INTERNATIONAL STANDARD

ISO 13785-2

First edition
2002-12-15

Reaction-to-fire tests for façades —

Part 2: Large-scale test

Essais de réaction au feu des façades —

Partie 2: Essai à grande échelle

Reference number
ISO 13785-2:2002(E)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 13785 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 13785-2 was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 1, *Fire initiation and growth*.

ISO 13785 consists of the following parts, under the general title *Reaction-to-fire tests for façades*:

— *Part 1: Intermediate-scale test*

— *Part 2: Large-scale test*

Annex A forms a normative part of this part of ISO 13785. Annex B is for information only.

Introduction

Fire is a complex phenomenon. Its behaviour and effects depend on a number of interrelated factors. The behaviour of materials and products depends on the characteristics of the fire, the method of use of the materials and the environment in which they are exposed. The theory of “reaction to fire tests” is explained in [2].

The need for improved thermal insulation of buildings, both for single- and multi-storey dwellings and for industrial buildings, has led to an increased use of insulated and often ventilated façades.

In their end use, façade assemblies can potentially be subjected to three primary fire exposure scenarios. These are:

a) an interior compartment fire venting through a window on to a façade;

b) an exterior fire in combustibles accumulated near a wall (e.g. rubbish, vegetation, bush fires);

c) radiant exposure from fire in an adjacent building.

This part of ISO 13785 only covers items a) and b). Item c) is typically regulated by spatial separation and allowable openings in the building codes.

The test specified in this part of ISO 13785 is for a post-flashover fire scenario within a building compartment venting through a window opening and impinging directly on to a façade. The window fire exposure may also simulate a fire from combustibles accumulated near a wall. The results may not, however, reflect the actual performance of exterior wall assemblies under all fire exposure conditions.

Fire on a façade can spread in several ways, with the most significant over a combustible exterior surface. Fire can also travel vertically and horizontally through air cavities within cladding or façade components or through an insulation core. Experience from real fire accidents, and also laboratory studies worldwide on configurations with and without internal corners, show that the worst-case situation is with an internal corner. This part of ISO 13785 therefore includes an internal corner.

Fire incidents show that fire can spread along an exterior façade, from the level of fire origin to the level above, regardless of the contribution from façade components. This test method therefore is intended to determine the contribution from the façade components to upward fire spread, beyond the floor immediately above the level of fire origin (i.e. the contribution from façade components for fire to spread from the level of fire origin to two levels above, also called leap-frogging).

The two parts of ISO 13785 provide two methods of test: an intermediate-scale test specified in Part 1 which should only be used for screening or for evaluation of subcomponents or “families of products”, and the large scale test specified in this part, which should be used to provide an end-use evaluation of all aspects of the façade system. A direct correspondence between the intermediate-scale test, specified in Part 1, and the full-scale test specified in this part, should not be assumed. The purpose of Part 1 is only to reduce the burden of testing in Part 2 by eliminating systems which fail Part 1.

The test specified in this part of ISO 13785 is intended to evaluate external wall or facing materials and constructions of façades which are not suitable for assessment using ISO 9705[3], which evaluates the fire growth from a surface product intended to be used for internal wall and ceiling linings.

The test specified in this part of ISO 13785 does not rely on the use of asbestos-based materials.

Reaction-to-fire tests for façades —

Part 2:
Large-scale test

WARNING — So that suitable precautions may be taken to safeguard health, all persons involved in the fire tests should be aware of the possibility that toxic or harmful gases may be evolved during exposure of test specimens.

Hazards are encountered when assessing the fire performance of any product on a large scale and it is essential that adequate precautions be taken.

Particular attention should be paid to the potential evolution of smoke and toxic gases and to the fact that extensive flaming of specimens can occur sometimes, resulting in mechanical failure of fixings and joints and possible structural collapse.

An adequate means of extinguishing the specimen should be provided.

1 Scope

This part of ISO 13785 specifies a method of test for determining the reaction to fire of materials and construction of façade claddings when exposed to heat and flames from a simulated interior compartment fire with flames emerging through a window opening and impinging directly on the façade. The information generated from this test may also be applicable to the scenario of an external fire impinging on a façade; however, the results may not be applicable for all fire exposure conditions.

