

Single burner gas-fired overhead radiant tube heaters for non-domestic use

Part 1: Safety

ICS 97.100.20

National foreword

This British Standard is the UK implementation of EN 416-1:2009. It supersedes BS EN 416-1:1999 and which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GSE/20, Non-domestic space heaters (gas).

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

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Foreword

This document (EN 416-1:2009) has been prepared by Technical Committee CEN/TC 180 “Domestic and non-domestic gas fired air heaters and non-domestic gas fired overhead radiant heaters”, the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by September 2009, and conflicting national standards shall be withdrawn at the latest by September 2009.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 416-1:1999.

This revision modifies EN 416-1:1999. It has been prepared to incorporate requirements for combustion products evacuation ducts, POCEDs, supplied as an integral part of the appliance to support EU Directive 89/106/EEC on construction products under Mandate M/105. To this end, it extends the scope of the standard to cover Type B₄ and B₅ appliances.

Furthermore, the opportunity presented by this amendment has been taken to update the standard in respect to EN 437:2003.

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

For relationship with EC Directive(s), see informative Annexes ZA and ZB, which are integral parts of this document.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, 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 the United Kingdom.

1 Scope

This European Standard specifies the requirements and test methods for the construction, safety, classification and marking of non-domestic gas fired overhead radiant tube heaters incorporating a single burner system under the control of an automatic burner control system, referred to in the body of the text as 'appliances'.

This standard is applicable to Type A₂, A₃, B₁₂, B₁₃, B₂₂, B₂₃, B₄₂, B₄₃, B₅₂, B₅₃, C₁₂, C₁₃, C₃₂ and C₃₃ appliances intended for use in other than domestic dwellings, in which the supply of combustion air and/or the evacuation of the products of combustion is achieved by mechanical means located upstream of the draught diverter, if provided.

This standard is not applicable to:

- a) appliances designed for use in domestic dwelling;
- b) outdoor appliances;
- c) appliances of heat input in excess of 120 kW (based on the net calorific value of the appropriate reference test gas);
- d) appliances having fully pre-mixed gas and air burners in which:
 - 1) either the gas and all the combustion air are brought together just before the level of the combustion zone; or
 - 2) the pre-mixing of the gas and all combustion air is carried out in a part of the burner upstream of the combustion zone;
- e) appliances that are designed for continuous condensation within the flue system under normal operating conditions;
- f) appliances having combustion products evacuation ducts that are non-metallic.

This standard is applicable to appliances which are intended to be type tested. It also includes requirements concerning the evaluation of conformity, including factory production control, but these requirements only apply to POCEDs and their associated terminals.

NOTE Requirements for appliances which are not intended to be type tested would need to be subject to further consideration.

Requirements concerning the rational use of energy have not been included in this European Standard.

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 88-1:2007, *Pressure regulators and associated safety devices for gas appliances - Part 1: Pressure regulators for inlet pressures up to and including 500 mbar*

EN 126:2004, *Multifunctional controls for gas burning appliances*

EN 161:2007, *Automatic shut-off valves for gas burners and gas appliances*

EN 257:1992, *Mechanical thermostats for gas-burning appliances*

EN 298:2003, *Automatic gas burner control systems gas burners and gas burning appliances with or without fans*

EN 437:2003, *Test gases - Test pressures - Appliance categories*

EN 10226-1:2004, *Pipe threads where pressure-tight joints are made on the threads – Part 1: Taper external threads and parallel internal threads - Dimensions, tolerances and designation*

EN 10226-2:2005, *Pipe threads where pressure tight joints are made on the threads – Part 2: Taper external threads and taper internal threads - Dimensions, tolerances and designation*

EN 13410, *Gas-fired overhead radiant heaters - Ventilation requirements for non-domestic premises*

EN 60335-1:2002, *Household and similar electrical appliances - Safety - Part 1: General requirements*

EN 60335-2-102:2006, *Household and similar electrical appliances - Safety - Part 2-102: Particular requirements for gas, oil and solid-fuel burning appliances having electrical connections*

EN 60529:1992, *Degrees of protection provided by enclosures (IP Code)*

EN 60584-1:1995, *Thermocouples — Part 1: Reference tables*

EN 60584-2:1993, *Thermocouples — Part 2: Tolerances*

EN ISO 228-1:2003, *Pipe threads where pressure-tight joints are not made on the threads - Part 1: Dimensions, tolerances and designation (ISO 228-1:2000)*

EN ISO 3166-1:2006, *Codes for the representation of names of countries and their subdivisions – Part 1: Country codes (ISO 3166-1:2006)*

EN ISO 6976:2005, *Natural gas - Calculation of calorific values, density, relative density and Wobbe index from composition (ISO 6976:1995 including Corrigendum 1:1997, Corrigendum 2:1997 and Corrigendum 3:1999)*

ISO 274:1975, *Copper tubes of circular section — Dimensions*

ISO 7005-1:1992, *Metallic flanges - Part 1: Steel flanges*

ISO 7005-2:1988, *Metallic flanges - Part 2: Cast iron flanges*

ISO 7005-3:1988, *Metallic flanges - Part 3: Copper alloy and composite flanges*

CR 1404:1994, *Determination of emissions from appliances burning gaseous fuels during type-testing*

3 Definitions

For the purposes of this standard the following definitions apply:

3.1 Appliance and its constituent parts

3.1.1

overhead radiant tube heater

gas fired appliance intended for installation above head level which is designed to heat the space beneath by radiation by means of a tube or tubes, heated by the internal passage of combustion products

3.1.2

single burner systems

those radiant tube heaters which employ a single combustion system incorporating independent flame monitoring and combustion air fan

3.1.3

inlet connection

the part of the appliance intended to be connected to the gas supply

3.1.4

mechanical joint

means of ensuring the soundness of an assembly of several parts (e.g. metal to metal joints, conical joints, toroidal sealing rings ('O' rings), flat joints without the use of liquids (e.g. pastes and tapes)

3.1.5

gas circuit

part of the appliance that conveys or contains the gas between the appliance gas inlet connection and the burner(s)

3.1.6

restrictor

device with an orifice, which is placed in the gas circuit so as to create a pressure drop and thus reduce the gas pressure at the burner to a predetermined value for a given supply pressure and rate

3.1.7

gas rate adjuster

component allowing an authorised person to set the gas rate of the burner to a predetermined value according to the supply conditions

NOTE 1 Adjustment can be progressive (screw adjuster) or in discrete steps (by changing restrictors).

