INTERNATIONAL STANDARD

ISO 13927

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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.

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.

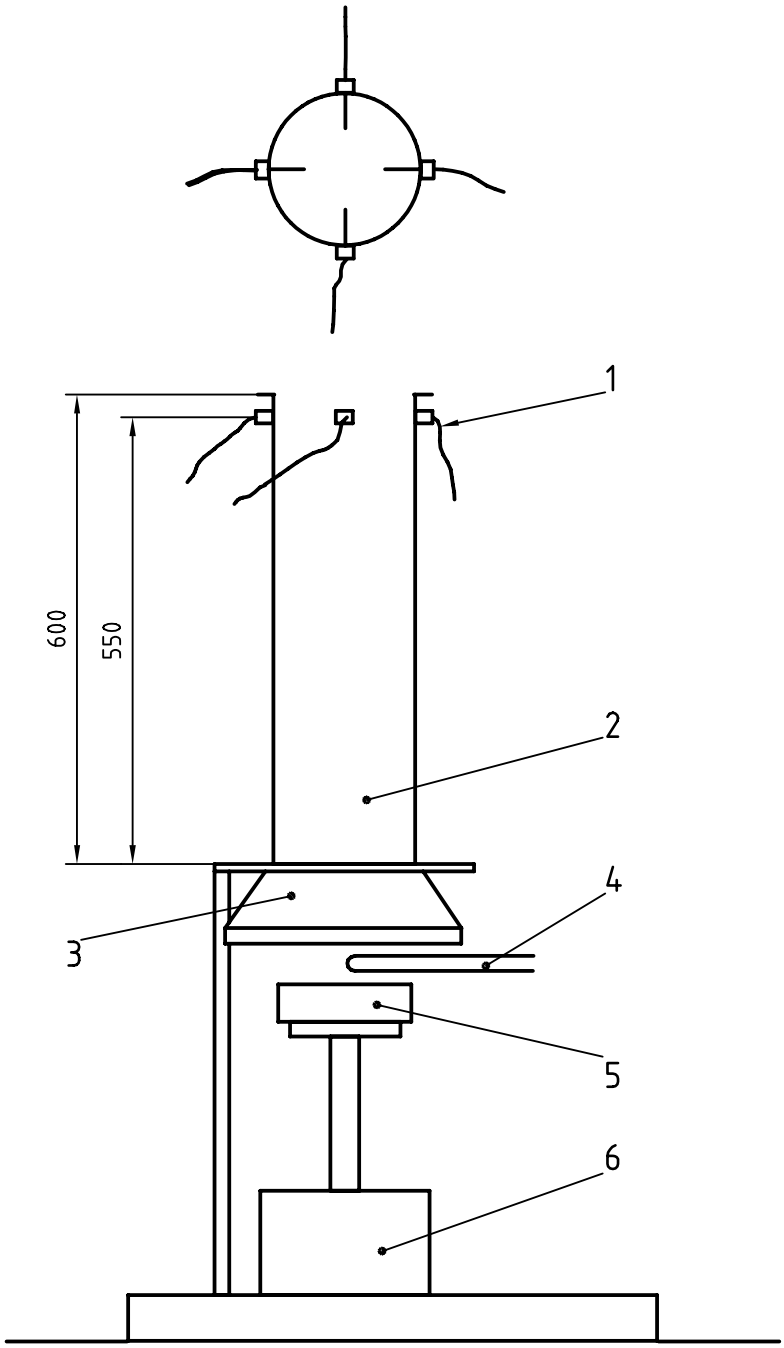
6 Apparatus

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

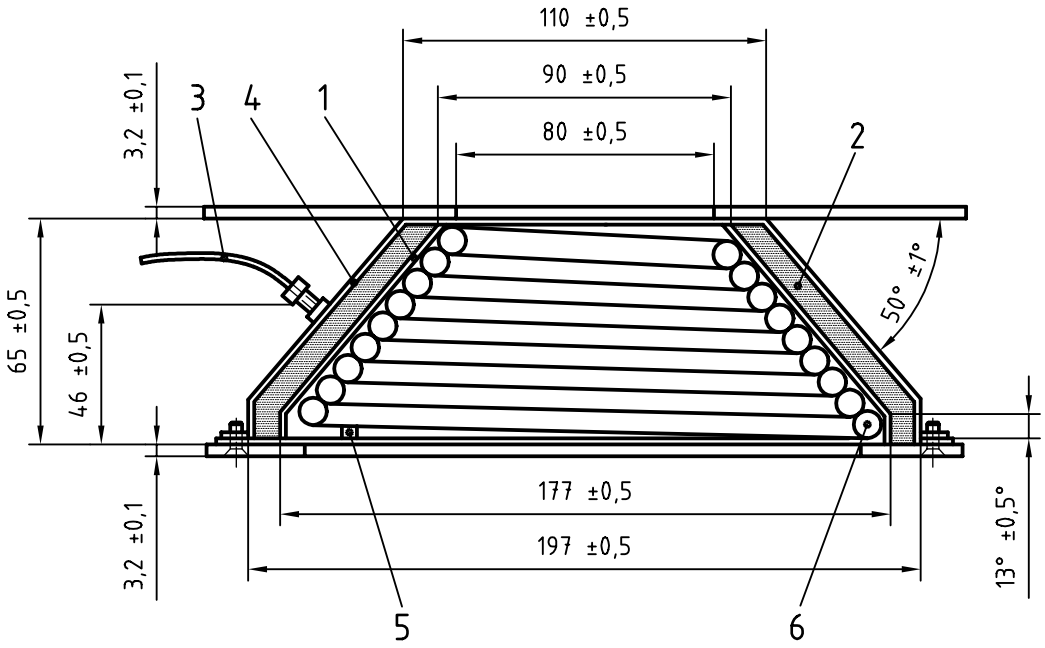
The active element of the heater shall consist of an electrical heater rod, capable of delivering 5 000 W at the operating voltage, tightly wound into the shape of a truncated cone (see Figure 2). The heater shall be encased on the outside with a double-walled stainless-steel cone, filled between the 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 $\times$ 50 mm area of the exposed specimen surface, to within $\pm$ 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 $\pm$ 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

