BRITISH STANDARD

BS EN
50266-1:2001

Common test methods for cables under fire conditions — Test for vertical flame spread of vertically-mounted bunched wires or cables —

Part 1: Apparatus

The European Standard EN 50266-1:2001 has the status of a British Standard

ICS 13.220.40; 29.060.20

National foreword

This British Standard is the official English language version of EN 50266-1:2001. Together with BS EN 50266-2-1, BS EN 50266-2-2, BS EN 50266-2-3; BS EN 50266-2-4 and BS EN 50266-2-5, it supersedes BS 4066-3:1994 which is withdrawn.

BS 4066-3: 1994 had a number of test categories. All these test categories are retained in BS EN 50266, and can be found in the respective parts of the new publication as follows:

Test category in BS 4066-3	Equivalent part of BS EN 50266[a]
A F/R	BS EN 50266-2-1
A	BS EN 50266-2-2
B	BS EN 50266-2-3
C	BS EN 50266-2-4
—	BS EN 50266-2-5[b]

[a] In all cases, the particular part is to be used in conjunction with BS EN 50266-1, which describes the test apparatus.
[b] This part describes Category D, which did not form part of BS 4066-3.

The UK participation in its preparation was entrusted by Technical Committee GEL/20, Electric cables, to Subcommittee GEL/20/3, Insulation and sheath, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

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This British Standard, having been prepared under the direction of the Electrotechnical Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 August 2001

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 17 and a back cover.

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EUROPEAN STANDARD **EN 50266-1**

NORME EUROPÉENNE

EUROPÄISCHE NORM February 2001

ICS 13.220.40; 29.020; 29.060.20 Supersedes HD 405.3 S1:1993

English version

Common test methods for cables under fire conditions - Test for vertical flame spread of vertically-mounted bunched wires or cables Part 1: Apparatus

Méthodes d'essai communes aux câbles soumis au feu - Essai de propagation verticale de la flamme des fils ou câbles en nappes en position verticale
Partie 1: Appareillage

Allgemeine Prüfverfahren für Kabel und isolierte Leitungen im Brandfall - Prüfung der senkrechten Flammenausbreitung von senkrecht angeordneten Bündeln von Kabeln und isolierten Leitungen
Teil 1: Prüfvorrichtung

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 50266-1:2001 E

Foreword

This European Standard was prepared by Working Group 10 of the Technical Committee CENELEC TC 20, Electric cables.

When used in conjunction with the relevant parts 2 of EN 50266 this European Standard supersedes HD 405.3 S1.

The description of the apparatus given in this part 1 updates that in HD 405.3 S1. All pre-existing categories of test from HD 405.3 S1 have been retained and updated in the different parts 2. A new category (category D) has been added to cater for testing at very low non-metallic volumes.

The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 50266-1 on 2000-08-01.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2001-08-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2002-08-01

Annexes designated 'informative' are given for information only.
In this standard, annexes A and B are informative.

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Introduction

Methods of test for flame spread characteristics for a single vertical insulated wire or cable are given in EN 50265, but it cannot be assumed that, because a cable or wire meets the requirements of that standard, a vertical bunch of similar cables or wires will behave in a similar manner. This is because flame spread along a vertical bunch of cables depends on a number of features, such as:

a) the volume of combustible material exposed to the fire and to any flame which may be produced by the combustion of the cables;
b) the geometrical configuration of the cables and their relationship to an enclosure;
c) the temperature at which it is possible to ignite the gases emitted from the cables;
d) the quantity of combustible gas released from the cables for a given temperature rise;
e) the volume of air passing through the cable installation;
f) the construction of the cable, e.g. armoured or unarmoured, multi or single core.

All of the foregoing assume that the cables are able to be ignited when involved in an external fire.

EN 50266 gives details, in various parts, of a test where a number of cables are bunched together to form various test sample installations. For easier use and differentiation of the apparatus and the various test categories, the parts are designated as follows:

Part 1	Apparatus
Part 2-1	Category A F/R
Part 2-2	Category A
Part 2-3	Category B
Part 2-4	Category C
Part 2-5	Category D

Parts from 2-1 onwards define the various categories and the relevant procedures. The categories are distinguished by test duration, the volume of non-metallic material of the test sample and the method of mounting the sample for the test. In all categories, cables having at least one conductor of cross-sectional area greater than 35 mm² are tested in a spaced configuration, whereas cables of conductor cross-sectional area of 35 mm² or smaller are tested in a touching configuration.

The categories are not necessarily related to different safety levels in actual cable installations. The actual installed configuration of the cables may be a major determinant in the level of flame spread occurring in an actual fire.

The method of mounting described as category A F/R (part 2-1) is intended for special cable designs used in particular installations.

Categories A, B, C and D (parts 2-2 to 2-5 respectively) are for general use where different non-metallic volumes are applicable.

