
**Plastics — Simple heat release test
using a conical radiant heater and a
thermopile detector**

*Plastiques — Essai simple pour la détermination du débit calorifique
au moyen d'un radiateur conique et d'une sonde à thermopile*

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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).

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).

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

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary Information](#)

The committee responsible for this document is ISO/TC 61, *Plastics*, Subcommittee SC 4, *Burning behaviour*.

This second edition cancels and replaces the first edition (ISO 13927:2001), which has been technically revised.

Introduction

Fire is a complex phenomenon; its behaviour and 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 (see also ISO 13943).

A test such as the one specified in this International Standard deals only with a simple representation of a particular aspect of the potential fire situation, typified by a radiant heat source, and it cannot alone provide any direct guidance on the behaviour or safety in fire. A test of this type can, however, be used for comparative purposes or to ensure the existence of a certain quality of performance (in this case, heat release from a composite material or an assembly) considered to have a bearing on fire performance generally. It would be wrong to attach any other meaning to performance in this test.

The attention of all users of this test is drawn to the warning that immediately precedes [Clause 10](#).

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Plastics — Simple heat release test using a conical radiant heater and a thermopile detector

1 Scope

This International Standard specifies a method suitable for the production control or product development purposes for assessing the heat release rate of essentially flat products exposed in the horizontal orientation to controlled levels of radiant heating with an external igniter. The heat release rate is determined by the use of a thermopile instead of the more accurate oxygen consumption techniques. The time to ignition (sustained flaming) is also measured in this test. Test specimen mass loss can also be measured optionally.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 13943, *Fire safety — Vocabulary*

ISO 14934-3, *Fire tests — Calibration and use of heat flux meters — Part 3: Secondary calibration method*

3 Terms and definitions

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

3.1

essentially flat surface

surface whose irregularity from a plane does not exceed ± 1 mm

3.2

ignition

onset of *sustained flaming* (3.7)

3.3

material

single substance or uniformly dispersed mixture, for example, metal, stone, timber, concrete, mineral fibre, or polymer

3.4

orientation

plane in which the exposed face of the specimen is located during testing either vertical or horizontal face upwards

3.5

product

material, composite or assembly, about which information is required

3.6

test specimen

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

Note 1 to entry: The test specimen may include an air gap.

**3.7
sustained flaming**

existence of flame on or over the surface of the specimen for a period of over 10 s

**3.8
transitory flaming**

existence of flame on or over the surface of the specimen for a period of between 1 s and 10 s

4 Symbols

t_{ig} time to ignition (onset of sustained flaming), expressed in seconds (s)

\dot{q}''_{180} heat release rate per unit area at 180 s after ignition, expressed in kilowatts (kW/m²)

\dot{q}''_{300} heat release rate per unit area at 300 s after ignition, expressed in kilowatts (kW/m²)

\dot{q}''_{max} maximum heat release rate per unit area, expressed in kilowatts (kW/m²)

5 Principle

The heat release rate is assessed by measurement of the output of a thermopile located in a chimney situated above a burning test specimen that is subjected to a known heat flux from a conical heater. The output (in mV) which represents temperature (in °C) is converted into heat release rate per unit area (in kW/m²) by use of a calibration graph obtained previously by burning methane gas of known calorific value in the same apparatus. The specimen mass loss rate during the test can also be measured by continuously recording the specimen load cell output.