NOTE 2 The adjusting screw of an adjustable regulator is regarded as a gas rate adjuster.

NOTE 3 The action of adjusting this device is called 'adjusting the gas rate'.

NOTE 4 A factory sealed gas rate adjuster is considered to be non-existent.

3.1.8

setting an adjuster

immobilizing a gas rate adjuster by such means as e.g. a screw, after the gas rate has been adjusted by the manufacturer or installer

3.1.9

sealing an adjuster

term applied to any arrangement in respect of the adjuster such that any attempt to change the adjustment breaks the sealing device or sealing material and makes this interference apparent

NOTE 1 A factory sealed adjuster is considered to be non-existent.

NOTE 2 A regulator is considered to be non-existent if it has been factory sealed in a position such that it is not operational in the range of supply pressure corresponding to the appliance category.

3.1.10

putting an adjuster or a control out of service

putting an adjuster or a control (of temperature, pressure, etc.) out of action and sealing it in this position. The appliance then functions as if the adjuster or control had been removed.

3.1.11

injector

component that admits the gas into a burner

3.1.12

main burner

burner that is intended to ensure the thermal function of the appliance and is generally called the burner

3.1.13

premixed burner

burner in which the gas and a quantity of air, at least equal to that theoretically necessary for complete combustion, are mixed before the flame port(s)

3.1.14

ignition burner

burner whose flame is intended to ignite another burner

3.1.15

ignition device

means (e.g. flame, electrical ignition device or other device) used to ignite the gas at the ignition burner or at the main burner

3.1.16

primary aeration adjuster

device enabling the primary air to be set at the necessary value according to the supply conditions

3.2 Combustion circuit

3.2.1

combustion products circuit

circuit including the combustion chamber, the radiant tube, the combustion products evacuation duct and either the fitting piece or the connection to the terminal, if any

3.2.2

air supply and combustion products evacuation ducts

means for transporting combustion air to the burner and combustion products to the terminal or fitting piece

NOTE A fitting piece is not utilised by appliances of Type C₁ or of Type C₃. It is necessary to distinguish between:

- a) completely surrounded ducts where the combustion products evacuation duct is surrounded by combustion air throughout its length; and

- b) separate ducts where the combustion products evacuation duct and the combustion air supply duct are neither concentric nor completely surrounded ducts

3.2.3

combustion chamber

enclosure inside which combustion of the air-gas mixture takes place

3.2.4

flue outlet

part of a Type B appliance that connects with a flue to evacuate the products of combustion

3.2.5

draught diverter

device placed in the combustion products circuit to reduce the influence of flue-pull and that of down-draught on the burner performance and combustion

3.2.6

terminal

device(s) fitted to the outside of the building, which are connected to the air supply and combustion products evacuation ducts for Type C₁ and Type C₃ appliances (one or two devices)

3.2.7

terminal guard

device that protects the terminal from mechanical damage from outside influences

3.2.8

POCED

combustion products evacuation duct that is intended to be used only with a specific appliance/system; this duct being either supplied with the appliance/system or specified in the manufacturer's instructions

3.3 Adjusting, control and safety devices

3.3.1

automatic burner control system

system comprising at least a programming unit and all the elements of a flame detector device

NOTE The various functions of an automatic burner control system may be in one or more housings.

3.3.2

air proving device

device intended to cause safety shutdown in the event of abnormal conditions of air admission or of combustion products evacuation

3.3.3

programming unit

device which reacts to signals from control and safety devices, gives control commands, controls the start-up sequence, supervises the burner operation and causes controlled shut-down, and if necessary, safety shut-down and lock-out; the programming unit follows a predetermined sequence of actions and always operates in conjunction with a flame detector device

3.3.4

programme

sequence of control operations determined by the programming unit involving switching on, starting up, supervising and switching off the burner

3.3.5

flame detector

device by which the presence of a flame is detected and signalled

It can consist of a flame sensor, an amplifier and a relay for signal transmission. These parts, with the possible exception of the flame sensor, may be assembled in a single housing for use in conjunction with a programming unit.

3.3.6

flame signal

signal given by the flame detector, normally when the flame sensor senses a flame

3.3.7

flame supervision device

device that, in response to a signal from the flame detector, keeps the gas supply open and shuts it off in the absence of the supervised flame

3.3.8

flame simulation

condition which occurs when the flame signal indicates the presence of a flame when in reality no flame is present

3.3.9

pressure regulator ¹⁾

device which maintains the outlet pressure constant, independent of the variations in inlet pressure within defined limits

3.3.10

adjustable pressure regulator

regulator provided with means for changing the outlet pressure setting

3.3.11

volume regulator ¹⁾

device which maintains the gas rate constant within a given tolerance, independent of the upstream pressure

3.3.12

range-rating device

component on the appliance intended to be used by the installer to adjust the heat input of the appliance, within a range of heat inputs stated by the manufacturer, to suit the actual heat requirements of the installation

This adjustment may be progressive (e.g. by use of a screw adjuster) or in discrete steps (e.g. by changing restrictors).

3.3.13

automatic shut-off valve

valve designed to open when energized and to close automatically when de-energized

3.4 Operation of the appliance

3.4.1

heat input

Q

quantity of energy used in unit time corresponding to the volumetric or mass flow rates; the calorific value used being the net or gross calorific value

NOTE The heat input is expressed in kilowatts (kW). [EN 437:2003]

¹ The term 'regulator' is used in both cases.

3.4.2

nominal heat input

Q_n

value of the heat input (kW) declared by the manufacturer

3.4.3

volume flow rate

V

volume of gas consumed by the appliance in unit time during continuous operation

NOTE The volume flow rate is expressed in cubic metres per hour (m^3/h), litres per minute (l/min), cubic decimetres per hour (dm^3/h) or cubic decimetres per second (dm^3/s) [EN 437:2003].

3.4.4

mass flow rate

M

mass of gas consumed by the appliance in unit time during continuous operation

NOTE The mass flow rate is expressed in kilograms per hour (kg/h) or grams per hour (g/h) [EN 437:2003].

3.4.5

start gas

gas that is supplied at the start gas rate either at the main burner or at a separate ignition burner

3.4.6

start gas rate

restricted gas flow rate admitted either to a separate ignition burner or to the main burner during start up

3.4.7

start gas flame

flame established at the start gas rate either at the main burner or at a separate ignition burner

3.4.8

flame stability

characteristic of flames which remain on the burner ports or in the flame reception zone intended by the construction

3.4.9

flame lift

total or partial lifting of the base of the flame away from the burner port or the flame reception zone provided by the design

Flame lift may cause the flame to blow out (i.e. extinction of the air-gas mixture).