Additional categories, especially to cover the use of small diameter communication cables in closely bunched configurations, will be further considered when more data is available.

1 Scope

EN 50266 specifies methods of test for the assessment of vertical flame spread of vertically-mounted bunched wires or cables, electrical or optical, under defined conditions.

NOTE For the purpose of this standard the term "electric wire or cable" covers all insulated metallic conductor cables used for the conveyance of energy or signals.

This part 1 details the apparatus and its arrangement and calibration.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the 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.

EN 60695-4 Fire hazard testing - Part 4: Terminology concerning fire tests.

3 Definition

For the purpose of EN 50266-1 the following definition applies. Definitions are taken from EN 60695-4.

3.1
ignition source
a source of energy that initiates combustion

4 Test environment

The test shall not be carried out if the external wind speed measured by an anemometer fitted on the top of the test rig is greater than 8 m/s and shall not be carried out if the temperature of the inside walls is below 5 °C or above 40 °C measured at a point approximately 1 500 mm above floor level, 50 mm from a side wall, and 1 000 mm from the door. The enclosure door shall be closed throughout the test.

5 Test apparatus

The test apparatus consists of the following:

5.1 Test chamber

The test rig (Figure 1) shall comprise a vertical test chamber having a width of (1 000 ± 100) mm, a depth of (2 000 ± 100) mm and a height of (4 000 ± 100) mm; the floor of the chamber shall be raised above ground level. The test chamber shall be nominally airtight along its sides, air being admitted at the base of the test chamber through an aperture of (800 ± 20) mm x (400 ± 10) mm situated (150 ± 10) mm from the front wall of the test chamber (see Figure 1).

An outlet (300 ± 30) mm x (1 000 ± 100) mm shall be made at the rear edge of the top of the test chamber. The back and sides of the test chamber shall be thermally insulated to give a coefficient of heat transfer of approximately 0,7 $W.m^{-2}.K^{-1}$. For example, a steel plate 1,5 mm to 2,0 mm thick covered with 65 mm of mineral wool with a suitable external cladding is satisfactory (see Figure 2). The distance between the ladder and the rear wall of the chamber is (150 ± 10) mm, and between the bottom rung of the ladder and the floor (400 ± 5) mm. The clearance between the lowest point of the test piece and the floor is approximately 100 mm (see Figure 3).

5.2 Air supply

A means of supplying a controlled air flow through the chamber shall be fitted.

NOTE 1 It is recommended that the air should be blown into the test chamber, via the air inlet, using a suitable fan.

Prior to burner ignition, the air flow shall be adjusted to a rate of (5 000 ± 500) litre/min at a constant controlled temperature of (20 ± 10)°C and at atmospheric pressure and measured at the inlet side before the test commences. This air flow shall be maintained throughout the test until cable burning or glowing has ceased or for a maximum time of one hour from completion of the test flame application period, after which period the flame or glowing shall be extinguished.

NOTE 2 In order to remove noxious gases it is recommended to maintain the air flow for some minutes after the end of test, before entering the test chamber.

5.3 Ladder types

There are two types of tubular steel ladder: a standard ladder of (500 ± 5) mm width and a wide ladder of (800 ± 10) mm width. Details of the types of ladder are given in Figures 4a and 4b.

5.4 Effluent cleaning attachment

Legal requirements may make it necessary for equipment for collecting and washing the effluent to be fitted to the test chamber. This equipment shall not cause a change in the air flow rate through the test chamber.

6 Ignition source

6.1 Type

As required by the test procedure the ignition source shall be one or two ribbon-type propane gas burners complete with venturi mixer, and their own set of flow meters. The propane gas shall be technical grade propane of nominal 95 % purity. The flame-producing surface of the burner(s) shall consist of a flat metal plate through which 242 holes of 1,32 mm in diameter are drilled on 3,2 mm centres in three staggered rows of 81, 80 and 81 holes each to form an array having the nominal dimensions 257 mm x 4,5 mm. As the burner plate may be drilled without the use of a drilling jig, the spacing of the holes may vary slightly. Additionally, a row of small holes may be milled on each side of the burner plate to serve as pilot holes with the function of keeping the flame burning.

The burners are shown in Figures 5a and 5b, and the placement of the holes in Figure 6.

NOTE 1 To ensure reproducibility between results from different testing stations, a burner, which is readily available, is recommended for use. For details, see annex A.

Each burner shall be individually fitted with an accurate means of controlling the propane gas and air input flow rates, either by means of a rotameter-type flowmeter or mass flowmeter.

NOTE 2 Mass flowmeters are recommended for ease of use.

Figure 7 shows an example of a rotameter-type system.

Safety Note: The following precautions are recommended to ensure safe operation of the ignition source:

- a flame failure protection device should be used;
- the gas supply system should be equipped with flashback arrestors;
- safe sequencing of the propane and air supply should be employed during ignition and extinguishing.

