INTERNATIONAL STANDARD

ISO 9239-1

Second edition
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Reaction to fire tests for floorings —

Part 1: Determination of the burning behaviour using a radiant heat source

Essais de réaction au feu des revêtements de sol —

Partie 1: Détermination du comportement au feu à l'aide d'une source de chaleur rayonnante

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 9239 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 9239-1 was prepared by the European Committee for Standardization (CEN) in collaboration with Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 1, *Fire initiation and growth*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this document, read "...this European Standard..." to mean "...this International Standard...".

This second edition cancels and replaces the first edition (ISO 9239-1:1997), which has been technically revised.

ISO 9239 consists of the following parts, under the general title *Reaction to fire tests for floorings*:

— *Part 1: Determination of the burning behaviour using a radiant heat source*

— *Part 2: Determination of flame spread at a heat flux level of 25 kW/m²*

Annex A forms a normative part of this part of ISO 9239. Annexes B and C are for information only.

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Foreword

The text of EN ISO 9239-1:2002 has been prepared by Technical Committee CEN/TC 127 "Fire safety in buildings", the secretariat of which is held by BSI, in collaboration with Technical Committee ISO/TC 92 "Fire safety".

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2002, and conflicting national standards shall be withdrawn at the latest by December 2003.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

The measurements in this test method provide a basis for estimating one aspect of fire exposure behaviour of floorings. The imposed radiant flux simulates the thermal radiation levels likely to impinge on the floor of a corridor whose upper surfaces are heated by flames or hot gases or both, during the early stages of a developing fire in an adjacent room or compartment under wind-opposed flame spread conditions.

The test specimen is placed in a horizontal position below a gas-fired radiant panel inclined at 30°where it is exposed to a defined heat flux. A pilot flame is applied to the hotter end of the specimen. The test principle is illustrated in Figure 1. Following ignition, any flame front which develops is noted and a record is made of the progression of the flame front horizontally along the length of the specimen in terms of the time it takes to spread to defined distances. If required, the smoke development during the test is recorded as the light transmission in the exhaust stack.

The results are expressed in terms of flame spread distance versus time, the critical heat flux at extinguishment and smoke density versus time.

Safety warning:

The possibility of a gas-air fuel explosion in the test chamber should be recognized. Suitable safeguards consistent with sound engineering practice should be installed in the panel fuel supply system. These should include at least the following:

— a gas feed cut-off which is immediately activated when air and/or gas supply fail;

— a temperature sensor or a flame detection unit directed at the panel surface that stops fuel flow when the panel flame goes out.

Attention is drawn to the possibility that toxic or harmful gases may be produced during exposure of the specimens. In view of the potential hazard from products of combustion, the exhaust system should be designed and operated so that the laboratory environment is protected from smoke and gas. The operator should be instructed to minimize his exposure to combustion products by following sound safety practice, for example ensuring that the exhaust system is working properly, wearing appropriate clothing including gloves, etc.

1 Scope

This European Standard specifies a method for assessing the wind-opposed burning behaviour and spread of flame of horizontally mounted floorings exposed to a heat flux radiant gradient in a test chamber, when ignited with pilot flames. Annex A gives details of assessing the smoke development, when required.

This method is applicable to all types of flooring e.g. textile carpet, cork, wood, rubber and plastics coverings as well as coatings. Results obtained by this method reflect the performance of the flooring, including any substrate if used. Modifications of the backing, bonding to a substrate, underlay or other changes of the flooring may affect test results.

This European Standard is applicable to the measurement and description of the properties of floorings in response to heat and flame under controlled laboratory conditions. It should not be used alone to describe or appraise the fire hazard or fire risk of floorings under actual fire conditions.

Information on the precision of the test method is given in annex B.