This method is applicable only to façades and claddings that are non-loadbearing. No attempt is made to determine the structural strength of the façade or cladding.

This test is not intended to determine the fire behaviour of a given building façade. Details such as balconies, windows, window shutters, curtains, etc., are not considered in this test. This test does not include the risk of fire spread, for example through the window details of the façade system, as it only is constructed as a façade wall. There is clear evidence that an internal corner (also called a re-entrant corner) configuration produces a more intense fire exposure than a flat façade. The most commonly encountered internal re-entrant corner is with an angle of 90°. The test façade specimen therefore contains an internal corner with a re-entrant angle of 90°.

The test method described is intended to evaluate the inclusion of combustible components within façades and claddings of buildings which are otherwise of non-combustible construction.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 13785. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 13785 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 13943:2000, *Fire safety — Vocabulary*

IEC 60584-2, *Thermocouples — Part 2: Tolerances*

3 Terms and definitions

For the purposes of this part of ISO 13785, the terms and definitions given in ISO 13943:2000 and the following apply.

3.1
assembly
fabrication of materials and/or composites

EXAMPLE Sandwich panels.

NOTE An assembly may include an air gap, and vertical and horizontal joints.

3.2
composite
combination of materials that are generally recognized in building construction as discrete entities

EXAMPLES Coated, laminated or heterogeneous mixed materials.

3.3
exposed surface
surface of a product subjected to the heating conditions of the test

3.4
façade
cladding
products or constructions added to the external surface of an existing wall or frame

NOTE The structure can be of concrete, lightweight concrete block work, masonry, steel, timber, etc. The cladding may be applied directly to this structure or may incorporate an air gap and/or an insulating layer.

3.5
material
single substance or uniformly dispersed mixture

EXAMPLES Metal, stone, timber, concrete, mineral wool, polymers.

3.6
product
material, composite or assembly about which information is required

3.7
specimen
façade or cladding representing the product of the end-use façade including joints and fixings

NOTE 1 The specimen does not include the lightweight concrete block wall, if used, of the test rig.

NOTE 2 The specimen may include an air gap.

3.8
surface product
any part of a building that constitutes an exposed surface on the walls and/or the ceiling/roof

EXAMPLES Panels, boards.

4 Principle

The reaction to fire behaviour of a façade or cladding is assessed when exposed to flames impinging directly on the face of the façade or cladding after venting through a window aperture. The specimen is constructed with a re-entrant angle of 90°, creating a re-entrant corner.

Fire exposure of the façade specimen is specified by the level of total heat flux measured on the exterior surface of the façade 0,5 m above the top of the window opening. In addition, minimum temperature conditions are set for the hot air plume venting from the fire compartment in order to ensure that the exposure simulates a post-flashover compartment fire.

Fire compartment dimensions are not considered paramount for the evaluation of the façade assembly. However, the fire compartment volume is specified, within a broad range, to eliminate extreme fire exposures. Testing laboratories may find that an existing combustion chamber can be suitably adapted for façade testing purposes. An example of a typical facility is shown in Figure 1. The choice of fuel is left to the discretion of the testing laboratory. The fire source should not produce smoke to a level that could obstruct visual observation of the façade performance.

Visual observation of flame spread will constitute an important measurement for qualitative assessment of the performance of the façade assembly. The resulting flame spread and mechanical behaviour on or within the façade construction will, however, be quantified by measurements such as total heat flux and temperature, in addition to visual observation.

The objective of this test is to determine if the façade components could contribute to spreading the fire from the level of origin to two levels above.

5 Test facility and test facility calibration

5.1 Test facility

5.1.1 The test facility shall comprise a vertically-held main façade, containing a window opening to the combustion chamber (fire compartment). The facility shall also contain a vertically held wing façade to form a re-entrant corner with a re-entrant angle of 90°. The location of the re-entrant corner shall be in the proximity of one vertical edge of the window opening. An example of a test facility is shown in Figure 1.

5.1.2 The height of the test facility shall be at least 4 m above the window opening. The width of the main façade shall be at least 3 m. The width of the wing façade shall be at least 1,2 m. Both the main and the wing façades shall be mounted on a horizontal floor with no gaps between the horizontal floor and the vertical façades. Preferably, the wing wall should be movable horizontally, in parallel with the main façade, 0 m to 0,5 m from the edge of the window, to accommodate specimen thickness in the range 0 m to 0,5 m.

