INTERNATIONAL STANDARD

ISO 14934-3

Second edition
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Fire tests — Calibration and use of heat flux meters —

Part 3: Secondary calibration method

Essais au feu — Étalonnage et utilisation des appareils de mesure du flux thermique —
Partie 3: Méthode d'étalonnage secondaire

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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 2.

The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 14934-3 was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 1, *Fire initiation and growth*.

This second edition cancels and replaces the first edition (ISO 14934-3:2006), which has been technically revised.

ISO 14934 consists of the following parts, under the general title *Fire tests — Calibration and use of heat flux meters*:

— *Part 1: General principles*

— *Part 2: Primary calibration methods*

— *Part 3: Secondary calibration method*

— *Part 4: Guidance on the use of heat-flux meters in fire tests* [Technical Specification]

Introduction

In many fire test methods, the radiation level is specified and, therefore, it is of great importance that the radiant heat flux is well defined and measured with sufficient accuracy. Radiant heat transfer is also the dominant mode of heat transfer in most real fires.

A number of fire tests described in International Standards published by ISO require test specimens to be exposed to specified levels of irradiance. It is, therefore, necessary for fire test laboratories to be able to maintain working-standard heat flux meters to measure irradiance.

This part of ISO 14934 describes methods for the calibration of heat flux meters used as working standards in fire testing and for measuring heat flux in fire testing. Two different approaches can be used, either calibration in one of the primary calibration apparatuses or by means of a transfer calibration. The transfer calibration is performed by comparison of the heat flux meter with a heat flux meter with known sensitivity referred to as a secondary standard. The latter will have been calibrated according to ISO 14934-2.

The calibration of heat flux meters for use as primary and secondary standards requires considerable expertise and equipment that is not covered by this part of ISO 14934. For information on the calibration of primary standards and for a detailed account of the principles of the measurement of thermal radiation, reference is also made to ISO 14934-1 and ISO 14934-2.

Information on the accuracy of calibration, care of heat flux meters and guidance notes for carrying out the calibration are given in Annexes A to C. Annex D outlines a suitable procedure for the maintenance of a secondary standard of irradiance at a test laboratory.

Fire tests — Calibration and use of heat flux meters —

Part 3: Secondary calibration method

1 Scope

This part of ISO 14934 specifies methods for the calibration of heat flux meters for use in fire testing.

The methods apply only to instruments having plane receivers. They do not apply to receivers in the form of wires, spheres, etc.

2 Normative references

The following referenced documents are indispensable for the application 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 13943, *Fire safety — Vocabulary*

ISO 14934-1, *Fire tests — Calibration and use of heat flux meters — Part 1: General principles*

ISO 14934-2, *Fire tests — Calibration and use of heat flux meters — Part 2: Primary calibration methods*

3 Terms and definitions

For the purposes of this part of ISO 14934, the terms and definitions given in ISO 14934-1 and ISO 13943 apply.

4 Principle

Two different approaches can be used, either calibration in one of the primary calibration apparatuses or by means of a transfer calibration.

5 Transfer calibration

5.1 General

Transfer calibration of heat flux meters (total hemispherical radiometers and total heat flux meters) for use as working standards is carried out by comparing the heat flux meter response at various levels of irradiance with the response of a secondary-standard heat flux meter of the same type at the same levels of irradiance. The measurements are made at different levels of irradiance, which are obtained by varying the distance between the radiant source and the heat flux meter or by varying the temperature of the radiant source. The transfer calibration is conducted at a minimum of 10 different levels of irradiance. The secondary-standard heat flux meter is calibrated according to one of the primary methods described in ISO 14934-2.

5.2 Apparatus

5.2.1 Radiant source

The radiant source can be spherical, flat or conical. It shall be an electrically powered heater. The irradiance from the radiant source shall be maintained at a preset level by controlling the temperature. This can be done

as with the heater described in ISO 5660-1. The temperature shall be kept constant during the calibration. The source shall be larger than the measuring surface of the heat flux meters under calibration.

The radiant source shall be placed in such a way that the irradiance from the radiant source is given vertically downward to the heat flux meter to be calibrated, which is placed below the radiant source.

