INTERNATIONAL STANDARD

ISO 17554

Second edition
2014-12-15

Reaction to fire tests — Mass loss measurement

Essais de réaction au feu — Mesurage de la perte de masse

Reference number
ISO 17554:2014(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.org
Web www.iso.org

Published 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.

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 92, *Fire safety*, Subcommittee SC 1, *Fire initiation and growth*.

This second edition cancels and replaces the first edition (ISO 17554:2005), which has been technically revised.

Reaction to fire tests — Mass loss measurement

1 Scope

This International Standard specifies a small-scale method for assessing the mass loss rate of essentially flat specimens exposed in the horizontal orientation to controlled levels of radiant heating with an external igniter under well-ventilated conditions. The mass loss rate is determined by measurement of the specimen mass and is derived numerically. The time to ignition (sustained flaming) is also measured in this test. Mass loss rate can be used as an indirect measure of heat release rate for many products. However, this is not an apparatus for determining heat release rates, and the measured mass loss rates for some products are not so closely linked to their heat release rates. Such products need to be tested in accordance with ISO 5660-1 for correct assessment of heat release.

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 5660-1, *Reaction-to-fire tests — Heat release, smoke production and mass loss rate — Part 1: Heat release rate (cone calorimeter method)*

ISO 13943, *Fire safety — Vocabulary*

ISO 14934-3; *Fire tests — Calibration of heat flux meters – Part 3: Secondary calibration method*

ISO 14697:2007, *Reaction-to-fire tests — Guidance on the choice of substrates for building and transport products*

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

3.3
ignition
onset of sustained flaming as defined in 3.9

3.4
irradiance
at a point on a surface quotient of the radiant flux incident on an infinitesimal element of surface containing the point, and the area of that element

Note 1 to entry: Convective heating is negligible in the horizontal specimen orientation. For this reason, the term “irradiance” is used instead of “heat flux” throughout this International Standard, as it best indicates the essentially radiative mode of heat transfer.

3.5
material
single substance or uniformly dispersed mixture

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

3.6
orientation
plane in which the exposed face of the specimen is located during testing, with either the vertical or horizontal face upwards

3.7
product
material, composite, or assembly about which information is required

3.8
specimen
representative piece of the product which is to be tested together with any substrate or treatment

Note 1 to entry: For certain types of product, for example, products that contain an air gap or joints, it is sometimes not possible to prepare specimens that are representative of the end-use conditions (see Clause 7).

3.9
sustained flaming
existence of flame on or over the surface of the specimen for periods of over 10 s

3.10
transitory flaming
existence of flame on or over the surface of the specimen for periods of between 1 s and 10 s

4 Symbols

Symbol	Designation	Unit
A_{s}	initially exposed surface area of the specimen	m^2
m	mass of the specimen	g
m_{I}	mass of the specimen at the start of the test	g
m_{f}	mass of the specimen at the end of the test	g
m_{10}	mass of the specimen at 10 % of total mass loss	g
m_{90}	mass of the specimen at 90 % of total mass loss	g
$\dot{m}$	mass loss rate of the specimen	$g \cdot s^{-1}$
$\dot{m}_{\mathrm{max}}$	maximum value of the mass loss rate	$g \cdot s^{-1}$
$\dot{m}_{A,10-90}$	average mass loss rate per unit area between 10 % and 90 % of mass loss	$g \cdot m^2 \cdot s^{-1}$
m_{10}	mass of the specimen at 10 % of total mass loss	g
m_{90}	mass of the specimen at 10 % of total mass loss	g
$\dot{m}_{180}$	average mass loss rate over the period starting at t_{ig} and ending 180s later	$g \cdot s^{-1}$

Symbol	Designation	Unit
$\dot{m}_{300}$	average mass loss rate over the period starting at t_{ig} and ending 300s later	$g{\cdot}s^{-1}$
t	time	s
t_{ig}	time to ignition (onset of sustained flaming)	s
Δt	sampling time interval	s

5 Principle

The test method is used to assess the mass loss rate that the product undergoes under the test conditions. This rate is determined on small representative specimens burning in a well-ventilated environment.

6 Apparatus

6.1 General

The test apparatus shall consist essentially of the following components:

6.1.1 Cone-shaped radiant electrical heater.

6.1.2 Weighing device for measuring specimen mass.

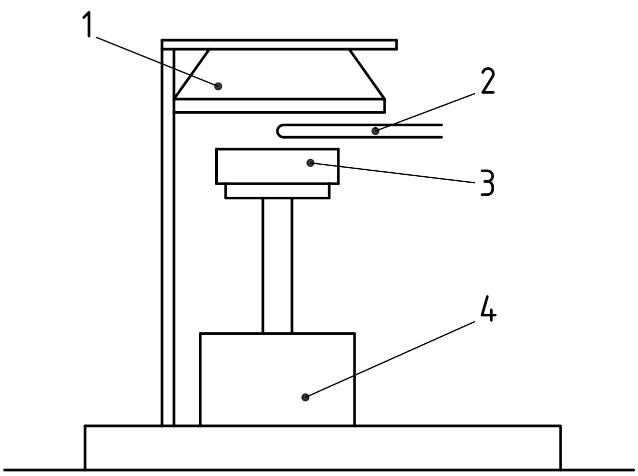
6.1.3 Specimen holder.

6.1.4 Spark ignition circuit.

6.1.5 Heat flux meters.

6.1.6 Data collection and analysis system.

A schematic representing the assembly is given in Figure 1. The apparatus should be located under a suitable exhaust system with a flow rate of less than 0,025$m^3{\cdot}s^{-1}$. The individual components are described in detail in the following sections.