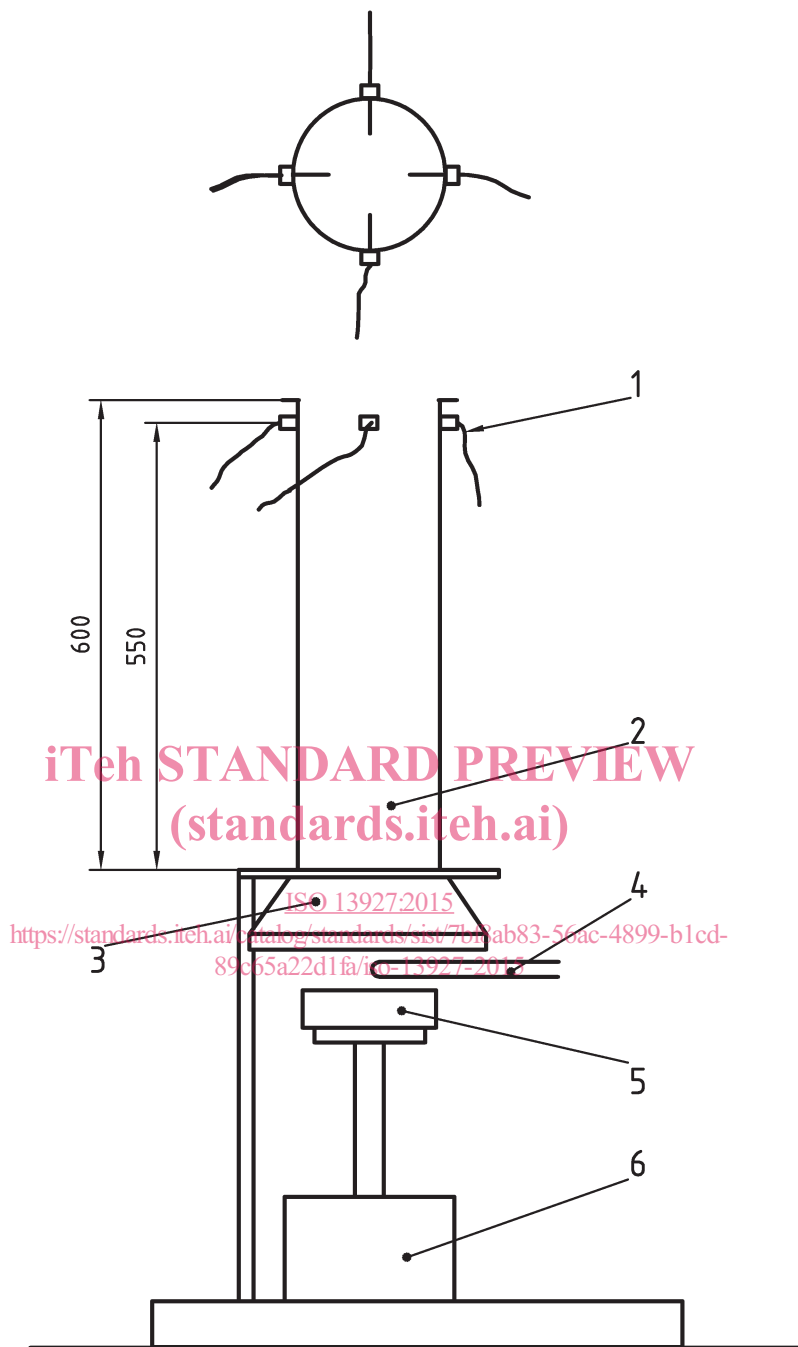
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6 Apparatus

6.1 General

The test apparatus shall consist essentially of the following components: a cone-shaped radiant heater, a chimney housing a thermopile, a load cell, a specimen holder, and a fume extraction system. A schematic representation of the assembly is given in [Figure 1](#). The individual components are described below.

Untoleranced dimensions are recommended values, but should be followed closely.



Key

- 1 thermopile
- 2 chimney
- 3 cone heater
- 4 spark igniter
- 5 specimen
- 6 load cell (optional)

Figure 1 — Schematic drawing of apparatus

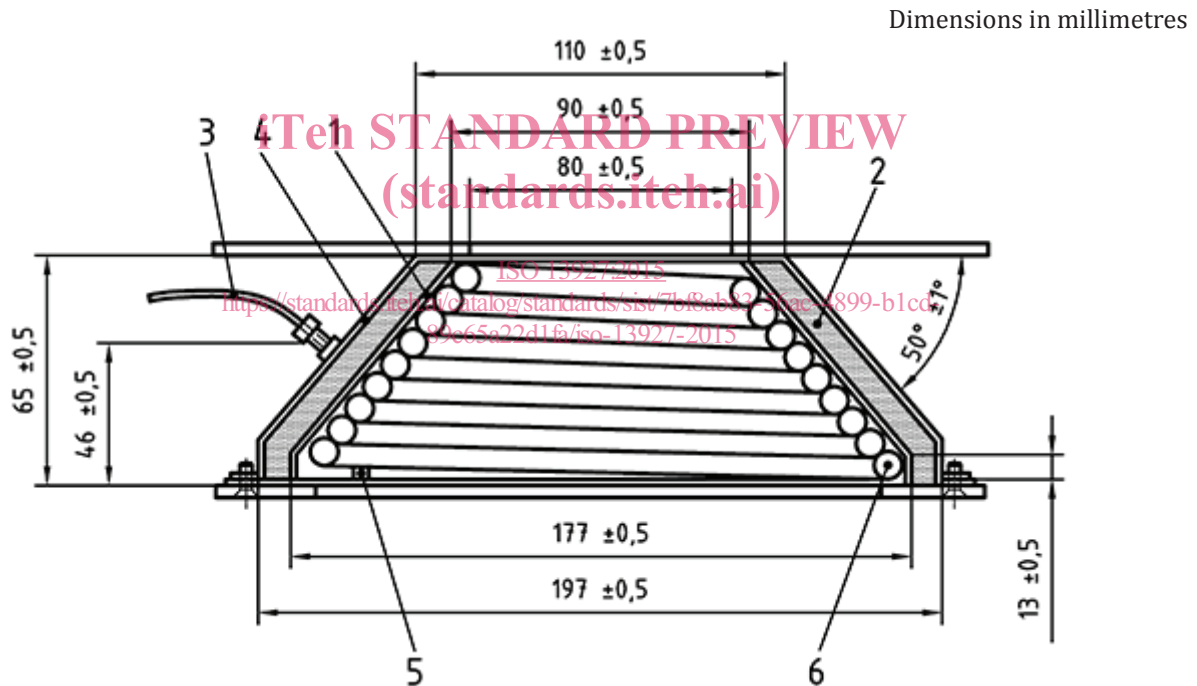
6.2 Cone-shaped radiant electrical heater

