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Method of test for resistance to fire of larger unprotected power and control cables for use in emergency circuits

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EUROPEAN STANDARD **EN 50362**

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English version

Method of test for resistance to fire of larger unprotected power and control cables for use in emergency circuits

Méthode d'essai de résistance au feu des câbles de contrôle et d'énergie de grande dimension non protégés pour utilisation dans les circuits de secours

Prüfung des Isolationserhaltes im Brandfall von Kabeln und Leitungen mit großen Durchmessern für die Verwendung in Notstromkreisen bei ungeschützter Verlegung

This European Standard was approved by CENELEC on 2002-12-01. 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.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists 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 Central Secretariat has the same status as the official versions.

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CENELEC
European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 20, Electric cables.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50362 on 2002-12-01.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2003-12-01
- latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2005-12-01

Contents

1 Scope

This European Standard specifies a test method for cables designed to have intrinsic resistance to fire and intended for use as emergency circuits.

The standard is applicable to power and control cables for emergency circuits of rated voltage not exceeding 0,6 /1 kV.

The test method is intended for cables with an overall diameter exceeding 20 mm. Cables of smaller diameter shall be tested in accordance with EN 50200.

The test method is based on the direct impingement on the cable of the flame from a propane burner giving a constant temperature attack of a notional 842 °C and under the influence of mechanical impact.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 50200 Method of test for resistance to fire of unprotected small cables for use in emergency circuits

EN 60269-3 Low voltage fuses — Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for domestic and similar applications)

EN 60584-1 Thermocouples — Part 1: Reference tables

EN 60695-4 Fire hazard testing — Part 4: Terminology concerning fire tests

3 Definitions

For the purposes of this standard, the definitions given in EN 60695-4 apply.

4 Duration of survival

4.1 Time

The duration of survival, measured in minutes, to the point of failure shall be recorded for each cable tested up to a maximum survival time of 120 min, or the required survival time given in the particular cable standard.

4.2 Point of failure

The criteria for determining the point of failure shall be as follows:

– the voltage is not maintained during the test duration, as indicated by fuse failure or by interruption of the circuit breaker;

– a conductor ruptures during the test duration, as indicated by the lamp extinguishing.

Failure by either one of the criteria listed shall be sufficient to show failure for that cable.

5 Test environment

The test shall be carried out in a suitable chamber with facilities for disposing of any noxious gases resulting from the burning. Sufficient ventilation shall be available to sustain the flame for the duration of the test.

The chamber and test apparatus shall be in the range 10 °C to 40 °C at the start of each test.

The same ventilation and shielding conditions shall be used in the chamber during both the verification and cable test procedures.

NOTE 1 The test given in this standard involves the use of dangerous voltages and temperatures. Suitable precautions should be taken against shock, burning, fire and explosion risks that may be involved and against any noxious fumes that may be produced.

NOTE 2 An example of a suitable chamber is the 3 m smoke cube as specified in EN 50268-1.

NOTE 3 Shields, such as those described in EN 50268-1, may need to be placed in an appropriate position to protect the burner from draughts that may influence the flame geometry.

6 Test apparatus

6.1 Test equipment

The test equipment consists of the following:

a) a test ladder on to which the cable is mounted, comprising steel framework fastened to a rigid support as described in 6.2;

b) a continuity checking and voltage withstand arrangement as described in 6.3;

c) a source of heat comprising a horizontally mounted ribbon burner as described in 6.4;

d) a shock producing device as described in 6.5;

e) a test wall equipped with thermocouples for verification of the source of heat as described in Clause 7.

A general arrangement of the test equipment is shown in Figures 1, 2 and 3.

6.2 The test ladder and its mounting

The test ladder consists of a steel framework as shown in Figure 1. The two central vertical elements of the ladder are adjustable in order to accommodate different sizes of cable under test. The test ladder is approximately 1 200 mm long and 600 mm high, and the total mass of the test ladder shall be (18 ± 1) kg. Ballast, if required, shall be placed on the steel supports.

Each horizontal element shall have a mounting hole not more than 200 mm from each end, the exact position and diameter being determined by the particular supporting bush and supporting framework used. The test ladder shall be fastened to a rigid support by four bonded rubber bushes of hardness 50 to 60 Shore A fitted between the horizontal steel elements of the ladder and the support framework, as shown in Figures 1 and 2 so as to allow movement under impact.

NOTE 1 Angle iron approximately 45 mm wide and 6 mm thick, with suitable slots cut to allow for movement of vertical elements and fixing of the bolts and clips, has been found to be a suitable material for construction of the ladder.

NOTE 2 A typical rubber bush which has been found to be suitable is shown in Figure 4.

6.3 Continuity checking and voltage withstand arrangement

During the test a current for continuity checking is passed through all conductors of the cable and this shall be provided by a three phase star-connected or single phase transformer(s) of sufficient capacity to maintain the test voltage up to the maximum leakage current allowable.

