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Reaction to fire tests — Spread of flame —

Part 4: Intermediate-scale test of vertical spread of flame with vertically oriented specimen

Essais de réaction au feu — Propagation du feu —
Partie 4: Essais à échelle intermédiaire de la propagation de la flamme avec éprouvette orientée verticalement

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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 5658 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 5658-4 was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 1, *Fire initiation and growth*.

ISO 5658 consists of the following parts, under the general title *Reaction to fire tests — Spread of flame*:

— *Part 1: Guidance on flame spread* (Technical Report)

— *Part 2: Lateral spread on building products in vertical configuration*

— *Part 4: Intermediate-scale test of vertical spread of flame with vertically oriented specimen*

Annexes A, B and D form a normative part of this part of ISO 5658. Annexes C and E are for information only.

Introduction

ISO/TR 5658-1 describes the development of standard tests for flame spread and explains the theory of flame spread for various orientations.

ISO 5658-2 provides a simple method by which the lateral surface spread of flame on a vertical specimen can be determined for comparative purposes. This method is particularly useful for research, development and quality control purposes.

This part of ISO 5658 provides an intermediate-scale method by which the ignitability and vertical surface spread of flame on a vertical specimen can be determined. The specimen is sufficiently large to obtain a measure of lateral flame spread. Downward flame spread can also be examined as a wind-opposed spread on the specimen surface or by the observation of any flaming drips.

Fire is a complex phenomenon; its behaviour and its effects depend upon a number of interrelated factors. The behaviour of materials and products depends upon the characteristics of the fire, the method of use of the materials and the environment in which they are exposed. The methodology of reaction-to-fire tests is explained in ISO/TR 3814.

A test such as specified in this part of ISO 5658 deals only with a simple representation of a particular aspect of the potential fire situation typified by a radiant heat source and flame; it cannot alone provide any direct guidance on behaviour or safety in fire.

The attention of all users of the test is drawn to the warning given before clause 1.

Reaction to fire tests — Spread of flame —

Part 4:
Intermediate-scale test of vertical spread of flame with vertically oriented specimen

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 may be evolved during exposure of test specimens. The advice on safety given in annex A should also be noted.

1 Scope

1.1 This part of ISO 5658 specifies an intermediate-scale method of test for measuring the vertical spread (upward and downward) of flame over a specimen of a product orientated in the vertical position. A measure of lateral spread can also be obtained. It provides data suitable for comparing the performance of materials, composites or assemblies, which are used as the exposed surfaces of walls or other vertically orientated products in construction applications. Some products with profiled surfaces can also be tested with a modified procedure representative of the end-use conditions of the product.

1.2 Upward flame spread is not limited to surfaces which are vertical. It is recognized that an enhanced form of upward, wind-aided flame spread can also occur on surfaces at an angle greater than 20° from the horizontal without any external ventilation. This type of flame spread can occur in both planar sloping surfaces and stepped surfaces such as stairs. Flame spread in these situations can become very rapid and can cause serious problems in escape ways such as staircases. When assessing stepped or sloping surface materials, it may be more appropriate to use a vertical flame spread test rather than a test in which the specimen is horizontal.

1.3 This part of ISO 5658 is applicable to the measurement and description of the properties of materials, products, composites or assemblies in response to radiative heat in the presence of non-impinging pilot flames under controlled laboratory conditions. The heat source may be considered to represent a single burning item such as a wastepaper bin or an upholstered chair within an enclosure, and this scenario would generally be considered to apply during the early developing stage of a fire (see ISO/TR 11696-1 and ISO/TR 11696-2). This part of ISO 5658 should not be used alone to describe or appraise the fire hazard or fire risk of materials, products, composites or assemblies under actual fire conditions.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 5658. 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 5658 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 554, *Standard atmospheres for conditioning and/or testing — Specifications.*

ISO/TR 11696-1, *Uses of reaction to fire test results — Part 1: Application of test results to predict fire performance of internal linings and other building products.*

ISO/TR 11696-2, *Uses of reaction to fire test results — Part 2: Fire hazard assessment of construction products.*

ISO 13943, *Fire safety — Vocabulary.*

ISO/TR 14697, *Fire tests — Guidance rules on the choice of substrates for building products.*

3 Terms and definitions

For the purposes of this part of ISO 5658, the terms and definitions given in ISO 13943 apply, together with the following.

