INTERNATIONAL STANDARD

ISO 5658-2

Second edition
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Reaction to fire tests — Spread of flame —

Part 2: Lateral spread on building and transport products in vertical configuration

Essais de réaction au feu — Propagation du feu —
Partie 2: Propagation latérale sur les produits de bâtiment et de transport en position verticale

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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 2.

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 5658-2 was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 1, *Fire initiation and growth*.

This second edition of ISO 5658-2 cancels and replaces the first edition (ISO 5658-2:1996), which has been technically revised.

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 Specification]

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

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

Introduction

This part of ISO 5658 is based on the method of the International Maritime Organization (IMO) published as IMO Resolution A.653 (16)[4], and has been developed as an International Standard in order to allow its wider use. The major differences between ISO 5658-2 and the IMO test are that ISO 5658-2 is limited in scope to testing the spread of flame over vertical specimens and does not include the stack for estimating heat release rate. The second edition of this part of ISO 5658 avoids the use of acetylene for the pilot flame and uses the propane pilot flame in an impinging mode. The current IMO flame spread procedure is still based on ISO 5658-2:1996.

ISO/TS 5658-1[2] describes the development of standard tests for flame spread and explains the theory of flame spread for various orientations. This part of ISO 5658 provides a simple method by which 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.

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 to which they are exposed. The methodology of “reaction-to-fire” tests is explained in ISO/TR 3814[1].

A test such as is 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.

Annexes A and F form integral parts of this part of ISO 5658. Annexes B to E are for information only. A precision statement based on inter-laboratory trials using this test method is given in Annex E.

This test procedure does not rely on the use of asbestos-based materials.

The attention of all users of the test is drawn to the introductory caution statement.

Reaction to fire tests — Spread of flame —

Part 2:
Lateral spread on building and transport products in vertical configuration

CAUTION — 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 exposure of test specimens. The advice on safety given in Annex A should also be noted.

1 Scope

This part of ISO 5658 specifies a method of test for measuring the lateral spread of flame along the surface of a specimen of a product orientated in the vertical position. It provides data suitable for comparing the performance of essentially flat materials, composites or assemblies that are used primarily as the exposed surfaces of walls in buildings and transport vehicles, such as ships and trains. Some profiled products (such as pipes) can also be tested under specified mounting and fixing conditions.

This part of ISO 5658 is applicable to the measurement and description of the properties of materials, products or assemblies in response to radiative heat in the presence of a pilot flame under controlled laboratory conditions. It is not suitable to be used alone to describe or appraise the fire hazard or fire risk of materials, products or assemblies under actual fire conditions.

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 13943:2000, *Fire safety — Vocabulary*

3 Terms and definitions

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

3.1
assembly
fabrication of materials, products and/or composites

EXAMPLE Sandwich panels.

NOTE The assembly may include an air gap.

3.2
average heat for sustained burning
average of the values of heat for sustained burning, measured at a number of specified positions

NOTE The average heat for sustained burning is expressed in megajoules per square metre (MJ/m^2).

3.3
backing board
non-combustible board with the same width and length as the test specimen and (12,5 ± 3) mm thick, used in every test to back the specimen

NOTE 1 See 9.7.

NOTE 2 A non-combustible board is one that, when tested to ISO 1716[10], yields a gross calorific potential (PCS) of ⩽ 2,0 MJ/kg.

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

EXAMPLE Coated or laminated materials.

3.5
critical heat flux at extinguishment
CFE
incident heat flux at the surface of a specimen at the point along its horizontal centreline where the flame ceases to advance and may subsequently go out

NOTE 1 The heat flux value reported is based on interpolations of measurements with a non-combustible calibration board.

NOTE 2 The critical heat flux at extinguishment is expressed in kilowatts per square metre (kW/m^2).

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

3.7
flame front
furthest extent of travel of a sustained flame centrally along the length of the test specimen

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

3.9
heat for sustained burning
product of the time from the start of exposure of a specimen to the arrival of the flame front at a specified position and the incident radiant heat flux corresponding to that position measured on a non-combustible calibration board

NOTE 1 The heat for sustained burning is expressed in megajoules per square metre (MJ/m^2).

NOTE 2 The positions are specified in Table 1.

3.10
irradiance
⟨at a point of a surface⟩ quotient of the radiant heat flux incident on an infinitesimal element of surface containing the point, by area of that element

3.11
material
single substance or uniformly dispersed mixture

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

3.12
product
material, composite or assembly about which information is required

3.13
radiant heat flux
power emitted, transferred or received in the form of radiation

3.14
specimen
representative piece of the product that is tested together with any substrate or treatment

NOTE The specimen may include an air gap.

