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Reaction-to-fire tests — Small room test for pipe insulation products or systems

Essais de réaction au feu — Essai en chambre de petite taille de produits ou systèmes de calorifugeage de tuyauterie

Reference number
ISO 20632:2008(E)

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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.

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 20632 was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 1, *Fire initiation and growth*.

Introduction

The test method described in this document is intended to assess the fire performance of a pipe insulation product, supported on a steel pipe, under controlled conditions.

The method can be used as part of a fire hazard assessment that takes into account all of the factors that are pertinent to a particular end use of a pipe insulation product.

Reaction-to-fire tests — Small room test for pipe insulation products or systems

Caution — So that suitable precautions can be taken to safeguard health, the attention of all concerned in fire tests is drawn to the possibility that toxic or harmful gases can be evolved during combustion of the test specimen.

The test procedures involve high temperatures and combustion processes from ignition to a fully developed room fire. Therefore, hazards can exist for burns, ignition of extraneous objects or clothing. The operators should use protective clothing, helmet, face-shield and equipment for avoiding exposure to toxic gases.

1 Scope

This International Standard specifies a test method for determining the reaction to fire performance of pipe insulation products and some pipe insulation systems installed in a small room.

The scenario is valid for fires in a room where pipe insulation products are installed within building applications, e.g. pipe and duct rooms in public buildings, apartment blocks, hospitals and ships.

This method is suitable for products that cannot be tested in a small-scale test, or for correlation of small-scale test data. The method can also serve as a reference scenario for pipe insulation products or for systems fitted in a room within a building or a ship.

The method is not suitable for pipe insulation in concealed spaces, such as a horizontal or a vertical shaft. This method is not intended for evaluating the fire resistance of pipe insulation systems.

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 9705:1993, *Fire tests — Full-scale room test for surface products*

ISO 13943, *Fire safety — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13943 and the following apply.

3.1
pipe insulation product
thermally-insulating material or product that covers a pipe

NOTE One layer is an insulating material, such as mineral or glass wool or cellular plastics. Facings on one or both sides can protect this insulating layer. Facings can be selected from a variety of materials, such as aluminium foil or glass fibre reinforced resin. The insulating material can be preformed, sprayed or wrapped around the pipe.

3.2
pipe insulation system
system comprising the pipe, the pipe insulation product, a product to keep the joint together such as tape or steel wire, possibly a finish layer or jacketing and pipe hangers

NOTE Pipe hangers can be fitted on the steel pipe (hot applications) or on the insulation product (cold applications).

4 Principle

The test methodology for determining the reaction to fire performance of pipe insulation products consists of assessing the following hazards:

— the potential of fire growth along the lines of pipes in the room by measurement of heat release rate, HRR;

— the potential for sustained fire and subsequent spread by measurement of the total heat release, THR;

— the potential to reach flashover and spread fire outside the room;

— reduced visibility by the measurement of light-obscuring smoke;

— potential for discontinuous fire spread by observation of flaming droplets/particles.

5 Test room

The test room dimensions, the position and size of the doorway and the construction material shall be as described in ISO 9705.