The calibration of the propane gas and air rotameter-type flowmeters shall be checked after installation to ensure that the pipework and venturi mixer have not affected the calibration.

Corrections for the variations in temperature and pressure from that specified on the propane gas and air rotameter-type flowmeters should be applied when necessary, see annex B.

Propane gas and air rotameter-type flow meters shall be calibrated according to the following reference conditions.

Reference temperature and pressure are 20 °C and one bar (100 kPa).

For the purpose of this test the air shall have a dew-point not higher than 0 °C.

The flow rates at reference conditions (1 bar and 20 °C) for the test shall be as follows:

Air (77,7 ± 4,8) litre/minute
Propane (13,5 ± 0,5) litre/minute

to provide a nominal (73,7 ± 1,68) x 10^6 J/h ((70 000 ± 1 600) Btu/h))[1)] to each burner.

NOTE 3 The net heat of combustion is used to calculate the propane flow rate.

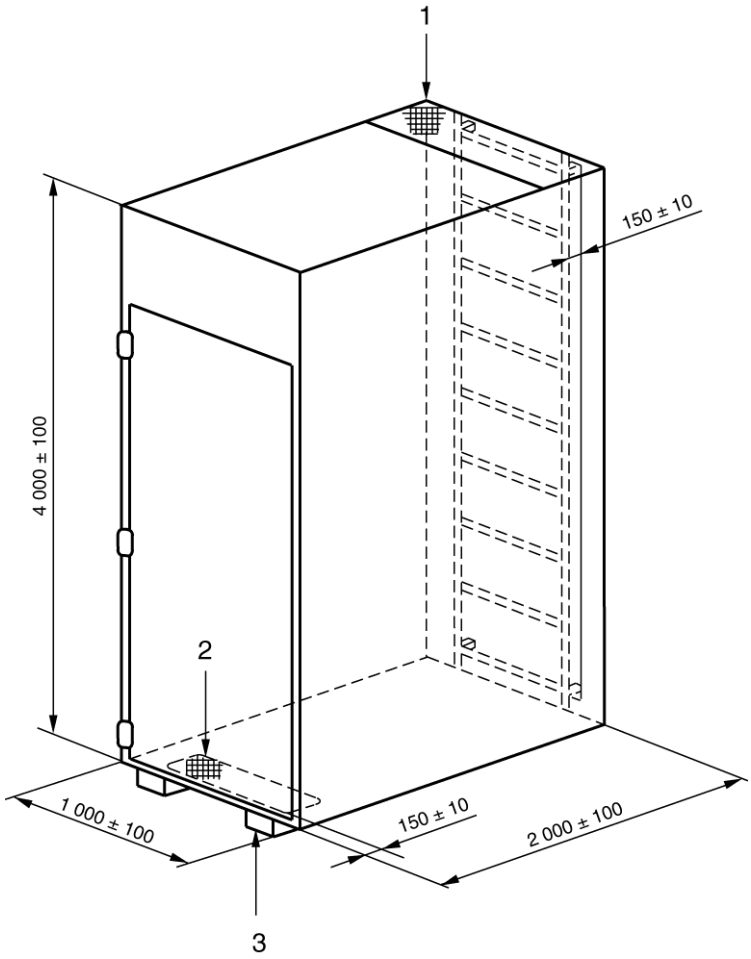
6.2 Positioning

For the test the burner shall be arranged horizontally at a distance of (75 ± 5) mm from the front surface of the cable sample and (600 ± 5) mm above the floor of the test chamber and approximately symmetrical with the axis of the ladder. The point of application of the burner flame shall lie in the centre between two cross-bars on the ladder and at least 500 mm above the lower end of the sample (see Figure 3 and Figure 5a).

Adjustment of air and gas flows prior to the test may be carried out away from the test position.

Where two burners are used in combination with the wide ladder they shall be arranged so as to be approximately symmetrical with the axis of the ladder, as shown in Figure 5b. The burner system shall be positioned such that the centre line of the burner system is approximately coincident with the centre of the ladder.