3.1
assembly
fabrication of materials and/or composites, for example sandwich panels

NOTE The assembly may include an air gap (see 6.3.6).

3.2
backing board
board with the same dimensions as the specimen and used to back the specimen so as to represent end-use conditions

NOTE See 7.10.

3.3
burned area
that part of the damaged area of a material which has been destroyed by either combustion or pyrolysis, under specified test conditions

3.4
composite
combination of materials which are generally recognized in building construction as discrete entities

EXAMPLE Coated or laminated materials.

3.5
damaged area
total of the area of material affected by thermal phenomena under specified test conditions

NOTE See 10.11.

3.6
exposed surface
that surface of the specimen subjected to the heating conditions of the test

3.7
flame front
boundary of the combustion zone in the gaseous phase at the surface of a material

NOTE For vertical flames, the flame front is the tip of continuous flames, disregarding any detached transitory flame-segments.

3.8
flashing
existence of flame on or over the surface of the specimen for periods of less than 1 s

3.9
irradiance
⟨at a point of a surface⟩ quotient of the radiant heat flux incident on an infinitesimal element of surface containing the point, and the area of that element

3.10
material
single substance or uniformly dispersed mixture

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

3.11
product
material, composite or assembly about which information is required

3.12
radiant heat flux
power emitted, transferred or received in the form of radiation

3.13
specimen
representative piece of the product which is to be tested together with any substrate or treatment

NOTE The specimen may include an air gap. The specimen may also be tested as a stand-alone product without substrates if this is representative of end-use conditions.

3.14
spread of flame
propagation of a flame front over the surface of a product under the influence of imposed irradiance and non-impinging pilot flames

3.15
substrate
material which is used or is representative of that used, immediately beneath a surface product in end-use

EXAMPLE Skimmed plasterboard beneath a wall-covering.

3.16
sustained flaming
existence of flame on or over the surface of the specimen for periods of more than 4 s

3.17
transitory flaming
existence of flame on or over the surface of the specimen for periods of between 1 s and 4 s

3.18
lateral flame spread
progression of the flame front in a lateral direction over the specimen width

3.19
vertical flame spread
progress of the flame front in a vertical direction (upwards or downwards) over the specimen height

4 Principle

4.1 The test method consists of exposing conditioned vertically-orientated specimens to a single well-defined field of radiant heat flux (see Figure 1) and measuring the time of ignition, vertical spread of flame and, where appropriate, observing other fire spread effects such as flaming drips or debris and lateral spread.

4.2 A test specimen is placed in a vertical position adjacent to a gas-fired radiant panel which exposes the lower part to a defined field of radiant heat flux. A non-impinging line pilot burner is positioned above the radiated area of the specimen to ignite volatile gases issuing from the surface (see Figures 2 and 3).

4.3 Following ignition, any flame front which develops is noted and a record is made of the progression of the flame front vertically over the height of the specimen in terms of the time it takes to travel to various distances.

4.4 The results are expressed in terms of ignition time and flame spread distance versus time.

Mass loss, heat release and smoke data may also be measured if required. For these measurements, the apparatus should be positioned underneath a calibrated hood/duct facility; for example, see ISO 9705.

