INTERNATIONAL STANDARD

ISO 1716

Second edition
2002-02-01

Reaction to fire tests for building products — Determination of the heat of combustion

Essais de réaction au feu des produits de construction — Détermination de la chaleur de combustion

Reference number
ISO 1716:2002(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

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.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 1716 was prepared by the European Committee for Standardization (CEN) in collaboration with Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 1, *Fire initiation and growth*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this document, read "...this European Standard..." to mean "...this International Standard...".

This second edition cancels and replaces the first edition (ISO 1716:1973), which has been technically revised.

Annex A forms a normative part of this International Standard. Annexes B to D are for information only.

Contents

Foreword

This document has been prepared by Technical Committee CEN /TC 127 "*Fire safety in buildings",* the secretariat of which is held by BSI, in collaboration with Technical Committee ISO/TC 92 "*Fire safety",* SC 1 "*Fire initiation and growth"*.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of the Construction Products Directive.

This document shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2002, and conflicting national standards shall be withdrawn by December 2003.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this document: Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

In this test a test specimen of specified mass is burned under standardized conditions, at constant volume, in an atmosphere of oxygen, in a bomb calorimeter calibrated by combustion of certified benzoic acid. The heat of combustion determined under these conditions is calculated on the basis of the observed temperature rise, taking account of heat loss and the latent heat of vaporisation of water.

It should be noted that this is a test method for determining an absolute value of the heat of combustion for a product and does not take into account any inherent variability of the product.

Safety warning

So that suitable precautions are taken to safeguard health, the attention of all persons concerned in fire tests is drawn to the possibility that toxic or harmful gases may be evolved in the combustion of test specimens. In this test procedure, suitable measures should be taken to prevent harm in the event of an explosion.

1 Scope

This European Standard specifies a method for the determination of the heat of combustion of building products at constant volume in a bomb calorimeter.

This European Standard describes a test method for the measurement of the gross heat of combustion (*PCS*). Annex A describes the calculation of the net heat of combustion (*PCI*) when required.

Information on the precision of the test method is given in Annex B.

2 Normative references

This European Standard incorporates by dated or undated reference provisions from other publications. These normative references are cited at appropriate places in the text and the publications are listed hereafter. For dated references subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 13238, *Reaction to fire tests for building products — Conditioning procedures and general rules for selection of substrates*

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

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN ISO 13943:2000, together with the following terms and definitions, apply.

3.1
product
material, element or component about which information is required

3.2
material
single basic substance or uniformly dispersed mixture of substances e.g. metal, stone, timber, concrete, mineral wool with uniformly dispersed binder, polymers

3.3
homogeneous product
product consisting of a single material having uniform density and composition throughout the product

3.4
non-homogeneous product
product that does not satisfy the requirements of a homogeneous product and which is composed of more than one component, substantial and/or non-substantial

3.5
substantial component
material that constitutes a significant part of a non-homogeneous product, a layer of which having a mass/unit area $\geq$ 1,0 kg/m^2 or a thickness $\geq$ 1,0 mm

3.6
non-substantial component
material that does not constitute a significant part of a non-homogeneous product. A layer with a mass/unit area < 1,0 kg/m^2 and a thickness < 1,0 mm is considered to be a non-substantial component

Two or more non-substantial layers that are adjacent to each other (i.e. with no substantial component(s) in between the layers) are regarded as one non-substantial component when they collectively comply with the requirements for a layer being a non-substantial component.

3.7
internal non-substantial component
non-substantial component that is covered on both sides by at least one substantial component

3.8
external non-substantial component
non-substantial component that is not covered on one side by a substantial component

3.9
heat of combustion
thermal energy produced by combustion of unit mass of a given substance

NOTE It is expressed in joules per kilogram.

[EN ISO 13943:2000]

3.10
gross heat of combustion, *PCS* (MJ/kg)

heat of combustion of a substance when the combustion is complete and any produced water is entirely condensed under specified conditions

[EN ISO 13943:2000]

3.11
net heat of combustion, *PCI* (MJ/kg)
heat of combustion of a substance when the combustion is complete and any produced water is in the vapour state under specified conditions

NOTE The net heat of combustion may be calculated from the gross heat of combustion.

