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English Version

Fire test - Large-scale room reference test for surface products

Essais au feu - Essai dans une pièce en vraie grandeur
pour les produits de surface

Brandverhalten von Bauprodukten - Referenzversuch im
Realmaßstab an Oberflächenprodukten in einem Raum

This European Standard was approved by CEN on 13 October 2006.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Ref. No. EN 14390:2007: E

Contents

Foreword

This document (EN 14390:2007) has been prepared by Technical Committee CEN/TC 127 "Fire safety in buildings", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2007, and conflicting national standards shall be withdrawn at the latest by July 2007.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

This method is intended to describe the fire behaviour of a product under controlled laboratory conditions.

The test method may be used as part of a fire hazard assessment which takes into account all of the factors which are pertinent to an assessment of the fire hazard of a product in a particular end use.

WARNING — 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 test specimens.

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.

Means of extinguishing a fully developed fire should be available.

1 Scope

This European Standard specifies a test method to evaluate the reaction to fire performance of building products. A fire is simulated which under well-ventilated conditions starts in a corner of a small room with a single open doorway.

The method is intended to evaluate the contribution of a surface product to fire growth in a room configuration, using a specified ignition source. It constitutes a reference test for this type of product within the European classification system for reaction to fire performance of construction products.

The method is particularly suitable for construction products which cannot be tested in their end use application in a small or intermediate laboratory scale. The method can also be used to assess the effect of an insulating substrate on the product performance.

A test performed in accordance with the method specified in this European Standard provides data for the early stages of a fire from ignition up to flashover.

The method is not intended to evaluate floor coverings. It may not be suitable for some free-standing products because their integrity, when exposed to fire, could have a decisive influence on their behaviour.

NOTE   The term "surface product" as used in the title and scope of this European Standard specifically relates to internal surface linings, assemblies, pipes and pipe insulation products used in buildings.

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.

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

EN 13501-1:2002, *Fire classification of construction products and building elements — Part 1: Classification using test data from reaction to fire tests*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 13943:2000 and the following apply.

3.1
exposed surface
surface of the product subjected to the heating conditions of the test

3.2
material
single substance or uniformly dispersed mixture

EXAMPLE   metal, stone, timber, concrete, mineral fibre or polymers

3.3
product
material, composite or assembly about which information is required

3.4
test specimen
representative piece of the product which is to be tested together with any substrate or treatment

NOTE   The test specimen may include an air gap.

3.5
surface product
any part of a building that constitutes an exposed surface on the interior walls and/or the ceiling

3.6
flashover
point in the fire history when the sum of the rate of heat release from the ignition source and the product reaches 1 000 kW

3.7
$FIGRA_{RC}$
FIre Growth RAte
growth rate of the fire during a specified time period

3.8
$SMOGRA_{RC}$
SMOke Growth RAte
growth rate of the production of smoke during a specified time period

3.9
burning droplets
continuous occurrence of flaming droplets/particles from the test specimen for at least 10 s or a pool fire formed on the floor

4   Principle

The hazard of fire growth is evaluated in a fire test room by the measurement of the rate of heat release of the fire based on calculation of oxygen consumption. See also Annex B.

The hazard of reduced visibility is estimated by the measurement of the production of light-obscuring smoke.

Phenomena attributed to the fire growth, for example flame spread and emission of burning droplets, are visually documented by photographic and/or video recording.

NOTE   If further information is required, measurements for example of heat flux to the floor, toxic gas species, the gas temperature in the room and the mass flow in and out the doorway may be performed, see also ISO/TR 9705-2:2001 (Bibliography [2]).

5   Fire test room

5.1   Dimensions

The room (see Figure 1) shall consist of four walls at right angles, a floor and a ceiling and shall have the following inner dimensions:

a) length: (3,6 ± 0,05) m;

b) width: (2,4 ± 0,05) m;

c) height: (2,4 ± 0,05) m.

Dimensions in metres
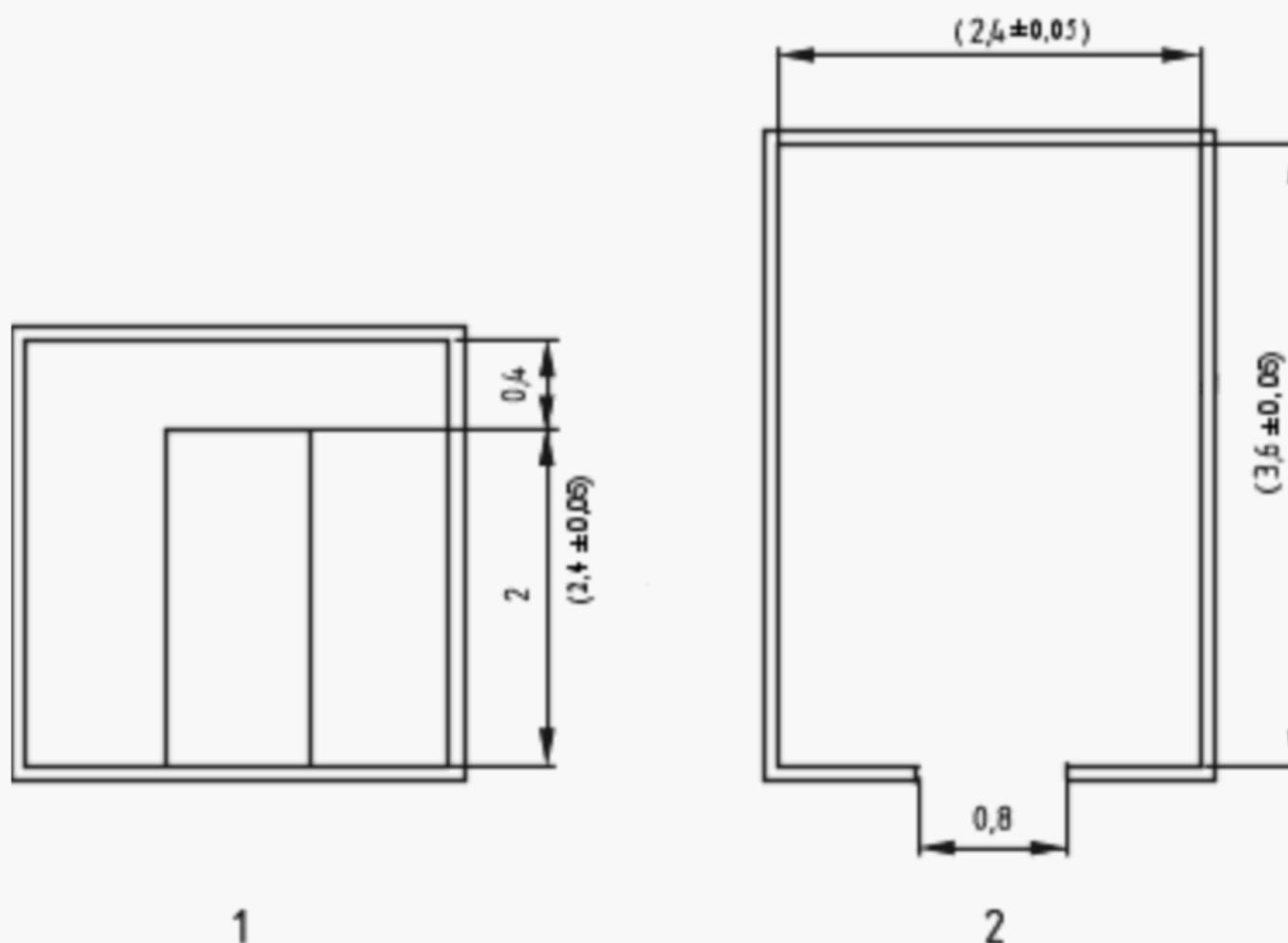
Key

1   front view

2   top view

Figure 1 — Fire test room

The room shall be placed indoors in an essentially draught free, heated space, large enough to ensure that there is no influence on the test fire. In order to facilitate the mounting of the instruments and of the ignition source, the test room may be placed so that the floor can be accessed from beneath.

5.2   Doorway

There shall be a doorway in the centre of one of the 2,4 m × 2,4 m walls and no other wall, floor or ceiling shall have any openings that allow ventilation. The doorway shall have the following dimensions:

a) width: 0,8 m ± 0,02 m;

b) height: 2,0 m ± 0,02 m.

The distance between the top of the doorway and the ceiling shall be (0,4 ± 0,02) m.

5.3   Construction material

The test room shall be constructed of Class A1 material according to EN 13501-1:2002, with a density of (600 ± 200) kg/m^3. The minimum thickness of the construction shall be 20 mm.

6   Ignition source

6.1   General

The ignition source design is specified in Annex A.

The ignition source shall be a propane gas burner having a top surface layer of sand. 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. Attention is therefore drawn to the following warning.

All equipment such as tubes, couplings and flowmeters, should be approved for propane. The installations should be performed in accordance with existing regulations.

The burner should, for reasons of safety, be equipped with a remote-controlled ignition device, for example a pilot flame or a glow wire. There should be a warning system for leaking gas and a valve for immediate and automatic cut-off of the gas supply in case of extinction of the ignition flame.

6.2   Location

The burner shall be placed on the floor in a corner opposite to the doorway wall. The top of the burner shall be 145 mm from the floor level. The burner walls shall be in contact with the test specimen.

6.3   Gas

The burner shall be supplied with commercial grade propane of at least 95 % purity. The gas flow to the burner shall be measured with an accuracy of at least ± 3 %.

6.4   Heat output

The net heat output shall be 100 kW during the first 10 min after ignition and then shall be increased to 300 kW for a further 10 min. The heat output from the burner shall be controlled within ± 5 % of the prescribed value.

7   Hood and exhaust duct

The system for collecting the combustion products shall have sufficient 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 at normal pressure and a temperature of 25 °C. Exhaust systems based on natural convection shall not be used.

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

8 Instrumentation in the exhaust duct

8.1 General

This clause specifies minimum requirements for instrumentation in the exhaust duct. Additional information and designs can be found in Annex C.

8.2 Volume flow rate

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

8.3 Gas analysis

8.3.1 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 C).

8.3.2 Oxygen

The O_2 analyser shall be of the paramagnetic type or equivalent in performance and capable of measuring a range of at least 0 Vol % to 21 Vol % oxygen ($Volume_{oxygenO2}/Volume_{air}$). The uncertainty of measurement shall be $\leq 0,1$ Vol % O_2 when measured as recommended. The stability of the analyser shall be within 0,01 Vol % O_2 over a period of 30 min (measured in accordance with C.3.2). The output from the analyser and also the data acquisition system shall have a resolution of 0,01 Vol % O_2 or better.

8.3.3 Carbon dioxide

The CO_2 analyser shall be of the IR type or equivalent in performance and capable of measuring a range of at least 0 Vol % to 10 Vol % carbon dioxide. The uncertainty of measurement shall be $\leq 0,1$ Vol % CO_2 up to 5 Vol % CO_2 and $\leq 0,2$ Vol % CO_2 from 5 Vol % to 10 Vol % CO_2. The linearity of the analyser shall be 1 % of full scale or better. The output from the analyser and also the data acquisition system shall have a resolution of 0,01 Vol % CO_2 or better. It is sufficient to show linearity of the CO_2 analyser by using three calibration points over the measuring range.

8.4 Optical density

8.4.1 General

The optical density of the smoke is determined by measuring the light obscuration with a system consisting of a lamp, lenses, an aperture and a photocell (see Figure 2).

8.4.2 Lamp

The lamp shall be of the incandescent filament type and shall operate at a colour temperature of (2 900 ± 100) K. The lamp shall be supplied with stabilized direct current, stable within ± 0,5 % (including temperature, short-term and long-term stability).

8.4.3 Lenses

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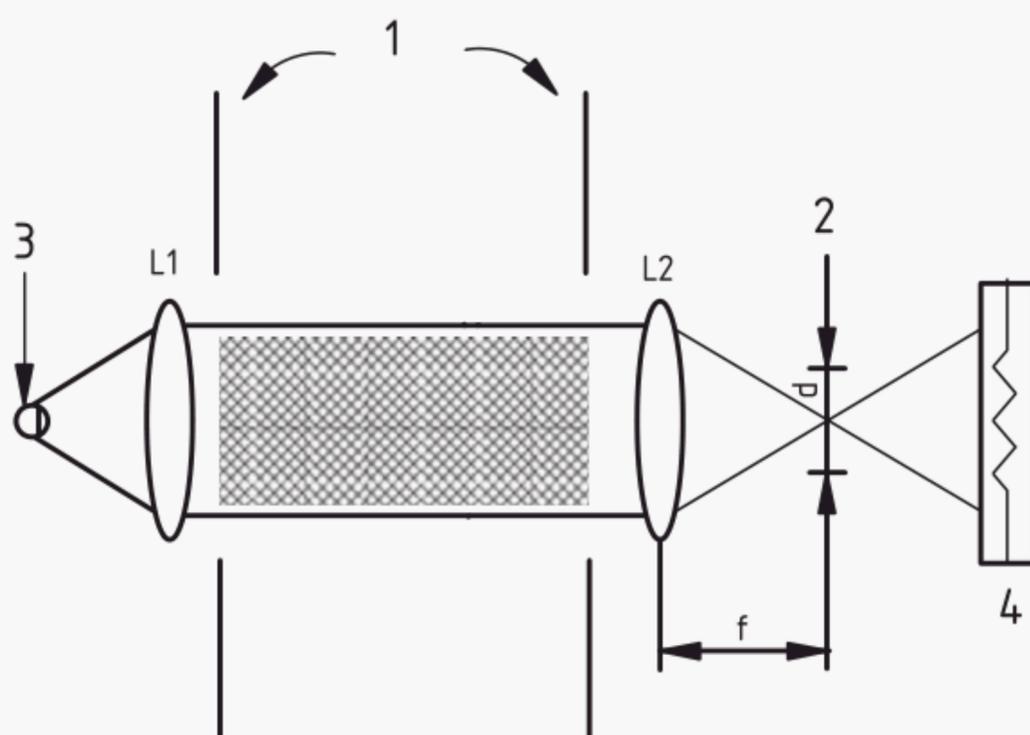
Key

1   walls of exhaust duct

2   aperture

3   lamp

4   detector

Figure 2 — Optical system

8.4.4   Aperture

The aperture shall be placed at the focus of the lens L_2 as shown in Figure 2 and it shall have a diameter, d, chosen with regard to the focal length, f, of L_2 so that d/f is less than 0,04. Other equivalent solutions to avoid light scattering are allowed.