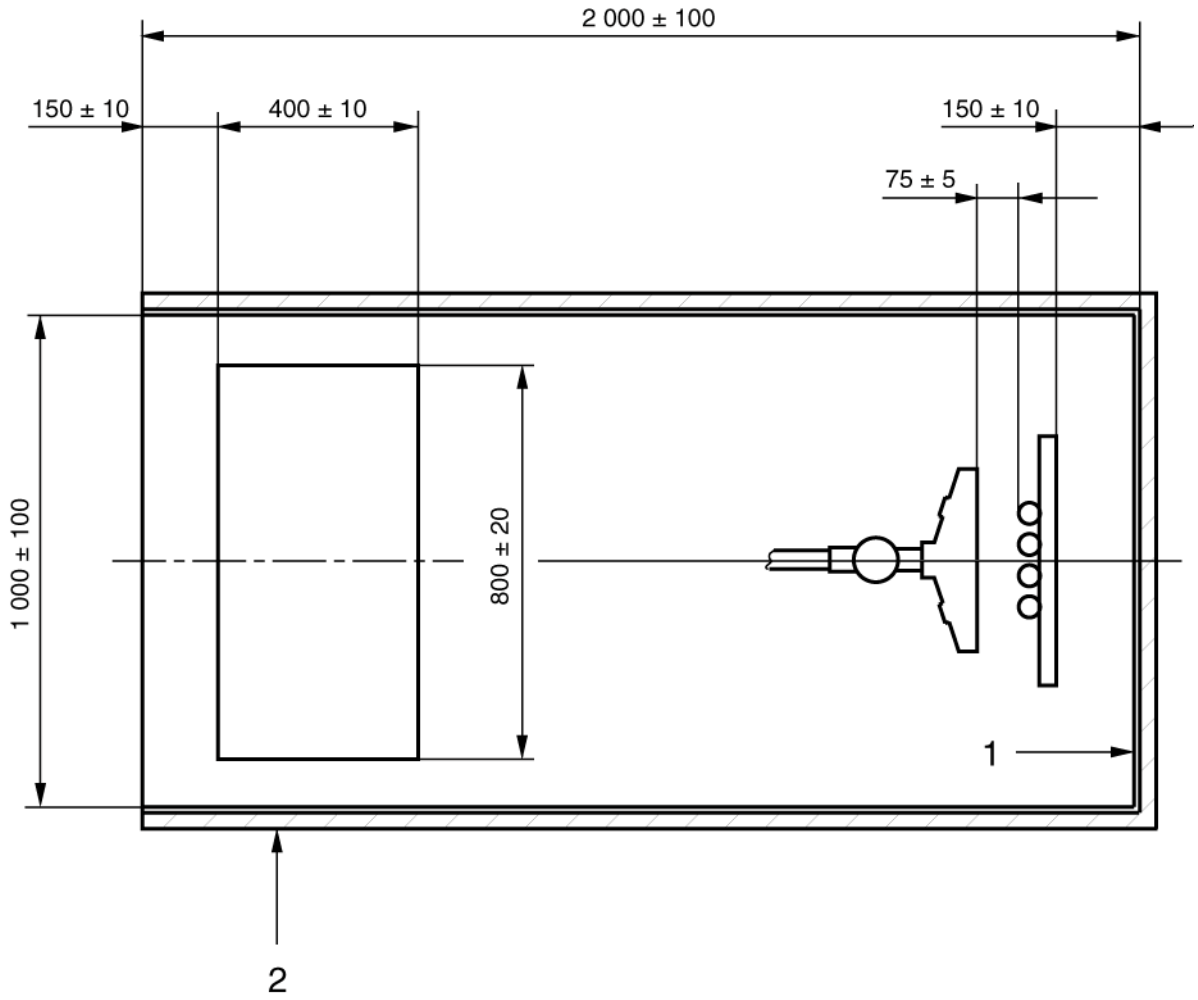
[1)] This is also equivalent to (20,5 ± 0,5) kW



Key:
1 Smoke outlet - (300 ± 30) x (1 000 ± 100)
2 Air inlet - (800 ± 20) x (400 ± 10)
3 Rig raised above ground level