3.4.10

light-back

entry of a flame into the body of the burner

3.4.11

light-back at the injector

ignition of the gas at the injector, either as a result of light-back into the burner or by the propagation of a flame outside the burner

3.4.12

sooting

phenomenon appearing during incomplete combustion and characterized by deposits of soot on the surfaces or parts in contact with the combustion products or with the flame

3.4.13

yellow tipping

yellowing of the tip of the blue cone of an aerated flame

3.4.14

purge

forced introduction of air through the combustion chamber and flue passages in order to displace any remaining fuel/air mixture and/or products of combustion

3.4.14.1

pre-purge

purge which takes place between the start signal and energising of the ignition device

3.4.14.2

post-purge

purge which takes place immediately following shut-down

3.4.15

first safety time ²⁾

interval between the ignition burner valve, start gas valve or main gas valve, as applicable, being energised and the ignition burner valve, start gas valve or main gas valve, as applicable, being de-energized if the flame detector signals the absence of a flame at the end of this interval

3.4.16

second safety time

where there is a first safety time applicable to either an ignition burner or to a start gas flame only, the second safety time is the interval between the main gas valve being energized and the main gas valve being de-energized if the flame detector signals the absence of a flame at the end of this interval

3.4.17

extinction safety time

time which elapses between the moment when the supervised flame is extinguished and the moment when the automatic burner control system initiates shut-down of the burner by removing power to the automatic gas shut-off valves

3.4.18

running condition of the system

condition in which the burner is in normal operation under the supervision of the programming unit and its flame detector

3.4.19

controlled shut-down

process by which the power to the gas shut-off valve(s) is removed immediately (e.g. as a result of the action of a controlling function)

3.4.20

safety shut-down

process which is effected immediately following the response of a safety control or sensor or the detection of a fault in the burner control system and which puts the burner out of operation by immediately removing the power to the gas shut-off valve(s) and the ignition device

²⁾ Where there is no second safety, this is called safety time.

3.4.21

non-volatile lock-out

safety shut-down condition of the system, such that a restart can only be accomplished by a manual reset of the system and by no other means

3.4.22

volatile lock-out

safety shut-down condition of the system, such that a restart can only be accomplished by either the manual reset of the system, or an interruption of the mains electrical supply and its subsequent restoration

3.4.23

spark restoration

process by which, following the loss of the flame signal, the ignition device will be switched on again without the total interruption of the gas supply

NOTE This process ends with the restoration of the running condition or, if there is no flame signal at the end of the safety time, with volatile or non-volatile lock out.

3.4.24

automatic re-cycling

process by which, after a safety shut-down, a full start-up sequence is automatically repeated

NOTE This process ends with the restoration of the running condition or, if there is no flame signal at the end of the safety time, or if the cause of the accidental interruption has not disappeared, with volatile or non-volatile lock out.

3.5 Gases

3.5.1

calorific value

quantity of heat produced by the complete combustion, at a constant pressure equal to 1 013,25 mbar, of a unit volume or mass of gas, the constituents of the combustible mixture being taken at reference conditions and the products of combustion being brought back to the same conditions

A distinction is made between:

- a) the gross calorific value H_s in which the water produced by combustion is assumed to be condensed;
- b) the net calorific value H_i in which the water produced by combustion is assumed to be in the vapour state.

NOTE The calorific value is expressed either in MJ/m³ of dry gas at the reference conditions or in MJ/kg of dry gas [EN 437:2003].

3.5.2

relative density

d

ratio of the masses of equal volumes of dry gas and dry air at the same conditions of temperature and pressure

3.5.3

Wobbe index

gross Wobbe index: W_s and net Wobbe index: W_i .

ratio of the calorific value of a gas per unit volume and the square root of its relative density under the same reference conditions. The Wobbe index is said to be gross or net according to whether the calorific value used is the gross or net calorific value

NOTE The Wobbe index is expressed either in megajoules per cubic metre of dry gas at the reference conditions (MJ/m^3) or in megajoules per kilogram of dry gas (MJ/kg) [EN437:2003].

3.5.4

test pressure

gas pressures used to verify the operational characteristics of appliances using combustible gases; they consist of normal and limit pressures

NOTE Test pressures are expressed in mbar; $1 \text{ mbar} = 10^2 \text{ Pa}$ [EN 437:2003].

3.5.5

normal pressure

p_n

pressure under which the appliances operate in nominal conditions when they are supplied with the corresponding reference gas

[EN 437:2003]

3.5.6

limit pressure

(maximum limit pressure $p_{\max}$ and minimum limit pressure $p_{\min}$)

pressures representative of the extreme variations in the appliance supply conditions

[EN 437:2003]

3.5.7

pressure couple

combination of two distinct gas distribution pressures applied by reason of the significant difference existing between the Wobbe indices within a single family or group in which:

- a) the higher pressure corresponds only to gases of low Wobbe index
- b) the lower pressure corresponds to gases of high Wobbe index

3.6 Conditions of operation and measurement

3.6.1

reference conditions

for the purposes of this standard, the following reference conditions apply:

- a) for calorific values, temperature: 15°C
- b) for gas and air volumes dry, brought to 15°C and to an absolute pressure of $1\,013,25 \text{ mbar}$

3.6.2

cold condition

condition of the appliance required for some tests and obtained by allowing the unlit appliance to attain thermal equilibrium at room temperature

3.6.3

hot condition

condition of the appliance required for some tests and obtained by heating to thermal equilibrium at the nominal heat input

3.6.4

equivalent resistance

resistance to flow (in mbar) measured at the outlet of the appliance, which is equivalent to that of the actual flue

3.6.5

thermal equilibrium

operating state of the appliance, corresponding to a particular setting of the input in which the flue gas temperature (°C) does not change by more than ± 2 % over a period of 10 min

3.7 Country of destination

3.7.1

direct country of destination

country for which the appliance has been certified and which is specified by the manufacturer as the intended country of destination; at the time of putting the appliance on the market and/or installation, the appliance shall be capable of operating, without adjustment or modification, with one of the gases distributed in the country concerned, at the appropriate supply pressure

More than one country can be specified if the appliance, in its current state of adjustment, can be used in each of these countries.