NOTE 1 Due note should be taken of the fuse characteristics when determining the power rating of the transformer.

This current is achieved by connecting, at the other end of the sample, a suitable load and indicating device (e.g. lamp) to each conductor, or group of conductors.

NOTE 2 A current of 0,25 A at the test voltage, through each conductor or group of conductors, has been found to be suitable.

6.4 Source of heat

The source of heat shall be a ribbon type propane gas burner with a nominal burner face length of 500 mm with Venturi mixer. A centre feed burner is recommended. The nominal burner face width shall be 10 mm. The face of the burner shall have three staggered rows of drilled holes nominally 1,32 mm in diameter and drilled at centres 3,2 mm from one another, as shown in Figure 5. Additionally, a row of small holes milled on each side of the burner plate, to serve as pilot holes for keeping the flame burning, is permitted.

Guidance on the choice of recommended burner systems is given in EN 50200, Annex A.

Mass flow meters shall be used as the means of controlling accurately the input flow rates of fuel and air to the burner.

NOTE 1 Rotameter type flow meters may be used as an alternative, but are not recommended. Guidance on their use, and the application of appropriate correction factors, may be found in EN 50200. Figure 6 shows an example of a rotameter type system.

By reference to the centre point of the cable to be tested, the burner shall be positioned centrally at a horizontal distance of ($H \pm 2$) mm from the burner face to the centre of the cable and at a vertical distance of ($V \pm 2$) mm from the burner centre line to the centre of the cable, as shown in Figure 3. The burner shall be positioned in the test chamber such that it is at least 200 mm above the floor of the chamber or any solid mounting table and 500 mm from any chamber wall.

The flow rates used for the test at reference conditions (1 bar and 20 °C) shall be as follows:

propane: (10,0 ± 0,4) litres/min;

air: (160 ± 8) litres/min.

The burner and control system of this test shall be subject to verification following the procedure given in Clause 7. The exact burner position to be used during cable testing shall be determined during the verification procedure, where the values of V and H to be used shall be determined.

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

NOTE 2 The burner should be rigidly fixed during the test so as to prevent movement relative to the test sample.

6.5 Shock producing device

The shock producing device consists of a mild steel round bar (25 ± 0,1) mm in diameter and (600 ± 5) mm long. The bar is freely pivoted about an axis parallel to the test ladder, which is in the same horizontal plane as, and (200 ± 5) mm away from, the upper edge of the test ladder. The axis divides the bar into two unequal sections of length, (400 ± 5) mm and approximately 200 mm respectively, the longer section impacting the ladder. The bar drops under its own weight from an angle of 60° to the horizontal to strike the test ladder at its midpoint as shown in Figure 1 and Figure 3.

7 Verification procedure for the source of heat

7.1 The flame temperature shall be measured using two 1,5 mm mineral insulated, stainless steel sheathed thermocouples Type K to EN 60584-1, mounted on a test wall as shown in Figure 8. The thermocouple tips shall be (20 ± 1,0) mm in front of the test wall. The horizontal line of the thermocouples shall be approximately 100 mm above the bottom of the wall.

NOTE Details of the test wall may be found in 6.2 of EN 50200.

Position the burner in the range 100 mm to 120 mm horizontally from the thermocouples and in the range 40 mm to 60 mm vertically below the centre line of the thermocouples as shown in Figure 8.

Ignite the burner and adjust the gas and air supplies to those given in 6.4.

7.2 Monitor the temperature as recorded by the thermocouples over a period of 10 min to ensure conditions are stable.

7.3 The verification procedure shall be considered satisfied if the average of the two thermocouple readings over the 10 min falls within the requirement of (830^{+40}_{0}) °C and the maximum difference of the average individual thermocouple readings does not exceed 40 °C. At least one measurement shall be made every 30 s in order to obtain the average.

NOTE The actual method of obtaining the average thermocouple reading over the period is not specified but it is recommended that a recorder with averaging facilities is used in order to damp the variability caused by point measurement.

7.4 If the verification is not successful, the flow rates shall be altered within the tolerances given in 6.4 and a further verification carried out.

7.5 If the verification of 7.4 is not successful, the distances (*H* and *V*) between burner and thermocouples shall be altered (within the tolerance given in 7.1) and further verifications carried out.

7.6 The positions established for successful verification (*H* and *V*) and flow rates used shall be recorded.

7.7 If no successful verification can be achieved within the tolerances given, then the burner system shall be considered as incapable of providing the source of heat required by this standard.

8 Test sample

8.1 Sample preparation

The sample to be tested shall be a piece of cable not less than 1 500 mm long with approximately 100 mm of sheath and outer coverings removed at each end. At each end of the cable, each conductor shall be suitably prepared for electrical connections, and the exposed conductors shall be spread apart to avoid contact with each other.