Dimensions are in millimetres

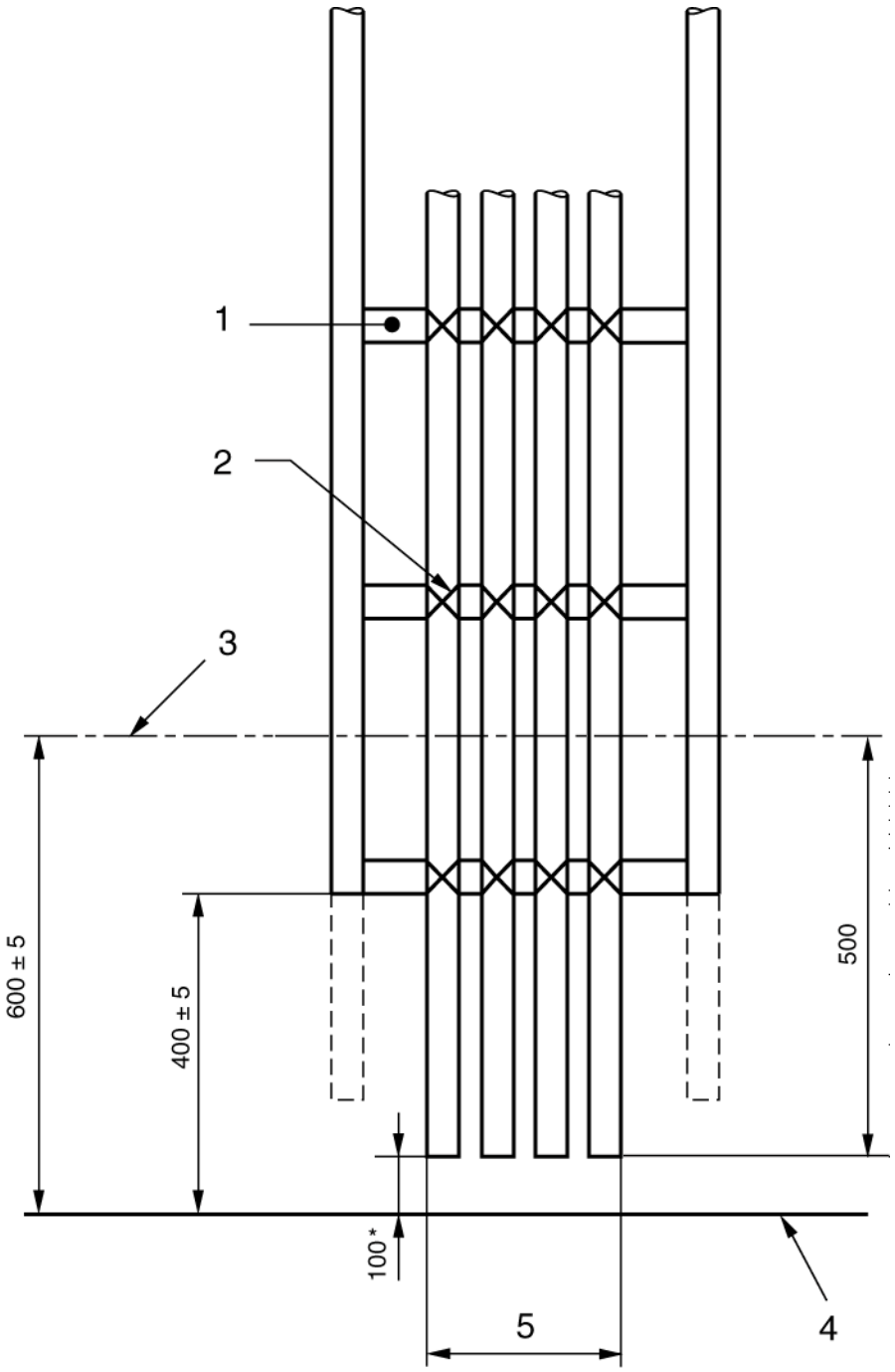
Figure 1 - Test chamber



Key:
1 Steel plate, 1,5 mm to 2 mm thick
2 Thermal insulation of mineral wool approximately 65 mm thick with suitable external cladding to give a coefficient of heat transfer of approximately 0,7 $W.m^{-2}.K^{-1}$

Dimensions are in millimetres

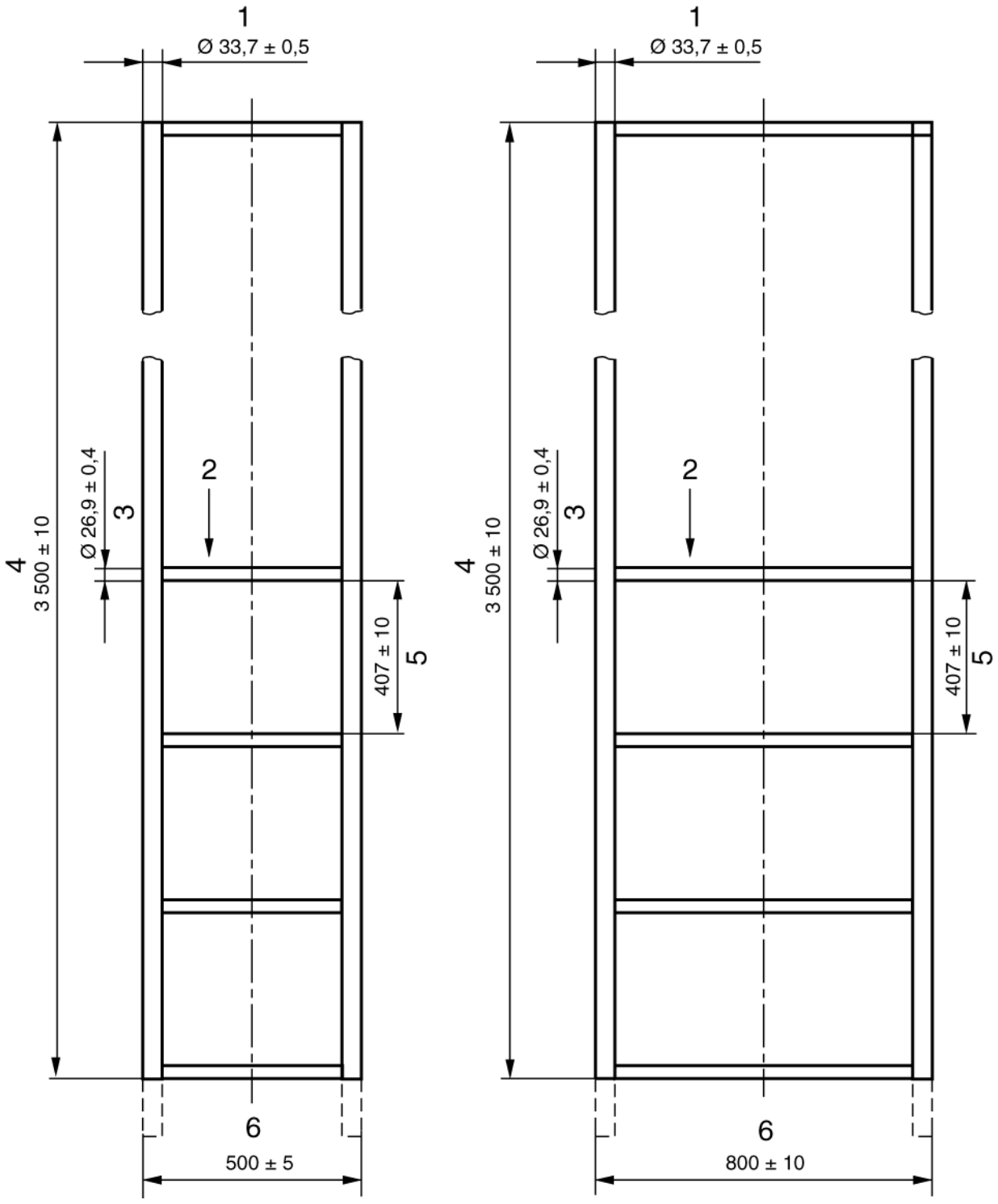
Figure 2 - Thermal insulation of back and sides of the test chamber