3.7.2

indirect country of destination

country for which the appliance has been certified, but for which, in its present state of adjustment, it is not suitable. Subsequent modification or adjustment is essential in order that it can be utilized safely and correctly in this country

4 Appliance classification

4.1 Classification according to the nature of the gases used (categories)

Gases are classified into three families, possibly divided into groups according to the value of the Wobbe index. Table 1 specifies the families and groups of gas used in this standard.

Table 1 — Gas classification

Gas family	Gas Group	Gross Wobbe index (MJ/m ³) at 15 °C and 1 013,25 mbar	
		Minimum	Maximum
First	a	22,4	24,8
Second	H	39,1	54,7
	L	45,7	54,7
	E	39,1	44,8
	E	40,9	54,7
Third	B/P	72,9	87,3
	P	72,9	87,3
	P	72,9	76,8
	B	81,8	87,3

4.2 Classification according to the gases capable of being used

4.2.1 Category I

Appliances of Category I are designed exclusively for the use of gases of a single family or of a single group:

- a) Appliances designed for use on first family gases only:

Category I_{1a}: appliances using only gases of Group A of the first family at the prescribed pressure (this category is not used).

- b) Appliances designed for use on second family gases only:

Category I_{2H}: appliances using only gases of Group H of the second family at the prescribed supply pressures;

Category I_{2L}: appliances using only gases of Group L of the second family at the prescribed pressures;

Category I_{2E}: appliances using only gases of Group E of the second family at the prescribed pressures;

Category I_{2E+}: appliances using only gases of Group E of the second family, and operating with a pressure couple without adjustment on the appliance. The appliance gas regulator, if it exists, is not operative in the range of the two normal pressures of the pressure couple.

- c) Appliances designed for use on third family gases only:

Category I_{3B/P}: appliances capable of using the third family gases (propane and butane) at the prescribed pressure;

Category I₃₊: appliances capable of using gases of the third family (propane and butane) and operating with a pressure couple without adjustment of the appliance. However, for certain types of appliance specified in the particular standards adjustment of the primary combustion air may be permitted when changing from propane to butane and vice versa. No gas pressure regulating device is permitted on the appliance;

Category I_{3P}: appliances using only gases in Group P of the third family only (propane) at the prescribed pressure.

4.2.2 Category II

Appliances of category II are designed for use on gases of two families:

- a) Appliances designed for use on gases of the first and second families gases:

Category II_{1a2H}: appliances capable of using gases of Group A of the first family and gases of Group H of the second family. The first family gases are used under the same conditions as for category I_{1a}. The second family gases are used under the same conditions as those for category I_{2H};

- b) Appliances designed for use on gases of the second and third families:

Category II_{2H3B/P}: appliances capable of using gases of Group H of the second family and gases of the third family. The second family gases are used under the same conditions as for category I_{2H}. The third family gases are used under the same conditions as for category I_{3B/P};

Category II_{2H3+}: appliances capable of using gases of Group H of the second family and gases of the third family. The second family gases are used under the same conditions as for category I_{2H}. The third family gases are used under the same conditions as for category I₃₊;

Category II_{2H3P}: appliances capable of using gases of Group H of the second family and gases of Group P of the third family. The second family gases are used under the same conditions as for category I_{2H}. The third family gases are used under the same conditions as for category I_{3P};

Category II_{2L3B/P}: appliances capable of using gases of Group L of the second family and gases of the third family. The second family gases are used under the same conditions as for category I_{2L}. The third family gases are used under the same conditions as for category I_{3B/P};

Category II_{2L3P}: appliances capable of using gases of Group L of the second family and gases of Group P of the third family. The second family gases are used under the same conditions as for category I_{2L}. The third family gases are used under the same conditions as for category I_{3P};

Category II_{2E3B/P}: appliances capable of using gases of Group E of the second family and gases of the third family. The second family gases are used under the same conditions as for category I_{2E}. The third family gases are used under the same conditions as for category I_{3B/P};

Category II_{2E3+}: appliances capable of using gases of Group E of the second family and gases of the third family. The second family gases are used under the same conditions as for category I_{2E+}. The third family gases are used under the same conditions as for category I₃₊;

Category II_{2E3P}: appliances capable of using gases of Group E of the second family and gases of the third family. The second family gases are used under the same conditions as for category I_{2E+}. The third family gases are used under the same conditions as for category I_{3P}.

4.2.3 Category III

Category III appliances are designed for use on gases of the three families.

This category is not in general use.

Category III appliances which are in use in certain countries are given in A.3.

4.3 Classification according to the mode of evacuation of the combustion products

4.3.1 General

Appliances are classified into several types according to the method of evacuation of the combustion products and admission of the combustion air.

4.3.2 Type A

An appliance not intended for connection to a flue or to a device for evacuating the products of combustion to the outside of the room in which the appliance is installed.

This standard applies to:

- a) Type A₂: an appliance with a fan downstream of the combustion chamber;
- b) Type A₃: an appliance with a fan upstream of the combustion chamber.

4.3.3 Type B

An appliance intended to be connected to a flue which evacuates the products of combustion to the outside of the room containing the appliance. The combustion air is drawn directly from the room.

The variations of Type B relevant to this standard are:

- a) Type B₁: a Type B appliance incorporating a draught diverter;
- b) Type B₂: a Type B appliance without a draught diverter;
- c) Type B₄: a Type B appliance, incorporating a draught diverter, that is designed for connection via its flue duct to its flue terminal;
- d) Type B₅: a Type B appliance, without a draught diverter, that is designed for connection via its flue duct to its flue terminal.

This standard applies to:

- e) Type B₁₂: a Type B₁ appliance designed for a natural draught flue incorporating a fan downstream of the combustion chamber/heat exchanger and upstream of the draught diverter;
- f) Type B₁₃: a Type B₁ appliance designed for a natural draught flue incorporating a fan upstream of the combustion chamber/heat exchanger;
- g) Type B₂₂: a Type B₂ appliance incorporating a fan downstream of the combustion chamber/heat exchanger;
- h) Type B₂₃: a Type B₂ appliance incorporating a fan upstream of the combustion chamber/heat exchanger;
- i) Type B₄₂: a Type B₄ appliance designed for a natural draught flue incorporating a fan downstream of the combustion chamber/heat exchanger and upstream of the draught diverter;
- j) Type B₄₃: a Type B₄ appliance designed for a natural draught flue incorporating a fan upstream of the combustion chamber/heat exchanger;
- k) Type B₅₂: a Type B₅ appliance incorporating a fan downstream of the combustion chamber/heat exchanger;

- l) Type B₅₃: a Type B₅ appliance incorporating a fan upstream of the combustion chamber/heat exchanger.