The active element of the heater shall consist of an electrical heater rod, capable of delivering 5 000 W at the operating voltage, tightly wound into the shape of a truncated cone (see Figure 2). The heater shall be encased on the outside with a double-walled, stainless-steel cone filled between the walls with a refractory blanket of nominal thickness 13 mm and nominal density 100 kg/m³. The heat flux from the heater shall be maintained at a pre-set level by controlling the average temperature of three type K sheathed stainless-steel thermocouples symmetrically disposed and in contact with, but not welded to the heater element (see Figure 2). 1,0 mm to 1,6 mm outside diameter sheathed (unearthed) thermocouples with an unexposed hot junction may be used. The heater shall be capable of producing heat fluxes on the surface of the specimen of up to 75 kW/m². The heat flux shall be uniform within the central 50 mm × 50 mm area of the exposed specimen surface to within ±2 % for an irradiance of 50 kW/m².

The cone heater shall be provided with a removable radiation shield to protect immediately the specimen from heat prior to the start of the test.

6.3 Heat flux controller

The heat flux control system shall maintain the average temperature of the heater element steady to within ±2 °C.



Key

- 1 inner shell
- 2 refractory-fibre packing
- 3 thermocouple
- 4 outer shell
- 5 spacer block
- 6 heating element

Figure 2 — Cross-sectional view through heater

6.4 Thermopile and housing

A circular cross-section chimney 600 mm \pm 2 mm long and 115 mm \pm 2 mm internal diameter constructed from 1-mm-thick stainless steel shall be used to house the thermopile. This shall be fixed on top of the top-plate of the cone heater. The axis of the chimney shall coincide with the axis of the cone heater. The thermopile shall then consist of four 1,6 mm \pm 0,2 mm outside diameter type K sheathed thermocouples. The thermocouples shall be housed within the chimney at a height of 550 mm above the cone top-plate and the chimney penetration points shall be equally distributed about the circumference of the chimney. The tips of the thermocouples shall be fixed 17 mm from the centreline of the chimney. The four thermocouples shall be connected in series and the two ends shall be connected to the data collection system.

An additional set of thermocouples shall be housed 275 mm above the cone top-plate and the chimney penetration points are equally distributed across, about the circumference of the chimney. The tips of the thermocouples are fixed 17 mm from the centreline of the chimney. The output from this set of thermocouples is used for assessing the heat release from the low heat release specimens.

6.5 Specimen holder

The specimen holder is shown in [Figure 3](#).

The specimen holder shall have the shape of a square pan with an opening of (106 \pm 1) mm \times (106 \pm 1) mm and a depth of 25 mm. The holder shall be constructed from stainless steel with a thickness of (2,4 \pm 0,15) mm. It shall include a handle to facilitate insertion and removal and a mechanism to ensure central location of the specimen under the heater and proper alignment with the weighing device. The distance between the bottom surface of the cone heater and the top of the specimen shall be adjusted to 25 mm, except when testing dimensionally unstable materials, in which case, the distance shall be adjusted to 60 mm \pm 1 mm. All tests shall be conducted with the retainer frame shown in [Figure 4](#). Details of specimen and specimen holder preparation are given in [8.3](#).

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