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**Plastics — Development and use  
of intermediate-scale fire tests for  
plastics products —**

**Part 2:  
Use of intermediate-scale tests for  
semi-finished and finished products**

*Plastiques — Développement et utilisation des essais au feu à une  
échelle intermédiaire pour les produits plastiques —*

*Partie 2: Utilisation des essais à une échelle intermédiaire pour les  
produits semi-finis et les produits finis*

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ISO/TS 15791-2:2022

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Published in Switzerland

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 4, *Burning behaviour*.

This second edition cancels and replaces the first edition (ISO/TS 15791-2:2017), which has been technically revised.

The main changes are as follows:

- technical update in [Clause 4](#) has been updated;
- the following references have been added:
  - ISO 14697 (as a normative reference);
  - ISO/TS 17431 (as an informative reference).

A list of all parts in the ISO 15791 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

The major benefit in intermediate-scale testing is the ability to reflect more accurately the fire conditions of real fires than small-scale tests. For example:

- Specimen mounting. Specimens can incorporate end-use fixings, joints and air-gaps (see [Annex A](#)) in the larger test apparatus. In addition, thick and/or profiled products may be accommodated. This capability is valuable for testing thick multilayer composites (such as sandwich structures). It is also useful for testing profiled product such as pipes, pipe insulations, cable trays, GRP frames and similar products.
- Test specimen size and orientation. Intermediate-scale tests allow to evaluate fire growth. The ability to measure flame spread beyond the impingement zone of the ignition source is a desirable feature.
- Observation of actual phenomena of products (especially thermoplastics) exposed to ignition sources. Representative behaviour may be observed with intermediate-scale test specimens.

The test results may be useful to the manufacturers of the products and regulation authorities<sup>[11]</sup>.

However, intermediate-scale tests may have the following disadvantages because of their large scale.

- Intermediate-scale tests may develop an increased amount of fire effluent.
- Intermediate-scale tests may require higher cost.
- An intermediate-scale test may limit the fire scenario and cannot realize a wide range of fire behaviours.

An intermediate-scale test can be used as a screening test for large-scale tests for the purpose of research and product development. [ISO/TS 15791-2:2022](#)

In addition to the usage mentioned above, this document has been prepared for manufacturers of semi-finished plastics products. These semi-finished products may be tested for production control or developmental reasons. They cannot always be tested in the end-use conditions (such as mounting and fixing) that are appropriate for finished products.

This document is intended to support the information that product manufacturers may require as part of a quality assurance scheme. In addition, it should be recognized that this document is not intended to replace finished product technical specifications for products containing a semi-finished plastics component.

The information given in this document is in accordance with the principles recommended in ISO 10840, which was established to develop a general policy and philosophy for the development and use of fire tests for plastics.



# Plastics — Development and use of intermediate-scale fire tests for plastics products —

## Part 2: Use of intermediate-scale tests for semi-finished and finished products

### 1 Scope

This document provides guidelines and specifies requirements for the development and use of intermediate-scale fire tests applicable to semi-finished and finished products made of, or containing, plastics.

This document covers typical applications of such tests, as well as methods of preparation and mounting of test specimens.

This document applies to planar, linear or profiled plastics products. These products can be tested in horizontal or vertical orientation.

This document defines the parameters to be measured, the way that test results are expected to be reported and explains how they can be used for direct product assessment or as input data for scaling studies.

### 2 Normative references

[ISO/TS 15791-2:2022](https://standards.iteh.ai/catalog/standards/sist/17a5f1a9-20bc-4e7e-8614-5de4f2c79b21/iso-15791-2-2022)

[https://standards.iteh.ai/catalog/standards/sist/17a5f1a9-20bc-4e7e-8614-5de4f2c79b21/iso-](https://standards.iteh.ai/catalog/standards/sist/17a5f1a9-20bc-4e7e-8614-5de4f2c79b21/iso-15791-2-2022)

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 834-12, *Fire resistance tests — Elements of building construction — Part 12: Specific requirements for separating elements evaluated on less than full scale furnaces*