8.4.5   Detector

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

The detector output shall over an output range of at least 2 decades be linear within 5 % of measured transmission value or 1 % absolute transmission.

8.4.6   Location

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

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[1]   Commission internationale d'éclairage.

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 D.

The calibration shall be performed with the burner heat outputs given in Table 1, with the burner positioned directly under the hood. Measurements shall be taken at least every 3 s and shall be started 1 min prior to ignition of the burner. At steady state conditions, the difference between the mean rate of heat release 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.

9.2 System response times

9.2.1 Procedure

The delay times and response times of the gas analysers shall be checked for a stepwise change of the heat output from the burner according to Table 1. The burner shall be placed centrally 3,5 m below the centre line of the duct. Measurements shall be taken every 3 s.

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

9.2.2 Delay times

The delay time of the oxygen analyser shall be calculated as the time difference between a 3 K change in the duct temperature and a 0,05 % change in the oxygen concentration. The delay time of the carbon dioxide analyser is found as the time difference between a 3 K change in the duct temperature and a 0,02 % change in the carbon dioxide concentration. Neither delay time shall exceed 30 s. The data shall be corrected on the basis of these delay times before calculating the heat release rate.

9.2.3 Response times

The response times shall be calculated as the time between a 10 % and 90 % change in the measured oxygen or carbon dioxide level. The response times shall not exceed 12 s.

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 (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 not more than 10 % of the actual heat output from the burner.

9.4 Methanol calibration

9.4.1 General

At least once a year, or more often if needed, a calibration check using methanol shall be performed.

9.4.2 Container

The container for burning the methanol shall be of circular geometry and made of steel. The diameter of the container shall be (720 ± 10) mm and the height shall be (150 ± 10) mm. The thickness of the steel sheets shall be 2,0 mm. This gives a fuel area of (0,41 ± 0,01) m^2.

9.4.3 Methanol

The methanol shall have a purity of at least 98 %. The volume of methanol shall be 10 litres.

NOTE   The fire from the pool will release about 140 kW. A sample of methanol may be collected from the same stock and stored in a separate container. In case any doubt should arise about the purity of the liquid it can be chemically analysed at a later stage.

9.4.4 Procedure

9.4.4.1 General

The calibration procedure is described in the following subclauses.

9.4.4.2 Initial conditions

The fuel container shall be placed on a weighing platform consisting of a slab placed on top of a weight measuring device. The slab shall have the dimensions (1,2 ± 0,05) m x (2,4 ± 0,05) m and be of calcium silicate boards according to EN 13238. The container shall not be insulated from below.

The weight measuring device, e.g. load cells, shall measure the test specimen mass with an accuracy of at least ± 150 g up to at least 90 kg of test specimen mass. It shall be installed in such a way that the heat from the burning sample and any eccentricity of the load does not affect the accuracy. Care shall be taken to avoid range shifts during measurements. All parts of the weight-measuring device, e.g. load cells, shall be below the top level of the slab.

The distance from the upper surface of the slab to floor level shall not exceed 0,5 m. The area between the slab and the floor level shall be shielded in order to avoid lifting forces due to fire induced air flow that could influence the measurement.

The container shall be centred under the hood and be horizontal.

The temperature of the fuel, the container and the temperature measured by the ambient thermocouple shall be (20 ± 5) °C. The fuel container shall be allowed to cool to within 5°C of ambient temperature between tests. The amount of fuel dispensed into the container shall be weighed with an accuracy of ± 100 g.

The horizontal wind draught measured at a distance of 0,5 m from the boundary of the weighing platform level with the slab shall not exceed 0,5 m/s.

9.4.4.3 Volume flow

The volume flow rate of the exhaust system shall be set to $(2,5 \pm 0,5)$ m^3/s.

9.4.4.4 Base line recording

Record a baseline of at least 2 min prior to the ignition of the fuel.

9.4.4.5 Ignition sequence

The fuel shall be ignited in a safe way such that the weighing of the sample is not disturbed, for instance by using a burning taper on a long stick.

9.4.4.6 End of calibration test

After the fuel has burnt out the measurements shall continue for another 2 min.

9.4.5 Requirements for methanol calibration

The effective heat of combustion, ΔHc_{eff}, calculated as the total heat released/total mass lost shall not deviate from the theoretical value of 19,83 kJ/g by more than 10 %. The value 17,3 MJ/m^3 at 25 °C for E (see D.2.2) shall be used.

10 Preparation of test specimens

10.1 Test specimen configuration

The product to be tested shall, as far as possible, be mounted in the same way as in the end use application. The walls (excluding the wall containing the doorway) and the ceiling shall be covered with the product. This is designated as the standard specimen test configuration.

10.2 Boards

In cases where the product to be tested is in board form, the normal width, length and thickness of the boards shall be used as far as possible.

10.3 Mounting

The product shall be attached either to a substrate or directly to the interior of the fire room. The mounting technique (for example, nailing, gluing, using a support system) shall, as far as possible, conform to that used for the product in its end use application. The thickness of the test specimen including an air gap is a maximum 150 mm. The mounting technique shall be clearly stated in the report.

10.4 Substrates

If a substrate is used, it shall be chosen and fixed according to EN 13238 or shall be a substrate used in end use.

10.5 Paints and varnishes

Paints and varnishes shall be applied to the substrates and/or the product as specified by the sponsor.

10.6 Conditioning

Test specimens shall be conditioned according to EN 13238. Any weighing operation shall be performed on a representative piece of the test specimen.

11 Testing

11.1 Initial conditions

11.1.1 Ambient temperature

The temperature in the fire test room and the surrounding area from the start of the installation of test specimens until the start of the test shall be (20 ± 10) °C. Testing outdoors is not permitted. The time between the removal of the test specimens from conditioning and the start of the test shall be kept to a minimum.

11.1.2 Ambient wind speed

The horizontal wind speed measured at a horizontal distance of 1 m from the centre of the doorway shall not exceed 0,5 m/s.

11.1.3 Burner

The burner shall be in contact with the test specimen in the corner wall. The surface area of the burner opening shall be free from debris.

11.1.4 Photographs

The product shall be photographed or video filmed before testing.

11.2 Procedure

11.2.1 Automated recording of data

The following data shall be measured and recorded automatically every 3 s. The recording shall begin at least 2 min before the ignition of the burner and continue to at least 22 min after the ignition or 2 min after flashover, whichever occurs first.

a)   Time (t), in s. The start of recording of data, t = -120 s equates to 2 min before the ignition of the burner.

b)   Mass flow of propane gas to the burner ($\dot{m}_b$) in mg/s. If a rotameter is used, the data shall be added manually.

c)   Pressure difference between the two chambers of the bi-directional probe (Δp), at the measuring point in the exhaust duct, in Pa.

d)   Signal from the light receiver (I), of the white light system at the measuring point in the exhaust duct, in %.

e) O_2 percentage in exhaust flow sampled at the gas sampling probe in the measuring point in the exhaust duct.

f) CO_2 percentage in exhaust flow sampled at the gas sampling probe in the measuring point in the exhaust duct.

g)   The duct temperature (T_S) in the measuring point in the exhaust duct, in K.

11.2.2 Adjustments of burner and exhaust flow

Adjust the burner to the output level given in 6.4 within 10 s of ignition of the burner. Continuously adjust the exhaust capacity so that all of the combustion products are collected.

11.2.3 Photographs

A photographic and/or video recording shall be made of the test. If photographs are taken, there shall be at least 6, including 1 each before starting the test, at the end, at burner ignition and at the increase of burner heat output. A clock shall appear in all photographic records, giving time to the nearest 1 s.

NOTE   It has been found useful to have a hand-held video recorder as well as a fixed one to better record specific events such as flaming droplets/particles.

11.2.4 Observations

During the test, record the following observations, including the time when they occur:

a)   ignition of the ceiling;

b)   whether flames spread down the walls of the test room to within 0,5 m of the floor excluding the area which is within 1,2 m either side of the corner where the ignition source is located;

c)   change of the heat output from the burner;

d)   flames emerging through the doorway;

e)   occurrence and location of flaming droplets/particles;

f)   smoke not captured by the hood or smoke loss through the cracks of the room.

Burning droplets shall be recorded only when occurring outside a distance of 1,2 m from the test specimen corner where the burner is placed.

11.2.5 Termination of test

Stop the test 20 min after ignition of the burner or earlier if flashover occurs.

NOTE   Safety considerations may dictate an earlier termination.

11.2.6 Damage of tested sample

The extent of damage of the product after the test shall be noted.

11.2.7 Unusual behaviour

Any unusual behaviour shall be recorded.

12 Test report

The test report shall contain the following information as a minimum. A clear distinction shall be made between the data provided by the sponsor and data determined by the test.

a)   reference that the test was carried out in accordance with this European Standard, i.e. EN 14390;

b)   any deviations from the test method;

c) name and address of the testing laboratory;

d) date and identification number of the report;

e) name and address of the sponsor;

f) name and address of the manufacturer/supplier, if known;

g) date of sample arrival;

h) identification of the product;

i) description of the sampling procedure, where relevant;

j) a general description of the product tested including density, mass per unit area and thickness, together with the form of construction of the test specimen;

k) description of substrate and fixing to the substrate (if used);

l) details of conditioning;

m) date of test;

n) test results (see Annex D):

  i) time to flashover;

  ii) graphical output of time vs heat release rate (HRR); and if the burner is included, time/heat release from the burner;

  iii) ambient temperature;

  iv) graphical output of time vs smoke production rate (SPR) at actual duct flow temperature;

  v) description of the fire development (photographs);

  vi) $FIGRA_{RC}$ calculated according to Annex D;

  vii) $SMOGRA_{RC}$ calculated according to Annex D;

  viii) Total Smoke Production, TSP, calculated according to Annex D and specifying the time of integration;

  ix) Total Heat Released, THR, calculated according to Annex D and specifying the time of integration;

o) on request of the sponsor: data file with data recorded automatically according to 9.4, and/or latest calibration reports;

p) the statement: "The test results relate only to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the material in use.";

q) visual observations of flame spread and droplets/particles.

Annex A
(normative)

Ignition source

The burner shall be as shown in Figure A.1 having a top surface layer of sand. The burner shall be filled with gravel of size 4 mm to 8 mm and sand of size 2 mm to 3 mm. The two layers shall be stabilized with two metal gauzes: the upper shall be of mesh size 1,4 mm and the lower of mesh size 2,8 mm. The upper layer of sand shall be level with the upper edge of the burner. Dimensions are nominal.

Dimensions in millimetres
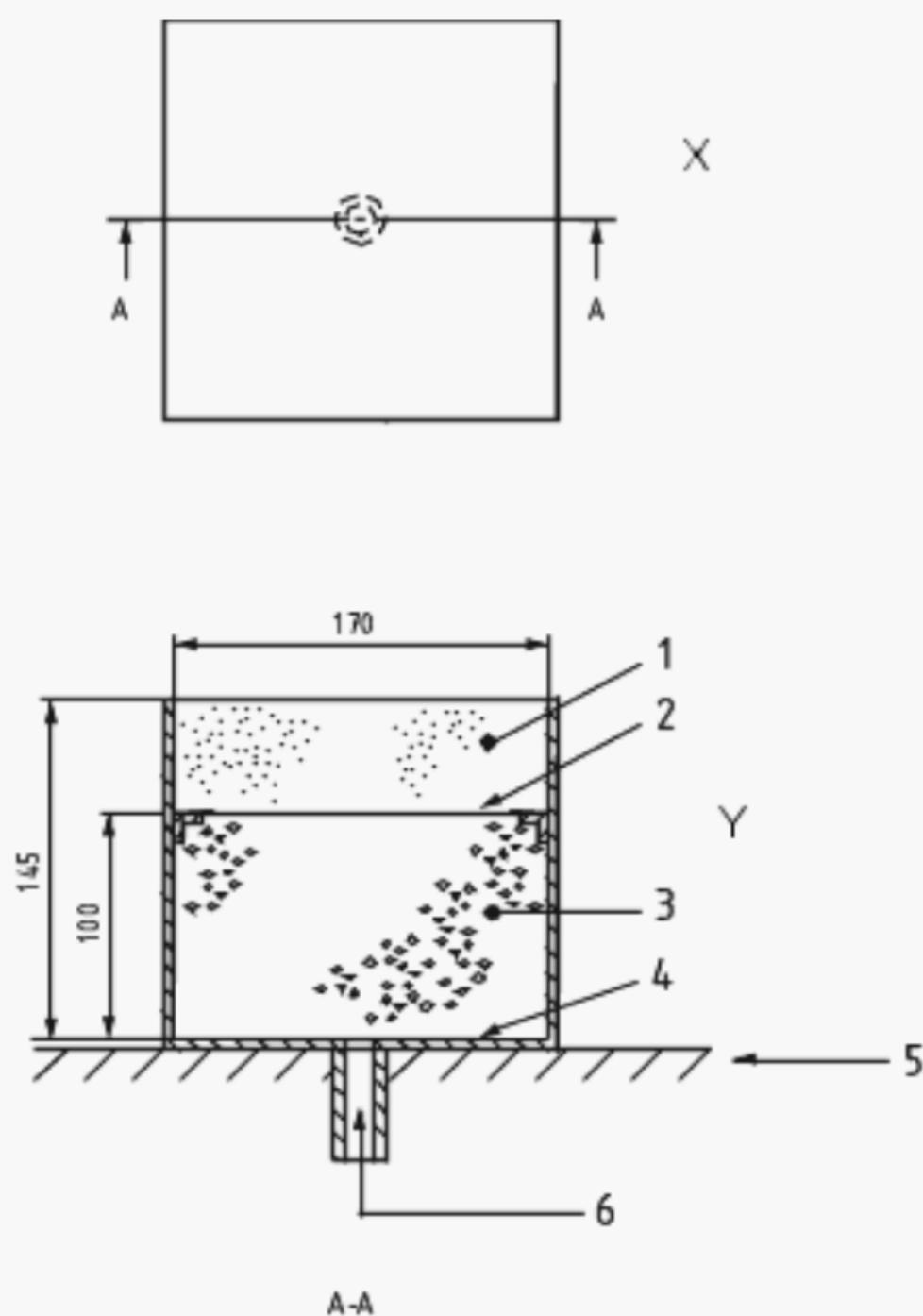
Key

1	sand	4	brass wire gauze
2	brass wire gauze	5	floor of test room
3	gravel	6	gas inlet
X	top view	Y	side view

Figure A.1 — Standard ignition source

Annex B
(informative)

Design of exhaust system

B.1 General

During the fire growth process, the mass flow rate of combustion gases out of the test room can have a magnitude of 1 kg/s and the velocity of the gas, which varies with gas temperature, can be up to 4 m/s. The gases are collected by a hood. The following system has been tested in practice and has proved to comply with the requirements of this European Standard.