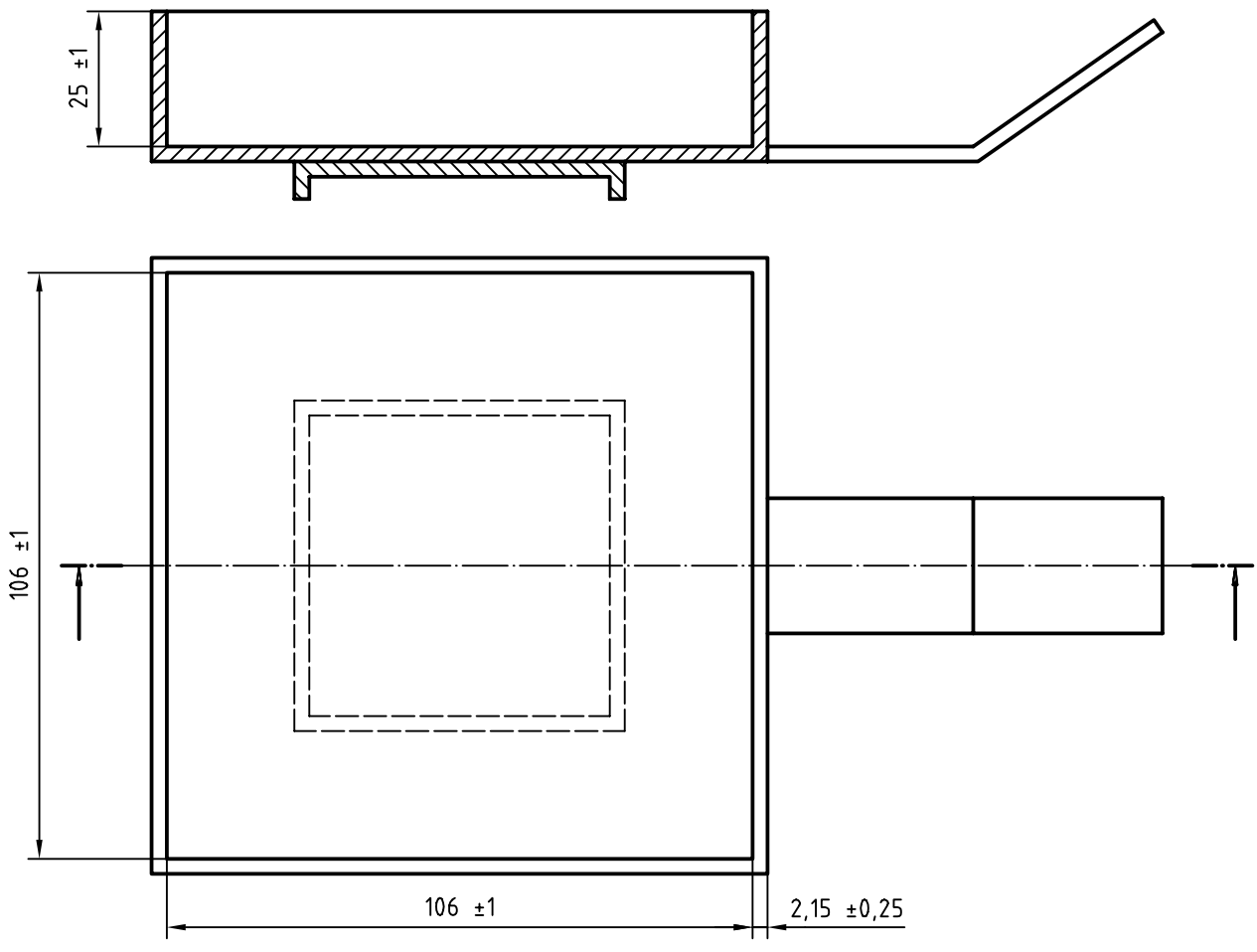


Figure 3 — Specimen holder

Dimensions in millimetres

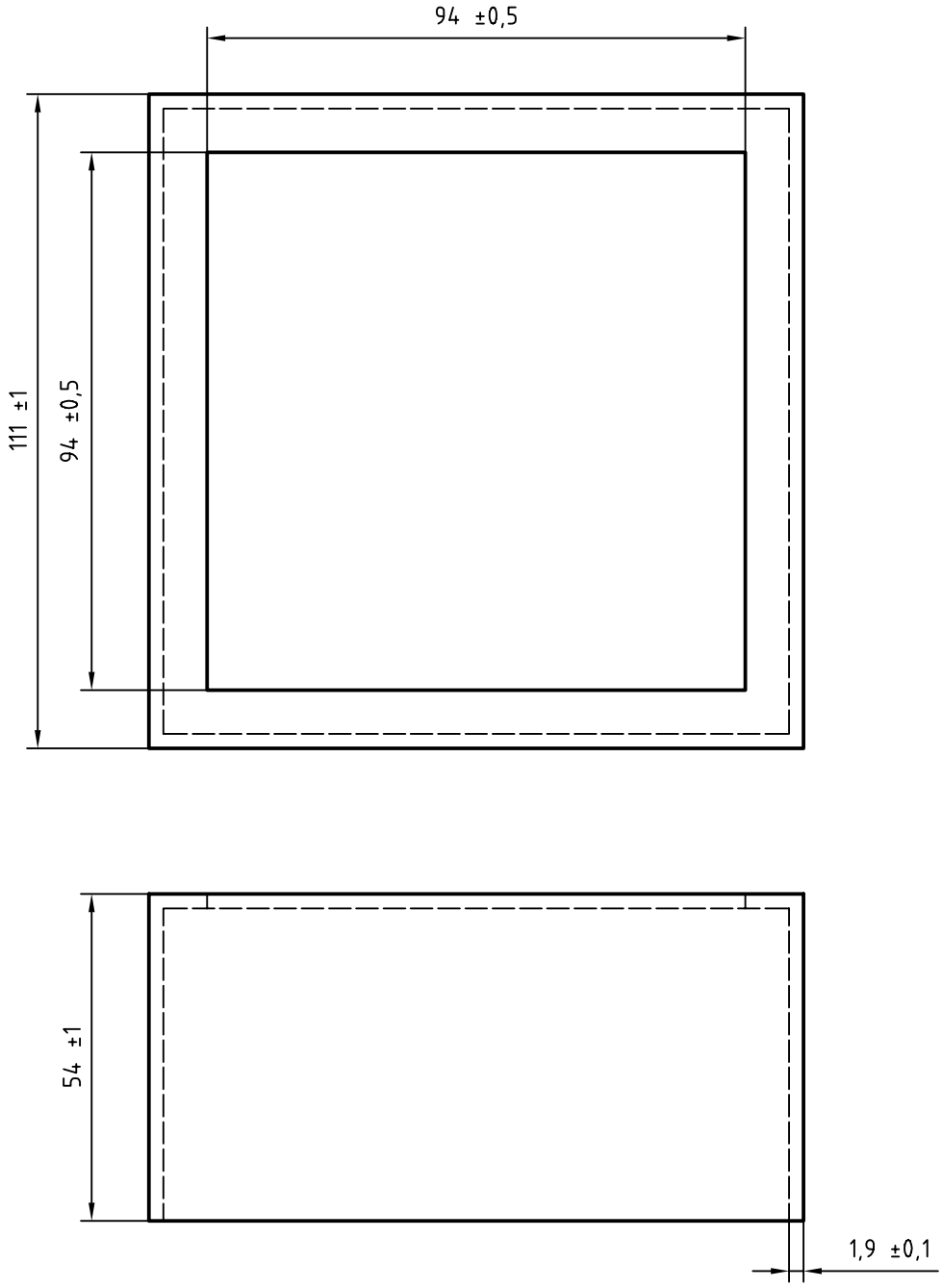


Figure 4 — Retainer frame

6.6 Fume extraction system

The apparatus shall be used under a hood or in a fume cupboard, with adequate ventilation to remove safely combustion products from the laboratory.