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 13238, *Reaction to fire tests for building products — Conditioning procedures and general rules for selection of substrates*

EN 60584-1, *Thermocouples — Part 1: Reference tables (IEC 60584-1:1995)*

EN ISO 13943, *Fire safety — Vocabulary (ISO 13943:2000)*

3 Terms and definitions

For the purposes of this European Standard, the definitions given in EN ISO 13943, together with the following terms and definitions, apply.

3.1
heat flux (kW/m^2)
incident heat power per unit area; this includes both radiant heat flux and convective heat flux

3.2
critical heat flux at extinguishment (CHF)
incident heat flux (kW/m^2) at the surface of a specimen at the point where the flame ceases to advance and may subsequently go out. The heat flux value reported is based on interpolations of measurements with a non-combustible calibration board

3.3
heat flux at X min (HF-X)
heat flux (kW/m^2) received by the specimen at the most distant spread of flame position observed during the first X minutes of the test

3.4
critical heat flux
heat flux at which the flame extinguishes (CHF) or the heat flux after the test period of 30 min (HF-30), whichever is the lower value (i.e. the flux corresponding with the furthest extent of spread of flame within 30 min)

3.5
flux profile
curve relating heat flux on the specimen plane to distance from the zero point

The zero point of the heat flux profile is specified as the inner edge of the hottest side of the specimen holder.

3.6
sustained flaming
persistence of flame on or over the surface of the specimen for a period of more than 4 s

3.7
distance of flame spread
furthest extent of travel of a sustained flame along the length of the test specimen within a given time

3.8
flooring
upper layer(s) of a floor, comprising any surface finish with or without an attached backing and with any accompanying underlay, interlay and/or adhesive

3.9
substrate
product which is used immediately beneath the product about which information is required. For a flooring, it is the floor on which the flooring is mounted or the material to represent the floor

4 Test apparatus

4.1 The test apparatus shall be placed in a room, at a distance of at least 0,4 m to the walls and the ceiling. It shall have the dimensions shown in Figures 2 to 5. The chamber shall be made of calcium silicate boards of (13 ± 1) mm thickness and 650 kg/m^3 nominal density, with a tightly fitting panel of fire resistant glass with dimensions of (110 ± 10) mm x (1 100 ± 100) mm, situated at the front so that the whole length of the specimen can be observed during the test. The chamber may have an outside metal cladding. Below this observation window, a tightly closing door shall be provided through which the test specimen platform can be moved in and out.

A steel scale marked with 10 mm and 50 mm intervals starting at the inner edge of the test specimen holder shall be mounted on both sides of the test specimen.

4.2 The bottom of the chamber shall consist of a sliding platform which shall have provision for rigidly securing the test specimen holder in a fixed and level position (see Figure 1). The total air access area between the chamber and the test specimen holder shall be (0,23 ± 0,03) m^2 uniformly distributed on all sides of the test specimen.

4.3 The source of radiant heat energy shall be a panel of porous refractory material mounted in a metal frame, with a radiation surface of (30[1] 0 ± 10) mm × (450 ± 10) mm.

The panel shall be capable of withstanding temperatures up to 900 °C and use a fuel gas/air mixing system with suitable instrumentation (see annex C) to ensure consistent and repeatable operation.

The radiant heat panel is placed over the test specimen holder with its longer dimension at (30 ± 1)° to the horizontal plane (see Figure 5).

4.4 The test specimen holder is fabricated from heat resistant L-profile stainless steel of (2,0 ± 0,1) mm thickness to the dimensions shown in Figure 6. The test specimen is exposed through an opening (200 ± 3) mm × (1 015 ± 10) mm. The test specimen holder is fastened to the sliding steel platform by means of two bolts on each end.

1) Propane and/or butane air mixtures have been proved to be suitable but other fuel gas/air mixtures may be utilised as well.

The test specimen holder shall be provided with means to secure the specimen (e.g. steel bar clamps). The overall thickness of the holder is (22 ± 2) mm.