5.1.3 The combustion chamber shall be of a regular shape with an internal volume not less than 20 m^3 and not more than 100 m^3.

5.1.4 The combustion chamber shall have only one opening in the main façade that shall be flush with the wall. The width of the opening shall be $(2{,}0 \pm 0{,}1)$ m. The height of the opening shall be $(1{,}2 \pm 0{,}1)$ m.

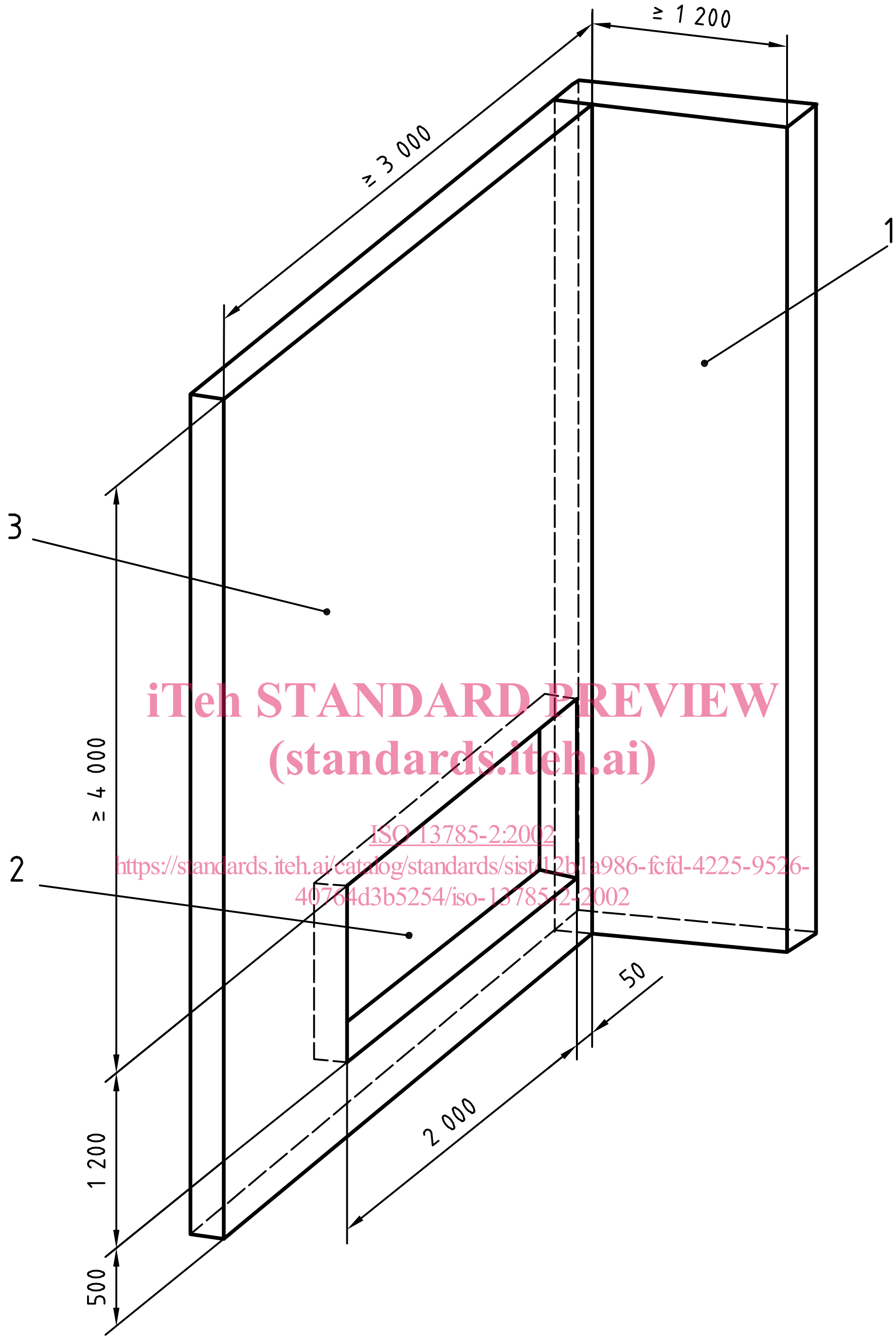
NOTE Other openings in the other walls of the combustion chamber are allowed in order to allow for natural ventilation and to fulfil the calibration requirements.