B.2 Hood

The hood is located centrally above the opening of the test room with the lower edge aligned to the roof of the room. The bottom dimensions of the hood are 3 m × 3 m and the height 1,0 m (Figure B.1). On three sides, steel sheets are extended 1,0 m downwards (the fourth side is connected to the test room). The effective height of the hood will thus be 2 m (see Figure B.2). The hood feeds into a plenum having a 0,9 m × 0,9 m cross-sectional area. The plenum has a minimum height of 0,9 m.

In the plenum chamber, two plates approximately 0,5 m x 0,9 m are located to increase mixing of the combustion gases (see Figure B.2).

The hood should be designed and manufactured so that no leakage exists.

B.3 Duct

An exhaust duct is connected with the plenum chamber. The inner diameter of the exhaust duct should be 400 mm. The rectilinear duct should have a minimum length of 4,8 m.

To facilitate flow measurement, guide vanes are located at both ends of the exhaust duct (see Figure B.1 and Figure B.2), or the rectilinear part of the exhaust ducts should have such a length that a uniform flow profile is established at point of measurement.

The exhaust duct is connected to an evacuation system.

B.4 Capacity

The capacity of the extraction system should be designed to exhaust at least all combustion gases leaving the test room. This requires an exhaust capacity of at least 4 kg/s (about 12 000 m^3/h at standard atmospheric conditions) corresponding to a driving under pressure of about 2 kPa at the end of the duct. It should be possible to control the exhaust flow between 0,5 kg/s and 4 kg/s during the test process. If the airflow is not decreased during the initial part of the test, measurement precision will be too low.

B.5 Alternative systems

An alternative exhaust system may be used if it has been shown to produce equivalent results. Equivalence is demonstrated by complying with the requirements specified in Clause 9.

Dimensions in millimetres

Key
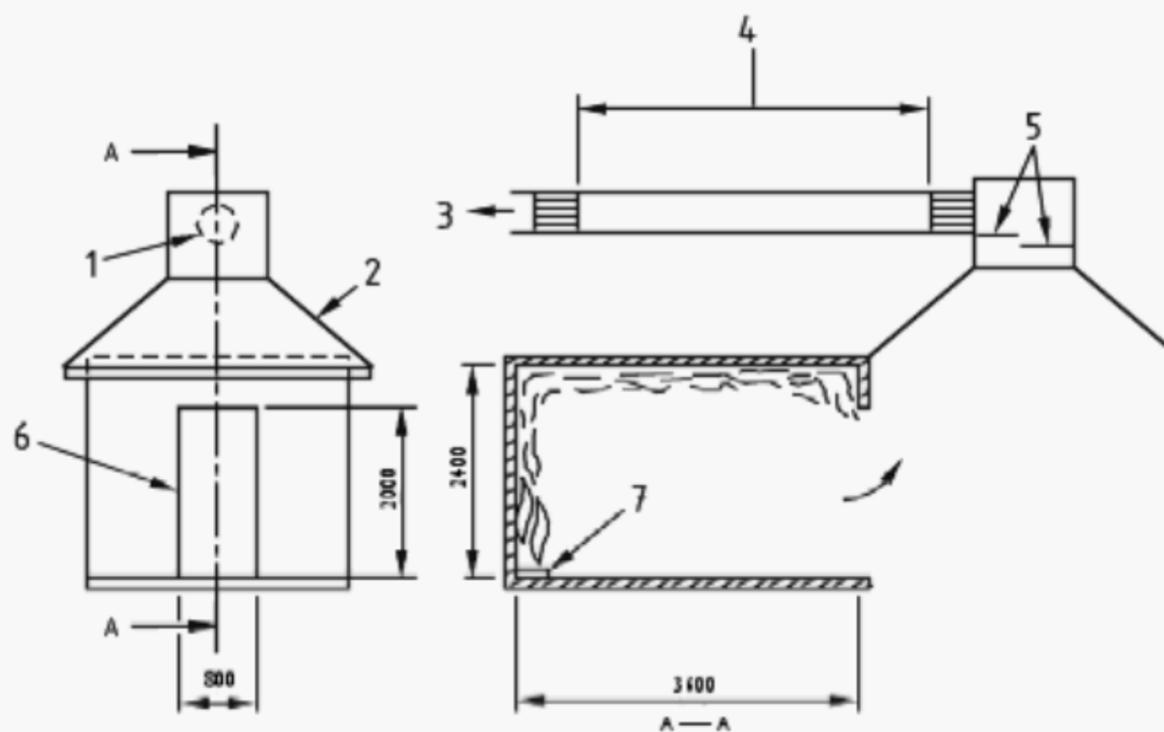
1   exhaust duct (Ø 0,4)

2   hood (3 000 mm x 3 000 mm)

3   to exhaust gas cleaning

4   length 5 000 mm

5   baffles

6   doorway

7   gas burner

Figure B.1 — Principle of design (without steel sheet extensions)

Dimensions in millimetres

Key

1	guide vanes	8	opening 3 000 mm $\times$ 3 000 mm
2	bi-directional probe	9	frame of steel profile 50 mm $\times$ 100 mm $\times$ 3,2 mm
3	guide vanes	10	steel plates 1 000 mm $\times$ 3 000 mm
4	to exhaust gas cleaning	11	steel plates 2 mm $\times$ 500 mm $\times$ 900 mm
5	lamp, photocell system	12	hood of 2 mm thick steel plates
6	gas analysis	13	4 steel plates 395 mm $\times$ 400 mm
7	exhaust duct Ø 400 mm		

Figure B.2 — Details of exhaust system and location of sampling probes

Annex C
(informative)

Instrumentation in exhaust duct

C.1 Volume flow[2)]

C.1.1 Bi-directional probe

The flow may be measured by a bi-directional probe located at the centre line of the duct. The probe shown in Figure C.1 consists of a stainless steel cylinder, 32 mm long and with an inner diameter of 14 mm. The cylinder is divided into two equal chambers. The pressure difference between the two chambers is measured by a pressure transducer. The plot of the probe response versus the Reynolds number is shown in Figure C.2.

C.1.2 Pressure transducer

The pressure transducer should have a measuring precision better than ± 5 Pa and be of the capacitance type. A suitable range of measurement is 0 Pa to 2 000 Pa. The response time of the pressure transducer should be less than 3 s.

C.1.3 Thermocouple

The gas temperature in the immediate vicinity of the probe is measured by a type K sheathed thermocouple with a maximum diameter 0,25 mm. The thermocouple should not be allowed to disturb the flow pattern around the bi-directional probe.

C.2 Sampling line

C.2.1 Sampling probe

The sampling probe should be located where the exhaust duct flow is well mixed. The probe should have a cylindrical form so that disturbance of flow is minimised. The gas samples should be taken along the whole diameter of the exhaust duct.

C.2.2 Sampling line

The sampling line (see Figure C.3) should be manufactured from non-corrosive material, e.g. PTFE. The combustion gases should be filtered with inert filters to the degree of particle concentration required by the gas analysis equipment. The filtering procedure should be carried out in more than one step. The gas mixture should be cooled to a maximum of 10 °C.

For gases other than CO, CO_2 and O_2, heated sampling lines (150 °C to 175 °C) should be used. The sampling lines should be as short as possible. The gases should be filtered with heated filters at the same temperature as the sampling line to avoid creating any cold points along the whole of the sampling line (see also C.2.3 and C.2.4).

[2)] Suitable locations for the probes described in C.1 to C.4 are shown in Figure C.3.

C.2.3 Pump

The combustion gas should be transported by a pump which does not emit oil, grease or similar products, which can contaminate the gas mixture. A membrane pump is suitable.

C.2.4 Sampling line end

Gas from the sampling line should be distributed to the various analysers without causing a pressure gradient. Suitable systems include either a container vented to atmosphere or a pressure control valve.

C.2.5 Specifications

A suitable sampling probe is shown in Figure C.4. The sampling line is shown in Figure C.3. A suitable pump should have the capacity of 10 l/min to 50 l/min. The pump should generate a pressure differential of at least 10 kPa to reduce the risk of smoke clogging of the filters. The intake of the sampling probe is turned downstream in order to avoid soot clogging in the probe.

C.3 Combustion gas analysis

C.3.1 General

The analysis of oxides of carbon and oxygen requires that any water vapour in the combustion gases is trapped out by means of a suitable drying agent, e.g. anhydrous calcium sulphate. Silica gel is not suitable.

C.3.2 Oxygen concentration

The stability of the oxygen analyser output using the data acquisition system should be checked after set up, maintenance, repair or replacement of the oxygen analyser or other major components of the gas analysis system and at least every six months.

The procedure for checking the stability of the oxygen analyser output should be as follows:

a) feed the oxygen analyser with oxygen-free nitrogen gas, until the analyser reaches equilibrium;

b) after at least 60 min in oxygen-free conditions, adjust the volume flow in the exhaust duct to $(2,5 \pm 0,5)$ m^3/s and switch to air from the exhaust duct with the same flow rate, pressure and drying procedure as for sample gases. When the analyser reaches equilibrium, adjust the analyser output to $(20,95 \pm 0,01)$ %;

c) within 1 min, start recording the oxygen analyser output at intervals ≤ 3 s for a period of 30 min;

d) determine the drift by use of the least squares fitting procedure to fit a straight line through the data points. The absolute value of the difference between the readings at 0 min and at 30 min of this linear trend line represents the drift;

e) determine the noise by computing the root-mean-square (rms) deviation around the linear trend line.

The sum of drift and noise (both taken as positive values) should not be more than 0,01 % (V_{O_2} / V_{air}).

C.3.3 Carbon dioxide concentration

The carbon dioxide analyser should comply with the requirements specified in 8.3.3.

C.4 Optical density

C.4.1 General

Typical components of a suitable light measuring system are as follows:

Lenses: Plane convex; diameter 40 mm, focal length 50 mm.

Lamp: Halogen lamp; 6 V, 10 W.

Photocell: Silicon photodiode with a coloured glass subtractive filter that produces a spectral response equivalent to that of the human eye.

The photocell is connected to an appropriate resistance or amplifier that gives a minimum resolution of 2 decades. Lenses, lamp and photocell are mounted inside two housings, located on the exhaust duct diametrically opposite each other.

The system should be self-cleansing with respect to soot deposits, which may be achieved by having holes in the periphery of the two housings with the system being under pressure in the exhaust duct.

A suitable light measuring system is given in ISO/TR 5924.

C.4.2 Calibration

C.4.2.1 General

The light system calibration should be performed before tests, after set up, maintenance, repair or replacement of the smoke measurement system holder or other major components of the exhaust system and at least every six months. The calibration consists of two parts: an output stability check and an optical filter check.

C.4.2.2 Stability check

Perform the following steps with the measuring equipment operating:

a) set the volume flow of the exhaust to: $\dot{V}_{298} = (2{,}5 \pm 0{,}5)$ m^3/s;

b) start the time measurement and record the signal from the light receiver for a period of 30 min;

c) determine the drift by use of a least squares fitting procedure to fit a straight line through the data points. The absolute value of the difference between reading at 0 min and at 30 min of this linear trend line represents the drift;

d) determine the noise by computing the root-mean-square (rms) deviation around the linear trend line.

Criterion: Both noise and drift should be less than 0,5 % of the start value.

C.4.2.3 Optical filter check

The light system should be calibrated with at least five neutral density filters in the optical density range of 0,05 to 2,0. The optical density calculated with the measured light receiver signal should be within ± 5 % or ± 0,01 of the theoretical value of the filters. ND filters are strongly recommended. The filters should be calibrated using the correct IEC curve for the response of the human eye.