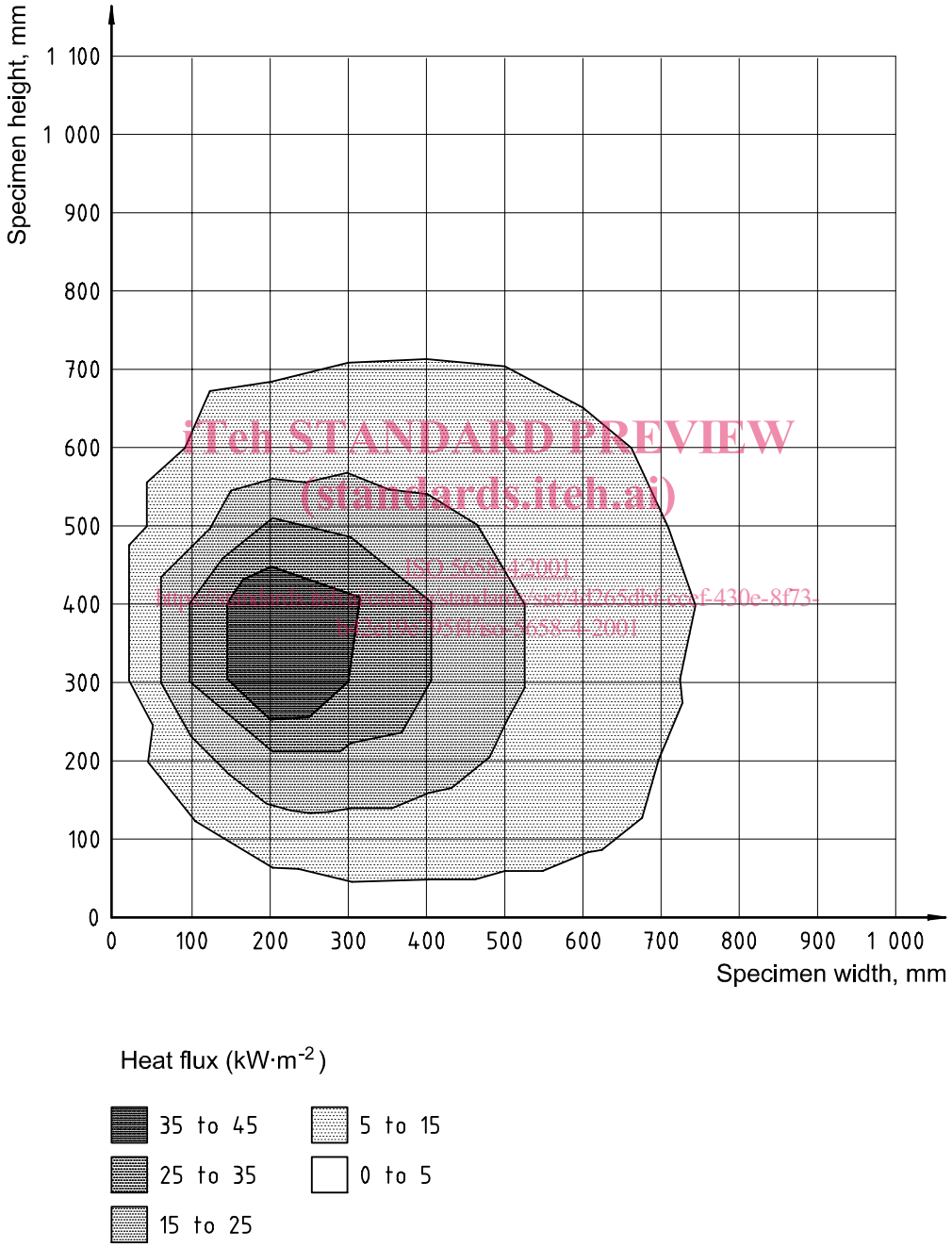
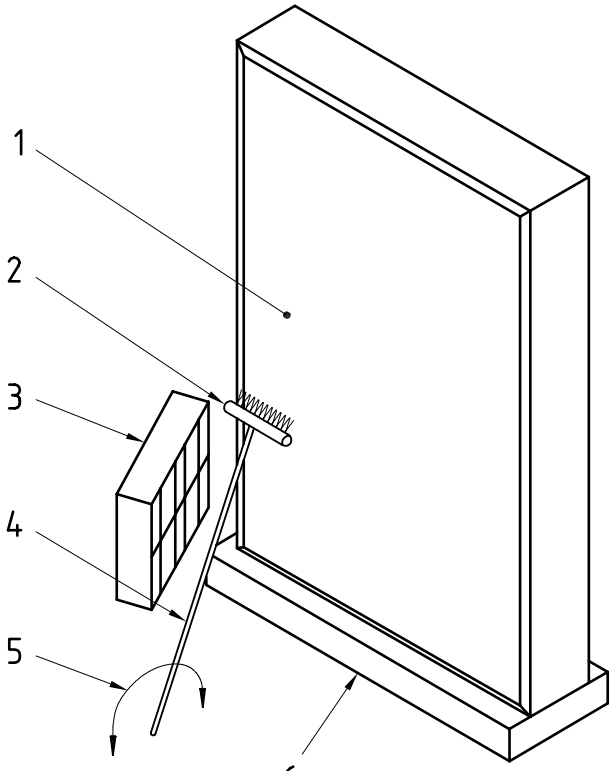