See Annex B.1 for the types of appliance identified above, in which the combustion air is supplied and/or in which the products of combustion are evacuated by mechanical means.

4.3.4 Type C

An appliance in which the combustion circuit is sealed with respect to the inhabitable area of the building in which the appliance is installed.

The variations of Type C relevant to this standard are:

- a) Type C₁: a Type C appliance that is designed for connection via its ducts to a horizontal terminal, which at the same time admits fresh air to the burner and discharges the products of combustion to the outside through orifices that are either concentric or close enough to come under similar wind conditions;
- b) Type C₃: a Type C appliance that is designed for connection via its ducts to a vertical terminal, which at the same time admits fresh air to the burner and discharges the products of combustion to the outside through orifices that are either concentric or close enough to come under similar wind conditions.

This standard applies to:

- c) Type C₁₂: a Type C₁ appliance incorporating a fan downstream of the combustion chamber/heat exchanger;
- d) Type C₁₃: a Type C₁ appliance incorporating a fan upstream of the combustion chamber/heat exchanger;
- e) Type C₃₂: a Type C₃ appliance incorporating a fan downstream of the combustion chamber/heat exchanger;
- f) Type C₃₃: a Type C₃ appliance incorporating a fan upstream of the combustion chamber/heat exchanger.

See B.2 for the types of appliance identified above, in which the combustion air is supplied and/or in which the products of combustion are evacuated either by natural draught or mechanical means.

5 Constructional requirements

5.1 General

5.1.1 Conversion to different gases

The only acceptable operations when converting from a gas of one group or family to a gas of another group or family and/or to adapt to different gas distribution pressures are given below for each category.

It is recommended that these operations should be possible without disconnecting the appliance.

5.1.1.1 Category I

- a) Category I_{2H}, I_{2L}, I_{2E}, I_{2E+}: no modification to the appliance;

- b) Categories I_{3B/P}: no modification to the appliance;
- c) Category I₃₊: replacement of injectors or calibrated orifices but only in order to convert from one pressure couple to another (e.g. 28-30/37 mbar to 50/67 mbar);
- d) Category I_{3P}: no modification to appliance relative to a change of gas. For changing pressure replacement of injectors and adjustment of gas rates.

5.1.1.2 Category II

5.1.1.2.1 Categories of appliance designed for use with gases of first and second families

Adjustment of the gas rate with, if necessary, a change of injector, restrictor or regulator.

Adjustment of the gas rate of the ignition burner, either by using an adjuster or by a change of injector or restrictor and, if necessary, a change of complete ignition burner or of some of its parts.

Putting the regulator out of service under the conditions of 5.2.6.

Putting the gas rate adjusters out of service under the conditions of 5.2.2 and 5.2.3 if applicable.

The adjustments or component changes are only acceptable when converting from a gas of the first family to a gas of the second family or vice versa.

5.1.1.2.2 Categories of appliance designed for use with gases of the second and third families

Adjustment of the gas rate with, if necessary, a change of injector, restrictor or regulator.

Adjustment of the gas rate of the ignition burner, either by using an adjuster or by a change of injectors or restrictor and, if necessary, a change of complete ignition burners or of some of its parts.

Putting the regulator out of service under the conditions of 5.2.6.

Putting the gas rate adjusters out of service under the conditions of 5.2.2.

The adjustments or component changes are only acceptable when:

- a) converting from a gas of the second family to a gas of the third family or vice versa;
- b) converting from one butane/propane pressure couple to another (e.g. 28-30/37 mbar to 50/67 mbar).

5.1.1.3 Category III

Category III appliances admitted in certain countries are given in A.3.2.3.

5.1.2 Materials and method of construction

The quality and thickness of materials used in the construction of an appliance, including its POCED in the case of Type B₄, B₅, C₁ and C₃ appliances, shall be:

- a) such that the construction and performance characteristics are not altered so as to affect the safe operation of the appliance in normal conditions of use and of maintenance by the user;
- b) such as to ensure a reasonable operating life.

In particular, when the appliance is installed according to the manufacturer's instructions, all the components shall withstand the mechanical, chemical and thermal conditions to which they may be subjected when used in a manner which can be reasonably foreseen.

Copper shall not be used for gas carrying parts where the temperature is likely to exceed 100 °C.

Asbestos or materials containing asbestos shall not be used.

Solder that has a melting point below 450 °C after application shall not be used for gas carrying parts.

5.1.3 Accessibility for maintenance and use

Components and controls shall be arranged such that they are readily accessible for adjustment, maintenance or exchange. Where necessary, access doors or removable panels shall be provided.

Parts that are intended to be removed for maintenance or cleaning shall be readily accessible, shall be simple to assemble correctly and difficult to assemble incorrectly. Such parts shall be difficult to assemble incorrectly where incorrect assembly would create a hazardous condition or result in damage to the appliance and its controls.

Parts of the appliance which are not intended to be removed by the user and for which removal would affect safety shall be capable of removal only with the aid of tools.

5.1.4 Means of sealing

5.1.4.1 Soundness of the gas circuit

Holes for screws, studs, etc., intended for the assembly of components shall not open into the gas ways. The wall thickness between holes (including threads) and gas ways shall be not less than 1 mm.

The soundness of components and assemblies connected to the gas circuit and likely to be dismantled for routine maintenance at the consumer's premises shall be assured by means of mechanical joints (e.g. metal to metal joints, 'O'-ring joints and packing) but excluding the use of any sealing compound such as tape, mastic or paste. The soundness shall be maintained after dismantling and re-assembly.

Sealing compounds may be used for permanent threaded assemblies. The sealing material shall remain effective under normal conditions of appliance use.

5.1.4.2 Soundness of the combustion circuit (Type B appliances)

The soundness of the combustion circuit of the appliance shall be affected by mechanical means only, with the exception of those parts which do not require to be disconnected for routine maintenance, and which may be joined with mastic or paste in such a way that permanent soundness is assured under normal condition of use.

5.1.4.3 Soundness of the combustion circuit (Type C appliances)

Parts which have to be removed during routine service and affect the soundness of the appliance and/or its ducts, shall be sealed by mechanical means, excluding pastes, liquids and tapes. The need for replacement of the seal(s), following a cleaning or servicing operation as stated by the manufacturer, is permitted.

However, parts of the assembly that are not intended to be dismantled for maintenance may be joined in such a way that permanent soundness is assured during continuous service under normal conditions of use.