Dimensions in millimetres

Key
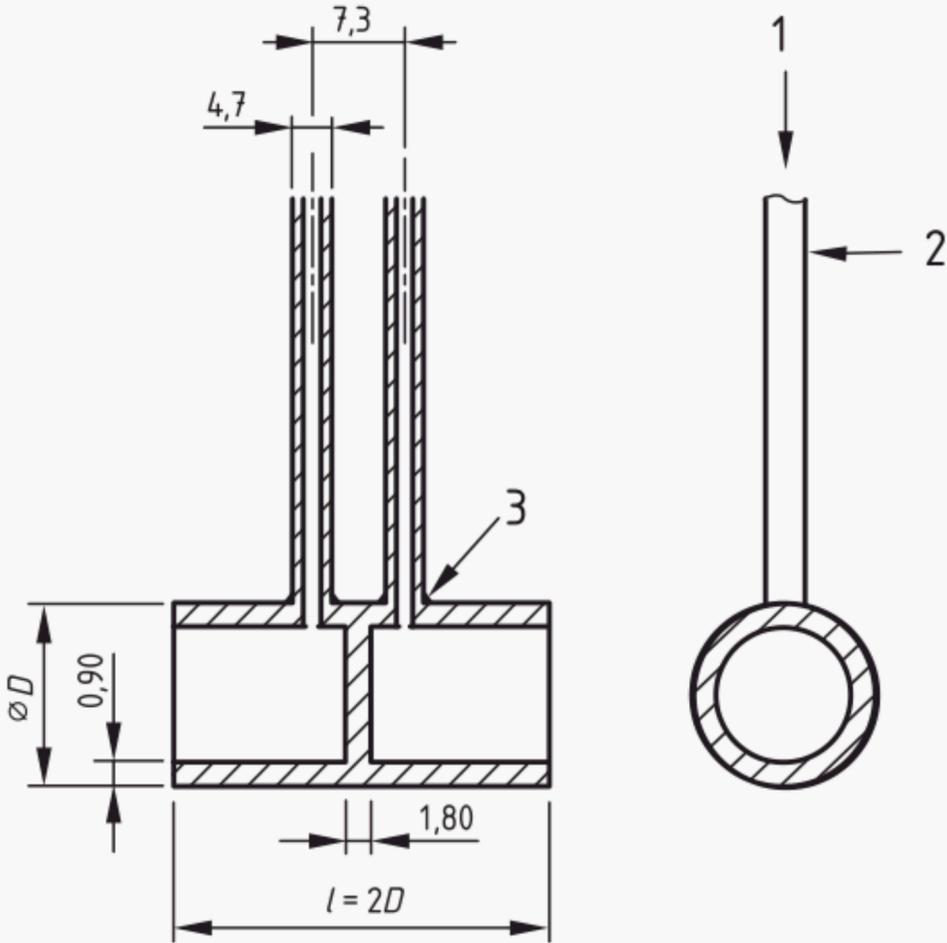
1   to Δp instrument

2   variable length support tubes

3   weld

NOTE   Taken from McCaffrey and Heskestad (Bibliography [3]).

Figure C.1 — Bi-directional probe

Key

Symbol	D mm
○	12,7
□	15,9 ref.2
◇	25,4
×	22,2 ref.1
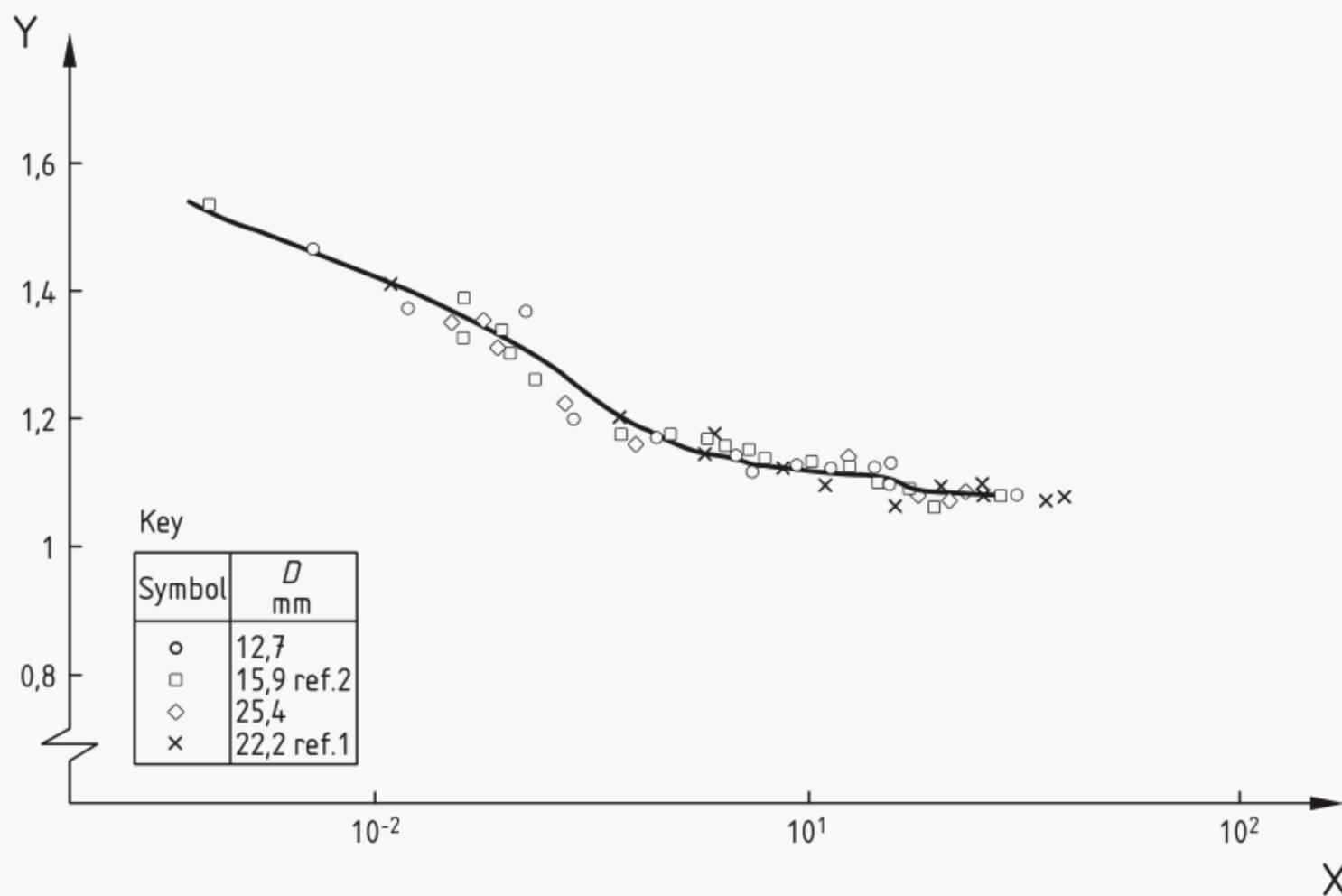
$$X \quad Re = \frac{\rho V D}{\mu} \qquad Y \quad \frac{\left(\dfrac{2\Delta p}{\rho}\right)^{1/2}}{V}$$

Figure C.2 — Probe response versus Reynolds number

1   Source: MCCAFFREY and HESKESTAD (Bibliography [3]).

2   The pressure differences were measured with a sensitive electronic manometer; the uniform low velocity flows were provided by two independent facilities described in McCaffrey and Heskestad. Basically, a hot wire anemometer and pitot-static tube, where appropriate, were used to determine the stream velocity. For data reduction via computer, the polynomial curve fit obtained for the points shown in Figure C.2 is:

$(2\,\Delta p\,/\,p)^{1/2}/V = 1{,}533 - 1{,}366 \times 10^{-3}\,Re + 1{,}688 \times 10^{-6}\,Re^{2} - 9{,}706 \times 10^{-10}\,Re^{3} + 2{,}555 \times 10^{-13}\,Re^{4} - 2{,}484 \times 10^{-17}\,Re^{5}$

This representation is valid for 40 < Re < 3 800 and is accurate to about 5 %.

3   A suitable value of D is 16 mm.
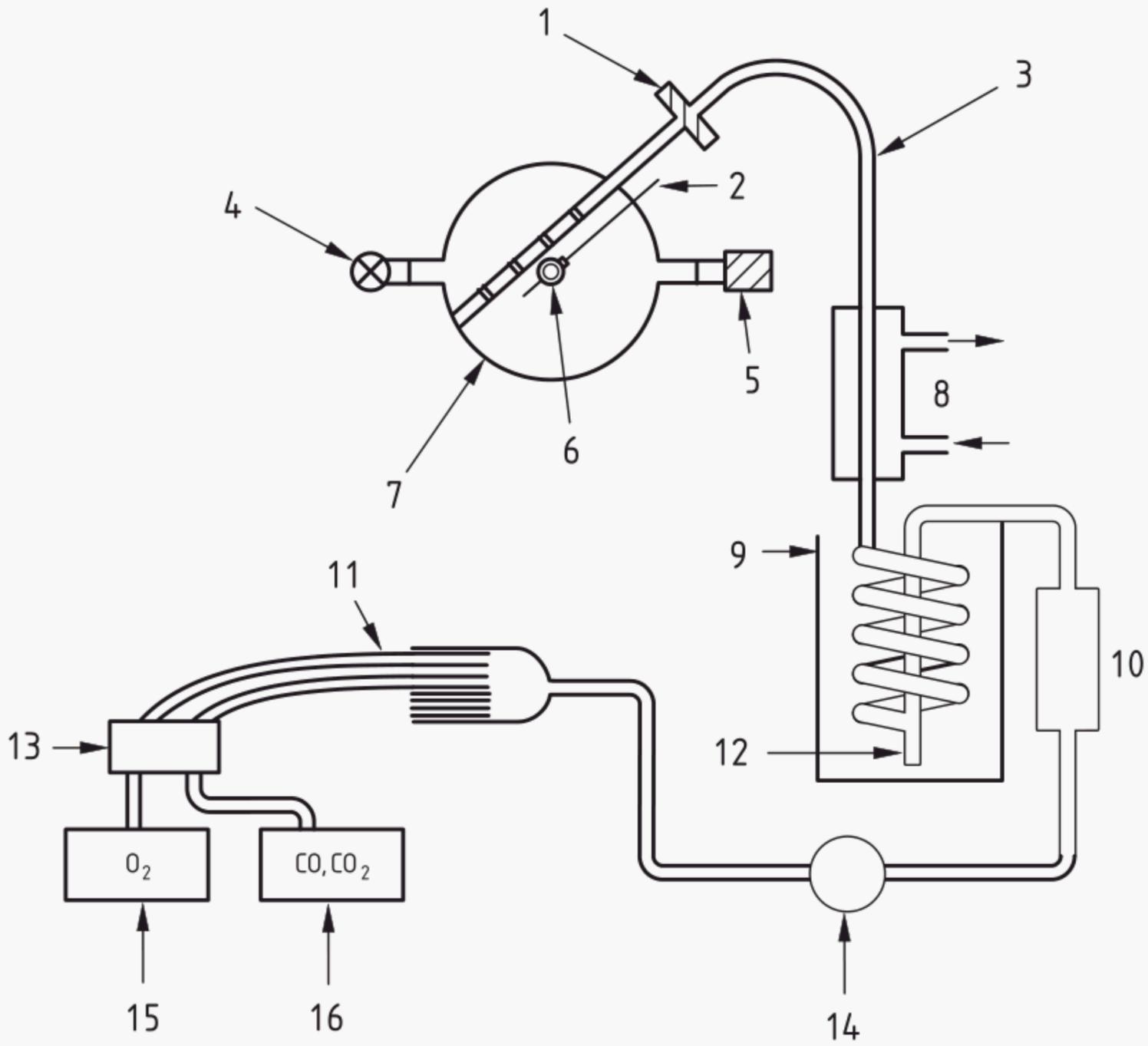
1	glass filters 150 μm to 200 μm
2	thermocouple
3	stainless steel sampling line Ø 10 mm
4	lamp
5	photocell
6	bi-directional probe
7	exhaust duct
8	water cooler
9	cooler
10	membrane filter 3 μm
11	surplus gas
12	water drainage
13	filter for water absorption
14	membrane pump
15	paramagnetic oxygen analyser (O_2)
16	infrared spectrophotometer (CO, CO_2)