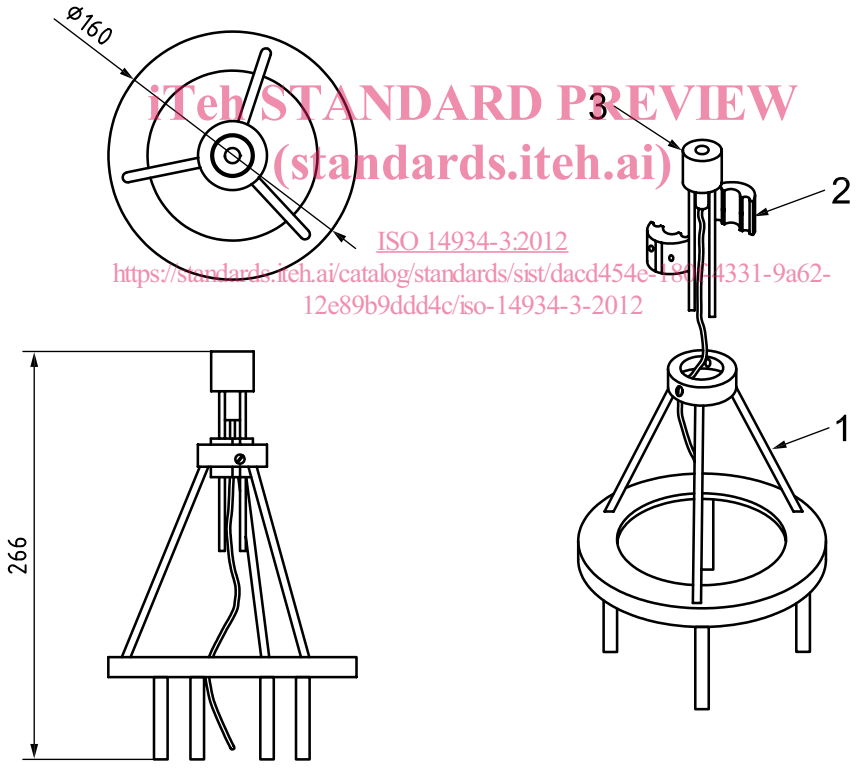
5.2.2 Mounting arrangements

5.2.2.1 Mounting arrangement for transfer calibration by varying the temperature of the heat source

The mounting apparatus shall be designed to bring the sensing surface of each heat flux meter (working-standard and secondary-standard) quickly in turn into a preset position beneath the centre of the radiant source in such a way that the irradiance to the heat flux meter can be varied. This can be achieved, for example, by a system where the position of a heat flux meter is fixed by adjusting the output from the radiant source (e.g. the conical heater of ISO 5660-1, ISO 13927 and ISO 17554).

For mounting the heat flux meters with water pipes parallel to the heat flux meter axis under the conical heater as in ISO 5660-1, ISO 13927 and ISO 17554, the arrangement shown in Figure 1 should be used. The heat flux meter calibration stand can also be used for mounting heat flux meters having the water pipes perpendicular to the heat flux meter axis as shown in Figure 2.