6.7 Ignition circuit

Specimen ignition shall be accomplished by a spark plug powered by a 10 kV transformer or a 10 kV spark generator capable of continuous sparking. The spark electrodes shall have a gap of 3 mm. If a transformer is used it shall be of a type specifically designed for spark ignition use. The transformer shall have an isolated (unearthed) secondary to minimize interference with the data-transmission lines. The electrode length and location of the spark plug shall be such that the spark gap is located 13 mm above the centre of the specimen in the horizontal orientation.

6.8 Ignition timer

The timer shall be capable of recording elapsed time to the nearest second and accurate to within 1 s in 1 h.

6.9 Heat flux meter

The heat flux meter shall be of the Schmidt-Boelter (thermopile) type with a design range of up to about 100 kW/m^2. The target receiving radiation, and possibly to a small extent convection, shall be flat, circular, of approximately 12,5 mm in diameter and coated with a durable matt-black finish. The target shall be water-cooled but care shall be taken that this does not cause water condensation on the target surface of the meter.

Radiation shall not pass through any window before reaching the target. The instrument shall be robust, simple to set up and use, and stable in calibration. The instrument shall have an accuracy of within ± 3 % and a repeatability of within 0,5 %.

The calibration of the heat flux meter shall be checked, whenever re-calibration of the apparatus is carried out, as described in annex A.

6.10 Calibration burner

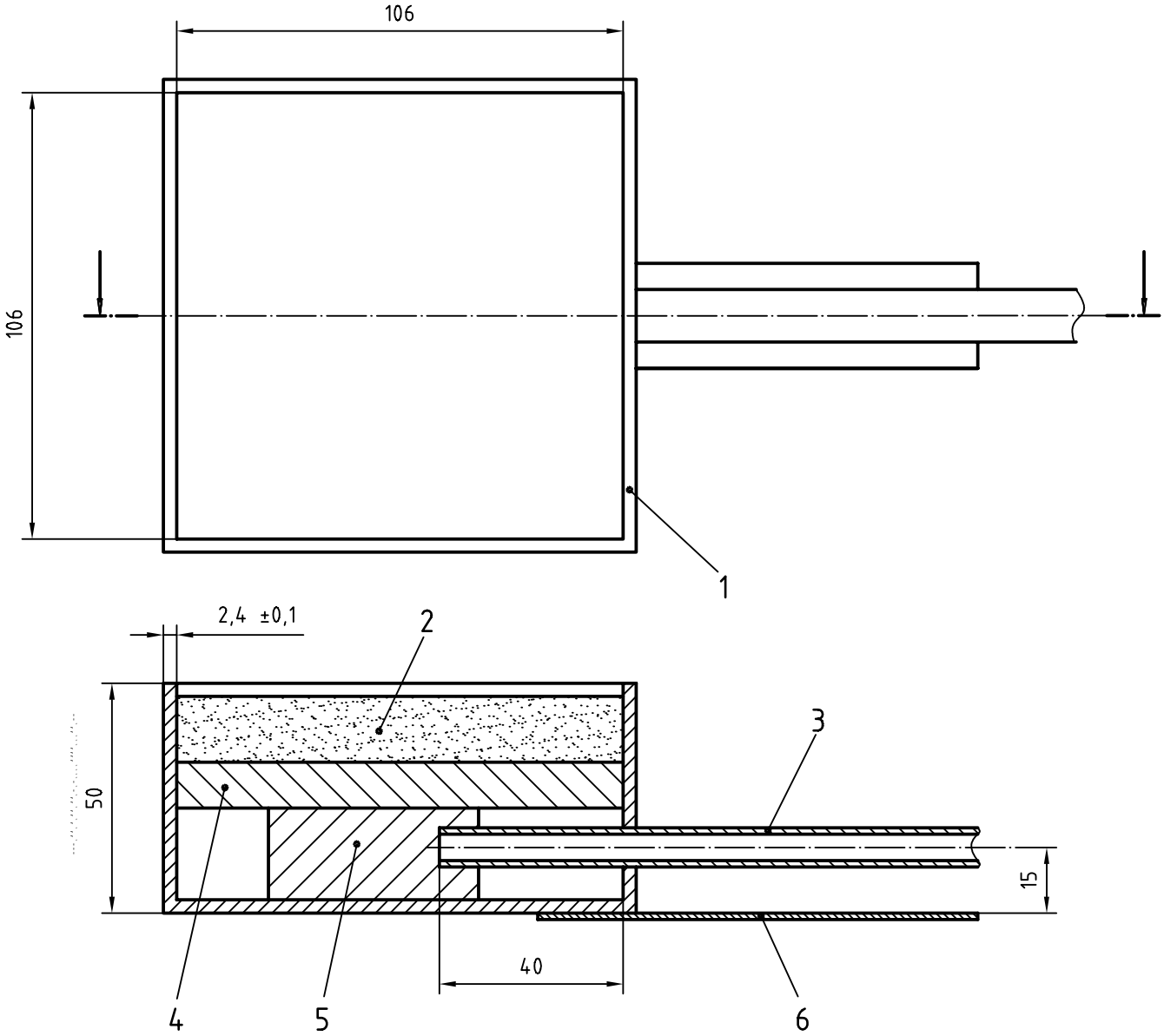
The calibration burner shall consist of a square pan with a top opening of 106 mm by 106 mm, constructed from stainless steel of thickness 2,4 mm ± 0,1 mm and filled with sand. The burner shall have a handle to facilitate insertion and removal and a mechanism to ensure central location of the burner under the heater and proper alignment with the weighing device. The burner shall be designed so that a metered supply of methane of at least 99,5 % purity can be introduced through a tube in the side wall as shown in Figure 5. The flowmeter used to monitor the methane flow may be a rotameter, a dry-test meter, a wet-test meter or an electronic mass flow controller.