Key

1 cone heater

2 spark igniter

3 specimen

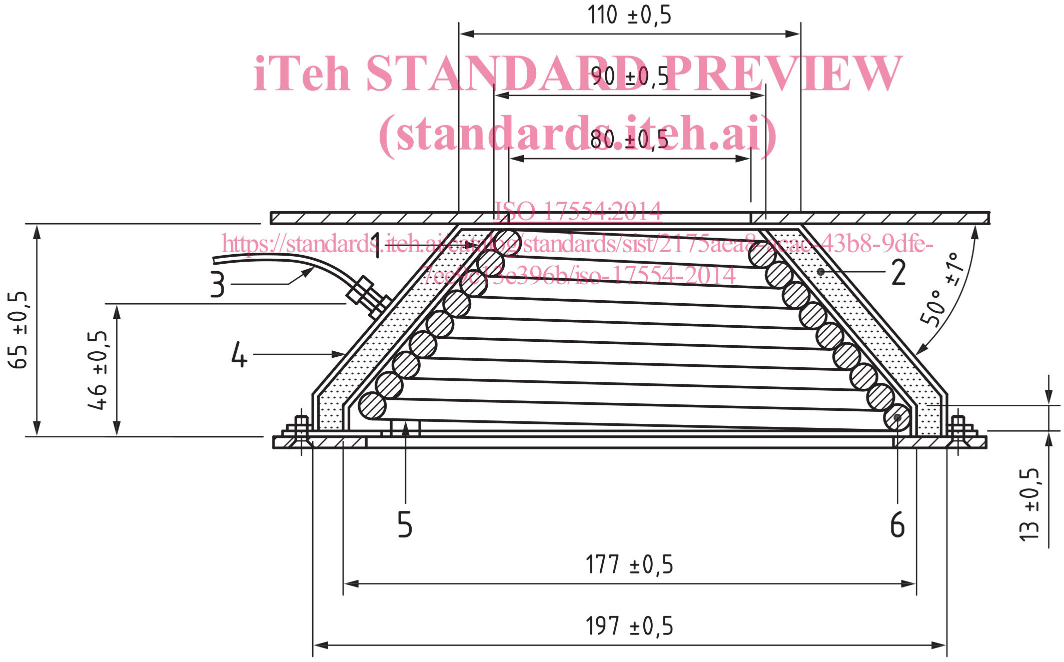
4 load cell

Figure 1 — Schematic 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-wall stainless steel cone, filled with a ceramic fibre blanket of nominal thickness 13 mm and nominal density 100 kg·m^{-3}. The irradiance from the heater shall be maintained at a preset level by controlling the average temperature of three thermocouples, (type K, stainless-steel sheathed thermocouples, have proved suitable, but Inconel[1)] or other high-performance materials are also acceptable) symmetrically disposed and in contact with, but not welded to, the heater element (see Figure 2). Either 3,0 mm outside-diameter sheathed thermocouples with an exposed hot junction or 1,0 mm to 1,6 mm outside-diameter sheathed thermocouples with an unexposed hot junction shall be used. The heater shall be capable of producing irradiances on the surface of the specimen of up to 75 kW·m^{-2}. The irradiance 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·m^{-2}.

Dimensions in millimetres



Key

1 inner shell

2 ceramic fibre packing

3 thermocouple

4 outer shell

5 spacer block

6 heating element

Figure 2 — Conical heater assembly

1) Iconel is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of thisproduct.

6.3 Radiation shield

The cone heater shall be provided with a removable radiation shield to protect the specimen from the irradiance prior to the start of a test. The shield shall be made of non-combustible material, with a total thickness not exceeding 12 mm. The shield shall be one of the following:

— water cooled and coated with a durable matt black finish of surface emissivity $\varepsilon = 0,95 \pm 0,05$;

— not water-cooled, which may be either metal with a reflective top surface or metal with a ceramic top surface, or ceramic, in order to minimize radiation transfer.

The shield shall be equipped with a handle or other suitable means for quick insertion and removal. The cone heater base plate shall be equipped with a mechanism for introducing the shield into position.

6.4 Irradiance control

The irradiance control system shall be properly tuned so that it maintains the average temperature of the heater thermocouples during the calibration described in 10.1.1 at the preset level to within ±10°C.

6.5 Weighing device

The weighing device shall have a resolution of ± 0,1 g and an accuracy of ± 0,3 g or better, measured according to the calibration procedure described in 10.2.1. The weighing device shall be capable of measuring the mass of specimens of at least 500 g. The weighing device shall have a 10 % to 90 % response time of 1 s to 4 s as determined according to the calibration described in 10.1.2. The output of the weighing device shall not drift by more than 1 g over a 30 min period, as determined with the calibration described in 10.1.3.

6.6 Specimen holder and retainer frame

6.6.1 The specimen holder is shown in Figure 3. The specimen holder shall have the shape of a square pan with an opening of (106 ± 1) mm × (106 ± 1) mm at the top, and a depth of (25 ± 1) mm. The holder shall be constructed of stainless steel with a thickness of (2,4 ± 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 bottom of the holder shall be lined with a layer of low-density (nominal density 65kg·m^{-3}) ceramic fibre blanket with a thickness of at least 13 mm. The distance between the bottom surface of the cone heater and the top of the specimen shall be adjusted to be (25 ± 1) mm except when testing dimensionally unstable materials for which the distance is (60 ± 1) mm (7.5).