ISO 10840, *Plastics — Guidance for the use of standard fire tests*

ISO 13943, *Fire safety — Vocabulary*

ISO 14697, *Reaction-to-fire tests — Guidance on the choice of substrates for building and transport products*

ISO 25762, *Plastics — Guidance on the assessment of the fire characteristics and fire performance of fibre-reinforced polymer composites*

ISO 30021, *Plastics — Burning behaviour — Intermediate-scale fire-resistance testing of fibre-reinforced polymer composites*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 10840, ISO 13943 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at <https://www.iso.org/obp>

— IEC Electropedia: available at <https://www.electropedia.org/>

**3.1  
end-use application**

real application of a product including method of installation

**3.2  
finished product**

manufactured article ready for end-use

**3.3  
intermediate-scale fire test**

fire test performed on a *test specimen* (3.9) of smaller dimensions than the final end-use product/system

**3.4  
pre-selection test**

test which provides data for the process of assessing and choosing candidate materials, components or subassemblies for making an end-product

**3.5  
product parameter**

aspect of a product which may vary and which may have an influence on the product's fire performance, e.g. thickness, composition and density

**3.6  
profiled product**

homogenous product with a non-planar surface

**3.7  
sample**

representative part of a manufactured product or piece of a material or *semi-finished product* (3.8)

**3.8  
semi-finished product**

manufactured article ready for assembly for an *end-use application* (3.1)

**3.9  
test specimen**

test piece that may be cut from a sample of a product, or prepared by moulding or otherwise, as specified by the test procedure, or a representative sample of the product itself

## 4 Different applications of intermediate-scale fire tests

### 4.1 General

The intermediate-scale fire test can be used for direct product assessment when a test specimen of a finished product can be tested in end-use conditions.

Intermediate-scale tests can evaluate several parameters such as ignitability, flame spread, orientation and the mounting effects of products. These parameters may be used to indicate the behaviour of products in large-scale or full-scale fire tests.

An intermediate-scale tests may be used

- as a pre-selection test to evaluate the influence of product parameters on the fire behaviour of semi-finished products and to aid the development process, and/or
- to evaluate, as far as possible, end-use conditions.

The ways in which different types of tests are used are explained in the following subclauses.



## 4.2 Pre-selection tests on semi-finished products

An intermediate-scale test can be used as a pre-selection test

- to aid the selection of materials, components and sub-assemblies during the design stage when small-scale tests are not appropriate because of the complexity of the product, and/or
- to study the influence of product parameters on the fire behaviour of the products.

## 4.3 End-product tests

If it is possible to reproduce the end-use condition for a product, the test should be conducted in such condition. The test should reflect the end-use application scenario as far as possible. Important factors to consider include relevance of configuration, orientation, ventilation and the nature of the ignition source.

Reaction-to-fire testing for fire safety and for fire hazard assessment of products should be programmed as follows:

- a) define the relevant product-application (or misuse) scenario;
- b) specify the fire hazard to be assessed (e.g. vision impairment by smoke) and the required safety criteria;
- c) select the appropriate test method;
- d) conduct the tests and analyse the data with respect to the defined criteria;
- e) select acceptable or unacceptable for the candidate materials or products.

Intermediate-scale fire test methods permit measurements of the principal fire parameters (ignitability, spread of flame, heat release, ignited droplets, smoke effluent gases).

NOTE A guide for extended application is found in EN/TS 15117.

[Table 1](#) summarizes which test methods with an intermediate test specimen can be used and which measurements are possible.

**Table 1 — Examples of the applicability of intermediate-scale fire tests**

Use/ measurements	Test methods				
	ISO 9239-1 ISO 9239-2	ISO 5658-4 <sup>a</sup>	ISO 21367	ISO/TS 17431	ISO 14696
Preselection test	Only for flat products	Yes	Yes	Yes	Yes
End-product test	Only for horizontal flat products	Only for vertical product Adaptation of test specimen for profiled product	Only for vertical product Adaptation of test specimen for profiled product	Only for flat products	Only for vertical product Adaptation of test specimen for profiled product
Additional parameters	Possible presence of joints	Possible presence of joints	Possible presence of joints	Possible presence of joints	Possible presence of joints

<sup>a</sup> The standardized size of the test specimen is 1,5 m × 1,0 m. This method could apply on a test specimen with reduced size (e.g. 1 m × 1 m).