The ducts, bends, if any, and the terminal or fitting piece shall fit together correctly and shall form a stable assembly. Parts intended to be dismantled for periodic servicing shall be designed and arranged so that soundness is guaranteed after re-assembly.

Any fitting piece shall allow a sound connection to be made to the system intended for the evacuation of combustion products and supply of air.

5.1.5 Supply of combustion air and evacuation of combustion products

5.1.5.1 General

All appliances shall be designed so that there is an adequate supply of combustion air during ignition and over the whole range of possible heat inputs stated by the manufacturer.

Unless otherwise stated, fan assisted appliances may be fitted with a means of adjustment in the combustion circuit intended to adapt the appliances to the pressure losses in the installed ducts, either by restrictors or by setting the means of adjustment to predetermined positions in accordance with detailed instructions from the manufacturer.

According to the appliance type, the manufacturer shall supply any terminal and/or fitting piece, with the appliance for test.

If the appliance has a POCED that is capable of being installed in accordance with the manufacturer's instructions such that its outlet, when fitted with any terminal supplied with the appliance, or specified in the manufacturer's instructions, extends beyond the external surface of a building by more than 1,5 m, this duct, together with any associated air supply duct (Type C₁ and C₃ appliances), shall not undergo any permanent distortion when subjected to the wind load test specified in 4.3.2 of EN 1859:2000.

5.1.5.2 Air supply and combustion products evacuation ducts

The assembly of the various parts during installation shall be such that no work is necessary other than adjusting the length of the air supply and combustion products evacuation ducts (possibly by cutting them). Such adaptation shall not impair the correct operation of the appliance.

It shall be possible to connect the appliance, the air supply and combustion products evacuation ducts and the terminal or fitting piece using ordinary tools if necessary. All necessary accessories and the fitting instructions shall be supplied by the manufacturer.

The terminal outlets from separate ducts for the supply of combustion air and the evacuation of combustion products shall fit inside a square of 50 cm for Type C₁ and C₃ appliances.

NOTE In accordance with the national regulations sampling points in the combustion circuit may be required.

5.1.5.3 Air inlets

All openings for the supply of air into the appliance shall be adequately protected against inadvertent obstruction. In addition, such openings shall not permit the entry of a ball of 16 mm diameter applied with a force of 5 N. The cross section of the air passageway(s) shall not be adjustable.

5.1.5.4 Appliance outlet

The cross-section of the combustion circuit shall not be adjustable.

The outlet for products of combustion of a Type A appliance shall be so designed and arranged that it is protected against inadvertent obstruction (e.g. from matter falling from above).

5.1.5.5 Type B₁₂ and Type B₁₃ appliances

The draught diverter shall either be integral with the appliance or be supplied with the appliance by manufacturer.

The flue outlet shall be female and shall allow, if necessary by means of an adaptor supplied with the appliance, connection to a flue pipe whose diameter complies with the standards in force in the country where the appliance is to be installed (see A.6).

It shall be possible to insert a flue pipe of external diameter ($D - 2$) mm to a depth of at least $D/4$ but not so far that the evacuation of the combustion products is impaired. However, for a vertical connection, the depth of insertion can be reduced to 15 mm.

NOTE Where D is the nominal internal diameter of the appliance outlet.

5.1.5.6 Type B₂₂ and Type B₂₃ appliances

The flue outlet shall be female and shall allow, if necessary by means of an adaptor supplied with the appliance, connection to a flue pipe whose diameter complies with the standards in force in the country where the appliance is to be installed (see A.6).

It shall be possible to insert a flue pipe of external diameter ($D - 2$) mm to a depth of at least $D/4$ but not so far that the evacuation of the combustion products is impaired. However, for a vertical connection, the depth of insertion can be reduced to 15 mm.

NOTE Where D is the nominal internal diameter of the appliance outlet.

The manufacturer shall state the minimum and maximum equivalent resistance. The manufacturer's instructions shall give details for calculating the equivalent resistance (e.g. the allowance to be made for bends) and the mass flow rate of flue gases in kg/s (see Annex D). In addition, the manufacturer shall state the flue pressure (Pa) and flue gas temperature (°C).

Where the appliance is intended to be fitted to a flue having a wall termination, the manufacturer shall either supply a flue terminal or state the type of termination which shall be used. The design of this shall be such that it will not allow entry of a ball of 16 mm diameter applied with a force of 5 N.

5.1.5.7 Type B₄₂ and B₄₃ appliances

The draught diverter shall either be integral with the appliance or be supplied with the appliance by the manufacturer.

The POCED shall either be supplied with the appliance by the manufacturer or specified in the manufacturer's instructions. The specification shall include a description of the duct including any bends, its materials of construction and any critical tolerances e.g. in length, diameter, thickness, insertion depth, etc.

5.1.5.8 Type B₅₂ and B₅₃ appliances

The POCED shall either be supplied with the appliance by the manufacturer or specified in the manufacturer's instructions. The specification shall include a description of the duct including any bends, its materials of construction and any critical tolerances e.g. in length, diameter, thickness, insertion depth, etc.

The manufacturer shall state the minimum and maximum equivalent resistance. The manufacturer's instructions shall give details for calculating the equivalent resistance, for example, the allowance to be made for bends, etc.

Where the appliance is intended to be fitted to a flue having a wall termination, the manufacturer shall either supply a flue terminal or state the type of termination which shall be used. The design of this shall be such that it will not allow entry of a ball of 16 mm diameter applied with a force of 5 N.

5.1.6 Inlet connections

The appliance inlet connection shall be one of the following types:

- a) a thread conforming to EN ISO 228-1:2003. In this case the end of the gas inlet connection shall have a flat annular surface at least 3 mm wide for thread sizes 1³⁾, ½ and ¾ and at least 2,5 mm wide for thread size ¼, to allow the interposition of a sealing washer. Moreover, when the end of the gas inlet connection has a thread of nominal size ½, it shall be possible to insert a gauge of 12,3 mm diameter to a depth of at least 4 mm;
- b) a thread conforming to EN 10226-1:2004 or EN 10226-2:2005;
- c) a compression fitting suitable for copper tube conforming to Table 2 of ISO 274:1975;
- d) a straight tube at least 30 mm long, the end of which is cylindrical, smooth and clean, to allow connection by means of a compression fitting as specified in c);
- e) a flange to ISO 7005-1:1992, ISO 7005-2:1988 or ISO 7005-3:1988.

NOTE The conditions of inlet connections prevailing in the various countries are given in A.5.

The gas inlet connection shall be so secured that connections to the gas supply can be made without disturbing any controls or gas-carrying components of the appliance.

