INTERNATIONAL STANDARD

ISO 13927

First edition
2001-04-01

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

Reference number
ISO 13927:2001(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

Contents

Page

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

International Standard ISO 13927 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 4, *Burning behaviour*.

Annex A forms a normative part of this International Standard. Annexes B and C are for information only.

Introduction

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 (see also ISO/TR 6585 and ISO/IEC 13943).

A test such as is 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 behaviour or safety in fire. A test of this type may, 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 warnings that immediately precede clause 10.

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

1 Scope

This International Standard specifies a method suitable for 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 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 may optionally also be measured.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard 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 291:1997, *Plastics — Standard atmospheres for conditioning and testing*.

ISO/IEC 13943:2000, *Fire safety — Vocabulary*.

3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO/IEC 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 as defined in 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 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/m^2)

$\dot{q}''_{300}$ heat release rate per unit area at 300 s after ignition, expressed in kilowatts (kW/m^2)

$\dot{q}''_{max}$ maximum heat release rate per unit area, expressed in kilowatts (kW/m^2)

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) is converted into heat release rate per unit area (in kW/m^2) 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.

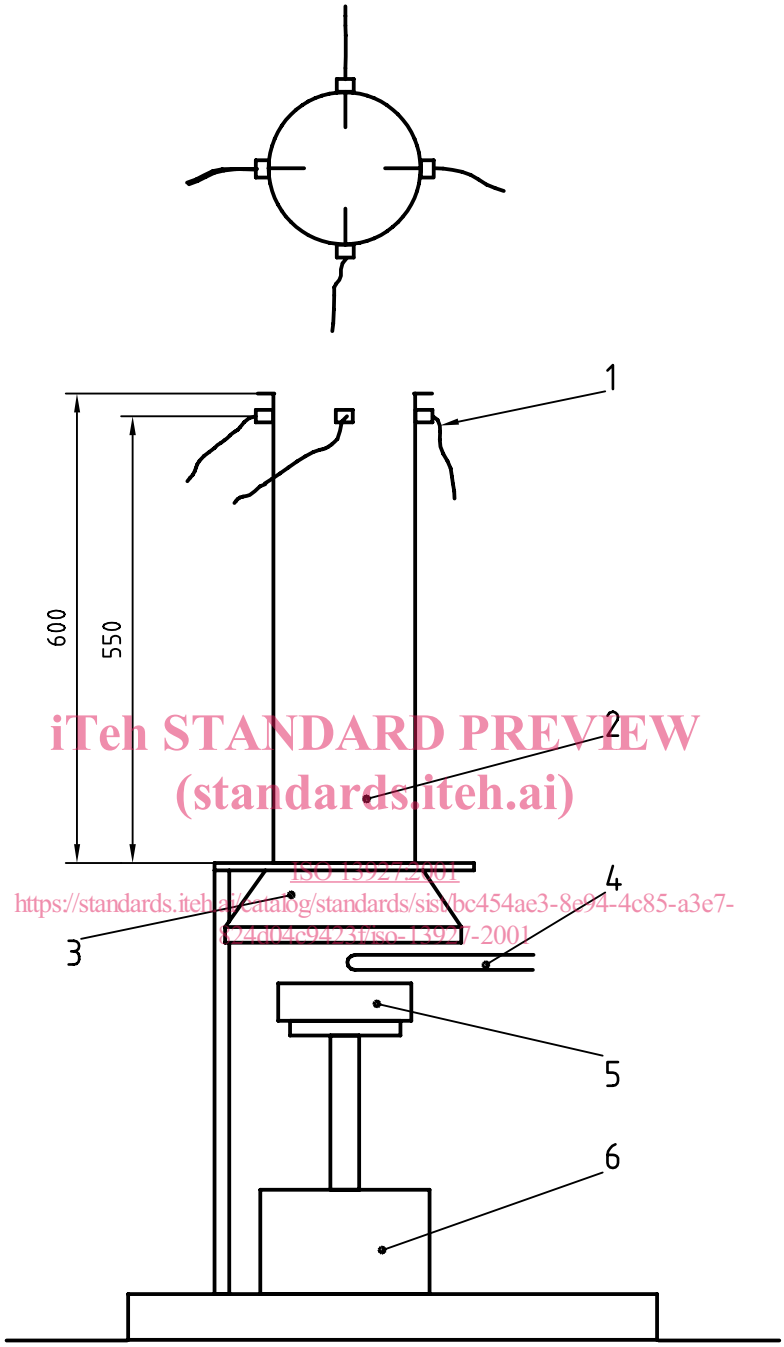
6 Apparatus

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.

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

Dimensions in millimetres



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

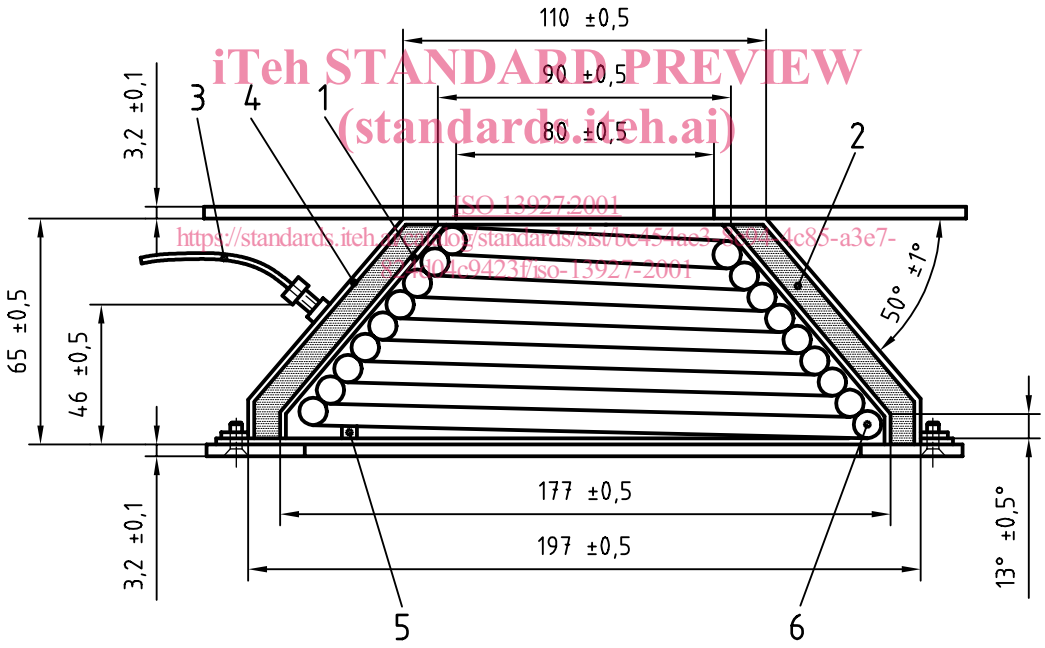
The active element of the heater shall consist of an electrical heater rod, capable of delivering 5 000 W at the operating voltage, tightly wound into the shape of a truncated cone (see Figure 2). The heater shall be encased on the outside with a double-walled stainless-steel cone, filled between the walls with a refractory blanket of nominal thickness 13 mm and nominal density 100 kg/m^3. The heat flux from the heater shall be maintained at a preset 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 100 kW/m^2. The heat flux shall be uniform within the central 50 mm × 50 mm area of the exposed specimen surface, to within ± 2 %.

The cone heater may be provided with a removable radiation shield to protect the specimen from heat immediately 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.

Dimensions in millimetres



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 long and 115 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 consist of four 1,6 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.

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 mm × 106 mm at the top, and a depth of 25 mm. The holder shall be constructed from stainless steel with a thickness of 2,15 mm ± 0,25 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 be 25 mm except when testing dimensionally unstable materials in which case the distance shall be adjusted to 60 mm ± 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.