The distance between the bottom surface of the cone heater and the top of the calibration burner shall be adjusted to be 25 mm.

6.11 Data-collection system

This system shall record the output from thermopile and (optionally) the load cell. It shall have an accuracy of 0,01 % of the full-scale output of the load cell (if used) and shall be capable of recording data every 5 s or less for at least 1 h and measuring temperature to a resolution of 0,5 °C.

Dimensions in millimetres



Key

1 Square stainless-steel, pan
2 Sand, grain size approximately 1 mm to 2 mm
3 Tube, inner diameter 8 mm
4 Ceramic-fibre blanket, (106 × 106 × 12) mm, density approximately 100 kg/m^3
5 Ceramic-fibre blanket, (50 × 50 × 22) mm, density approximately 100 kg/m^3
6 Handle

Figure 5 — Typical calibration burner design

7 Suitability of a product for testing

7.1 Surface characteristics

A product having one of the following properties is suitable for testing:

a) an essentially flat exposed surface;

b) an irregular surface whose irregularity is evenly distributed over the exposed surface provided that

   1) at least 50 % of the surface of a representative 100-mm-square area lies within a depth of 10 mm from a plane taken across the highest points on the exposed surface, or

   2) for surfaces containing cracks, fissures or holes not exceeding 8 mm in width or 10 mm in depth, the total area of such cracks, fissures or holes at the surface does not exceed 30 % of a representative 100-mm-square area of the exposed surface.

When an exposed surface does not meet the requirements of either a) or b) above, the product shall be tested in a modified form conforming as nearly as possible to the requirements given above. The test report shall state that the product has been tested in a modified form and clearly describe the modification.

7.2 Asymmetrical products

A product submitted for this test can have faces which differ or can contain laminations of different materials arranged in a different order in relation to the two faces. If either of the faces can be exposed in use within a room, cavity or void, then both faces shall be tested.

7.3 Thin materials

This test method can prove unsuitable for excessively thin products since insufficient data will be collected for the calculation of mass loss rates (optional) or thermopile output. For some materials, reducing the data-collection interval on any logging system used to 1 s or increasing chart recorder speeds may help to generate more data.

7.4 Composite specimens

Composite specimens may be tested, provided they are prepared as specified in 8.3.

7.5 Dimensionally unstable materials

This test method may prove unsuitable for materials that change their dimensions substantially when exposed to the cone heater radiation, for example materials that intumesce or shrink away from the cone radiator, because the heat flux on the surface of the specimen at the time of ignition can differ significantly from that set initially.

Specimens that intumesce may be tested by increasing the separation between the bottom side of the cone heater and the specimen surface to 60 mm to accommodate the intumescence. Calibrate the heater at this new separation. Specimens that intumesce so much that, when tested at this increased range, they still contact the spark plug or the underside of the cone heater prior to ignition cannot be readily tested by this method.