5.1.7 Confirmation of operation

Means shall be provided to allow observation of any ignition burner flame during commissioning and servicing. If the means of observation is a viewing port, it shall, when located in an area of high temperature, be covered with heat resistant glass or equivalent material and sealed with a suitable heat resistant sealant.

It shall at all times be possible for the user to ascertain visually whether the appliance is in operation or has gone to volatile or non-volatile lock-out where:

- a) mirrors or windows are used, their optical properties shall not have deteriorated at the completion of all the tests specified in this standard;
- b) indicator lights are used; their purpose shall be clearly and permanently identified on the appliance, or on the plate or label required by 8.1.1. The indicator lighting circuitry shall be so designed and arranged that:
 - 1) it indicates when a supervised flame is present and, in the case of a supervised ignition burner, it also indicates when the main burner is in operation;
 - 2) any failure arising in the indicator lighting circuitry shall either not affect the operation of any safety device or prevent the operation of the appliance.

³⁾ This inlet connection may be necessary for appliances burning first family gases.

5.1.8 Electrical equipment

The electrical equipment of the appliance shall be so designed and constructed as to obviate hazards of electrical origin and shall comply with the requirements of EN 60335-2-102:2006 which cover such hazards.

If the appliance is fitted with electronic components or electronic systems providing a safety function, these shall comply with the relevant requirements of EN 298:2003 with regard to electromagnetic compatibility immunity levels.

If the manufacturer specifies the nature of the electrical protection of the appliance on the data plate, this specification shall comply with EN 60529:1992:

- a) to give the degree of personal protection against contact with dangerous electrical components inside the appliance case;
- b) to give the degree of electrical protection, inside the appliance case, against harmful actions due to water penetration.

5.1.9 Operational safety in the event of fluctuation, interruption and restoration of the auxiliary energy

Interruption and subsequent restoration of the electricity supply at any time during the starting up or operation of the appliance shall result in the continued safe operation, non-volatile lock-out, volatile lock-out, or safety shut-down followed by automatic recycling.

Interruption and subsequent restoration of the electricity supply shall not override any lock-out condition except where the appliance is intended to be reset by means of switching off and on the electricity supply to the appliance (e.g. volatile lock-out). Such resetting shall only be possible if any interruption and subsequent restoration of the electricity supply cannot give rise to a hazardous appliance condition.

NOTE Requirements relating to the continued and safe operation of the appliance in the event of normal and abnormal fluctuation of auxiliary energy is specified in 6.6.1 d).

5.1.10 Motors and fans

The direction of rotation of motors and fans shall be clearly marked.

Belt drivers, where used, shall be so designed or positioned as to afford protection to the operator.

Means shall be provided to facilitate adjustment of belt tension. Access to such means shall be possible only with the use of commonly available tools.

Motors and fans shall be mounted in such a way as to minimize noise and vibration.

Lubrication points, if provided, shall be readily accessible.

5.2 Requirements for adjusting, control and safety devices

5.2.1 General

The functioning of any safety device shall not be overruled by that of any control device.

The appliance shall not incorporate any controls which need to be manipulated by the user when the appliance is in normal operation.

5.2.2 Gas rate adjusters

Appliances in categories I_{2H}, I_{2L}, I_{2E}, I_{2E+}, I_{3B/P}, I_{3P}, II_{2H3B/P}, II_{2H3+}, II_{2H3P}, II_{2L3B/P}, II_{2E3B/P}, II_{2E+3+} and II_{2E+3P} shall not be fitted with gas rate adjusters. However, regulated appliances in all these categories except II_{2E+3+} may have a gas rate adjuster consisting of an adjusting screw on the gas regulator.

Appliances in category II_{1a2H} shall have a gas rate adjuster for first family gases.

For appliances in categories II_{2H3+} having a gas rate adjuster, it shall be possible to put these devices out of service when these appliances are supplied with a third family gas, and the same applies for appliances in category II_{1a2H} when they are supplied with a second family gas. For appliances in category II_{2E+3P} having a gas rate adjuster, it shall be possible to put these devices out of service fully or partially (see 5.2.6) when these appliances are supplied with a second family gas.

The adjusters shall be adjustable only with the use of a tool and they shall be capable of being set in the operating position.

5.2.3 Range-rating devices

A range-rating device on an appliance is optional.

For appliances in categories II_{1a2H} the gas rate adjuster and the range-rating device may be one and the same. However, if the gas rate adjuster has to be sealed, either completely or partially, when the appliance is supplied with a second family gas, the gas rate adjuster or its sealed part shall no longer be used by the installer as a range-rating device.

5.2.4 Aeration adjusters

Aeration adjusters are not permitted.

5.2.5 Controls and safety devices

5.2.5.1 General

The functioning of any safety devices shall not be overruled by that of any control device.

5.2.5.2 Manual controls

5.2.5.2.1 Application

Manual valves, push buttons or electrical switches that are essential for normal operation and commissioning of the appliance shall either be provided with the appliance or specified in the manufacturer's installation instructions.

5.2.5.2.2 Manual valves

Manual valves shall be of the 90° turn type.

Manual valves shall be so designed or positioned as to prevent inadvertent operation but shall be easy to operate when required. They shall be so designed that in operation the OPEN and CLOSED positions are readily distinguishable.

When a manual valve is provided at the inlet of the appliance as an integral part of the appliance, it shall be capable of operating at a pressure equal to 1,5 times the maximum supply pressure and shall be readily accessible.

Manual valves used solely for OPEN/CLOSED operation shall be provided with positive stops at the OPEN and CLOSED positions.

5.2.6 Regulators

Regulators shall comply with EN 88-1:2007.

For an appliance burning first or second family gases, the gas supply to the burner and any ignition burner shall be under the control of an integral regulator fitted upstream of the automatic shut-off valves unless it is incorporated in the multifunctional control.

For an appliance burning third family gases, the fitting of a regulator is optional.

The design and accessibility of the regulator shall be such that it can be easily adjusted or put out of service for use with another gas, but precautions shall be taken to make unauthorised interference with the adjustment difficult.

However, for appliances in categories I_{2E+}, II_{2E+3+} and II_{2E+3P} the gas regulator shall not be operational in the range of the two normal pressures of the second family pressure couple (i.e. 20 mbar to 25 mbar). For appliances in categories II_{2E+3+} and II_{2E+3P}, it shall be possible to put the regulator partially out of service when they are supplied with second family gases, such that the regulator is not operational in the range of the two normal pressures of the second family pressure couple (i.e. 20 mbar to 25 mbar).