4.5 The pilot burner, used to ignite the test specimen, shall be nominal 6 mm ID, 10 mm OD, stainless steel burner having 2 lines of 19 evenly spaced 0,7 mm diameter holes drilled radially along the centre line and 16 evenly spaced 0,7 mm diameter holes drilled radially 60° below the centre line (see Figure 7). In operation the propane flow rate shall be adjusted to (0,026 ± 0,002) l/s. The pilot burner shall be positioned so that the flames generated from the lower line of holes will impinge on the specimen (10 ± 2) mm from the zero point (see Figure 8). The pilot burner tube shall be 3 mm above the edge of the specimen holder when the burner is in the ignition position. When not being applied to the test specimen, the burner shall be capable of being moved at least 50 mm away from the zero point of the test specimen. The gas used shall be commercial grade propane having a calorific value of approximately 83 MJ/m^3.

NOTE 1 It is important to keep the holes in the pilot burner clean. A soft wire brush is suitable to remove surface contaminants. Nickel-chromium or stainless steel wire, 0,5 mm diameter, is suitable for opening the holes.

NOTE 2 With the propane gas flow properly adjusted and the pilot burner in the test position, the pilot flame will vary in height from approximately 60 mm to approximately 120 mm across the width of the burner (see Figure 8).

4.6 An exhaust system[2)], de-coupled from the exhaust stack, shall be used to extract the products of combustion. With the panel turned off, the dummy specimen in place and the access door closed, the air velocity in the exhaust stack shall be (2,5 ± 0,2) m/s.

4.7 An anemometer with an accuracy of ± 0,1 m/s shall be provided for measuring the air velocity in the exhaust stack. It shall be fitted in the exhaust stack, in such a way that its measuring point coincides with the centre line of the exhaust stack at (250 ± 10) mm above the lower edge of the exhaust stack (see Figure 4).

4.8 In order to control the thermal output of the radiant panel, a radiation pyrometer with a range of 480 °C to 530 °C (black body temperature) and an accuracy of ± 5 °C suitable for viewing a circular area 250 mm in diameter at a distance of about 1,4 m shall be used (see 7.1.3 and 8.1).

The sensitivity of the pyrometer shall be substantially constant between the wavelengths of 1 µm and 9 µm.

4.9 A 3,2 mm stainless steel sheathed type K thermocouple, in accordance with EN 60584-1 with an insulated and ungrounded hot junction, shall be mounted in the flooring radiant test chamber. It shall be located in the longitudinal central vertical plane of the chamber, 25 mm down from the top and 100 mm back from the inside wall of the exhaust stack (see Figures 4 and 5).

A second thermocouple may be inserted centrally in the exhaust stack, at a distance of (150 ± 2) mm from the top of the exhaust stack. The thermocouples shall be cleaned after each test.

4.10 The heat flux meter used to determine the heat flux profile to the test specimen shall be of the Schmidt-Boelter type without window and with a diameter of 25 mm. Its range shall be from 0 kW/m^2 to 15 kW/m^2, and shall be calibrated over the operating heat flux level range from 1 kW/m^2 to 15 kW/m^2. A source of cooling water with a temperature of 15 °C to 25 °C shall be provided for this instrument.

The heat flux meter shall have an accuracy of ± 3 % of the measured value.

2) An exhaust capacity of 39 m^3/min to 85 m^3/min (at 25 °C,1 bar) has been proved suitable.

4.11 The dummy specimen used for calibration shall be made of (20 ± 1) mm thick uncoated calcium silicate board of (850 ± 100) kg/m^3 density. It shall be (250 ± 10) mm wide and (1 050 ± 20) mm long (see Figure 6), with (26 ± 1) mm diameter holes centred on and along the centre line at 110 mm, 210 mm through to 910 mm locations, measured from the zero point of the test specimen.

4.12 Smoke measurements, if required, are made using the apparatus described in annex A.

4.13 The output from the radiation pyrometer, the heat flux meter(s) and the smoke measurement system shall be recorded by an appropriate method.