8 Specimen construction and preparation

8.1 Specimens

8.1.1 Unless otherwise specified, three specimens shall be tested at each level of heat flux selected and for each different exposed surface.

8.1.2 The specimens shall be representative of the product and shall be square with sides measuring 100 mm ± 2 mm.

8.1.3 Products with a normal thickness of 50 mm or less shall be tested using their full thickness.

8.1.4 For products with a normal thickness of greater than 50 mm, the requisite specimens shall be obtained by cutting away the unexposed face to reduce the thickness to $(50\ ^{0}_{-3})$ mm.

8.1.5 When cutting specimens from products with irregular surfaces, the highest point on the surface shall be arranged to occur at the centre of the specimen.

8.1.6 Assemblies shall be tested as specified in 8.1.3 or 8.1.4 as appropriate.

NOTE Where thin materials or composites are used in the fabrication of an assembly, the presence of air or an air gap or the nature of any underlying construction can significantly affect the ignition and burning characteristics of the exposed surface. It is important that the influence of the underlying layers be understood and care taken to ensure that the test result obtained on any assembly is relevant to its use in practice.

When the product is a material or composite that would normally be attached to a well defined substrate, it shall be tested in conjunction with that substrate using the recommended fixing technique, for example bonded with the appropriate adhesive or fixed mechanically.

8.1.7 Products that are thinner than 6 mm shall be tested with a substrate representative of end-use conditions, such that the total specimen thickness is 6 mm or more. In the case of specimens of less than 6 mm thickness that would be used with an air space adjacent to the unexposed face, the specimens shall be mounted so that there is an air space of at least 12 mm between the unexposed face and the refractory-fibre blanket.

NOTE This can be achieved by the use of a metal spacer frame.

8.2 Conditioning of specimens

Before the test, specimens shall be conditioned to constant mass at a temperature of 23 °C ± 2 °C and a relative humidity of (50 ± 5) % in accordance with ISO 291.

NOTE Constant mass is considered to be reached 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 test piece or 0,1 g, whichever is the greater.

Materials such as polyamide, which require more than 1 week of conditioning to reach equilibrium, shall be conditioned at a temperature of 23 °C ± 2 °C and a relative humidity of (50 ± 5) % for not less than 1 week and the length of the conditioning period shall be stated in the test report.

8.3 Preparation

8.3.1 Specimen wrapping

A conditioned specimen shall be wrapped in a single layer of aluminium foil, of 0,03 mm to 0,05 mm thickness, with the shiny side of the foil towards the specimen, covering the unexposed surfaces. Composite specimens shall be exposed in a manner typical of the end-use condition [for example, if used with an air gap (see 8.1.6), an air gap shall be included behind the specimen, within the aluminium foil].

8.3.2 Specimen preparation

All test specimens shall be tested with the retainer frame shown in Figure 4. The following steps shall be taken to prepare the specimen for testing:

a) put the retainer frame on a flat surface facing downwards;

b) insert a foil-wrapped specimen in the frame with the exposed surface facing down;

c) put layers of ceramic-fibre blanket (nominal thickness 13 mm) on top of the specimen until two layers extend above the rim of the frame;

d) fit the specimen holder into the frame on top of the ceramic fibre and press down;

e) tighten the screw through the bottom of the frame and turn the assembly around.

9 Calibration

9.1 Heater calibration

Adjust the temperature controller so that the cone heater produces the required heat flux, as measured by the heat flux meter, at the start of each test day or when changing to a new heat flux.

No specimen or specimen holder shall be used when the heat flux meter is inserted into the calibration position. Operate the cone heater for at least 10 min and ensure that the temperature controller is within its proportional band before beginning this calibration.

9.2 Thermopile calibration

9.2.1 General

The thermopile shall be calibrated initially at each test heat flux using the procedure given in 9.2.2. Thereafter, it shall be checked at the operating heat flux before each day's work.

9.2.2 Initial calibration

The calibration burner described in 6.10 and either a data-logging system or a chart recorder shall be used for recording the thermopile output. The calibration shall be undertaken at each heat flux level used for testing. Set the radiators at the set heat flux and allow the system to stabilize. Place the calibration burner in position and introduce methane at a flow rate corresponding to 5 kW based on the net heat of combustion of methane ($50{,}0 \times 10^3$ kJ/kg) using a pre-calibrated flowmeter. Record the stabilized output from the thermopile and repeat the above procedure for methane flow rates equivalent to 4 kW, 3 kW, 2 kW, 1 kW, 0,75 kW, 0,5 kW and 0,25 kW. Plot a calibration graph of thermopile output versus heat input from Table 1.

