instance ladder hoisting devices) shall not be present in the hood. The exhaust capacity shall be at least 1 m^3/s at normal pressure and a temperature of 25 °C. The exhaust system design shall not be based on natural convection. In order to extract all gases and vapours, especially in the case of heavily burning cables, or cables which require to be specially extinguished and produce high volumes of gases and vapours, an exhaust system with a capacity of 1,5 m^3/s is recommended.