Figure C.3 — Principle of sampling line with gas analysis

Dimensions in millimetres
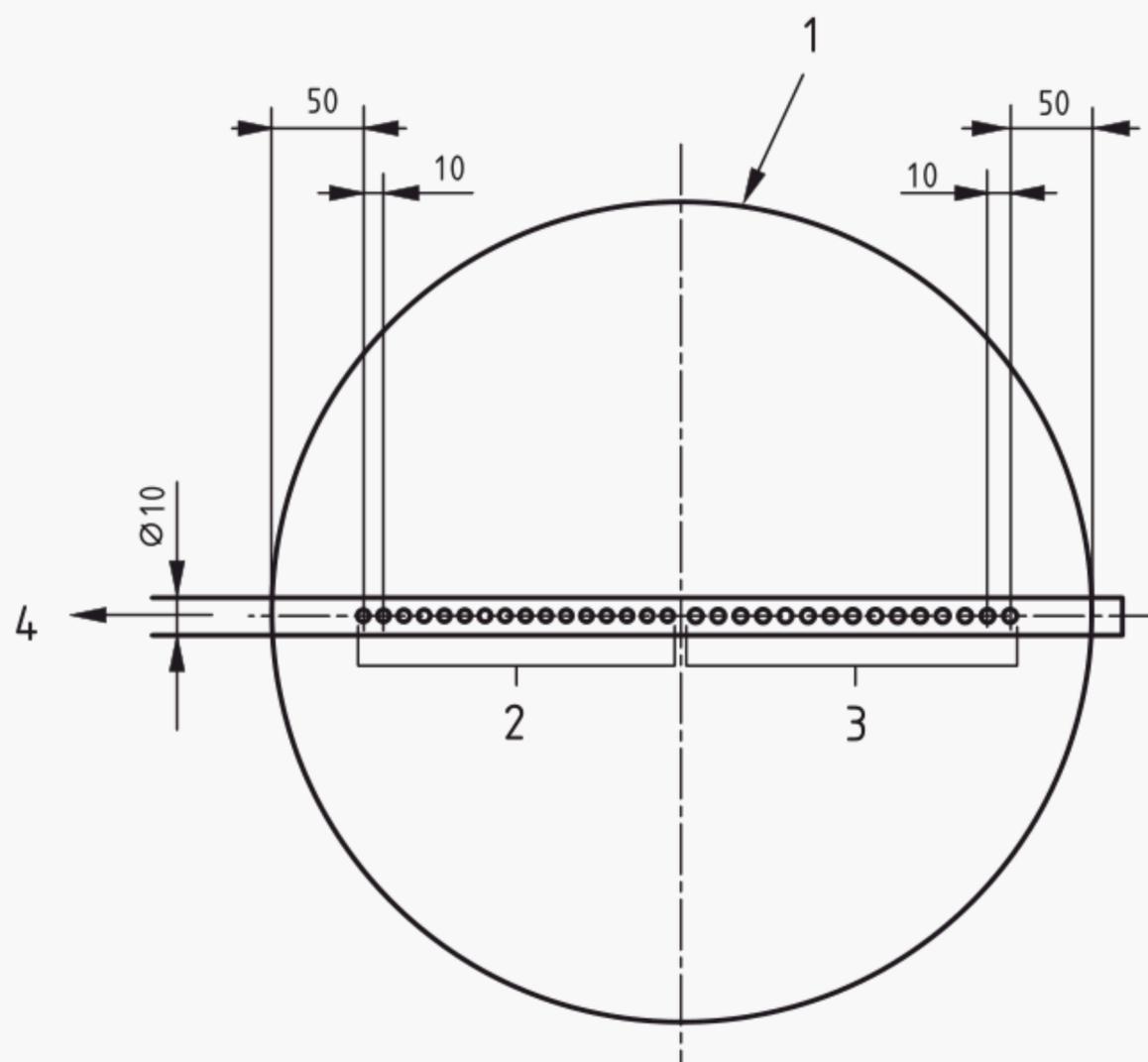
Key

1   exhaust duct

2   16 Ø 2 mm holes on down stream side of flow

3   15 Ø 3 mm holes on down stream side of flow

4   flow direction

Figure C.4 — Sampling probe

Annex D
(normative)

Calculation

D.1 Volume flow

For the instrumentation described in C.1, the volume flow in the exhaust duct, $\dot{V}_{298}$, expressed in cubic metres per second, related to atmospheric pressure and an ambient temperature of 25 °C, is given by the equation:

$$\dot{V}_{298} = (Ak_t / k_p) \times \frac{1}{\rho_{298}} \times (2\Delta p T_o \rho_o / T_s)^{1/2} \tag{D.1}$$

$$= 22,4(Ak_t / k_p)(\Delta p / T_s)^{1/2} \tag{D.2}$$

where

T_s is the gas temperature in the exhaust duct, expressed in Kelvin (K);

T_o = 273,15 K;

Δp is the pressure difference measured by the bi-directional probe, expressed in Pascals (Pa);

ρ_{298} is the air density at 25 °C and atmospheric pressure, expressed in kilograms per cubic metre (kg/m^3);

ρ_o is the air density at 0 °C and 0,1 MPa, expressed in kilograms per cubic metre (kg/m^3);

A is the cross-sectional area of exhaust duct, expressed in square metres (m^2);

k_t is the ratio of the mean mass flow per unit area to the mass flow per unit area in the centre of the exhaust duct;

k_p is the Reynolds number correction for the bi-directional probe suggested by McCaffrey and Heskestad. In the exhaust, duct conditions are such that Re is usually larger than 3 800 hence k_p may be taken as constant and equal to 1,08.

Equation (D.1) assumes that density changes in the combustion gases (related to air) are caused solely by the temperature increase. Corrections due to a changed chemical composition or humidity content may be ignored except in studies of the extinguishment process with water. The calibration constant k_t is determined by measuring the temperature and flow profile inside the exhaust duct along a cross-sectional diameter. Several series of measurements shall be made with representative mass flows and with both warm and cold gas flows. The error when determining the k_t factor shall not exceed ± 3 %.

D.2 Generated heat effect, calibration and tests process

D.2.1 Heat release rate from the ignition source

During the calibration process, the heat release rate from the ignition source, $\dot{q}_b$, expressed in kilowatts, is calculated from the consumption of propane gas from the equation:

$$\dot{q}_b = \dot{m}_b \Delta h_{c,eff} \tag{D.3}$$

where

$\dot{m}_b$ is the mass flow rate of propane to the burner, expressed in grams per second (g/s);

$\Delta h_{c,eff}$ is the effective lower heat combustion of propane, expressed in kilojoules per gram (kJ/g).

Assuming a combustion efficiency of 100 %, $\Delta h_{c,eff}$ may be set equal to 46,4 kJ/g.

D.2.2 Heat release rate from the product

Prior to ignition of the burner (11.2.1) the following parameters shall be recorded over a period of two minutes:

a)   the ambient temperature (T_a). This is taken as the mean duct temperature T_s measured over 1 min from the time t = -90 s to t = -30 s;

b)   the initial value for the oxygen ($x^0_{O_2}$) shall be measured as the mean over 1 min from the time t = -90 s to t = -30 s;

c)   the initial value for the carbon dioxide ($x^0_{CO_2}$) shall be measured as the mean over 1 min from the time t = -90 s to t = -30 s;

d)   the initial value for the light intensity (I_0) shall be measured as the mean over 1 min from the time t = -90 s to t = -30 s.

The rate of heat release from a tested product $\dot{q}$, expressed in kilowatts, is calculated from the equation:

$$\dot{q} = E^1 \dot{V}_{298} x^a_{O_2} \left(\frac{\phi}{\phi(\alpha - 1) + 1} \right) - \frac{E^1}{E_{C_3H_8}} \dot{q}_b \tag{D.4}$$

with Φ, the oxygen depletion factor, given by:

$$\phi = \frac{x^0_{O_2}(1 - x_{CO_2}) - x_{O_2}(1 - x^0_{CO_2})}{x^0_{O_2}(1 - x_{CO_2} - x_{O_2})} \tag{D.5}$$

and the ambient mole fraction of oxygen ($x^a_{O_2}$), given by:

$$x^a_{O_2} = x^0_{O_2} \left[1 - \frac{H}{100 p} \exp\left\{ 23,2 - \frac{3816}{T_a - 46} \right\} \right] \tag{D.6}$$

where

E is the heat release per volume of oxygen consumed, expressed in kilojoules per cubic metre (kJ/m^3), $E^1 = 17,2 \times 10^3$ kJ/m^3 (25 °C) for combustion of the tested product. If another value of E is used, that shall be reported and justified;

$E_{C_3H_8}$ $= 16,8 \times 10^3$ kJ/m^3 (25 °C) for combustion of propane;

E_{CH_3OH} $= 17,3 \times 10^3$ kJ/m^3 for combustion of methanol;

V_{298} is the volume flow rate of gas in the exhaust duct at atmospheric pressure and 25 °C calculated as specified in D.1, expressed in cubic metres per second (m^3/s);

α is the expansion factor due to chemical reaction of the air that is depleted of its oxygen ($\alpha = 1,105$ for combustion of the tested product);

$x_{O_2}^a$ is the ambient mole fraction of the oxygen including water vapour;

$x_{O_2}^0$ is the initial value of the oxygen analyser reading, expressed as a mole fraction;

x_{O_2} is the oxygen analyser reading during the test, expressed as a mole fraction;

$x_{CO_2}^0$ is the initial value of the carbon dioxide analyser reading during the test, expressed as a mole fraction;

x_{CO_2} is the carbon dioxide analyser reading during test, expressed as a mole fraction;

H is the relative humidity (%);

p is the ambient pressure (Pa);

$\dot{q}_b$ is the heat release rate from the burner.

Subtracting the heat release from the burner at the very beginning of a test will produce negative values of $\dot{q}$. This is due to combustion gas fill-up times in the room, transportation times to the hood etc. All negative values of $\dot{q}$ shall be set to zero.

D.2.3 Calculation of total heat release

The total heat release from a tested product, $THR(t)$, is defined as:

$$THR(t) = \int_0^t HRR(t)dt \tag{D.7}$$

where

$THR(t)$ is total heat release at time t;

$HRR(t)$ is heat release rate at time t.

The total heat release is calculated numerically at a time t = $N \times \Delta t$ as

$$THR(N \times \Delta t) = \sum_{n=1}^{N} HRR(n \times \Delta t) \times \Delta t \qquad \text{(D.8)}$$

where

Δt is a constant time increment chosen not to be longer than 3 s;

N is the total number of time increments.

N is chosen according to actual requirements of time duration. N may be chosen so that $N \times \Delta t$ is equal to the duration of the test. If flashover occurs, $N \times \Delta t$ shall be one record less than the time to flashover. The time to flashover is defined in D.5.1.

D.2.4 Limitations

Equations (D.3) to (D.6) are based on certain approximations leading to the following limitations:

a) the amount of CO generated is not taken into consideration. Normally, the error is negligible. If the concentration of CO is measured, corrections can be calculated for those cases where the influence of incomplete combustion may have to be quantified;

b) the influence of water vapour on the measurement of flow and gas analysis is only partially taken into consideration. A correction for this error can be obtained only by continuous measurement of the partial water vapour pressure;

c) the value of 17,2 MJ/m^3 for the factor E is an mean value for a large number of products and gives an acceptable accuracy in most cases. It shall be used unless a more accurate value is known, in which case the used E-value shall be reported.

These accumulated errors should normally be less than 10 %.

D.3 Combustion gases

By measuring the mole fraction of a specified gas, it is possible to calculate the instantaneous rate of gas production $\dot{V}_{gas}$, expressed in cubic metres per second at 0,1 MPa and 25 °C (m^3/s) and the total amount of gas production V_{gas}, expressed in cubic metres at 0,1 MPa and 25 °C (m^3), from the following:

$$\dot{V}_{gas} = \dot{V}_{298} x_i \qquad \text{(D.9)}$$

$$V_{gas} = \int_{0}^{t} \dot{V}_{gas} dt \qquad \text{(D.10)}$$

where

$\dot{V}_{298}$ is the rate of volume flow in exhaust duct, expressed in cubic metres per second at 0,1 MPa and 25 °C (m^3/s);

x_i is the mole fraction of specified gas in the analyser;

t is the time from ignition, expressed in seconds (s).

D.4 Light obscuration

D.4.1 General

The optical density is represented by the extinction coefficient, k, expressed in reciprocal metres (m^{-1}), and is defined as follows:

$$k = \frac{1}{L} \ln \left[\frac{I_o}{I} \right] \qquad \text{(D.11)}$$

where

I_0 is the light intensity for a beam of parallel light rays measured in a smoke free environment with a detector having the same spectral sensitivity as the human eye;

I is the light intensity for a parallel light beam having traversed a certain length of smoky environment;

L is the length of beam through smoky environment, expressed in metres (m).

The instantaneous smoke production rate, SPR, expressed in square metres per second (m^2/s), and the total amount of smoke, TSP, expressed in square metres (m^2) are then calculated from:

$$SPR(t) = k\dot{V}_s \qquad \text{(D.12)}$$

where

$\dot{V}_s$ is the volume flow rate in the exhaust duct at actual duct gas temperature, expressed in cubic metres per second (m^3/s),

t is the time from ignition of the burner, expressed in seconds (s).

D.4.2 Calculation of SPR_{smooth}

$SPR_{smooth}(t)$ is the mean of $SPR(t)$ over 60 s, calculated as in equation D.13:

$$SPR_{smooth}(t) = \frac{SPR(t-30s) + SPR(t-27s) + ... + SPR(t+27s) + SPR(t+30s)}{21} \qquad \text{(D.13)}$$

During flashover, the first minute and the last minute of a test the calculation of SPR_{smooth} according to equation (D.13) does not apply as the required 21 records are not available. For those cases the procedures given below apply.

Beginning of test:

For t = 0 s: SPR_{smooth} = 0 m^2/s,

For t = 3 s: SPR_{smooth} = SPR mean over the period (0 s ... 6 s),

For t = 6 s: SPR_{smooth} = SPR mean over the period (0 s ... 12 s),

For t = 27 s: SPR_{smooth} = SPR mean over the period (0 s ... 54 s),

For t ≥ 30 s: SPR_{smooth} is calculated according to Equation (D.13).

End of test:

SPR_{smooth} is calculated according to Equation (D.13) until the data point $SPR(t + 30\ s)$ is one record from the flashover point or, if there is no flashover, until $SPR(t + 30\ s)$ = 19 min 57 s. This means that there are no values of SPR_{smooth} given for the last 10 records, 30 s, of a test.

Flashover faster than 60 s:

In cases of flashover in shorter time than 60 s, SPR_{smooth} is calculated as the time mean over the entire actual time interval. The corresponding value of t is taken at the middle of the time interval.

D.4.3 Calculation of TSP

The total smoke production, $TSP(t)$, is defined as:

$$TSP(t) = \int_{0}^{t} SPR(t)dt \qquad\qquad (D.14)$$

where

$TSP(t)$ is total smoke production at time t;

$SPR(t)$ is smoke production rate at time t.

Any negative values of $SPR(t)$ shall be set to zero when calculating the TSP value.

The total smoke production is calculated numerically at a time $t = N \times \Delta t$ as:

$$TSP(N \times \Delta t) = \sum_{n=1}^{N} SPR(n \times \Delta t) \times \Delta t \qquad\qquad (D.15)$$

where

Δt is a constant time increment chosen not to be longer than 3 s;

N is the total number of time increments.

N is chosen according to actual requirements of time duration. N may be chosen so that $N \times \Delta t$ is equal to the duration of the test. If flashover occurs $N \times \Delta t$ shall be one record less than the time to flashover. The time to flashover is defined in D.5.1.