6 Ignition source

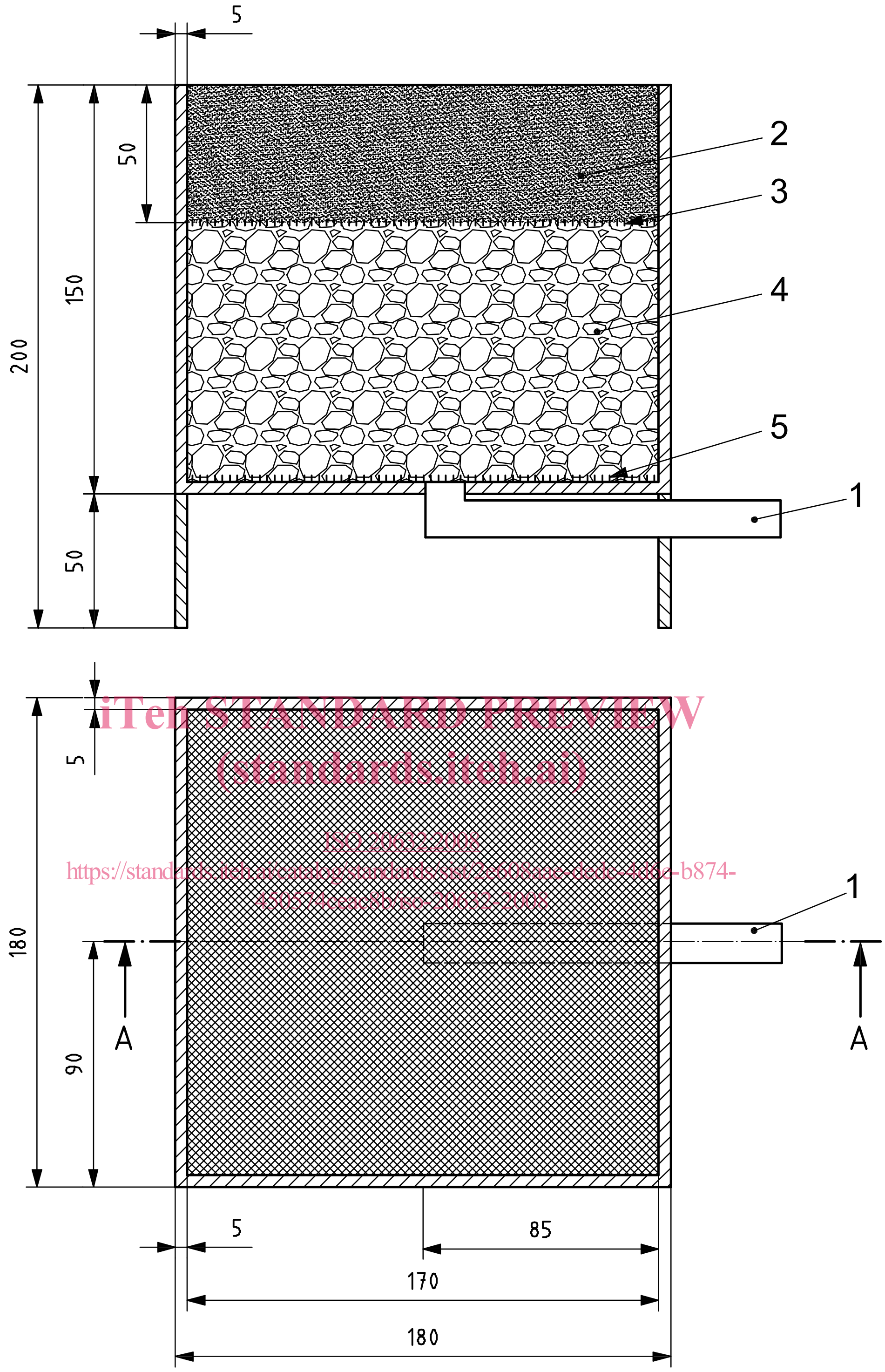
The ignition source shall be identical to the recommended standard ignition source described in Annex A of ISO 9705:1993. The position of the burner shall be 50 mm above floor level.

The ignition source shall be a propane gas burner having a square top surface layer of a porous, inert material, e.g. sand. The burner shall have face dimensions of 170 mm × 170 mm and a height of 200 mm above the floor (see Figure 1). The construction shall be such that an even gas flow is achieved over the entire opening area.

The ignition source is a propane gas burner that consumes relatively large amounts of gas. The attention of all concerned in fire tests is therefore drawn to the following warning.

WARNING — All equipment such as tubes, couplings, flowmeters, etc., shall be approved for propane and installed according to good practice. For reasons of safety, the burner should be equipped with a remote-controlled ignition device, for example, a pilot flame or a glow wire. There should be a warning system for gas leakage and a valve for immediate and automatic cut-off of the gas supply in case of extinction of the ignition flame.

Dimensions in millimetres



Key

1 gas inlet

2 sand (2 mm – 3 mm)

3 brass wire gauze (Ø1,8 mm)

4 gravel (4 mm – 8 mm)

5 brass wire gauze (Ø 2,8 mm)

Figure 1 — Standard ignition source (top view and cross section A-A)

The burner shall be placed on the floor in a corner opposite to the doorway wall. The burner walls shall be in contact with the specimen.

The burner shall be supplied with propane with a purity of at least 95 %. The gas flow to the burner shall be measured to an accuracy of at least ± 3 %. The heat output to the burner shall be controlled to within ± 5 % of the prescribed value.

The burner power output, based on the net (lower) calorific value of propane, shall be 100 kW during the first 10 min and then shall be increased to 300 kW for a further 10 min.

7 Hood and exhaust duct

The system for collecting the combustion products shall have such a capacity and be designed in such a way that all of the combustion products leaving the fire room through the doorway during a test are collected. The system shall not disturb the fire-induced flow in the doorway. The maximum exhaust capacity shall be at least 3,5 $m^3 s^{-1}$ at normal pressure and a temperature of 25 °C.

NOTE An example of one design of hood and an exhaust duct is given in Annex C.

8 Instrumentation in the exhaust duct

8.1 Volume flow rate

The volume flow rate in the exhaust duct shall be measured to an accuracy of at least ± 5 %.

The response time to a stepwise change of the duct flow rate shall be a maximum of 1 s at 90 % of the final value.

8.2 Gas analysis

8.2.1 Sampling line

The gas samples shall be taken in the exhaust duct at a position where the combustion products are uniformly mixed. The sampling line shall be made from an inert material which will not influence the concentration of the gas species to be analysed. (See Annex D.)

8.2.2 Oxygen

The oxygen consumption shall be measured to an accuracy of at least ± 0,05 % (volume fraction) oxygen. The oxygen analyser shall have a time constant not exceeding 3 s. (See Annex D.)

8.2.3 Carbon monoxide and carbon dioxide

The gas species shall be measured using analysers having an accuracy of at least ± 0,1 % (volume fraction) for carbon dioxide and ± 0,02 % (volume fraction) for carbon monoxide. The analysers shall have a time constant not exceeding 3 s. (See Annex D.)