Key:
1 Round steel rungs
2 Metal wire ties
3 Centre line of burner
4 Floor
5 Maximum width (according to test category)

Dimensions are in millimetres
(* = approximate)

Figure 3 - Positioning of burner and typical arrangement of test sample on ladder



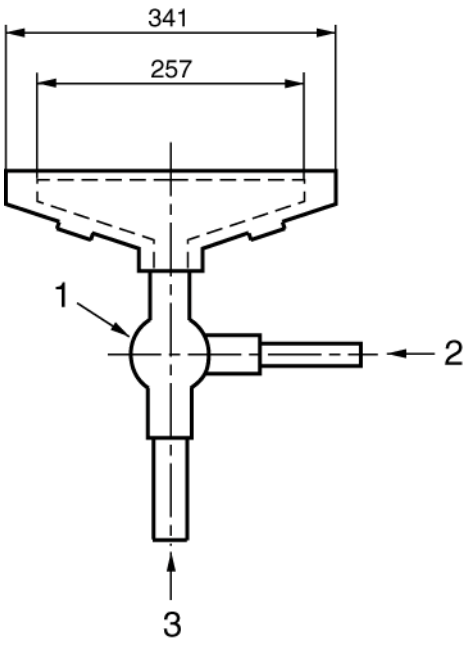
4a Standard ladder **4b Wide ladder**

Key:

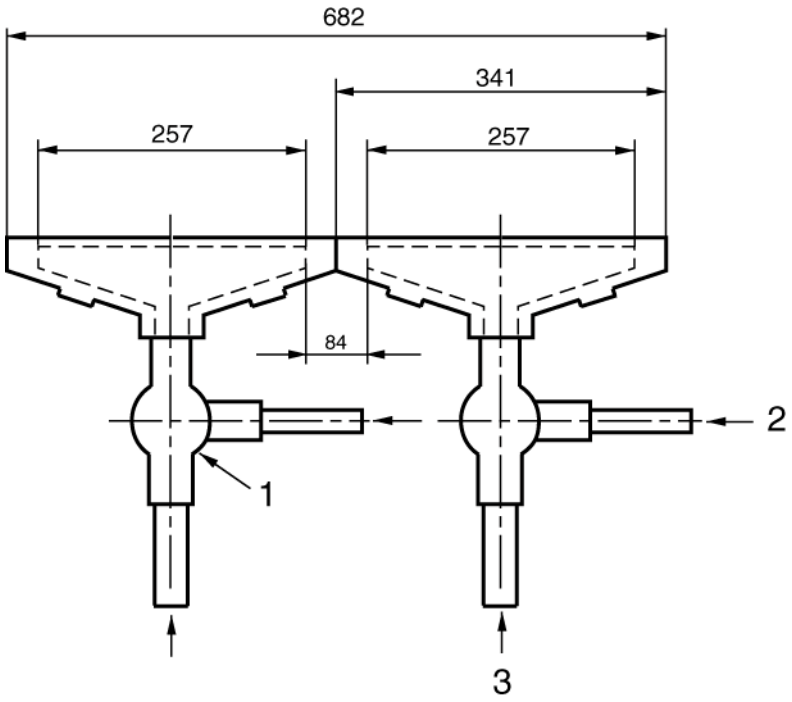
1 Diameter of upright
2 Number rungs = 9
3 Diameter of rungs
4 Total height of ladder
5 Distance between rungs
6 Width