3.15
spread of flame
propagation of a flame front over the surface of a product under the influence of imposed irradiance

3.16
substrate
material that is used, or is representative of that used, immediately beneath a surface product

EXAMPLE Skimmed plasterboard beneath a wall-covering.

3.17
sustained flaming
existence of flame on or over the surface of the specimen for periods of more than 4 s

3.18
transitory flaming
existence of flame on or over the surface of the specimen for periods of between 1 s and 4 s

3.19
lateral spread of flame
progression of the flame front in a lateral direction over the specimen length

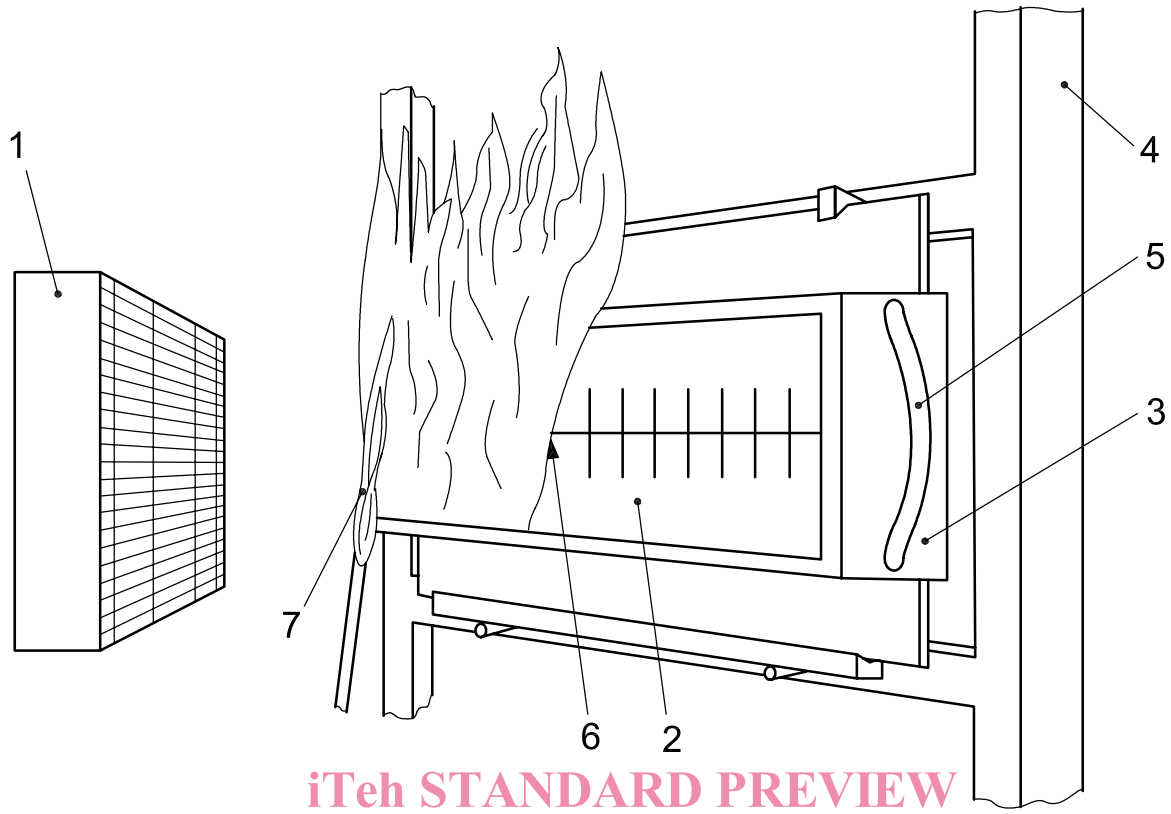
4 Principle

4.1 The test method consists of exposing conditioned specimens in a well-defined field of radiant heat flux and measuring the time of ignition, the lateral spread of flame and its final extinguishment.

4.2 A test specimen is placed in a vertical position adjacent to a gas-fired radiant panel where it is exposed to a defined field of radiant heat flux. A pilot flame is sited close to the hotter end of the specimen to ignite volatile gases issuing from the surface (see Figure 1).

4.3 Following ignition, any flame front that 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 travel various distances.

4.4 The results are expressed in terms of flame spread distance versus time, flame front velocity versus heat flux, the critical heat flux at extinguishment and the average heat for sustained burning.



Key

1 vertical radiant panel at an angle of 15° to the specimen
2 specimen
3 specimen holder
4 framework supporting specimen holder
5 handle
6 flame front
7 pilot flame

Figure 1 — Schematic of test

5 Suitability of a product for testing

5.1 Surface characteristics

5.1.1 A product having one of the following characteristics is suitable for evaluation using this method:

a) an essentially flat exposed surface, i.e. all surface irregularities are within ± 1 mm of plane;

b) a surface irregularity that is evenly distributed over the exposed surface provided that

1) at least 50 % of the surface of a representative square area, 155 mm × 155 mm, lies within a depth of 6 mm from a plane across the highest points of the exposed surface, and/or

2) 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 square area, 155 mm × 155 mm, of the exposed surface.

