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ISO 14934-2

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Fire tests — Calibration and use of heat flux meters —

Part 2: Primary calibration methods

Essais au feu — Étalonnage et utilisation des appareils de mesure du flux thermique —

Partie 2: Méthodes d'étalonnage primaire

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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 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 14934-2 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 14934-2:2006), 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*

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.

In practice, radiant heat flux is usually measured with so-called total heat flux meters of the Schmidt-Boelter (thermopile) or Gardon (foil) type. Such meters register the combined heat flux by radiation and convection to a cooled surface. The contribution to the heat transfer by convection depends mainly on the temperature difference between the surrounding gases and the sensing surface and on the velocity of the surrounding gases. It will, however, also depend on size and shape of the heat flux meter, its orientation and on its temperature level, which is near the cooling water temperature. In many practical situations in fire testing, the contribution due to convection to the sensing surface of the instrument can amount to 25 % of the radiant heat flux. Thus it is always necessary to determine and control this part.

To determine the fraction of total heat flux due to radiation, a calibration scheme is developed where primary calibration is performed on two different types of heat flux meters: (1) a total hemispherical radiometer sensitive to radiation only, and (2) a total heat flux meter, (most frequently used) sensitive to both radiant heat transfer and to convective heat transfer. A comparison of measurements between the two types of meters in secondary (or transfer) calibration methods allows a characterization of the influence of convection in the method. Where possible, in all calibrations and measurements of radiative heat flux, the uncertainty calculations should include the uncertainty associated with removing the convective component. For secondary calibration methods, a combined use of hemispherical radiometers and total heat flux meters makes it possible to estimate the convection contribution. The same arrangement can be used in calibration of fire test methods as well.

Primary calibration is performed in a black-body cavity under conditions where the convective part of the heat transfer can be neglected or controlled. One such apparatus is an evacuated black-body facility with the unique characteristic of negligible convection and conduction effects described in this document as the vacuum black-body cavity (VBBC) method (method 1). Other (non-evacuated) black-body facilities can also be suitable as primary heat sources for calibration, providing they are fully characterized, particularly in terms of any convection effects on the sensing surface of the heat flux meter being calibrated. One such facility, described in this document as the spherical black-body cavity method (method 2), is a furnace with an orifice pointing downwards to minimize the convection. Another is the variable temperature black-body method (method 3) in which the effect of the convective component is minimized by the adoption of a substitution procedure in which the heat flux meter to be calibrated is compared with a primary standard radiometer. Under such conditions the convective effect for each measurement can be asumed to be of a similar magnitude.

NOTE Schmidt-Boelter meters and Gardon meters are examples of suitable products available commercially. This information is given for the convenience of users of this part of ISO 14934 and does not constitute an endorsement by ISO of this product.

Fire tests — Calibration and use of heat flux meters —

Part 2: Primary calibration methods

1 Scope

This part of ISO 14934 describes three methods for calibration of total hemispherical radiometers and total heat flux meters that are exposed to a well-defined radiation from a radiant heat source. The equipment is designed to minimize influences due to convective heat transfer during calibration. It is important to note that when the instruments are used in practice they measure a combination of radiant and convective heat transfers. The latter will depend on the design of the heat flux meter, the orientation, local temperature and flow conditions, and on the temperature of the cooling water.

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 13943, *Fire safety — Vocabulary*

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

IEC 60584-2, *Thermocouples — Part 2: Tolerances*

ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

ISO/IEC Guide 99, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13943, ISO 14934-1, ISO/IEC Guide 98-3 and ISO/IEC Guide 99 apply.

4 Principles

4.1 General principles

Calibration of heat flux meters (total hemispherical radiometers and total heat flux meters) is performed with a black-body radiant heat source.

4.2 Principle of the vacuum black-body cavity (VBBC) method (method 1)

This method is used to calibrate heat flux meters between 2 kW/m^2 and 70 kW/m^2. It is designed to accept total heat flux meters or total hemispherical radiometers with a housing diameter of up to 50 mm. These may have pipes for water or/and air that are located axially. Calibration of heat flux meters consists of reading the output voltage of total heat flux meters or total hemispherical radiometers when irradiated by a traceable black-body radiant source operating under vacuum. By lowering the absolute pressure in the black-body cavity to between 0,5 Pa and 2 Pa, the convective heat transfer is significantly