Figure 1 — Heat flux distribution on the calibration board

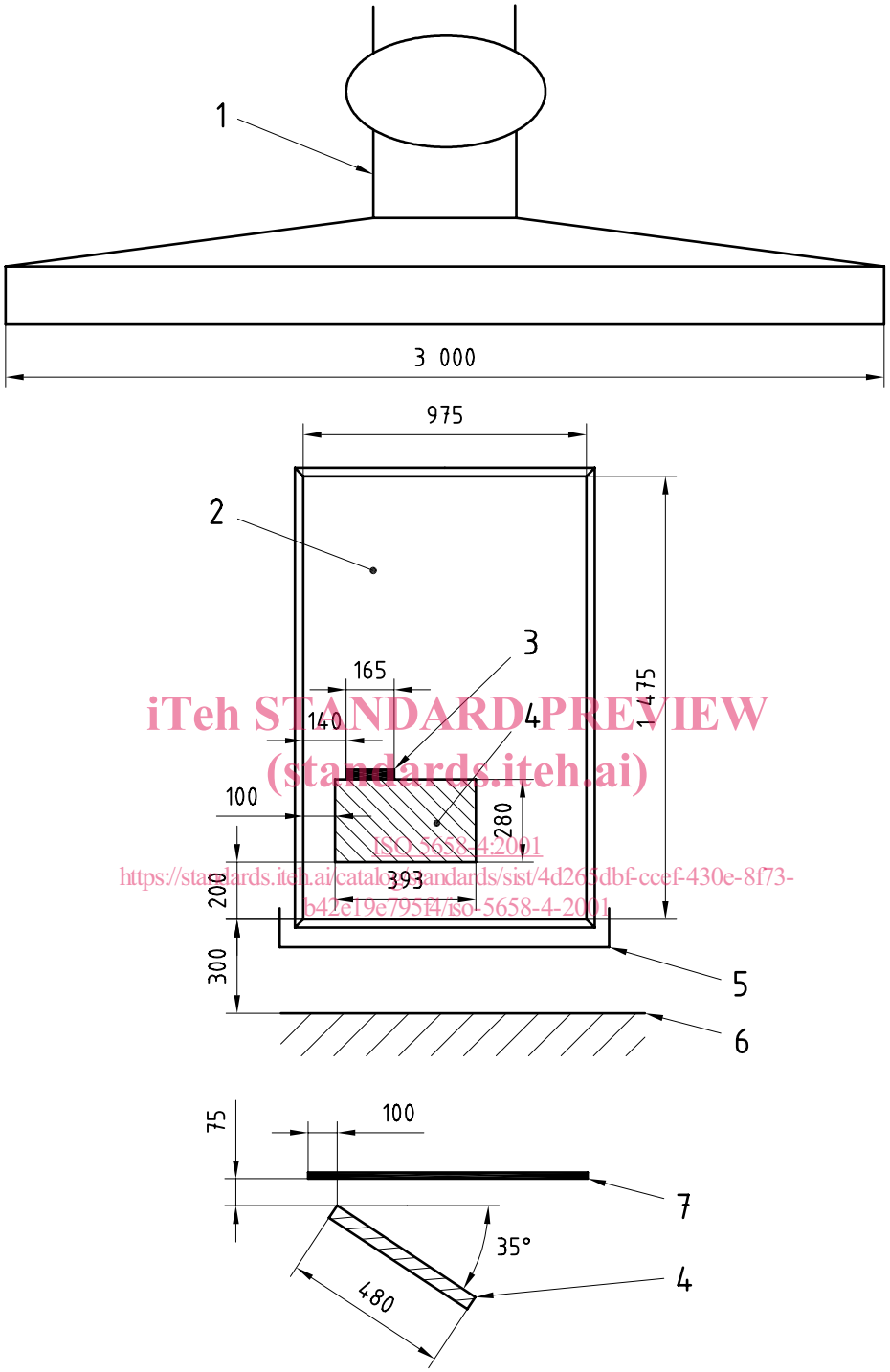


Key

1 Test specimen
2 Pilot flame burner
3 Vertical radiant panel at an angle of 35° to the specimen
4 Supply pipe
5 Direction of rotation of supply pipe
6 Debris collection tray

Figure 2 — Test apparatus

Dimensions in millimetres



Key

1 Exhaust hood
2 Exposed area of specimen
3 Pilot flame burner
4 Radiant panel
5 Debris collection tray
6 Floor level
7 Specimen

Figure 3 — Schematic of test apparatus

5 Suitability of a product for testing

A product having one of the following surface characteristics is suitable for evaluation by this method:

a) an essentially flat exposed surface;

b) a surface irregularity which is evenly distributed over the exposed surface provided that any cracks, fissures or holes do not exceed 8 mm in width or 10 mm in depth and the total area of such cracks, fissures or holes at the surface does not exceed 30 % of a representative area 155 mm square of the exposed surface;

c) products with profiled surfaces (e.g. ducting, panels, pipes) may also be tested in end-use conditions but it should be recognized that flame spread rates and distances are then not directly comparable to those obtained from essentially flat products.

6 Test specimens

6.1 Exposed surface

The product shall be tested on that face which will normally be exposed in practice, taking account of the following.

a) For asymmetric products where it is possible for either or both of the faces to be exposed in end-use, both faces shall be tested.

b) If the face of the product contains a surface irregularity that is specifically directional (e.g. corrugations, grain or machine-induced orientation which may, in practice, run horizontally or vertically), the product shall be tested in both orientations.

c) If the exposed face contains distinct areas of different surface finish or texture, then the appropriate number of specimens shall be provided for each distinct area of such finish or texture to be evaluated.