4.14 A timing device capable of recording elapsed time to the nearest second and with an accuracy of 1 s in 1 h shall be used.

5 Test specimen

5.1 The test specimens shall be representative of the flooring in its end use.

5.2 Cut six specimens (1 050 ± 5) mm × (230 ± 5) mm, three in one direction (e.g. production direction) and three in a direction perpendicular to the first direction.

NOTE If the thickness of the specimen is more than 19 mm, the length may be reduced to (1025 ± 5) mm.

5.3 The specimen shall be mounted on a substrate that simulates the actual floor (see EN 13238) and shall simulate actual installation practice.

The adhesive used for the specimens shall be representative of those used in practice. If in practice specific adhesives are used, the specimens shall be prepared, either using each of the specific adhesives or without adhesives.

Underlays used as part of the specimens shall be representative of those used in practice.

If the specimen consists of tiles, it shall be mounted in such a way that a joint is situated 250 mm from the zero point. If the tiles are not glued, the edges of the test specimen shall be secured on the substrate by mechanical means.

Flooring, which due to shrinkage withdraws from the specimen holder frame, can show different results depending on the fixing. Special attention shall therefore be given to the use of good fixing techniques for floorings with a tendency to shrink during the heat exposure.

Additional details for the mounting of the test specimen shall be in accordance with the relevant product specifications.

5.4 Washing and cleaning procedures to examine the durability of the flooring in terms of its fire performance shall be in accordance with any procedures specified in the relevant product specifications for the floorings.

6 Conditioning

The specimens shall be conditioned as specified in EN 13238.

The curing time for flooring, which is glued to the substrate, is at least three days. This time may be part of the conditioning.

7 Test procedure

7.1 Calibration procedure

7.1.1 The following calibration procedure shall be determined after each essential change of the apparatus, or at least once a month. If there are no changes in subsequent calibrations, this interval may be extended to six months.

7.1.2 Position the sliding platform and the mounting frame together with the dummy specimen in the chamber. Measure the airflow rate in the exhaust stack with the exhaust fan on and the access door closed, and if necessary adjust it to (2,5 ± 0,2) m/s. Ignite the radiant panel.

Allow the unit to heat for at least one hour until the chamber temperature has stabilized (see 7.2.2). The pilot burner shall be off during this period.

7.1.3 Measure the heat flux level at the 410 mm point with the total heat flux meter. Insert the heat flux meter in the opening so that its detecting surface is between 2 mm to 3 mm above and parallel to the plane of the dummy specimen. Read its output after 30 s. If the level is (5,1 ± 0,2) kW/m^2, start the heat flux profile determination. If it is not, make the necessary adjustments to the gas/air flows to the panel, in panel fuel flow at least 10 min before a new reading of the heat flux is taken.

7.1.4 Perform the determination of the heat flux profile.

Insert the heat flux meter in each hole in turn, starting with the 110 mm and ending with the 910 mm. Ensure that the detecting plane of the meter and time of measurement agree with 7.1.3. To determine whether the heat flux level has changed during these measurements, check the reading at 410 mm, after the 910 mm reading.

7.1.5 Record the heat flux data as a function of distance along the specimen plane. Carefully draw a smooth curve through the data points. This curve is the heat flux profile curve (see Figure 9).

If the heat flux profile curve is within the tolerances of Table 1, the test equipment is in calibration and the heat flux profile determination is completed. If not, carefully adjust the fuel flow and allow at least 10 min to ensure that the chamber temperature is stabilised. Repeat the procedure until the heat flux profile is within the specification in Table 1.

NOTE To correct the heat flux at the hotter end of the specimen, normally only a change of gas flow is necessary. To correct the heat flux at the colder end of the specimen, it may be necessary to change both gas and air flows.

7.1.6 Remove the dummy specimen and close the door. After 5 min measure the black body temperature of the radiant panel and the temperature of the chamber. Record the results for the daily calibration values.