[EN ISO 13943:2000]

3.12
latent heat of vaporisation of water (MJ/kg)
heat which is required to change water from a liquid to a gas

4 Test apparatus

4.1 General

The test apparatus is illustrated in Figure 1, and is detailed in 4.2 to 4.12. All dimensions given in the following description are nominal values, unless tolerances are specified.

4.2 Calorimetric bomb

The calorimetric bomb shall be constructed as follows:

a) volume: (300 ± 50) ml;

b) mass not greater than 3,25 kg;

c) casing thickness at least 1/10 of the inner diameter of the body.

The lid is intended to receive the crucible and the electric firing device. The lid, including any seals, shall be capable of withstanding an internal pressure of 21 MPa.

NOTE These conditions define a bomb in which 1 g of coal under an initial oxygen pressure no greater than 3 MPa (pressure gauge method) is able to withstand, with a sufficient coefficient of safety, the maximum amount of pressure created under combustion, without a need for a calorimetric bomb of overlarge mass.

The inner surface of the bomb shall be resistant to attack by products of combustion and, even when "fuels" rich in sulphur are used, it shall resist pitting and inter-crystalline corrosion by acids produced during combustion.

4.3 Calorimeter

4.3.1 Jacket

The jacket shall be a double walled container, which is thermally insulated together with an insulated lid. The jacket is filled with water. The dimensions of the jacket shall be such that there is at least 10 mm space around the calorimetric vessel. The calorimetric vessel shall be supported on an area as small as possible of non-conducting material preferably a 3 point support.

For an adiabatic calorimeter system, a heater and thermometer system shall be incorporated into the vessel so that the water temperature in the jacket is maintained at the same temperature as the water in the calorimetric vessel.

For an isothermal calorimeter system, the temperature of the water in the jacket shall be kept constant. For an isothermal calorimeter, the necessary corrections shall be made (see 8.2).

4.3.2 Calorimetric vessel

This shall be a polished metal container designed to accommodate the bomb. The dimensions shall be such that the bomb can be immersed in water(see 7.3 d)).

4.3.3 Stirrer

A stirrer driven by a constant speed motor shall be provided. To prevent the transfer of heat to and from the calorimeter, the driving shaft of the stirrer shall have a thermally insulated section in a gasket between the jacket lid and the jacket. A magnetic stirring device with a similar performance is an acceptable alternative.

4.4 Temperature measuring device

The temperature measuring device shall be capable of giving a resolution of 0,005 K.

When using a mercury thermometer, this shall have at least 0,01 K graduations with a device e.g. a lens, for taking readings to within 0,005 K. A mechanical vibrator shall also be used to tap gently the thermometer to ensure the mercury column does not stick.

4.5 The crucible

The crucible may be made of metal, such as platinum, nickel, stainless steel, or silica, with a flat base, 25 mm in diameter (maximum dimension if it is truncated) and 14 mm to 19 mm high. The following wall thickness is recommended:

Metal: 1,0 mm

Silica: 1,5 mm

NOTE Several shapes of crucible have proved satisfactory.

4.6 Timing device

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

4.7 Electric power source

The voltage to the firing circuit shall not exceed 20 V for the firing. An ammeter shall be added to the circuit to indicate the breaking of the firing wire. A circuit breaker is a useful addition to the supply circuit.

4.8 Pressure gauge and needle-valve

These shall be attached to the oxygen supply circuit to show the pressure in the bomb while it is being filled; this pressure shall be indicated with a resolution of 0,1 MPa.

4.9 Balances

Two balances are required:

— an analytical balance with an accuracy of 0,1 mg.

— a balance with an accuracy of 0,1 g.

4.10 Device for making the “cigarette”

The device and the procedure for making the “cigarette” are shown in Figure 2. The device for producing the “cigarette” comprises a mould and a metallic mandrel (not aluminium).

4.11 Device for making the pellet

If prefabricated pellets are not available, a suitable device for making the pellet shall be used.

4.12 Reagents

4.12.1 Distilled or de-mineralised water.

4.12.2 Pressurized oxygen, free from any other combustible product (purity ≥ 99,5 %).

NOTE Oxygen prepared by electrolysis may contain a small percentage of hydrogen, which makes it unsuitable for this use.