Dimensions are in millimetres

Figure 4 - Tubular steel ladders for cable test



5a - Single burner for use with standard ladder



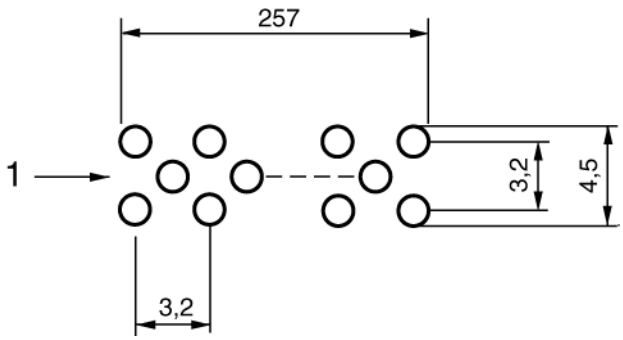
5b - Two burners in combination for use with the wide ladder

Key:

1 Venturi air-gas mixture
2 Propane gas entry
3 Compressed air entry

Dimensions are in millimetres

Figure 5 - Burner configurations

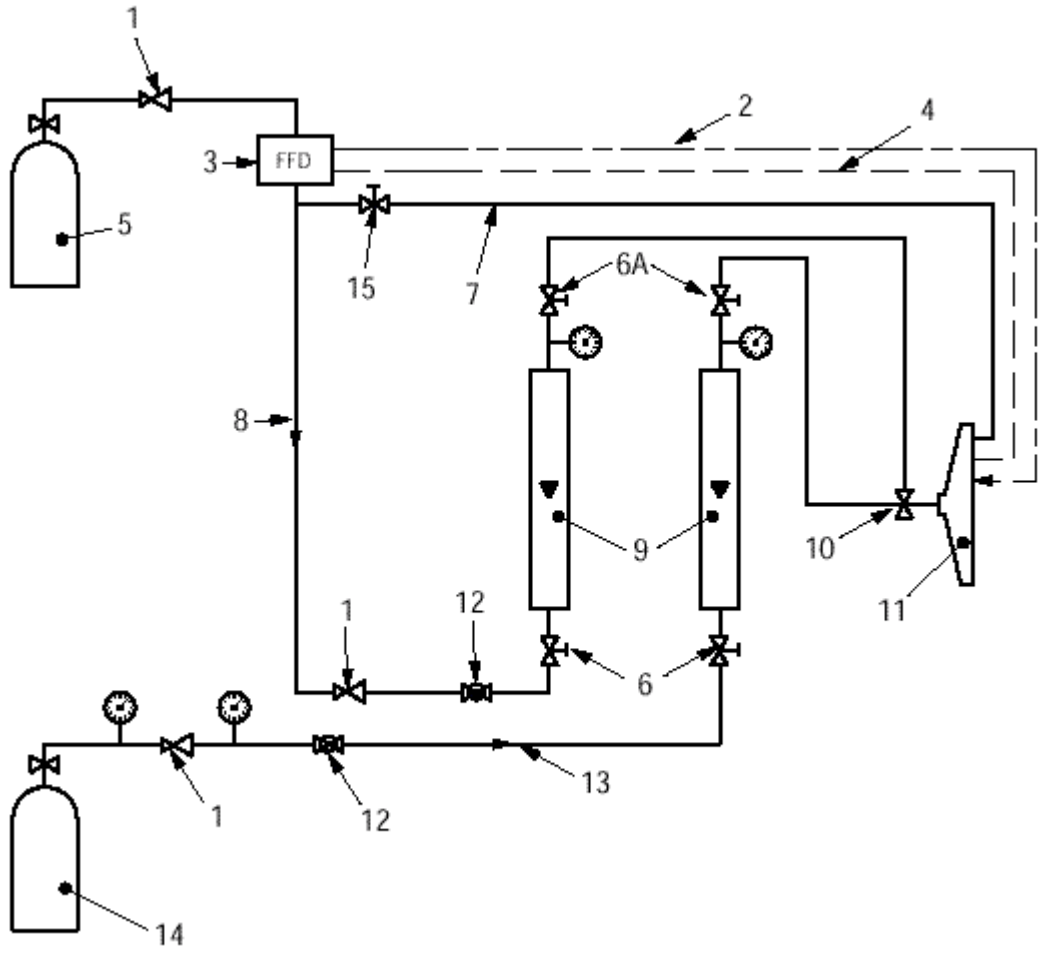


Key:

1 242 round holes, 1,32 mm in diameter on 3,2 mm centres, staggered in three rows of 81, 80 and 81 holes, centred on the face of the burner.