8.2 Sample mounting

The cable shall be bent to form an approximate arc of a circle. The internal radius of the bend shall be the manufacturer's declared minimum bending radius.

The cable shall be mounted centrally on the test ladder, as shown in Figure 7, using metal clips which shall be earthed. Two U-bolts on the upper horizontal element of the ladder are recommended but P-clips made of metal strip (20 ± 2) mm wide, for cables up to 50 mm diameter, and (30 ± 3) mm wide for larger cables shall be used on the central vertical elements. The P-clips shall be formed so as to have approximately the same diameter as the cable under test.

If the cable sample is too small to be mounted on the central vertical elements when in the position shown in Figure 7, the vertical elements shall be equally moved towards the centre so that the cable may be mounted as shown in Figure 9.

9 Cable test procedure

9.1 General

9.1.1 Position the cable test sample on the test ladder as described in 8.2, and then position the test ladder as shown in Figures 1, 2 and 3.

9.1.2 Position the burner (H ± 2) mm horizontally and (V ± 2) mm vertically from the centre of the cable, using the values of H and V determined in 7.6.

9.1.3 Fuses used in the test procedure in 9.2 shall be Type DII complying with EN 60269-3. Alternatively a circuit breaker with equivalent characteristics may be used.

Where a circuit breaker is used, its equivalent characteristics shall be demonstrated by reference to the characteristic curve shown in EN 60269-3.

The fuse shall be the reference method in the case of dispute.

9.2 Electrical test procedure

At the transformer end of the sample, earth the neutral conductor and any protective conductor. Any metal screens, drain wire or metallic layer shall be interconnected and earthed. Connect the transformer(s) to the conductors, excluding any conductor which is specifically identified as intended for use as a neutral or a protective conductor, as shown in the circuit diagram (Figure 10).

Where a metallic sheath, armour or screen acts as a neutral or protective conductor, it shall be connected as shown in the circuit diagram (Figure 10) as for a neutral or protective conductor.

For single, twin or three phase conductor cables, connect each phase conductor to a separate phase of the transformer(s) output with a 2 A fuse or circuit breaker with equivalent characteristics in each phase.

For multicore cables having four or more conductors (excluding any neutral or protective conductors), the conductors shall be divided into three roughly equal groups, ensuring that adjacent conductors are as far as possible, in different groups.

For multipair cables the conductors shall be divided into two equal groups, ensuring that the a-core of each pair is connected to one phase and the b-core of each pair is connected to another phase (L1 and L2 of Figure 10). Quads shall be treated as 2 pairs.

For multitriple cables the conductors shall be divided into three equal groups, ensuring that the a-core of each triple is connected to one phase, the b-core of each triple to another phase and the c-core of each triple to the third phase of the transformer (L1, L2 and L3 of Figure 10).

Connect the conductors of each group in series and connect each group to a separate phase of the transformer output with a 2 A fuse or circuit breaker with equivalent characteristics in each phase.

NOTE 1 The above test procedure connects the neutral conductor to earth. This may not be appropriate if the cable is designed for use on a system where neutral is not earthed. If required by the cable standard it is permissible for the neutral conductor to be tested as if it were a phase conductor. Where a metallic sheath, armour or screen acts as a neutral conductor it shall always be connected to earth. Any such variations in methodology shall be included in the test report.

NOTE 2 For cable constructions not specifically identified above, the test voltage should be applied, as far as is practicable, to ensure that adjacent conductors are connected to different phases.

At the end of the sample remote from the transformer

— connect each phase conductor, or group of conductors, to one terminal of the load and indicating device (as described in 6.3), the other terminal being earthed,

— connect the neutral conductor and any protective conductor to one terminal of the load and indicating device (as described in 6.3), the other terminal being connected to L1 (or L2 or L3) at the transformer end (see Figure 10).

9.3 Ignition and shock production

Ignite the burner and adjust the propane and air flow rates to those obtained during the verification procedure (see Clause 7).

Immediately after igniting the burner activate the shock producing device and start the test duration timer. The shock producing device shall impact the test ladder after 5 min ± 10 s from activation and subsequently at 5 min ± 10 s intervals. After each impact, the impacting bar shall be raised from the test ladder within 20 s of the impact.

9.4 Test voltage application

Immediately after starting the test duration timer switch on the electricity supply and adjust the voltage to the rated voltage of the cable (subject to a minimum voltage of 100 V a.c.), i.e. the test voltage between conductors shall equal the rated voltage between conductors and the test voltage from conductor to earth shall equal to rated voltage from conductor to earth.

9.5 End point

Continue the test until the point of failure up to a maximum of 120 min, or the required survival time given in the particular cable standard.

10 Retest procedure

In the event of a failure to conform to the relevant standard two further samples shall be tested. If both comply, the test shall be deemed to be successful.