TECHNICAL SPECIFICATION

ISO/TS 14934-1

First edition
2002-12-15

Reaction-to-fire tests — Calibration and use of radiometers and heat flux meters —

Part 1: General principles

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

Partie 1: Principes généraux

Reference number
ISO/TS 14934-1:2002(E)

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Published in Switzerland

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Foreword

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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.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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

ISO/TS 14934 consists of the following parts, under the general title *Reaction-to-fire tests — Calibration and use of radiometers and heat flux meters*:

— *Part 1: General principles*

— *Part 2: Primary calibration*

— *Part 3: Secondary calibration*

— *Part 4: Guidance on the use of heat flux meters in fire tests*

Introduction

Radiant heat transfer is an important mode of fire spread, particularly in large fires with flames and hot gas layer thickness larger than 1 m. To represent optimally realistic scenarios, many fire test methods specify the radiation level. Therefore, it is of great importance in fire safety engineering and in fire testing that the radiant heat flux be measured with sufficient accuracy (see 5.1).

In practice, radiant heat flux is usually measured with total heat flux meters of the Schmidt-Boelter (thermopile) or Gardon (foil) type. Such meters register the combined heat flux from radiation and convection. This introduces an uncertainty, as the measured heat flux will contain an unknown contribution from the convection heat transfer. The actual contribution due to convection, in calibrations and fire tests, will depend upon a number of factors such as the design of the heat flux meter, the orientation of the meter, the cooling water temperature, the temperature and flow conditions close to the meter, and the calibration method. In many practical situations, the uncertainty in the convection can amount to 25 % of the total heat flux measured.

To overcome the difficulties with the convection influence, a calibration procedure is outlined where primary calibration is performed on two different types of heat flux meters:

a) total hemispherical radiometer or a cavity radiometer which is sensitive only to radiation; and

b) total heat flux meter, as is typically used, which detects both modes of heat transfer.

Where possible, an effort should be made to minimize the convective influence. In all calibrations and measurements of radiative heat flux, the uncertainty calculations should include the uncertainty due to the residual 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.

Primary calibration is performed in fully characterized blackbody facilities, with total combined expanded uncertainty of less than $\pm$ 3,0 % with a 95 % confidence level, in the measured heat flux. One such facility is an evacuated blackbody with the unique characteristic of negligible convection and conduction effects on calibration. Other non-evacuated blackbody facilities are also suitable to be primary radiative flux calibration sources, provided that they are fully characterized, including any convection effects, and the combined expanded uncertainty is less than $\pm$ 3,0 %.

It should be noted that the wavelength spectrum and angular distribution of the radiation from a fire may be different from that of a blackbody source. This may introduce extra sources of error to the combined expanded uncertainty when a heat flux meter is used.

In this Technical Specification, three different methods of calibrations using blackbody radiation sources are proposed for provisional evaluation. The objective of this evaluation phase, expected to last about three years, is to determine the relative merits and limitations of the methods and the associated total combined uncertainty. The results and the operational experience gained during the evaluation phase will be reviewed to recommend a suitable test standard.

Within the ongoing European project “Improving heat flux meter calibration for fire testing laboratories HFCAL” SMT4-CT98-2266, total heat flux meters of the Schmidt-Boelter or Gardon type and a total hemispherical radiometer of the Gunners type will be characterized with respect to wavelength, geometry and convection. Different types of emissivity coatings will be investigated. Calibration results of two of the primary calibration methods described in this Technical Specification, the LNE vacuum blackbody cavity (VBBC) [1], and the NT FIRE 050 [2], and of secondary calibration methods will be compared in a round robin test.

Reaction-to-fire tests — Calibration and use of radiometers and heat flux meters —

Part 1: General principles

1 Scope

This Technical Specification gives guidelines for calibration and use of radiometers and heat flux meters in fire testing and for correction of the sensitivity function due to convection effects.

It briefly describes the calibration methods, the most commonly used types of radiometers and heat flux meters, and the fire tests in which these transducers are used.

This Technical Specification is applicable to total hemispherical radiometers, total heat flux meters of Schmidt-Boelter (thermopile) and Gardon (foil) type. It applies only to instruments having plane receivers and does 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 5657:1997, *Reaction to fire tests — Ignitability of building products using a radiant heat source*

ISO 5658-2:1996, *Reaction to fire tests — Spread of flame — Part 2: Lateral spread on building products in vertical configuration*

ISO 5659-2:1994, *Plastics — Smoke generation — Part 2: Determination of optical density by a single-chamber test*

ISO 5660-1:2002, *Reaction-to-fire tests — Heat release, smoke production and mass loss rate — Part 1: Heat release rate (cone calorimeter method)*

EN ISO 9239-1:2002, *Reaction to fire tests for floorings — Part 1: Determination of the burning behaviour using a radiant heat source*

EN ISO 13943:2000, *Fire safety — Vocabulary*

ISO/TR 14696:1999, *Reaction to fire tests — Determination of fire parameters of materials, products and assemblies using an intermediate-scale heat release calorimeter (ICAL)*

VIM, *International vocabulary of basic and general terms in metrology*, BIPM/IEC/IFCC/ISO/IUPAC/IUPAP/OIML, ISBN 92-67-01075-1

GUM, *Guide to the expression of uncertainty in measurement*, BIPM/IEC/IFCC/ISO/IUPAC/IUPAP/OIML, ISBN 92-67-10188-9