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Fire test — Reduced-scale model box test

Essais au feu — Essai à échelle réduite utilisant une boîte

ICS 13.220.40; 13.220.50

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Foreword

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The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 17431 was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 1, *Fire initiation and growth*.

Annexes A, B and C of this standard are for information only.

Introduction

This test method is intended to describe the fire behaviour of a product under controlled laboratory conditions.

The test method may be used as part of a fire hazard assessment which takes into account all of the factors which are pertinent to an assessment of the fire hazard of a particular and use.

WARNING — So that suitable precautions can be taken to safeguard health, the attention of all concerned in fire tests is drawn to the possibility that toxic or harmful gases can be evolved during combustion of test specimens.

The test procedures involve high temperatures and combustion processes from ignition to a fully developed fire. Therefore, hazards can exist for burns, ignition of extraneous objects or clothing. The operators should use protective clothing, e.g. helmet, face-shield and equipment for avoiding exposure to toxic gases.

Means for extinguishing a fully developed fire should be available.

Fire test — Reduced-scale model box test

1 Scope

This International Standard specifies an intermediate-scale test method that simulates a fire that under well-ventilated conditions starts in a corner of a small room with a single doorway until the room is fully involved with fire.

The method is primarily intended to evaluate the contribution to toxic hazard in, and potential for fire spread to, evacuation routes connected to the room of origin in which surface products are installed.

The method is especially suitable for products with which a full-scale room test has to be terminated before the full involvement of the room with fire because of the occurrence of flashover or any other safety reasons.

2 Normative references

The following referenced documents are indispensable for the application 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.

ISO 554:1976, *Standard atmospheres for conditioning and/or testing — Specifications*

ISO TR 3814: 1989, *Test for measuring "reaction to fire" of building materials — Their development and application*

ISO 9705:1993, *Fire tests — Full-scale room test for surface products*

ISO 13943:2000, *Fire safety — Vocabulary*

ISO TR 14697:1996, *Guide on the use of substrates*

ISO 14934-1:2002, *Fire tests — Calibration and use of heat flux meter — Part 1: General principle*

3 Definitions

For the purpose of this international standard, the definitions given in ISO 13943 and the following definitions shall apply.

3.1
exposed surface
the surface of the product subjected to the heating conditions of the test

3.2
surface product
any part of a compartment that constitutes an exposed surface on the interior wall, ceiling and/or floor such as panels, tiles, boards, wall papers or coatings

4 Principle

An indication of the toxic hazard in an evacuation route connected to the room of fire origin is provided by the measurement of certain toxic gas at the doorway of the model box.

The potential for fire spread to objects outside the room of fire origin is evaluated by the heat release rate and total heat release from the model box.

5 Combustion chamber

5.1 Dimensions

The combustion chamber (see Figure 1) shall consist of three walls, a ceiling and a floor connected at right angles. The inside dimension of the combustion chamber shall have the following dimensions:

a) Length: (1,8 m ± 0,01) m

b) Width: (1,1 m ± 0,01) m

c) Height: (1,0 m ± 0,01) m

5.2 Front panel

A front wall panel with an opening of the following dimensions (see Figure 1) shall be attached to the opening of the combustion chamber in prior to each test. The opening shall be at the centre of the front wall panel and touch the floor.