Dimensions in millimetres

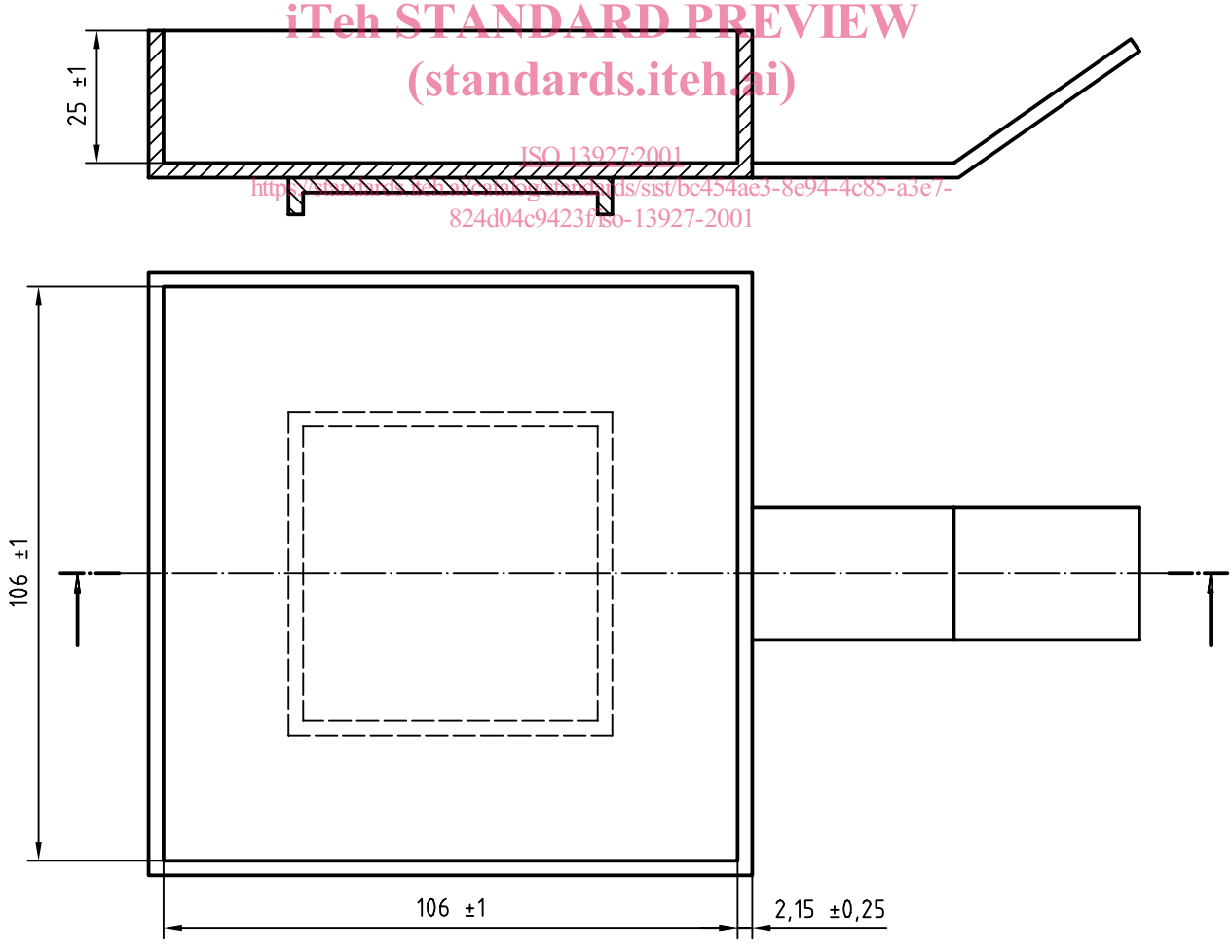


Figure 3 — Specimen holder