5.1.5 The walls and ceiling of the combustion chamber shall be constructed of concrete, masonry or any combination of materials that provide and maintain integrity, thermal properties and leakage characteristics that are consistent between calibration and specimen tests.

5.1.6 The walls and ceiling of the combustion chamber shall be lined on the room side with high temperature resistant insulation material.

NOTE Ceramic fibre insulation of nominal density 100 kg/m^3 and a thickness of 25 mm is suitable for this.

Dimensions in millimetres



Key

1 Side wall specimen (wing)

2 Window opening to combustion chamber

3 Main wall specimen (main façade)

NOTE Combustion chamber not drawn.

Figure 1 — Test facility

5.2 Test facility calibration

5.2.1 The objective of the calibration procedure is to establish the level of fire exposure on the test specimen. The calibration should be done after each considerable change in the test rig or at least every year.

5.2.2 During calibration the appropriate quantity or rate of fuel supply shall be determined.

5.2.3 The main and wing façades of the test facility shall be clad with non-combustible board. A 13 mm thick non-combustible board with a nominal density of (700 ± 200) kg/m^3 is suitable for this. The cladded area may be limited to the area extending from the top of the window opening to 4 m above.

5.2.4 After installation of the cladding, the horizontal distance from the vertical edge of the window opening to the wing façade shall be less than 50 mm.

5.2.5 Three total heat flux meters shall be installed 600 mm directly above along a line parallel to the horizontal centreline of the top of the window opening, with its sensing faces flush with the outer face of the cladding board (see Figure 2, flux meters 1, 7 and 8). One total heat flux meter shall be installed on the vertical centreline of the window opening 1,6 m above the top of the opening, with its sensing faces flush with the outer face of the cladding board (see Figure 2, flux meter 2). Heat flux meters in the range 0 kW/m^2 to 100 kW/m^2 are suitable for this purpose.

5.2.6 Thermocouples shall be installed as specified in 8.2.

5.2.7 The test environment specified in 10.1 to 10.4 shall be achieved prior to initiating the calibration procedure.

5.2.8 Start the data acquisition system 1 min before igniting the fuel.

5.2.9 Commence the calibration process by igniting the fuel(s) in the combustion chamber.

5.2.10 Adjust the fuel flow rate and/or ventilation gradually to increase the fire growth to full fire exposure. The levels of exposure shall be as specified in 6.2 to 6.4.

5.2.11 Record the amount of fuel and/or the fuel flow rate and/or rate of supply of air by ventilation during the calibration test.

5.2.12 The amount of fuel and/or the fuel flow rate established in a successful calibration run shall be used in testing until re-calibration is required.

The amount of fuel and/or fuel flow rate shall be established at least each year or after each considerable change in the test rig.

6 Fire source and exposure

6.1 The standard source of fuel used in the combustion chamber is propane. An example of the standard propane ignition source is given in annex A. Other choices of fuel can be made (see annex B), but the amount of smoke generated shall not obstruct visual observation of the performance of the façade assembly and the fuel shall conform to 6.2 to 6.5.

6.2 The duration of full fire exposure in the calibration test shall be 15 min, during which flames emerging from the opening shall impinge on the outer face of the cladding. Full fire exposure shall be preceded by 4 min to 6 min of gradual increase in fire intensity. The full fire exposure shall be followed by a gradual decrease in intensity of 4 min to 6 min. The total test duration shall be between 23 min and 27 min.

6.3 During full fire exposure in the calibration test the front face of the façade shall be subjected to a total heat flux of (55 ± 5) kW/m^2 measured by the total heat flux meters 1, 7 and 8 at 600 mm directly above along a line parallel to the horizontal centreline of the window opening (see Figure 2). The total heat flux at 1,6 m above the window opening shall be (35 ± 5) kW/m^2 (see 8.2).