5.1.2 Where a product has areas of its surface that are distinctly different, but each of these separate areas satisfies the surface characteristics specified in 5.1.1, then each of these separate areas shall be tested to evaluate the product fully.

5.1.3 When an exposed surface does not comply with the requirements of either 5.1.1 a), or 5.1.1 b), the product may be tested in a modified form with an essentially flat exposed surface. The modification shall be stated in the report.

5.2 Thermally unstable products

The test method may not be suitable for assessing products that react in particular ways under exposure to the specified heating conditions (see 11.12). Products showing these characteristics should be assessed using other test methods, as given in, for example, ISO 9705[3].

6 Test specimens

6.1 Exposed surface

The product shall be tested on that face that is normally exposed in use, taking account of the following.

a) If it is possible for either or both of the faces to be exposed in use then, if the core is asymmetrical, 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 that can, in use, 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) Textile materials shall be tested for spread of flame in both the warp and the weft directions.

If a bright, metallic-faced specimen is to be tested, it shall be tested both as-received and also finished with a thin coat of lamp black or colloidal graphite, applied before conditioning for test. Alternatively, spray the exposed top surface of the specimen with a single coat of flat black paint that is designed to withstand temperatures of (540 ± 10) °C. Prior to testing, cure the paint coating by conditioning the specimen at a temperature of (23 ± 3) °C and a relative humidity of (50 ± 5) % for 48 h. This coating is applied to ensure surface absorption of the imposed radiant heat flux.

6.2 Number and size of specimens

6.2.1 At least six specimens shall be provided for test.

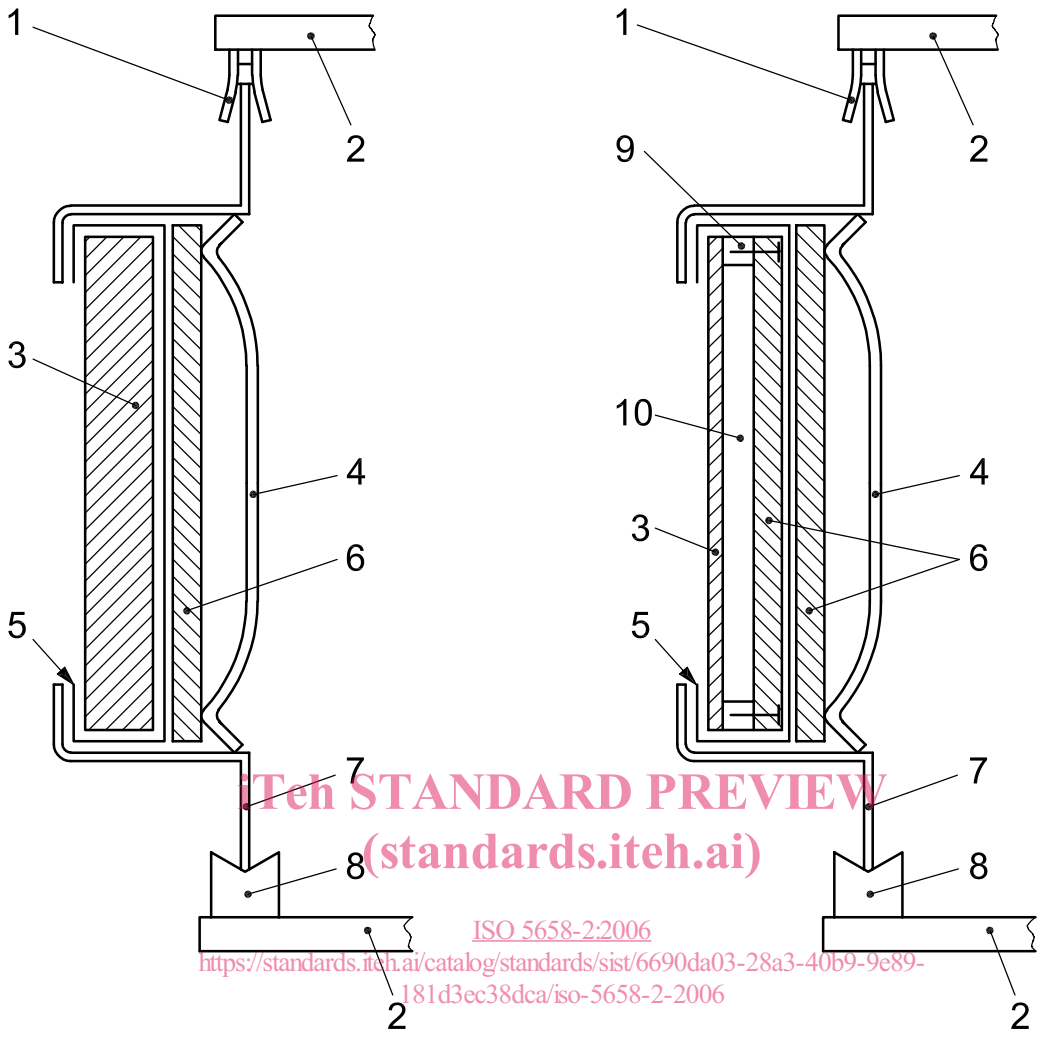
6.2.2 Three specimens shall be tested for each potentially exposed surface or orientation.