Dimensions are in millimetres
(approximate values)

Figure 6 - Arrangement of holes for burners



Key

1. Regulator
2. Piezoelectric igniter
3. Flame failure device
4. Control thermocouples
5. Propane cylinder
6. Screw valve (6A = alternative position)
7. Pilot feed
8. Gas flow
9. Flowmeters
10. Venturi mixer
11. Burner
12. Ball valve
13. Air flow
14. Compressed air cylinder
15. Screw valve on pilot feed

Figure 7 - Example of schematic diagram of fuel control system

Annex A
(informative)

Details of recommended burner

A burner (catalogue number 10L11-55) and venturi mixer (catalogue number 14-18) complying with the requirements of clause 6 can be obtained from:

American Gas Furnace
PO Box 496
140 Spring Street
Elizabeth, NJ 07207
USA

Tel: +1 201 352 2120

Telefax: +1 201 352 5174

NOTE The information given in this Annex, covering named products and their suppliers, is given for the convenience of users of this Standard and does not constitute an endorsement by CENELEC TC 20 of the product named. Equivalent products may be used if they can be shown to lead to the same results.

Annex B
(informative)

Flowmeter calibration correction factors

B.1 General

When using the rotameter type flowmeters to monitor the supply rate of the gases, two factors need to be considered in order to use them correctly. It is important

a) to know what the flowmeter is indicating when used under the actual operating conditions;

b) to know under what conditions of temperature and gas pressure the flowmeter was calibrated, and at what conditions it was designed to operate.

Considering point a), most flowmeters are designed to indicate the volumetric flow rate at atmospheric temperature and pressure i.e. 20 °C and 1 bar. However, considering point b), not all flowmeters are calibrated and designed to work at the same temperature and pressure, and care should be taken to ensure that the temperature and pressure of the gas flowing through a flowmeter are correct for that particular meter. Working the flowmeter at temperatures and pressure different from these conditions requires a correction factor such as provided hereafter.

B.2 Example

B.2.1 General

Assume that an air flow rate of 77,7 l/min at 1 bar and 20 °C is required at the burner:

Flowmeter 1 : Calibrated at 2,4 bar absolute and 15 °C, but to indicate l/min at 1 bar and 15 °C

Flowmeter 2 : Calibrated at 1 bar absolute and 20 °C , but to indicate l/min at 1 bar and 20 °C

Assume that the air supply pressure up to and including the flowmeters is alternatively at 1 bar (see B.2.2) or at 2,4 bar (see B.2.3) and 20 ºC.

The calibration correction factor is given as follows:

$$C=\sqrt{\frac{P_1}{P_2}\times\frac{T_2}{T_1}}$$

Where: T is the absolute temperature, in kelvins (K)
P is the absolute pressure, in bars (bar)

P_1, T_1 are the calibration conditions
P_2, T_2 are the operating conditions

B.2.2 Air supplied at 1 bar

Flowmeter 1

This will require a correction factor to be used since the meter is operating in conditions removed from its designed operating conditions:

P_1 = 2,4 bar T_1 = 15 °C = 288 K
P_2 = 1 bar T_2 = 20 °C = 293 K

Substituting these values:

$$C = \sqrt{\frac{2,4}{1} \times \frac{293}{288}} = 1,56$$

Thus to set a flow rate of 77,7 l/min at reference conditions a reading on this flowmeter of 121,2 l/min (77,7 x 1,56) is required.

Flowmeter 2

Since this meter is operating under its design conditions, the required flow rate of 77,7 l/min can be read directly from the meter with no correction factor necessary.

B.2.3 Air supplied at 2,4 bar

Flowmeter 1

This will require a correction factor for temperature, but not for pressure since the meter is operating at its design pressure:

P_1 = 2,4 bar T_1 = 15 ºC = 288 K
P_2 = 2,4 bar T_2 =20 ºC = 293 K

Substituting these values:

$$C = \sqrt{\frac{2,4}{2,4} \times \frac{293}{288}} = 1,01$$

Thus to set a flow rate of 77,7 l/min at reference conditions, a reading of 78,5 l/min (77,7 x 1,01) on this flowmeter is required.

Flowmeter 2

This will also require a correction factor since it is operating in conditions removed from its design conditions:

P_1 = 1 bar T_1 = 20 °C = 293 K
P_2 = 2,4 bar T_2 = 20 °C = 293 K

Substituting these values:

$$C = \sqrt{\frac{1}{2,4} \times \frac{293}{293}} = 0,65$$

Thus to set a flow rate of 77,7 l/min at reference conditions a reading of 50,5 l/min (77,7 x 0,65) on this flowmeter is required.

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