TECHNICAL SPECIFICATION

ISO/TS 5660-3

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Reaction-to-fire tests — Heat release, smoke production and mass loss rate —

Part 3: Guidance on measurement

Essais de réaction au feu — Débit calorifique, taux de dégagement de fumée et taux de perte de masse —

Partie 3: Lignes directrices relatives au mesurage

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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.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of 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order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn.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again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.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 5660-3 was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 1, *Fire initiation and growth*.

This first edition of ISO/TS 5660-3 cancels and replaces ISO/TR 5660-3:2003.

ISO 5660 consists of the following parts, under the general title *Reaction to fire tests — Heat release, smoke production and mass loss rate*:

— *Part 1: Heat release rate (cone calorimeter method)*

— *Part 2: Smoke production rate (dynamic measurement)*

— *Part 3: Guidance on measurement* [Technical Specification]

Introduction

The first edition of ISO 5660-1, which describes a test method for rate of heat release from building products by means of a cone calorimeter, was published in 1993, following approximately 10 years of development within ISO/TC 92, *Fire safety*, Subcommittee SC 1, *Fire initiation and growth*.

The cone calorimeter is a fire test instrument in which horizontal specimens are exposed to controlled levels of radiant heating by means of a truncated cone-shaped heater. Continuous spark ignition is provided and the time to ignition is recorded for specimens which ignite. The rate of heat release from the burning specimen is determined from measurements of the amount of oxygen consumed from the air flowing through the apparatus, which has been demonstrated to equate to heat release. The mass of the specimen is also measured throughout the burning period. The specimens are usually tested under well ventilated conditions.

Results are expressed in terms of peak and average rates of heat release, as well as total heat released and the effective net heat of combustion. ISO 5660-1:2002 limits the specimen type to essentially flat. Several other groups are now utilizing the cone calorimeter, and a number of new parameters in addition to those defined in ISO 5660-1:2002 and ISO 5660-2:2002 have been defined and used. Some of these, including smoke measurement, require that measurements be made from the beginning of the test rather than at the onset of ignition, which is commonly used as the starting point for heat release measurement.

The cone calorimeter is also designed to allow measurement of smoke and gases such as CO and CO_2. Smoke measurement is the subject of ISO 5660-2:2002. Further work is under way to define a quality control tool for measuring burning rates of building products. ISO 17554 specifies a test apparatus similar to that of ISO 5660-1:2002 but measures only loss of mass when exposed to radiant heat. Mass loss may be a surrogate for measurement of heat release for some classes of building materials. A similar system which measures the temperature of combustion products generated by this apparatus has been standardized as ISO 13927 [23]. The cone calorimeter fire model is used to measure corrosivity of gases products of combustion in ISO 11907-4 [24]. The effect of the evolved gases on the resistance of a printed circuit board target is used to assess corrosivity.

During development of the cone calorimeter it became apparent that there was considerable interest in the use of the instrument for products other than building products. Several standards have been developed by various national and international groups based on ISO 5660-1:2002 and ISO 5660-2:2002.

This part of ISO 5660 provides recommendations for the testing of products in the cone calorimeter and gives guidance on application of the test results. Supplementary guidance is given in documents referred to in References [1] and [2].

Reaction-to-fire tests — Heat release, smoke production and mass loss rate —

Part 3: Guidance on measurement

1 Scope

This part of ISO 5660 examines the measurement limitations and applications of the cone calorimeter data as currently used for building products, and recommends ways in which some of these may be overcome for other types of products for other application areas. It compiles information from a large body of experience with regard to the use of the instrument. This information is presented as a set of guidelines, which will help to standardize the use of the cone calorimeter in this wider scope.

Particular guidance is given on aspects of specimen preparation and on the behaviour, such as melting, spalling and intumescing, of specimens exposed to radiant heat. The relevance of specimen thickness and the use of substrate, and methods of fixing to substrate, are also discussed. Advice is given on approaches to testing a variety of "non-standard" products. Recommendations are made on techniques of calibration of the apparatus, selection of appropriate heat flux levels and ignition protocols.

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

ISO 5660-2:2002, *Reaction-to-fire tests — Heat release, smoke production and mass loss rate — Part 2: Smoke production rate (dynamic measurement)*

ISO/TS 14934-4:2007 *Fire tests — Calibration of heat flux meters — Part 4: Guidance on the use of heat flux meters in fire tests*

3 Capability and limitations of the cone calorimeter

Rate of heat release is one of the fundamental properties of fire and should almost always be taken into account in any assessment of fire hazard. Heat release significantly affects fire growth. Considerable progress has been made in methods of using rate of heat release and ignition time results from the cone calorimeter to predict full scale fire characteristics. These characteristics include time to flashover in a small room lined with the tested product and exposed to a high energy fire source such as that used in ISO 9705.

The design of the instrument also provides for measurement of smoke (both gravimetrically and optically) and other gaseous products of pyrolysis or combustion. The instrument may thus be applied to the assessment of real fire hazards such as smoke and toxic and corrosive gas emission in addition to heat release, particularly when the results are expressed in terms of fundamental physically based parameters, rather than ad hoc parameters.

When functioning as a rate of heat release apparatus, the parameter which is measured in the exhaust from the specimen is the concentration of oxygen. Temperature measurements are made, but these are not used to measure the heat output from the specimen in the manner of a conventional calorimeter.