D.5 Calculation of *FIGRA*$_{RC}$ and *SMOGRA*$_{RC}$

D.5.1 Time to flashover

Time to flashover is the time when the total *HRR* (*HRR* of product + *HRR* of burner) is 1 000 kW. It is found by linear interpolation between the nearest two measured data points.

D.5.2 Calculation of *FIGRA*$_{RC}$, FIre Growth RAte index

$$FIGRA_{RC} = PeakHRR_{product}/t \qquad (kW/s) \tag{D.16}$$

where

PeakHRR$_{product}$ = Maximum *HRR* from the product (contribution from ignition source is excluded) during the test;

t = test time in s corresponding to the *PeakHRR*$_{product}$.

At the time of flashover the total *HRR* is 1 000 kW (see 3.7). This means that peak *HRR* from the product can be either 900 kW or 700 kW depending on whether flashover occurs when the *HRR* of the ignition source is 100 kW or 300 kW, see Figure D.1. If flashover occurs, the value of *FIGRA*$_{RC}$ recorded is taken as that pertaining at the time.

For very small fires, i.e. a *HRR* less than or equal to 50 kW, the index may become uncertain and include noise. Therefore if the maximum *HRR* is less than 50 kW, *FIGRA*$_{RC}$ is set to zero.
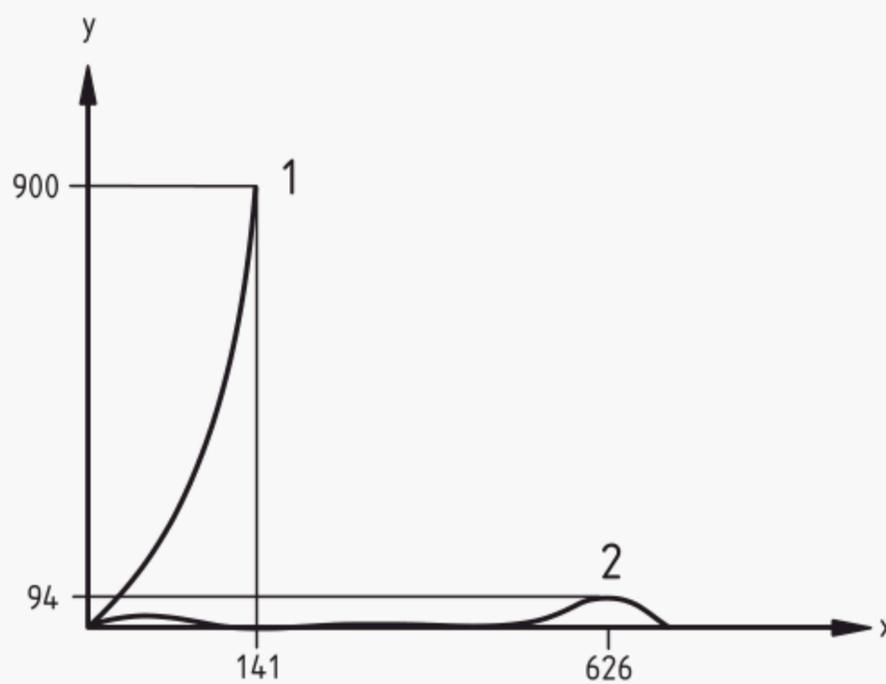
Key

x   time (s)

y   *HRR* from product (kW)

1   *FIGRA*$_{RC}$ = 900/141 = 6,4

2   *FIGRA*$_{RC}$ = 94/626 = 0,15

Figure D.1 — Calculation of the *FIGRA*$_{RC}$ index (two typical responses are shown)

D.5.3 Calculation of $SMOGRA_{RC}$, SMOke Growth RAte index

$$SMOGRA_{RC} = 1\,000\,PeakSPR_{smooth}/t \qquad\qquad\qquad (D.17)$$

where

$PeakSPR_{smooth}$ = maximum SPR_{smooth} during test, defined as in D.4.2;

t = test time in s corresponding to the $PeakSPR_{smooth}$.

When maximum SPR_{smooth} occurs at the end of a test (at flashover or at 20 min) then the test time t is taken as the time when the last calculation of SPR_{smooth} was performed. For flashover time shorter than within 60 s there is only one value of SPR_{smooth} and a corresponding t; these are used to calculate $SMOGRA_{RC}$.

Optionally $SMOGRA_{RC}$ data may also be reported as a graph from ignition to the point of flashover.

Correction for smoke produced by the ignition burner is small and may be neglected.

If the smoke production from the product is very small the index may become uncertain and be influenced by the smoke production from the burner. Therefore if the maximum SPR is less than 0,3 m^2/s, $SMOGRA_{RC}$ is set to zero.

Annex E
(informative)

Calculation examples

E.1 General

This annex shows two examples of the calculation procedure as described in Annex D. Both the examples are constructed, and do not represent the fire behaviour of existing products. The first page in each example is a common datasheet for the test including all test conditions, check points and the final results as the calculation of $FIGRA_{RC}$ and $SMOGRA_{RC}$ plus the diagrams for HRR, SPR and the flow. The following pages show tables for the calculation of each time step, including a proposal for the raw data file set up.

E.2 Example number 1

This shows a test which goes to the full duration, in which the product gives a small peak after the burner is increased to 300 kW. In order to minimise the data presented, only time steps from –120 s to 120 s and 540 s to 780 s, where the peak values occur, are shown.

E.3 Example number 2

This example shows a product with a fast flashover and then a stop of the test.

Large-scale room reference test for surface products

Product:		Operator	Test Date:	Print Date:
Example no.1		Operator	02-08-99	18-08-00

Test condition		Check points		Results	
Ambient Temp. $T_{s(t=-90...-30)}$[°K]	299.9	Minimum flow rate [m³/s]	2.22	Maximal HRR [kW]	327
Ambient pressure. [Pa]	101030	Maximum flow rate [m³/s]	2.58	Time to max HRR [s]	669
Humidity [%]	37.0			interpolated time to flashover (1000 kW) [s]	Do not
		Time to change of burner input [s]	600	FIGRA$_{RC}$ [kW/s] 327 kW / 669 s =	**0.49**
				Total Heat Release THR [MJ]	19.0
K(t)	0.82	Start date for conditioning	18-07-99 14:30	Maximal SPR$_{Smooth}$ [m²/s]	1.34
K(p)	1.08	End date for conditioning	02-08-99 08:00	Time to max SPR$_{Smooth}$ [s]	672
E [kJ/m³]	17200	Weight before conditioning [kg]	47.460	SMOGRA$_{RC}$ [m²/s²] 1.34 m²/s / 672 s * 1000 =	**2.0**
Duct Diameter: [m]	0.40	Weight after conditioning [kg]	47.255	Total Smoke Production TSP [m²]	582
		Weight diff. in percent per day	0.03		
				Visual observations	
Baseline O_2^a $_{(t=-90...-30)}$ [%]	20.672			Time to Ignition of ceiling [s]	9
Baseline O_2 $_{(t=-90...-30)}$ [%]	20.943	End data O_2 [%]	20.952	Time to occurrence of flame spread [s]	Do not
Baseline CO_2 $_{(t=-90...-30)}$ [%]	0.038	End data CO_2 [%]	0.039	Time to flames emerging through the doorway [s]	Do not
Baseline Light signal$_{(t=(90-30))}$ [%]	99.522	End data Light signal [%]	99.953	Time to occurrence of burning droplets [s]	Do not