a) Width of the front panel: (1,1 m ± 0,01) m

b) Height of the front panel: (1,0 m ± 0,01) m

c) Width of the opening: (0,3 m ± 0,01) m

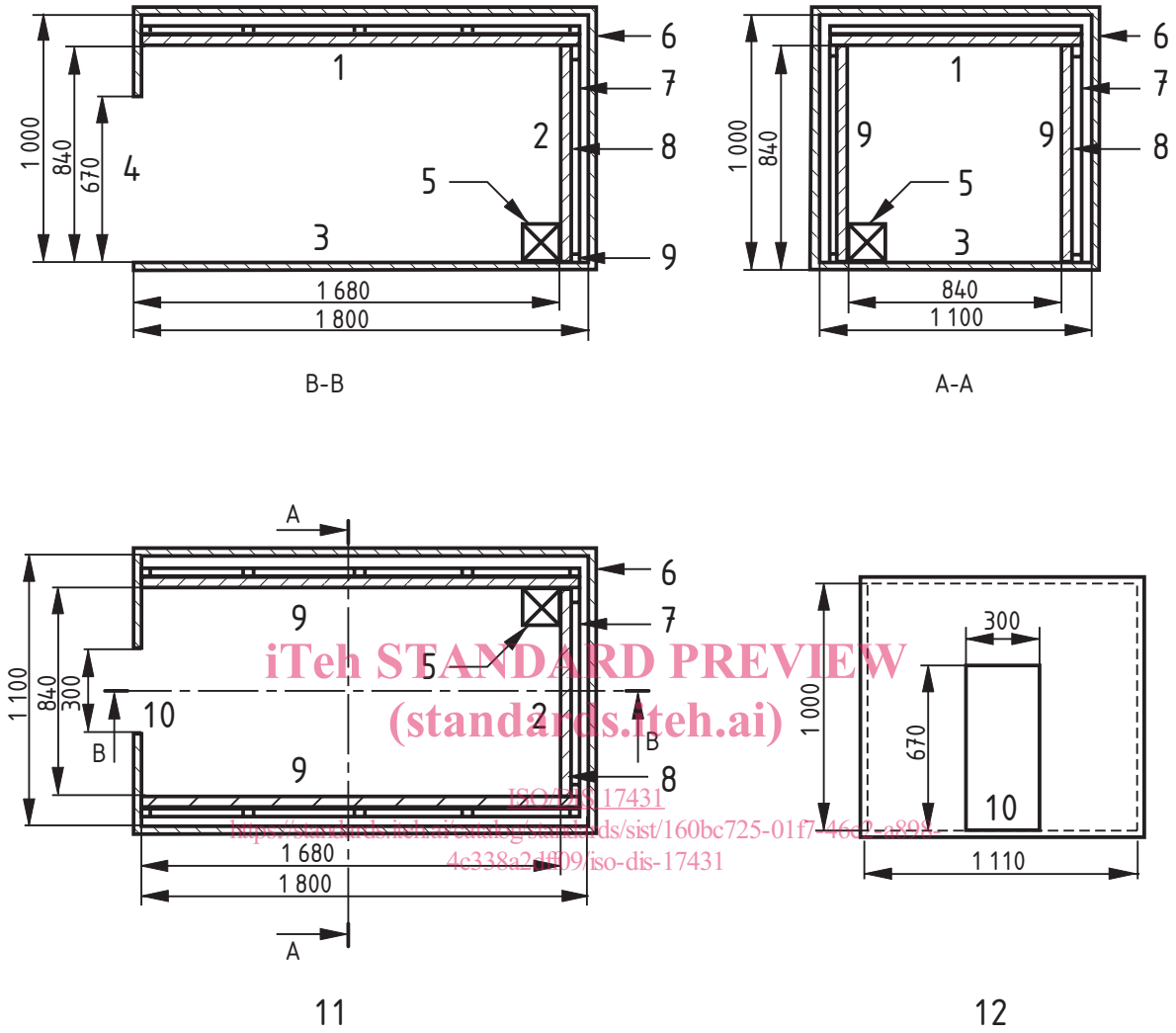
d) Height of the opening: (0,67 m ± 0,01) m

5.3 Material of combustion chamber

The combustion chamber shall be constructed of non-combustible material with a density of (400-900) kg m^{-3}. The thickness of the construction shall be (20 ± 2) mm.

5.4 Installation

The combustion chamber shall be placed in an essentially draught free space, large enough to ensure that there is no influence on the test fire. Hanging the combustion chamber can help measurement of mass loss and accurate collection of combustion products. An example of a design for hanging combustion chamber is given in Annex A.