Table 1 — Methane flow rate calibration

Heat release rate kW	**Methane flow rate** l/min
0,25	0,42
0,50	0,83
0,75	1,26
1,00	1,68
2,00	3,35
3,00	5,03
4,00	6,70

9.2.3 Daily calibration

At the beginning of each working day or when the operating heat flux is changed, the thermopile output shall be checked with a methane flow rate corresponding to 3 kW. If this lies within ± 5 % of that shown in the initial calibration, testing can proceed. If it does not, the thermopile shall be checked for correct positioning, and if this is not in error then the system shall be recalibrated in accordance with 9.2.2. If the thermopile is not correctly positioned, reposition and recalibrate.

10 Test procedure

WARNING — So that suitable precautions are 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 test procedures involve high temperatures and combustion processes. Therefore, hazards can exist for burns, ignition of extraneous objects or clothing. The operator shall use protective gloves for insertion and removal of test specimens. Neither the cone heater nor the associated fixtures shall be touched while hot except with the use of protective gloves. Care shall be taken never to touch the spark igniter which carries a substantial potential (10 kV). The apparatus shall be placed under a suitable fume extraction system. This extraction system shall be checked for proper operation before testing and shall discharge into a building extraction system with adequate capacity. The possibility of the violent ejection of hot, molten material or sharp fragments from some kinds of specimen when irradiated cannot be totally discounted, and it is therefore essential that eye protection be worn.

10.1 Initial preparation

10.1.1 Turn on the power to the cone heater and the extractor fan.

Do not turn the power to the load cell on and off on a daily basis.

10.1.2 Perform the calibration procedure specified in 9.2.3.

If a load cell is used, put a thermal screen on top of the cell (an empty specimen holder with refractory blanket may be used during warm-up and between tests to avoid excessive heat transmission to the load cell).

10.1.3 Position the spark igniter in the correct location.

10.2 Procedure

10.2.1 When ready to test, remove the empty specimen holder if one has been placed on top of the load cell (see 10.1.2).

10.2.2 Place the specimen in position and start the collection of mass loss (optional) and thermopile output data (the holder shall be at room temperature initially). If a computerized data-collection system is used, the data-collection intervals shall be 5 s or less.

10.2.3 Move the spark plug into place, turn on the power so that the spark plug is sparking continuously and at the same time start the ignition timer.

10.2.4 Record the time at which flashing or transitory flaming occurs. If sustained flaming occurs, record the time and remove the spark igniter. If the flames go out less than 15 min after t_{ig}, re-insert the spark igniter within 5 s of extinguishment and turn on the spark. Leave the spark igniter in position until sustained flaming resumes or until the 15 min post-t_{ig} period has elapsed. Report all these events in the test report.

10.2.5 Collect all thermopile and (optionally) mass loss data

a) either until 2 min after flaming or other signs of combustion have ceased;

b) or, if the specimen does not ignite, until 10 min have elapsed (in this case, remove and discard the specimen unless it is showing signs of heat evolution);

whichever occurs first. Observe and record physical changes to the specimen, such as melting, swelling and cracking.

10.2.6 Remove the specimen and specimen holder.

10.2.7 Replace with an empty specimen holder.

10.2.8 Test three specimens in this way and report as described in clause 12.

10.2.9 Use the calibration graph of heat release against thermopile output, produced as described in 9.2.2, to calculate all heat release data quoted in the test report.

NOTE The test data have limited validity if the specimen melts sufficiently to overflow from the specimen holder, if explosive spalling occurs, or if the specimen swells excessively and touches the spark igniter or the heater baseplate.

11 Precision

The precision of this test method is not known because interlaboratory data are not available. Interlaboratory data are being obtained and a precision statement will be added with the next revision.

12 Test report

The test report shall be as comprehensive as possible and shall include any observations made during the test and comments on any difficulties experienced during testing. The units for all measurements shall be clearly stated in the test report.