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
			Time (s)	m gas (g/s)	dp (Pa)	Light signal	XO2 (%)	XCO2 (%)	T-Duct (K)	O2 Shifted (%)	CO2 Shifted (%)	V (298)	phi	HRR-Tot	HRR Burner	HRR-Prod.	SPR	SPR (Smooth)
1	General Information																	
2																		
3	Test		-120	0.017	427.7	99.56			300.0	20.942	0.038	2.55	0.000	0	1	0	0.00	0.00
4	Standard used	prEN-RCT	-117	0.017	427.3	99.56			300.0	20.944	0.038	2.55	0.000	-1	1	0	0.00	0.00
5	Date of test	02-08-99 13:37	-114	0.017	434.7	99.55			300.0	20.943	0.039	2.57	0.000	0	1	0	0.00	0.00
6	Full test duration/performed	yes	-111	0.017	420.0	99.56			300.0	20.943	0.038	2.53	0.000	0	1	0	0.00	0.00
7			-108	0.017	420.7	99.55			300.0	20.943	0.039	2.53	0.000	0	1	0	0.00	0.00
8	Product		-105	0.017	422.8	99.55	20.942		299.9	20.943	0.038	2.54	0.000	0	1	0	0.00	0.00
9	Product identification	Example no.1	-102	0.017	436.8	99.54	20.944	0.038	300.0	20.943	0.039	2.58	0.000	0	1	0	0.00	0.00
10	Substrate	none	-99	0.017	422.7	99.54	20.943	0.038	300.0	20.944	0.039	2.54	0.000	0	1	0	0.00	0.00
11			-96	0.017	424.7	99.54	20.944	0.039	299.9	20.946	0.038	2.54	0.000	-1	1	0	0.00	0.00
12	Conditioning		-93	0.017	435.3	99.54	20.943	0.038	299.9	20.943	0.038	2.58	0.000	0	1	0	0.00	0.00
13	Start date for conditioning	7-18-99 14:30	-90	0.017	426.0	99.54	20.943	0.039	299.9	20.942	0.038	2.55	0.000	0	1	0	0.00	0.00
14	End date for conditioning	8-2-99 8:00	-87	0.017	422.0	99.55	20.943	0.038	299.9	20.942	0.038	2.54	0.000	0	1	0	0.00	0.00
15	Weight before conditioning [kg]	47.46	-84	0.017	413.3	99.54	20.944	0.039	299.9	20.943	0.039	2.51	0.000	0	1	0	0.00	0.00
16	Weight after conditioning [kg]	47.255	-81	0.017	432.6	99.53	20.946	0.039	299.9	20.943	0.038	2.57	0.000	0	1	0	0.00	0.00
17			-78	0.017	421.0	99.53	20.943	0.038	300.0	20.944	0.039	2.53	0.000	0	1	0	0.00	0.00
18	Laboratory		-75	0.017	425.4	99.53	20.942	0.038	300.0	20.942	0.038	2.55	0.000	1	1	0	0.00	0.00
19	Laboratory identification	Laboratory	-72	0.017	423.2	99.52	20.942	0.038	299.9	20.942	0.038	2.54	0.000	1	1	0	0.00	0.00
20	Operator	Operator	-69	0.017	435.6	99.53	20.943	0.038	300.0	20.942	0.039	2.58	0.000	0	1	0	0.00	0.00
21	Filename	Ex1.csv	-66	0.017	422.3	99.52	20.943	0.039	300.0	20.943	0.037	2.54	0.000	0	1	0	0.00	0.00
22	Report identification		-63	0.017	425.2	99.53	20.944	0.038	299.9	20.944	0.039	2.54	0.000	0	1	0	0.00	0.00
23			-60	0.017	423.0	99.52	20.942	0.039	299.9	20.943	0.038	2.54	0.000	0	1	0	0.00	0.00
24	Specifications apparatus		-57	0.017	425.7	99.52	20.942	0.038	300.0	20.945	0.039	2.55	0.000	-1	1	0	0.00	0.00
25	Flow profile kt (-)	0.82	-54	0.017	421.9	99.52	20.942	0.038	300.0	20.942	0.039	2.53	0.000	1	1	0	0.00	0.00
26	Probe constant krho (-)	1.08	-51	0.017	425.4	99.52	20.943	0.039	300.0	20.943	0.038	2.55	0.000	0	1	0	0.00	0.00
27	Duct diameter (m)	0.4	-48	0.017	418.5	99.52	20.944	0.037	300.0	20.943	0.039	2.52	0.000	0	1	0	0.00	0.00
28	O2 calibration delay time (s)	15	-45	0.017	426.2	99.52	20.943	0.039	300.0	20.944	0.038	2.55	0.000	-1	1	0	0.00	0.00
29	CO2 calibration delay time (s)	18	-42	0.017	426.8	99.52	20.945	0.038	299.9	20.944	0.038	2.55	0.000	0	1	0	0.00	0.00
30			-39	0.017	422.9	99.51	20.942	0.039	300.0	20.944	0.038	2.54	0.000	-1	1	0	0.00	0.00
31	Pre-test conditions		-36	0.017	426.4	99.50	20.943	0.039	300.0	20.942	0.038	2.55	0.000	1	1	0	0.00	0.00
32	Barometric pressure (Pa)	101030	-33	0.017	425.5	99.50	20.943	0.038	300.0	20.942	0.039	2.55	0.000	0	1	0	0.00	0.00
33	Relative humidity (%)	37	-30	0.017	417.4	99.50	20.944	0.039	300.0	20.944	0.038	2.52	0.000	-1	1	0	0.00	0.00
34			-27	0.017	409.8	99.50	20.944	0.038	300.1	20.944	0.039	2.50	0.000	0	1	0	0.00	0.00
35	Visual observations		-24	0.017	428.8	99.50	20.944	0.038	300.0	20.944	0.038	2.56	0.000	-1	1	0	0.00	0.00
36	Time to Ignition of ceiling (s)	9	-21	0.017	428.7	99.49	20.942	0.038	300.1	20.942	0.038	2.55	0.000	1	1	0	0.00	0.00
37	Time to occurrence of flame spread (s)	Do not	-18	0.017	435.6	99.49	20.942	0.038	300.1	20.942	0.038	2.58	0.000	1	1	0	0.00	0.00
38	Time to flames emerging through the doorway	Do not	-15	0.017	431.9	99.49	20.944	0.039	300.1	20.943	0.039	2.56	0.000	0	1	0	0.00	0.00
39	Time to occurrence of burning droplets (s)	Do not	-12	0.017	434.8	99.48	20.944	0.038	300.1	20.944	0.039	2.57	0.000	0	1	0	0.00	0.00
40	Time to change of burner input	600	-9	0.017	438.3	99.48	20.944	0.039	300.1	20.944	0.038	2.58	0.000	-1	1	0	0.00	0.00
41			-6	0.017	426.5	99.48	20.942	0.038	300.2	20.944	0.038	2.55	0.000	0	1	0	0.00	0.00
42	End of test conditions		-3	0.017	417.1	99.48	20.942	0.038	300.1	20.944	0.039	2.52	0.000	0	1	0	0.00	0.00
43	Light transmission (%)	99.953	0	0.018	425.2	99.48	20.943	0.038	300.1	20.943	0.038	2.54	0.000	0	1	0	0.00	0.00
44	X O2 (%)	20.952	3	0.536	428.5	99.48	20.944	0.039	300.1	20.943	0.039	2.55	0.000	0	25	0	0.00	0.00
45	X CO2 (%)	0.0392	6	2.210	425.7	99.47	20.944	0.039	300.2	20.941	0.039	2.55	0.000	1	103	0	0.00	0.00
46			9	2.297	427.6	99.47	20.944	0.038	300.1	20.944	0.039	2.55	0.000	-1	107	0	0.00	0.00
47			12	2.219	423.9	99.47	20.944	0.038	300.1	20.944	0.038	2.54	0.000	0	103	0	0.00	0.01
48			15	2.171	420.6	99.40	20.943	0.039	300.4	20.944	0.038	2.53	0.000	0	101	0	0.01	0.03
49			18	2.151	415.3	99.39	20.943	0.038	300.7	20.941	0.039	2.51	0.000	1	100	0	0.01	0.05
50			21	2.144	422.5	99.35	20.941	0.039	300.8	20.936	0.038	2.53	0.000	4	99	0	0.01	0.09
51			24	2.144	419.8	98.92	20.944	0.039	301.7	20.928	0.045	2.52	0.001	7	99	0	0.04	0.16
52			27	2.143	430.2	98.56	20.944	0.039	302.3	20.921	0.051	2.55	0.001	11	99	0	0.06	0.20
53			30	2.146	417.0	97.22	20.944	0.038	303.6	20.906	0.057	2.50	0.002	18	100	0	0.15	0.24
54			33	2.149	412.8	96.58	20.941	0.038	304.7	20.881	0.069	2.49	0.003	30	100	0	0.19	0.27
55			36	2.150	415.5	96.87	20.936	0.039	305.3	20.850	0.080	2.49	0.005	45	100	0	0.17	0.30
56			39	2.153	412.9	95.52	20.928	0.038	306.1	20.822	0.099	2.48	0.007	58	100	0	0.26	0.32
57			42	2.153	414.2	92.95	20.921	0.045	307.4	20.792	0.123	2.48	0.008	71	100	0	0.44	0.35
58			45	2.157	406.8	90.98	20.906	0.051	308.4	20.768	0.136	2.49	0.011	81	100	0	0.57	0.38
59			48	2.159	419.8	88.88	20.881	0.057	309.8	20.739	0.154	2.49	0.011	96	100	0	0.73	0.39
60			51	2.159	410.9	91.67	20.850	0.069	309.8	20.701	0.172	2.46	0.013	113	100	10	0.53	0.41
61			54	2.161	410.1	89.71	20.822	0.080	310.3	20.664	0.197	2.46	0.015	130	100	27	0.66	0.43
62			57	2.162	410.4	90.36	20.792	0.099	311.0	20.654	0.209	2.46	0.015	133	100	31	0.62	0.45
63			60	2.163	407.8	90.96	20.768	0.123	311.0	20.656	0.208	2.45	0.015	132	100	29	0.57	0.46
64			63	2.162	420.2	90.09	20.739	0.136	311.3	20.648	0.220	2.48	0.016	137	100	34	0.65	0.47
65			66	2.163	423.0	91.68	20.701	0.154	311.1	20.649	0.221	2.49	0.015	137	100	34	0.53	0.48
66			69	2.160	417.4	91.10	20.664	0.172	311.3	20.664	0.215	2.47	0.015	129	100	26	0.57	0.49
67			72	2.164	411.3	90.51	20.654	0.197	312.1	20.676	0.202	2.45	0.014	122	100	19	0.61	0.49
68			75	2.164	417.7	92.26	20.656	0.209	312.0	20.693	0.196	2.47	0.013	115	100	12	0.49	0.49
69			78	2.164	419.0	93.47	20.648	0.208	312.1	20.684	0.190	2.48	0.014	121	100	18	0.41	0.48
70			81	2.166	418.4	93.52	20.649	0.220	312.6	20.694	0.190	2.47	0.014	115	100	12	0.40	0.46
71			84	2.164	407.8	93.00	20.664	0.221	312.3	20.700	0.184	2.44	0.013	111	100	8	0.43	0.45
72			87	2.164	419.0	93.97	20.676	0.215	312.3	20.701	0.184	2.48	0.013	112	100	10	0.37	0.44
73			90	2.165	413.8	94.59	20.693	0.202	312.5	20.709	0.178	2.46	0.012	108	100	5	0.33	0.43
74			93	2.165	427.3	94.47	20.684	0.196	312.3	20.714	0.178	2.50	0.012	107	100	4	0.34	0.41
75			96	2.165	430.6	93.34	20.694	0.190	312.3	20.714	0.172	2.51	0.012	108	100	5	0.42	0.40
76			99	2.166	423.1	94.16	20.700	0.190	312.7	20.723	0.172	2.49	0.012	102	101	0	0.36	0.39
77			102	2.165	431.0	94.87	20.701	0.184	312.6	20.723	0.166	2.51	0.012	104	100	1	0.31	0.38
78			105	2.166	434.1	94.40	20.709	0.184	313.3	20.732	0.166	2.52	0.011	99	101	0	0.35	0.37
79			108	2.165	422.9	93.78	20.714	0.178	313.3	20.732	0.166	2.48	0.011	98	100	0	0.39	0.36
80			111	2.164	429.7	94.02	20.714	0.178	313.2	20.722	0.166	2.50	0.012	104	100	2	0.37	0.36
81			114	2.164	424.4	94.44	20.723	0.172	312.9	20.715	0.166	2.49	0.012	108	100	5	0.34	0.35
82			117	2.164	423.7	94.64	20.723	0.172	313.0	20.715	0.172	2.49	0.012	107	100	4	0.33	0.35
83			120	2.165	430.4	94.41	20.733	0.166	313.6	20.732	0.166	2.50	0.011	99	100	0	0.35	0.34

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
			Time (s)	m gas g/s	dp (Pa)	Light signal	XO2 (%)	XCO2 (%)	T-Duct (K)	O2 Shifted (%)	CO2 Shifted (%)	V (298)	phi	HRR-Tot	HRR Burner	HRR-Prod.	SPR	SPR (Smooth)
1	General Information																	
2																		
3			540	2.165	439	97	20.748	0.147	317	20.762	0.148	2.513	0.010	85	100	0	0.20	0.20
4			543	2.165	437	97	20.747	0.154	317	20.761	0.142	2.507	0.010	86	100	0	0.19	0.20
5			546	2.164	442	96	20.752	0.148	317	20.761	0.142	2.524	0.010	87	100	0	0.22	0.20
6			549	2.164	450	96	20.753	0.148	318	20.761	0.142	2.543	0.010	87	100	0	0.21	0.20
7			552	2.166	442	97	20.752	0.147	317	20.759	0.142	2.522	0.010	88	101	0	0.18	0.20
8			555	2.165	438	97	20.762	0.148	318	20.752	0.148	2.509	0.010	90	100	0	0.19	0.20
9			558	2.164	438	97	20.761	0.148	317	20.762	0.147	2.512	0.010	85	100	0	0.19	0.20
10			561	2.165	445	96	20.761	0.142	318	20.771	0.142	2.530	0.009	81	100	0	0.22	0.20
11			564	2.165	444	97	20.761	0.142	317	20.769	0.142	2.529	0.009	83	100	0	0.19	0.20
12			567	2.164	445	97	20.759	0.142	317	20.761	0.142	2.533	0.010	87	100	0	0.19	0.20
13			570	2.165	436	97	20.752	0.142	317	20.760	0.141	2.506	0.010	87	100	0	0.21	0.20
14			573	2.166	434	97	20.762	0.148	317	20.769	0.142	2.500	0.009	82	101	0	0.20	0.20
15			576	2.161	428	96	20.771	0.147	318	20.761	0.142	2.479	0.010	85	100	0	0.22	0.21
16			579	2.162	439	96	20.769	0.142	318	20.753	0.147	2.511	0.010	90	100	0	0.23	0.21
17			582	2.164	441	97	20.761	0.142	318	20.754	0.148	2.517	0.010	89	100	0	0.19	0.21
18			585	2.163	427	97	20.760	0.142	318	20.747	0.147	2.478	0.010	92	100	0	0.20	0.22
19			588	2.163	443	96	20.769	0.141	317	20.752	0.147	2.526	0.010	91	100	0	0.21	0.22
20			591	2.163	439	96	20.761	0.142	318	20.754	0.148	2.510	0.010	89	100	0	0.22	0.23
21			594	2.163	446	96	20.753	0.142	318	20.761	0.147	2.529	0.010	86	100	0	0.22	0.24
22			597	2.163	435	96	20.754	0.147	318	20.754	0.147	2.499	0.010	89	100	0	0.22	0.25
23			600	2.476	434	97	20.747	0.148	318	20.747	0.147	2.496	0.010	92	115	0	0.20	0.27
24			603	5.325	435	97	20.752	0.147	318	20.754	0.148	2.500	0.010	89	247	0	0.19	0.28
25			606	6.504	437	96	20.754	0.147	319	20.753	0.148	2.500	0.010	89	302	0	0.23	0.30
26			609	6.669	431	96	20.761	0.148	321	20.754	0.148	2.477	0.010	88	309	0	0.25	0.33
27			612	6.588	468	95	20.754	0.147	323	20.739	0.154	2.574	0.011	99	306	0	0.29	0.35
28			615	6.551	465	95	20.747	0.147	324	20.694	0.172	2.559	0.013	121	304	0	0.29	0.39
29			618	6.513	462	95	20.754	0.147	327	20.641	0.203	2.541	0.016	145	302	0	0.36	0.43
30			621	6.479	459	95	20.753	0.148	328	20.580	0.239	2.529	0.019	174	301	0	0.34	0.49
31			624	6.465	457	94	20.754	0.148	330	20.511	0.276	2.514	0.023	206	300	0	0.41	0.54
32			627	6.464	468	94	20.739	0.148	333	20.455	0.312	2.535	0.026	233	300	0	0.39	0.66
33			630	6.465	466	92	20.694	0.154	336	20.404	0.349	2.518	0.029	255	300	0	0.53	0.77
34			633	6.467	456	92	20.641	0.172	338	20.329	0.391	2.483	0.033	286	300	0	0.56	0.85
35			636	6.472	447	91	20.580	0.203	339	20.278	0.428	2.456	0.035	306	300	0	0.60	0.94
36			639	6.474	456	90	20.511	0.239	341	20.224	0.464	2.473	0.038	332	300	25	0.71	1.01
37			642	6.476	440	89	20.455	0.276	343	20.200	0.482	2.420	0.039	335	300	28	0.79	1.08
38			645	6.477	435	88	20.404	0.312	346	20.147	0.506	2.396	0.042	356	301	48	0.87	1.13
39			648	6.480	445	85	20.329	0.349	351	20.078	0.542	2.406	0.046	389	301	81	1.13	1.18
40			651	6.484	433	82	20.278	0.391	355	20.042	0.566	2.360	0.048	397	301	89	1.38	1.22
41			654	6.484	442	83	20.224	0.428	359	19.957	0.609	2.370	0.052	437	301	128	1.33	1.25
42			657	6.486	422	68	20.200	0.464	364	19.859	0.664	2.302	0.057	466	301	158	2.67	1.28
43			660	6.488	429	70	20.147	0.482	368	19.731	0.731	2.308	0.064	522	301	214	2.54	1.30
44			663	6.488	441	76	20.078	0.506	370	19.586	0.819	2.332	0.072	589	301	281	1.94	1.32
45			666	6.489	440	74	20.042	0.542	372	19.496	0.883	2.325	0.076	624	301	316	2.14	1.33
46			669	6.488	433	78	19.957	0.566	374	19.451	0.919	2.299	0.078	636	301	327	1.74	1.34
47			672	6.490	435	79	19.859	0.609	375	19.459	0.925	2.302	0.078	632	301	324	1.68	1.34
48			675	6.489	416	82	19.731	0.664	377	19.465	0.921	2.245	0.078	614	301	305	1.37	1.33
49			678	6.490	427	84	19.586	0.731	378	19.481	0.926	2.273	0.077	614	301	305	1.26	1.33
50			681	6.488	421	84	19.496	0.819	378	19.496	0.931	2.254	0.076	601	301	293	1.20	1.31
51			684	6.491	418	87	19.451	0.883	379	19.542	0.919	2.243	0.073	578	301	269	0.99	1.29
52			687	6.488	425	88	19.459	0.919	380	19.594	0.901	2.258	0.070	559	301	251	0.92	1.26
53			690	6.493	429	87	19.465	0.925	381	19.627	0.883	2.267	0.068	547	301	239	0.94	1.17
54			693	6.490	415	88	19.481	0.921	381	19.641	0.877	2.229	0.068	532	301	224	0.84	1.08
55			696	6.493	418	89	19.496	0.926	382	19.655	0.871	2.237	0.067	528	301	220	0.81	1.02
56			699	6.493	428	90	19.542	0.931	382	19.700	0.840	2.263	0.065	516	301	208	0.77	0.95
57			702	6.493	424	90	19.594	0.919	382	19.738	0.816	2.251	0.063	498	301	189	0.73	0.90
58			705	6.495	412	89	19.627	0.901	381	19.769	0.792	2.222	0.061	480	301	171	0.75	0.85
59			708	6.492	437	89	19.641	0.883	379	19.814	0.767	2.296	0.059	476	301	168	0.79	0.82
60			711	6.492	434	89	19.655	0.877	379	19.867	0.732	2.287	0.056	452	301	144	0.80	0.79
61			714	6.492	419	88	19.700	0.871	377	19.897	0.701	2.250	0.055	434	301	126	0.86	0.77
62			717	6.491	449	90	19.738	0.840	375	19.913	0.686	2.337	0.054	444	301	136	0.73	0.76
63			720	6.493	444	90	19.769	0.816	375	19.958	0.660	2.324	0.051	423	301	114	0.71	0.75
64			723	6.492	453	91	19.814	0.792	373	20.011	0.628	2.354	0.049	405	301	97	0.68	0.74
65			726	6.495	476	91	19.867	0.767	372	20.028	0.610	2.418	0.048	409	301	100	0.69	0.74
66			729	6.488	464	91	19.897	0.732	371	20.049	0.591	2.392	0.047	396	301	88	0.65	0.74
67			732	6.495	469	91	19.913	0.701	369	20.107	0.561	2.410	0.044	373	301	64	0.66	0.73
68			735	6.492	464	90	19.958	0.686	370	20.132	0.542	2.396	0.042	360	301	52	0.74	0.74
69			738	6.489	471	91	20.011	0.660	368	20.155	0.524	2.416	0.041	353	301	45	0.70	0.73
70			741	6.492	471	91	20.028	0.628	367	20.163	0.519	2.423	0.041	351	301	42	0.69	0.73
71			744	6.493	460	91	20.049	0.610	365	20.170	0.512	2.399	0.041	344	301	36	0.67	0.72
72			747	6.490	466	90	20.107	0.591	365	20.201	0.494	2.415	0.039	333	301	25	0.75	0.72
73			750	6.491	467	89	20.132	0.561	364	20.215	0.488	2.423	0.038	327	301	19	0.80	0.71
74			753	6.493	476	90	20.155	0.542	362	20.223	0.482	2.449	0.038	327	301	19	0.76	0.71
75			756	6.491	465	91	20.163	0.524	362	20.229	0.476	2.421	0.037	321	301	13	0.70	0.71
76			759	6.493	469	89	20.170	0.519	363	20.232	0.470	2.431	0.037	322	301	13	0.80	0.71
77			762	6.494	474	90	20.201	0.512	362	20.238	0.470	2.445	0.037	320	301	12	0.76	0.72
78			765	6.491	466	90	20.215	0.494	362	20.224	0.476	2.423	0.038	324	301	16	0.74	0.72
79			768	6.491	469	90	20.223	0.488	361	20.238	0.470	2.436	0.037	319	301	11	0.71	0.71
80			771	6.496	461	90	20.229	0.482	361	20.248	0.464	2.413	0.036	312	301	3	0.72	0.71
81			774	6.492	469	91	20.232	0.476	361	20.261	0.458	2.438	0.036	309	301	0	0.66	0.71
82			777	6.489	471	90	20.238	0.470	361	20.253	0.458	2.443	0.036	314	301	5	0.71	0.71
83			780	6.488	463	91	20.224	0.470	361	20.254	0.458	2.422	0.036	311	301	2	0.68	0.70