Dimensions in millimetres

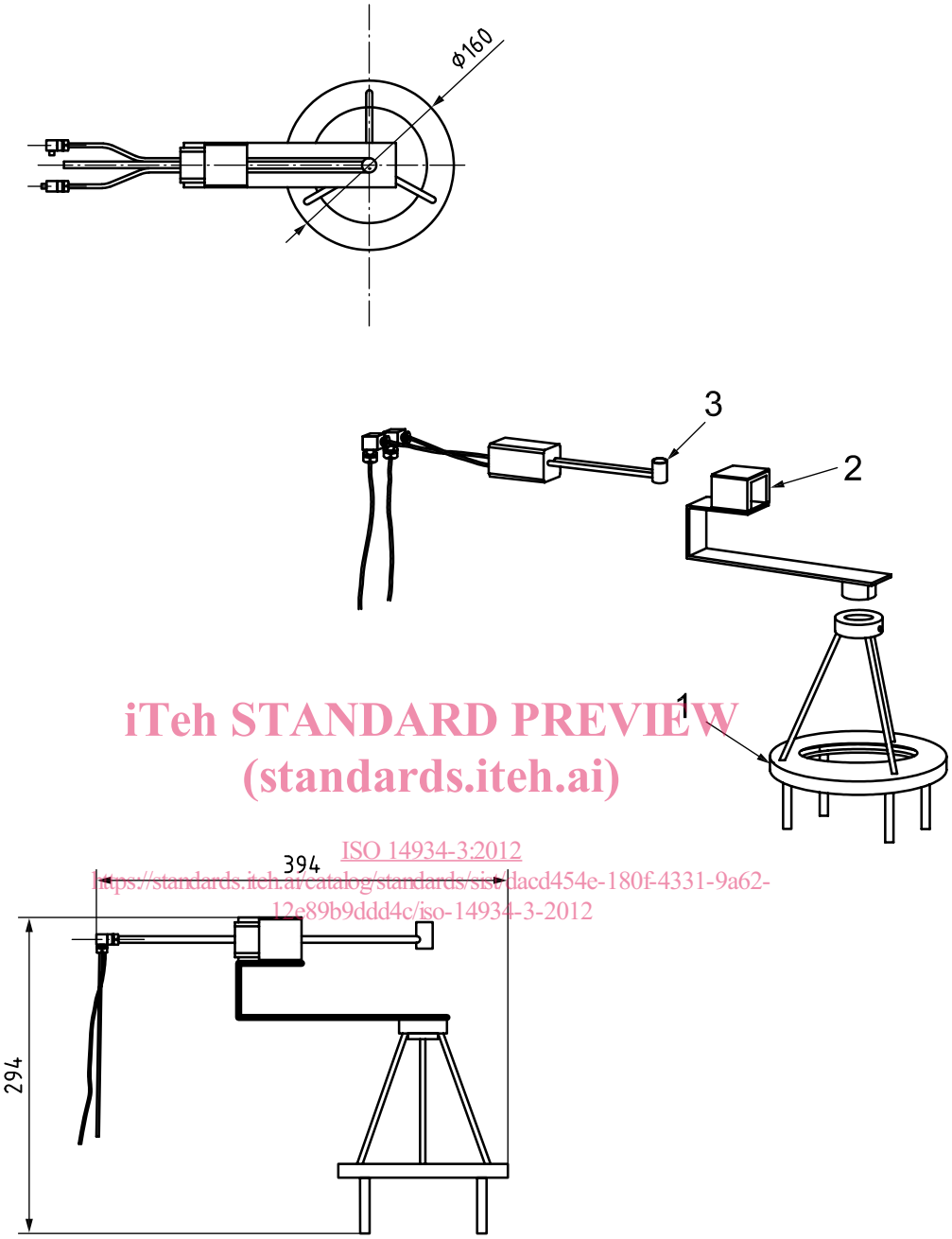


Key

1 heat flux meter calibration stand
2 heat flux meter clamp
3 heat flux meter with water pipes parallel to the heat flux meter axis

Figure 1 — Calibration stand for heat flux meters with water pipes parallel to the heat flux meter axis under a conical heater

Dimensions in millimetres



Key

1 heat flux meter calibration stand
2 heat flux meter clamp
3 heat flux meter with water pipes perpendicular to the heat flux meter axis

Figure 2 — Calibration stand for heat flux meters with water pipes perpendicular to the heat flux meter axis under a conical heater

Irradiance to the heat flux meter can be altered by changing the power, i.e. temperature, of the radiant source.

The change in radiant source power shall be over a range which will provide an appropriate range of irradiance compatible with the working range of the heat flux meter to be calibrated. The heat flux meter shall not be placed in any convective air flow initiated by the radiant source. The means for locking the heat flux meter in position shall be rigid and such that the centre of the sensing surface is in the centre of the radiator.

The heat flux meter mounting apparatus shall be designed so that meters are not mounted directly over a substantial mass of material that will get hot and in such a way that it can be placed in position after the irradiance of the radiant source reaches a preset level.

NOTE It has been found suitable to have two calibration stands so that both the secondary-standard heat flux meter and the working-standard heat flux meter can be mounted prior to the start of calibration (see 5.5.6).

No part of the mounting apparatus shall project in front of the heat flux meters being calibrated.

All exposed surfaces of the heat flux meter mounting apparatus shall be coated with a heat-resisting, matte black finish.

5.2.2.2 Mounting arrangement for transfer calibration by varying the distance between the radiant source and the heat flux meter

The mounting apparatus shall be designed to bring the sensing surface of each heat flux meter (working-standard and secondary-standard) quickly in turn into a preset position beneath the centre of the radiant source in such a way that the irradiance to the heat flux meter can be varied. This can be achieved, for example, by a system where the position of the heat flux meter is varied by adjusting the distance between the radiant source and the heat flux meter.