The following essential information shall be given in the report:

a) the name and address of the test laboratory;

b) the name and address of the person/organization requesting the test;

c) the name and address of the manufacturer/supplier of the material tested;

d) the date of the test;

e) the operator;

f) the trade name of the material tested and the specimen identification code or number;

g) the composition or generic identification of the material tested;

h) the specimen thickness, expressed in millimetres, and specimen mass, expressed in grams [with composites and assemblies, the nominal thickness and density of each of the components shall be given, together with the apparent (overall) density of the whole];

i) the colour of the specimens;

j) details of specimen preparation by the test laboratory;

k) details of specimen mounting, including any special mounting procedures used (e.g. for intumescent materials), and details of the face tested;

l) the heat flux produced by the heater, expressed in kilowatts per square metre, and the flow rate of the extraction system, expressed in cubic metres per second;

m) the number of replicate specimens tested under the same conditions [this will normally be three (see 8.1.1), except for exploratory testing];

n) the time to sustained flaming, expressed in seconds;

o) the test duration, i.e. the time between the start of the test and the end as defined in 10.2.5, expressed in seconds;

p) the values, expressed in kilowatts per square metre, of the heat release rate per unit area at 180 s after ignition, $\dot{q}''_{180}$, and at 300 s after ignition, $\dot{q}''_{300}$, and the maximum heat release rate per unit area reached $\dot{q}''_{max}$ (see 10.2.9);

q) the averages, for all replicate determinations, of the values reported in items n) and o);

r) any additional observations, such as transitory flaming or flashing;

s) (optionally) the mass loss results in accordance with clause C.4;

t) details of any difficulties encountered in testing.

Annex A
(normative)

Calibration of the heat flux meter

The calibration of the heat flux meter shall be checked, whenever re-calibration of the apparatus is carried out, by comparison with two instruments of the same type as the working heat flux meter and of similar range held as reference standards and not used for any other purpose.

One of the heat flux meter reference standards shall be fully calibrated against a primary reference standard instrument at yearly intervals. This meter shall be used to calibrate the heater temperature controller. It shall be positioned at a location equivalent to the centre of the specimen face during this calibration.

The inter-comparison of working and reference standard heat flux meters required above, may be made using the conical heater with each heat flux meter mounted in turn in the calibration position, care being taken to allow the whole apparatus to attain thermal equilibrium. Alternatively, an apparatus specially built for comparative purposes may be used (e.g. that specified in BS 6809).

NOTE The use of two reference standards rather than one provides a greater safeguard against change in sensitivity of the reference instruments.

Annex B
(informative)

Guidance notes for operators

B.1 General

This annex aims to provide the operator carrying out the test and the user of the test results with background information on the method, the apparatus and the data obtained.

B.2 Rate of heat release measurements

The test method does not prescribe the heat flux levels, nor whether external ignition is to be used. These should be determined separately for each product to be assessed. For given applications and products, a comparison with full-scale fires is generally necessary to determine the time period over which heat release is to be calculated.

For exploratory testing, it is recommended that the spark igniter and an heat flux of 35 kW/m^2 be used initially; in the absence of further specifications from the person/organization ordering the test, testing at 25 kW/m^2, 35 kW/m^2 and 50 kW/m^2 are recommended. The results obtained may then suggest whether additional testing at different heat flux levels is desirable.

The test results may not be statistically significant unless the heat flux used is substantially (10 kW/m^2) higher than the minimum heat flux level needed for sustained flaming to occur for that specimen.

B.3 Back face conditions

The heat losses through the back face of the specimen can have an influence on the burning rate near the end of the burning time. For reproducible measurements, the loss through the back face should be standardized, and this is achieved by using a layer of insulating material.

Annex C
(informative)

Measuring mass loss during testing

C.1 General

The use of a suitable weighing device to monitor changes in the mass of the specimen during the test can yield additional data.

C.2 Apparatus

C.2.1 Weighing device, for measuring mass loss, with an accuracy of 0,1 g and a 90 % response time of less than 3 s. It should be able to measure a mass of at least 500 g.

The weighing device should be calibrated, using a load cell and standard weightpieces covering the range of test specimen masses to be encountered, at least every day and also when the load cell zero needs to be adjusted.

C.3 Procedure

See clause 10.

C.4 Test report

It is suggested that the test report carry the following additional information:

a) a curve, recorded for the entire test, showing the rate of mass loss in kilograms per second;

b) the mass remaining after the test, expressed in grams, and the percentage of the total mass which has pyrolysed;

c) the overall mass loss per unit area, expressed in kilograms per square metre, and the average rate of mass loss per unit area, expressed in grams per square metre second ($g/m^2 \cdot s$), computed over the period between ignition and the end of the test;

d) the averages, for all replicate determinations, of the values reported in item c).

Bibliography

[1] ISO/TR 3814:1989, *Tests for measuring "reaction-to-fire" of building materials — Their development and application.*

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

[3] ISO/TR 6585:1979, *Fire hazard and the design and use of fire tests.*

[4] BS 6809:1987, *Method for calibration of radiometers for use in fire testing.*

1) To be published. (Revision of ISO 5660-1:1993)

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