d) If the product is a pile carpet or other surface which is compressible by the flange of the pilot burner, a check shall be made by presenting the specimen to the pilot burner without gas in the test position. If necessary, the flange shall be adjusted so that the distance between the burner tube and the specimen is 25 mm.

6.2 Number and size of specimens

6.2.1 Three specimens shall be tested for each potentially exposed surface or orientation.

6.2.2 The specimens shall be (1 525 ± 25) mm long by (1 025 ± 25) mm wide by their end-use thickness. They shall be representative of the product. The specimens may be constructed from a number of components suitably jointed together. For specimens containing one or more vertical joints, one joint shall be placed at a distance of 250 mm from the left (or hot) edge of the exposed specimen. For specimens containing one or more horizontal joints, one joint shall be placed at a distance of 350 mm from the lower edge of the exposed specimen.

6.2.3 The thickness of specimens of products with irregular surfaces (see 6.1) shall be measured from the highest point of the surface. Products of normal thickness 300 mm or less shall be tested using their full thickness.

6.3 Construction of specimen assemblies

6.3.1 For thin materials or composites used in the fabrication of an assembly, the presence of an air gap and/or the nature of any underlying construction can significantly affect the characteristics of the exposed surface. The influence of the underlying layers should be understood and care taken to ensure that the test result obtained on any assembly is relevant to its use in practice. Whenever possible, the specimen should be assembled in the specimen holder (see 7.4). However, some specimens may be particularly bulky or heavy (e.g. brick wall substrates). In these cases, the specimen may be assembled on the floor, with the exposed surface the usual distance above the floor and the radiant panel presented to the specimen according to the principles shown in Figure 3.