The output from the radiant source remains constant throughout the whole procedure. The movement of the heat flux meter shall be such that it will provide an appropriate range of irradiance. The heat flux meter shall not be placed in any convective air flow initiated by the radiant source. The means for locking the heat flux meter in position shall be rigid and such that the centre of the sensing surface is in the centre of the radiator.

The heat flux meter mounting apparatus shall be designed so that meters are not mounted directly over a substantial mass of material that will get hot and in such a way that it can be placed in position after the irradiance of radiant source reaches a preset level.

5.2.3 Instrumentation

5.2.3.1 Secondary-standard heat flux meters

The secondary-standard heat flux meter shall have the water pipes parallel to the heat flux meter axis. It shall be of the same type as the working-standard heat flux meter, which is to be calibrated, except if the working-standard heat flux meter has the water pipes perpendicular to the heat flux meter axis. Thus, if the working-standard heat flux meter is a Schmidt-Boelter type, then the secondary-standard heat flux meter shall also be a Schmidt-Boelter type. The measuring range and the outer diameter of the heat flux meters shall also be identical.

If the secondary-standard heat flux meter and the working-standard heat flux meter have different diameters, then the uncertainty analysis is required.

The secondary-standard heat flux meter shall be calibrated at regular intervals according to one of the primary methods described in ISO 14934-2.

The scheme for inter-laboratory comparisons outlined in Annex D can be used in order to stabilize the sensitivity of the secondary-standard heat flux meter. In this case, three or more secondary-standard heat flux meters are required for these periodic inter-comparisons.

5.2.3.2 Working-standard heat flux meters

Working-standard heat flux meters used for the fire tests according to ISO 5660-1, ISO 5659-2, ISO 13927 and ISO 17554, have the water pipes perpendicular to the heat flux meter axis (see Figure 2). For the calibration, this working-standard heat flux meter is mounted in the normal cone heater assembly holder or in the holder shown in Figure 2.

Working-standard heat flux meters used for the fire tests according to ISO 5658-2, IMO Res A.653 and ISO 9239-1, have the water pipes parallel to the heat flux meter axis. For the transfer calibration, this working-

standard heat flux meter is mounted as described in 5.2.2. This type of working-standard heat flux meter can also be directly calibrated in any of the primary calibration furnaces described in ISO 14934-2.

5.2.3.3 Recording instrumentation

Instrumentation shall be capable of assimilating the incoming data and producing a record, both permanent and immediately available to the operator, of the reading of each heat flux meter at intervals not longer than 5 s, having range settings appropriate to the outputs of the heat flux meters. It is recommended to use the same recording instrumentation for both secondary and working-standard heat flux meters.

5.2.4 Additional equipment

5.2.4.1 Protective clothing

Protective clothing, such as heat-resisting gloves and eye protection, should be worn, as necessary.

5.2.4.2 Low-pressure air and/or water supply

Low-pressure air and/or water supply for the heat flux meters should be supplied as required. An example is given in C.6.

5.3 Test environment

5.3.1 Room

The influence of the surroundings should be stable over time. The radiation from everything except for the radiant source should be limited by keeping all surrounding items including wall surfaces below 40 °C.

5.3.2 Draught

The calibration apparatus shall be contained in an essentially draught-free environment where the air flow does not exceed 0,2 m/s when the apparatus is cold. Particular care shall be taken to avoid draughts across the instruments under calibration. If necessary, screens shall be provided, but these shall be at least 1,5 m away from the heat flux meter under calibration.

5.4 Set-up procedure

5.4.1 General

Check that the apparatus is assembled correctly. If the sliding procedure is used then check that the mounting apparatus moves smoothly in relation to the face of the radiant source. Lubricate any sliding parts using a heat-resisting grease or graphite, if necessary.

Laboratories supplying instruments for calibration should be aware that with a new working-standard heat flux meter or one that has not been previously used, it is advisable to age the sensing surface artificially before a calibration is carried out to avoid or reduce initial drift in sensitivity. It is recommended that this should be done by exposing the sensing surface to radiation for 20 h to 25 h in a series of exposures of several hours' duration, at irradiance near the maximum at which it is likely to be used. With some types of heat flux meters, it is advisable to monitor sensitivity and continue ageing until the sensing surface has stabilized.

5.4.2 Mounting heat flux meters onto the calibration stand

5.4.2.1 Align the two parts of the clamp around the water pipes of the heat flux meter as shown in Figure 3 a), ensuring that the signal cable will run down the clearance provided in the middle.