8.3 Optical density

8.3.1 General

The optical density of the smoke shall be determined by measuring the light obscuration with a system consisting of a lamp, lenses, an aperture and a photocell (see Figure 2). The system shall be constructed in such a way as to ensure that soot deposits during the test do not reduce the light transmission by more than 5 %.

8.3.2 Lamp

The lamp shall be of the incandescent filament type and shall operate at a colour temperature of 2 900 K ± 100 K. The lamp shall be supplied with stabilized direct current, stable to within ± 0,2 % (including temperature, short-term and long-term stability).

8.3.3 Lenses

The lens system shall align the light to a parallel beam with a diameter, *D*, of at least 20 mm.

8.3.4 Aperture

The aperture shall be placed at the focus of the lens L2 as shown in Figure 2 and it shall have a diameter, *d*, chosen with regard to the focal length, *f*, of L2 so that *d*/*f* is less than 0,04.

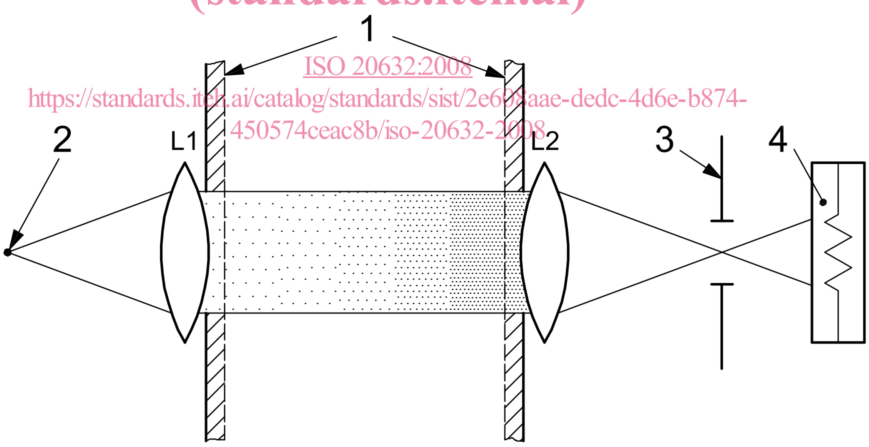
8.3.5 Detector

The detector shall have a spectrally distributed responsivity agreeing with the CIE[1)], V (λ)-function (with CIE photopic curves to an accuracy of at least ± 5 %.

The detector output shall be linear to within 5 % over an output range of at least 3,5 decades.

8.3.6 Location

The light beam shall cross the exhaust duct along its diameter at a position where the smoke is homogenous.



Key

1 wall of exhaust duct

2 lamp

3 aperture

4 detector

L1 and L2: lenses of focal length *f*

Figure 2 — Optical system

1) Commission internationale d'éclairage (International Commission on Illumination).

9 System performance

9.1 Calibration

A calibration test shall be performed prior to each test or continuous test series.

NOTE Equations for calculations are given in Annex B.

The calibration shall be performed at the burner heat outputs given in Table 1, with the burner positioned directly under the hood. Measurements shall be taken every 3 s and shall be started 1 min prior to ignition of the burner. At steady state conditions, the difference between the mean heat release rate over 1 min calculated from the measured oxygen consumption and that calculated from the metered gas input shall not exceed 5 % for each level of heat output.

Table 1 — Burner heat output profile

Time min	**Heat output** kW
0 to 2	0
2 to 7	100
7 to 12	300
12 to 17	100
17 to 19	0

9.2 System response

The time delay for a stepwise change of the heat output from the burner, when placed centrally 1 m below the hood, shall not exceed 20 s and shall be corrected for in-test data. The time delay for each step shall be determined by measuring the time taken to reach agreement to within 10 % of the difference between the initial and final measured heat release value, when going through the stepwise procedure given in Table 1, taking measurements at 3 s intervals.

9.3 Precision

The precision of the system at various volume flow rates shall be checked by increasing the volume flow in the exhaust duct in four equal steps, starting from 2 m^3 s^{-1} (at 0,1 MPa and 25 °C) up to maximum. The heat output from the burner shall be 300 kW. The error in the mean heat release rate, calculated over 1 min, shall be no more than 10 % of the actual heat output from the burner.

10 Preparation of test specimens

10.1 Test specimen configuration

The pipe insulation product shall be mounted as closely as possible to the end use application conditions. It shall be mounted and fixed as pipe sections with a (25 ± 1) mm gap maintained between each of the insulated pipe runs according to the configuration given in Annex A. A three-dimensional view is given in Figure 3.

10.2 Mounting of insulation on pipes

Pipe insulation shall be mounted and fixed on steel pipes. The steel pipes shall have an outside diameter of (21,3 ± 0,1) mm and a thickness of (2,55 ± 0,05) mm.

NOTE 1 Steel pipes produced according to ISO 65[1], medium series, fulfil these criteria.

NOTE 2 The standard configuration is steel pipes, but other types of pipe can be tested if required.