With products that can be exposed from either side and that also have directional irregularities on one side only, at least nine specimens are needed (see 11.10).

6.2.3 The specimens shall be $(800\ ^{0}_{-5})$ mm long × $(155\ ^{0}_{-5})$ mm wide and shall be representative of the product.

6.2.4 The thickness of specimens of products with irregular surfaces (see 6.1) shall be measured from the highest point of the surface. Products of a thickness of 50 mm or less shall be tested using their full thickness. For products of normal thickness greater than 50 mm, the unexposed face shall be cut away to reduce the thickness to $(50\ ^{0}_{-3})$ mm.

For products of thicknesses in the range of 50 mm to 70 mm, it is necessary to use an extension clip or restraint at the rear of the specimen holder (see Figure 2).



a) Specimen with backing board

b) Specimen with backing boards and spacers forming an air gap

Key

1 fork
2 specimen holder guide
3 specimen
4 spring clip or restraint
5 aluminium foil
6 backing board(s)
7 specimen holder
8 groove
9 spacer screwed to backing board
10 air gap

Figure 2 — Typical mounting of specimens

6.3 Construction of specimens

6.3.1 For thin materials or composites used in the fabrication of an assembly, the presence of air or 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.

6.3.2 When the product is a surface coating, it shall be applied to the selected substrate using a method and application rate recommended for its end use.

6.3.3 When the product is a material or composite that would normally be attached to a substrate, it shall be tested in conjunction with the selected substrate using the recommended fixing technique, e.g. bonded with the appropriate adhesive or mechanically fixed. The procedure for fixing the specimens to the substrate shall be clearly stated in the test report [see 13 f)].

6.3.4 Parts of a test specimen may be joined in various ways according to the orientation of the joint in end-use application conditions. If the product is constructed with horizontal joints, a horizontal joint shall be positioned at the horizontal centreline of the test specimen. If the product is constructed with vertical joints, a vertical joint shall be positioned at 100 mm from the hot end of the test specimen.

Joints should be constructed as closely as possible to the end-use application conditions; for example, sealants and adhesives should be applied at similar coverage weights to practical systems.

6.4 Conditioning

6.4.1 All specimens shall be conditioned to constant mass at a temperature of (23 ± 2) °C, and a relative humidity of (50 ± 5) %, and maintained in this condition until required for testing. Constant mass is considered to be attained when two successive weighing operations, carried out at an interval of 24 h, do not differ by more than 0,1 % of the mass of the specimen, or 0,1 g, whichever is the greater.

6.4.2 Backing boards and spacers (see 9.7) shall be conditioned for at least 12 h before use under the conditions specified in 6.4.1.

6.5 Preparation

6.5.1 Reference line

Mark a horizontal line centrally at half height along the length of each specimen. Draw vertical marks every 50 mm along the line. The zero mark shall correspond with the start of the exposed area of the specimen (see 7.4). Care shall be taken to avoid the possibility of the line influencing the performance of the specimen, for example by damaging the surface, or increasing its absorbency.

NOTE Some materials discolour or burn so that the line and/or the marks are obscured. The use of a stainless steel grid approximately 10 mm above the surface of the specimen allows the position of the flame front to be determined.

6.5.2 Products without air gaps

If a product is normally used without an air gap behind it, then, after the conditioning procedures specified in 6.4, the edges and the rear face of the specimen shall be wrapped in a single rectangular sheet of aluminium foil of a thickness of 0,02 mm to 0,03 mm and dimensions of $(175 + 2a)$ mm × $(820 + 2a)$ mm, where a is the thickness of the specimen, so that about 10 mm of foil laps evenly over the edges of the front face of the specimen. The foil shall be pressed down flat onto the front face of the specimen [see Figure 2 a)]. The specimen, wrapped in foil, shall then be placed on a backing board and both shall be inserted in a specimen holder (see Figure 3).