<sup>b</sup> Measurement using Fourier transform infrared (FTIR) spectroscopy following the guidance of ISO 19702 is technically possible, but has not been standardized. Care should be taken concerning the dilution of the fire effluent and the limits of quantification.

**Table 1** (continued)

Use/ measurements	Test methods				
	ISO 9239-1 ISO 9239-2	ISO 5658-4 <sup>a</sup>	ISO 21367	ISO/TS 17431	ISO 14696
Ignitability	Yes	Yes	Yes	No	Yes
Spread of flame	Only lateral spread of flame	Lateral and vertical spread of flame	Lateral and vertical spread of flame	Lateral and vertical spread of flame	Vertical spread of flame
Flash-over	No	No	No	Yes	No
Ignited droplets	No	Yes	Yes	No	Yes
Heat release	No	No	Yes	Yes	Yes
Smoke opacity	Yes	No	Yes	Yes	Yes
Smoke toxicity	No <sup>b</sup>	No <sup>b</sup>	No <sup>b</sup>	No <sup>b</sup>	No <sup>b</sup>

<sup>a</sup> The standardized size of the test specimen is 1,5 m × 1,0 m. This method could apply on a test specimen with reduced size (e.g. 1 m × 1 m).

<sup>b</sup> Measurement using Fourier transform infrared (FTIR) spectroscopy following the guidance of ISO 19702 is technically possible, but has not been standardized. Care should be taken concerning the dilution of the fire effluent and the limits of quantification.

## 5 Types of plastics and typical products

### 5.1 Generic types

All of the following types of plastics materials or products can be involved in a fire performance assessment:

- thermoplastics;
- thermosets;
- fibre-reinforced polymer composites;
- honeycomb composites contained plastics;
- sandwich panels contained cellular plastics.

### 5.2 Typical products

#### 5.2.1 General

Some applications of plastics which present particular problems in small-scale tests for their fire performance assessment and which may require the use of intermediate-scale fire testing are described in [5.2.2](#) and [5.2.3](#).

#### 5.2.2 Complex products ready for assembly for an end-use application

Composite products ready for assembly for an end-use application may be tested as semi-finished products. They include:

- boards/sheets with coating and joints;
- insulation materials with surface covering layers;

- composites:
  - laminates, e.g. melamine-formaldehyde-covered chipboard;
  - laminated film and sheet, e.g. weatherproofing membranes;
  - moulded foams, e.g. for packaging;
  - structural mouldings, e.g. for ships, lorries, coaches, trains, aircraft;
  - composite panels, e.g. rigid foams faced with metal sheets (especially steel or aluminium sheets) or inorganics (especially gypsum or plasterboard) for thermal insulation;
  - fibre-reinforced products.

### 5.2.3 Profiled products

Profiled products may be tested as finished products. They include:

- housings for electrical appliances;
- profiled sheets, e.g. roofing or panels for containers;
- profiles, e.g. conduits for electric cables, window-frames, extruded sections;
- weatherproof glazing for agricultural buildings;
- foam pipe-sections;
- pipes, e.g. rainwater drainage and discharge pipes;
- pipes for air ventilation systems in, for example, ships, trains, aircraft;
- containers for liquids, e.g. oil, kerosene;
- waste containers (for recycling materials or for rubbish).

## 6 Method of preparation and mounting of test specimens

### 6.1 General method of preparation and mounting of test specimens

#### 6.1.1 Finished products

In tests on a finished product, the preparation and mounting of the test specimen should aim to match the end-use application as far as practicably possible.

The general principles are specified in [Annex A](#).

#### 6.1.2 Substrates

Products which are self-standing or not applied to any substrate in the end-use condition will not require a substrate.

The substrate required in the end-use condition is used in the test. The method of choice of the substrate shall be in accordance with ISO 14697.

#### 6.1.3 Backing boards

Backing boards are required for many tests. For the backing board, alternatives are available:

- a) panels of calcium silicate board with thickness and density specified in each test standard, or