1 Top panel
2 Inner wall
3 Floor
4 Opening
5 Fire source
6 Combustion chamber
7 Steel sheet (0,27)
8 Specimen
9 Side wall
10 Opening
11 Horizontal section
12 Front wall panel

Figure 1 — Combustion chamber with specimen panels, front wall panel and ignition source

6 Ignition source

6.1 Design of ignition source

The ignition source shall be a propane gas burner having a 0,17 m × 0,17 m square top surface layer of a porous, inert material, e.g. sand. The construction shall be such that an even gas flow is achieved over the entire opening area. It is recommended to use the gas burner specified in Annex B.

WARNING — All parts and equipment of the burner system such as tubes, couplings, flow meters, etc. shall be of approved type for propane. The installation shall be performed in accordance with existing safety regulations.

The burner should, for reasons of safety, be equipped with a remote control ignition device, for example a pilot flame, electric spark or a glow wire. There should be a warning system for leakage of gas in case of extinction for the flame.

6.2 Fuel

The fuel for the burner shall be of industrial grade propane (95 % purity). The net heat of combustion of the fuel shall be 40 kW during test period. The fuel gas flow rate to the burner shall be measured with an accuracy of at least ± 3 % and shall be controlled within ± 5 % of the prescribed value of heat output.

7 Measurement at the opening of the combustion chamber

This clause specifies minimum requirement for the instrumentation attached to the opening of the combustion chamber. Additional information and designs can be found in Annex A.

7.1 Gas analyser

7.1.1 Sampling

The gas shall be sampled at the opening of the combustion chamber at a position where the combustion products flow out and any ambient air coming into the chamber shall not be sampled. The sampling line shall be made of an inert material that will not influence the concentration of the gas species to be analysed.

7.1.2 Carbon monoxide

The gas concentration shall be measured using an analyser having an accuracy of at least ± 0,02 % by volume for carbon monoxide. The analyser shall have a time constant not exceeding 3 s. (See Annex A).

7.2 Gas temperature

Gas temperature in the immediate vicinity of the gas-sampling probe shall be measured by a thermocouple with a maximum diameter of 0,25 mm.

8 Hood and exhaust duct

The system for collecting the combustion products shall have a capacity and be designed in such a way that all of the combustion products leaving the combustion chamber through the opening during a test are collected. The system shall not disturb the fire-induced flow in the opening. The exhaust

capacity shall be at least 2,0 (m^3 s^{-1}) at normal pressure and temperature of 25 °C. An example of the design of hood and exhaust duct is given in Annex C.

9 Instrumentation for measurement of gas in the exhaust duct

This clause specifies minimum requirements for the instrumentation for the measurement of the gas in the exhaust duct. Additional information and designs can be found in ISO 9705 Annex D and Annex E.

9.1 Volume flow rate

The volume flow rate in the exhaust duct shall be measured to an accuracy of at least ± 5 %. The response time to a stepwise change of the duct flow rate shall be a maximum of 1 s at 90 % of the final value.

9.2 Gas analyser

9.2.1 Sampling line

The gas in the duct shall be sampled at a position where the combustion products are uniformly mixed. The sampling line shall be made of an inert material which does not influence the concentration of the gas species to be analysed.

9.2.2 Oxygen

The oxygen consumption shall be measured with an accuracy of at least ± 0,01 % by volume. The oxygen analyser shall have a time constant not exceeding 3 s. (See ISO 9705 Annex D)

9.2.3 Carbon monoxide and carbon dioxide

The gas species shall be measured using analysers having an accuracy of at least + 0,1 % by volume for carbon dioxide and 0,02 % by volume for carbon monoxide. The analyser shall have a time constant not exceeding 3 s. (See ISO 9705 Annex D)

10 System performance

10.1 Calibration

A calibration test shall be performed prior to each test or one set of tests conducted continually.

The calibration shall be performed with the burner heat output given in Table 1, with the burner positioned centrally 1 m below the lower edge of the hood. Measurements shall be taken place at least every 6 s and shall be started 1 min prior to ignition of the burner. At steady state conditions, the difference between the mean heat release rate over 1 min calculated from the measured oxygen consumption and that calculated from metered gas input rate shall not exceed 3 % for each level of heat output.