Large-scale room reference test for surface products

Product:	Operator	Test Date:	Print Date:
Example No. 2	Operator	11-12-99	18-08-00

Test condition		Check points		Results	
Ambient Temp. $T_{s(t=-90...-30)}$ [°K]	285.3	Minimum flow rate [m³/s]	1.58	Maximal HRR [kW]	900
Ambient pressure. [Pa]	100150	Maximum flow rate [m³/s]	3.05	Time to max HRR [s]	
Humidity [%]	45.0			interpolated time to flashover (1000 kW) [s]	96.90
		Time to change of burner input [s]	600	$FIGRA_{RC}$ [kW/s] 900 kW / 96.9 s =	**9.29**
				Total Heat Release THR [MJ]	19.2
$K(t)$	0.82	Start date for conditioning	08-12-99 10:30	Maximal SPR_{Smooth} [m²/s]	2.57
$K(p)$	1.08	End date for conditioning	10-12-99 08:00	Time to max SPR_{Smooth} [s]	66
E [kJ/m³]	17200	Weight before conditioning [kg]	75.350	$SMOGRA_{RC}$ [m²/s²] 2.57 m²/s / 66 s * 1000 =	**38.9**
Duct Diameter: [m]	0.40	Weight after conditioning [kg]	75.340	Total Smoke Production TSP [m²]	162
		Weight diff. in percent per day	0.01		
				Visual observations	
Baseline O_2^a $_{(t=-90...-30)}$ [%]	20.812			Time to Ignition of ceiling [s]	6
Baseline O_2 $_{(t=-90...-30)}$ [%]	20.946	End data O_2 [%]	20.946	Time to occurrence of flame spread [s]	Do not
Baseline CO_2 $_{(t=-90...-30)}$ [%]	0.036	End data CO_2 [%]	0.039	Time to flames emerging through the doorway [s]	30
Baseline Light signal $_{(t=-(90-30))}$ [%]	99.781	End data Light signal [%]	98.300	Time to occurrence of burning droplets [s]	30

HRR value

SPR value

Flow
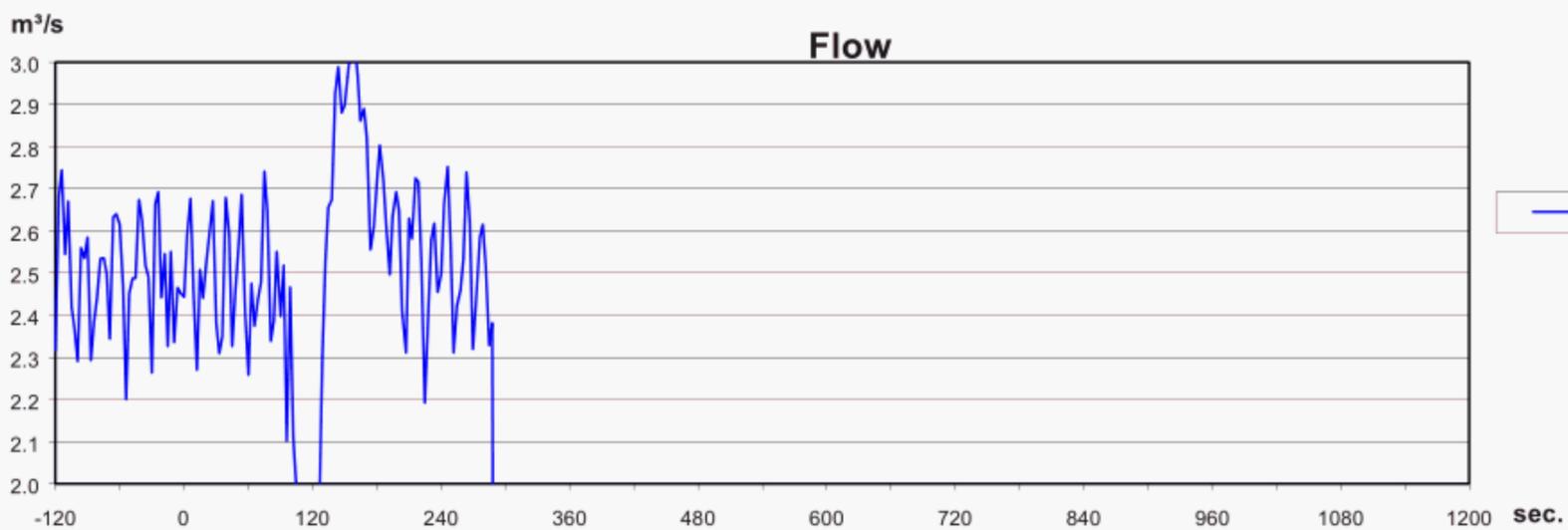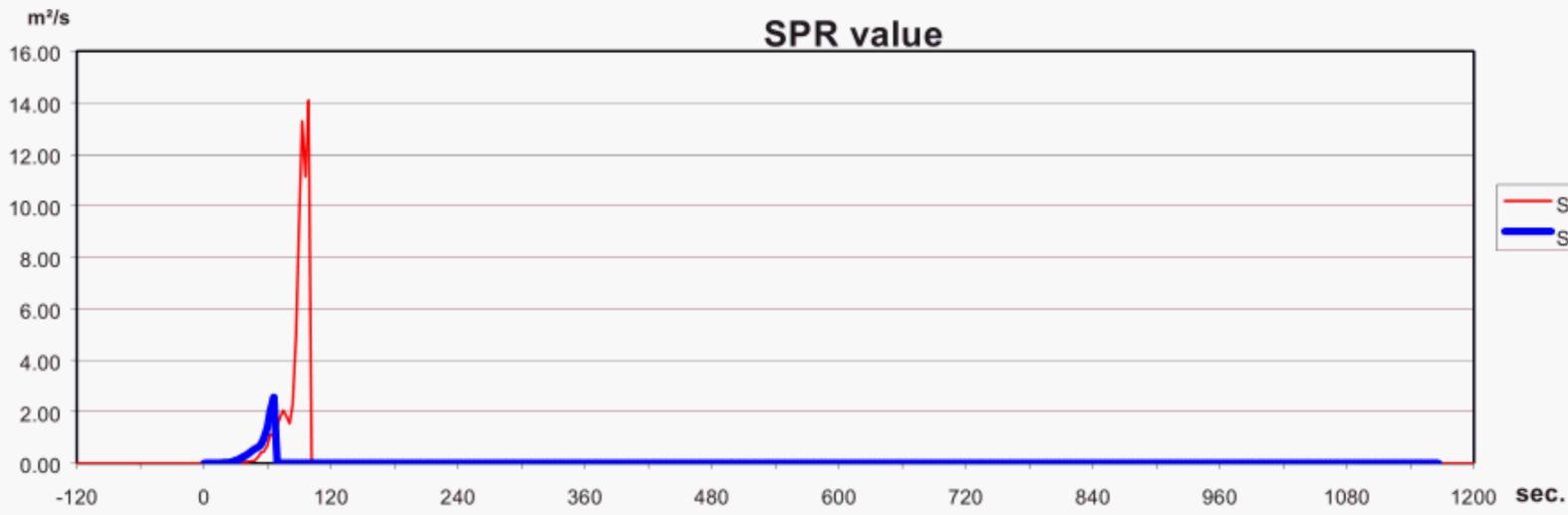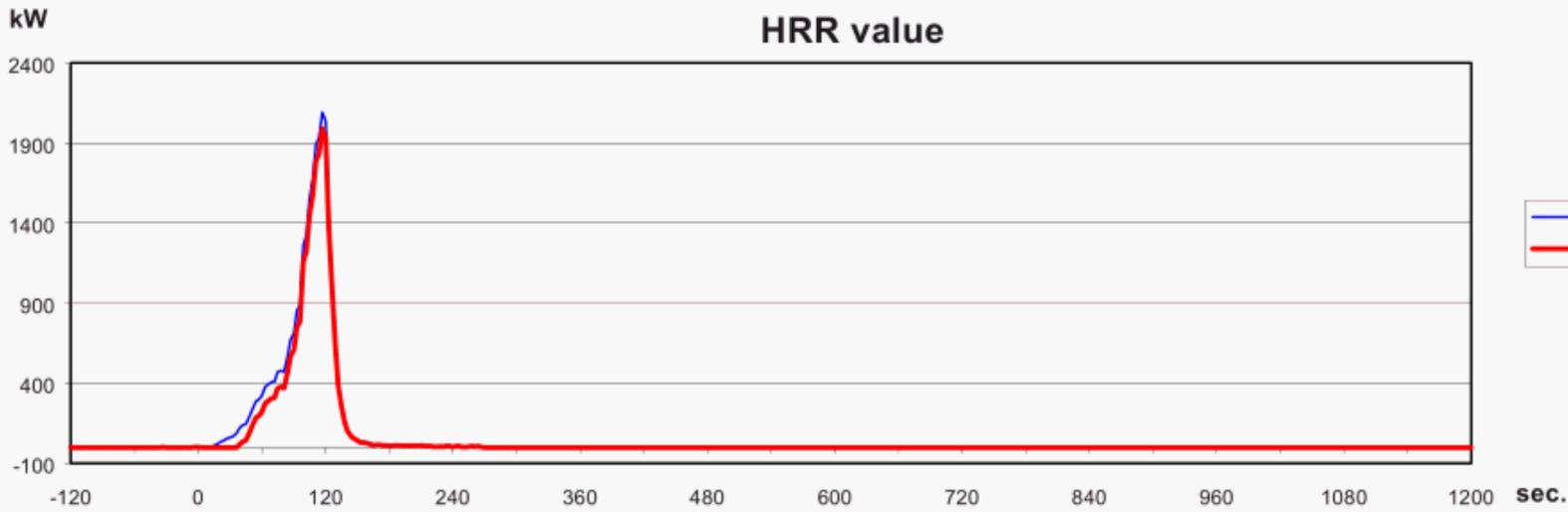
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[1]   Commission Decision of 8 February 2000 implementing Council Directive 89/106/EEC as regards the classification of the reaction to fire performance of construction products (2000/147/EC), see also note below

[2]   ISO TR 9705-2:2001, *Reaction to fire tests — Full scale room tests for surface products — Part 2: Technical background and guidance*

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[5]   SUNDSTRÖM, B., VAN HEES, P., THURESON, P. Results and analysis from fire tests of building products in ISO 9705, the Room/Corner Test. The SBI research programme. SP REPORT 1998:11.