5.2.7 Multifunctional controls

Multifunctional controls shall comply with EN 126:2004.

5.2.8 Automatic shut-off valves

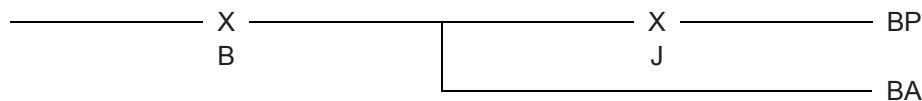
Automatic shut-off valves shall comply with EN 161:2007.

The gas supply to the main burner shall be under the control of two automatic shut-off valves connected in the gas line in series; one being of Class A or Class B, the other being of Class A, Class B, Class C or Class J. If a valve of Class J is utilised, a strainer shall be used such that it does not pass a 0,2 mm pin gauge. This strainer shall be fitted upstream of the Class J valve.

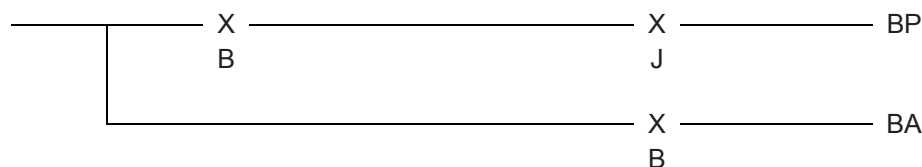
The start gas supply shall be under the control of one automatic shut-off valve of either Class A or Class B.

This valve may be the upstream valve in the gas supply to the main burner where it is of Class B and the start gas supply is taken from immediately downstream of this valve. Where the start gas supply is under the control of a single automatic shut-off valve, the heat input at the time of ignition shall not exceed 1 kW or 5 % of the main burner heat input, whichever is the smaller.

The arrangements shown in Figure 1 are given as examples. Any other arrangement giving at least an equivalent level of safety is permissible.



a) Appliances with an ignition burner with a heat input not exceeding 1 kW or 5 % of the main burner heat input



b) Appliances with direct ignition of the main burner

Key

BA Igniton burner
 BP Main burner

Figure 1 — Automatic shut-off valve configuration

5.2.9 Gas strainers

A strainer shall be fitted at the inlet of any gas circuit incorporating automatic shut-off valve(s) to prevent the ingress of foreign matter. The strainer may be integral with the upstream automatic shut-off valve. The maximum strainer hole dimension shall not be greater than 1,5 mm and the mesh shall not permit a 1 mm pin gauge to pass through it.

In gas circuits incorporating more than one automatic shut-off valve, only one strainer needs to be fitted, provided it gives adequate protection to all valves.

Where a regulator is fitted upstream of the automatic shut-off valve(s), the strainer may be fitted upstream of the regulator.

5.2.10 Thermostats

Integral mechanical thermostats shall comply with EN 257:1992.

5.2.11 Air proving device

Each burner shall be fitted with a suitable device for proving adequate air-flow during the pre-purge, ignition and operation of the burner (see 6.6.1 e), 7.3.6.2 Test No 5, 6.6.2.2 and 7.3.6.3.2.)

The sensor shall be located at the burner.

The air proving device shall be proved in the no air-flow state prior to start up. Failure to prove the device in the no air-flow state shall prevent start up.

Air-flow failure at any time during the pre-purge, ignition and operation of the burner shall cause non-volatile lock-out, volatile lock-out or safety shut-down such that re-start may only take place following automatic recycling.

5.2.12 Automatic burner control system

5.2.12.1 General

The appliance shall be fitted with an automatic burner control system complying with EN 298:2003.

5.2.12.2 Manually operated devices

The operation of push buttons, switches, etc., incorrectly or out of sequence shall not adversely affect the safety of the automatic burner control system.

Under the test conditions described in 7.2.1, the rapid (on and off) operation of any start switch shall not set up a hazardous condition.

5.2.12.3 Pre-purging

Immediately before any attempt at ignition or the opening of automatic shut-off valves, the appliance shall be purged.

Under the test conditions described in 7.2.2, the purge period shall be at least 10 s.

5.2.12.4 Flame detector

The flame detector shall incorporate a means to prevent the energizing any gas valve and of the ignition device if a flame or flame simulating condition is present during the start-up period.

Upon flame failure in the running condition the flame detector shall cause:

- a) a non-volatile lock-out; or
- b) a volatile lock-out; or
- c) one of the following, provided that such action cannot give rise to a hazardous condition:
 - 1) a safety shut-down followed by automatic recycling; or
 - 2) a spark restoration.

In the case of non-volatile lock-out or safety shut-down, the time for the flame detector system to de-energize the burner automatic shut-off valves upon flame failure shall not exceed 3 s. This shall be verified as described in 7.2.4.

In the case of spark restoration, the time for the flame detector system to de-energize the burner automatic shut-off valves upon flame failure shall not exceed 3 s. This shall be verified as described in 7.2.4. The spark restoration system shall be so designed that the ignition device is energized after loss of flame.

5.2.12.5 Start-gas flame establishment

The start-gas flame shall be established either at the main burner or at a separate ignition burner.

The first safety time shall be not more than 20 s. The safety time shall be specified by the appliance manufacturer and verified under the test conditions described in 7.2.3.

The ignition spark (or other means of ignition) shall not be energized before the completion of the pre-purge period and shall be de-energized at or before the end of the first safety time.

The start-gas automatic shut-off valve(s) shall not be energized before the ignition spark (or other means of ignition) is energized.

If the start-gas flame is not detected by the end of the first safety time, volatile or non-volatile lock-out shall result.

The main gas automatic shut-off valves shall not be energized to admit the main gas flow to the burner until after the start-gas flame has been detected.

The upstream automatic shut-off valve in the main gas supply may be opened to permit start-gas flow where the start-gas supply is taken from downstream of the first main gas automatic shut-off valve.

5.2.12.6 Direct main burner flame establishment

The safety time shall be not more than 10 s. The safety time shall be specified by the appliance manufacturer and verified under the test conditions described in 7.2.3.

The ignition spark (or other means of ignition) shall not be energized before the completion of the pre-purge period and shall be de-energized at or before the end of the safety time. Where a hot surface ignition system is used, the ignition system shall be so energized that the ignition source is capable of igniting incoming gas before the gas valves are opened.

The main gas valves shall not be energized before the ignition spark (or other means of ignition) is energized. If the main flame is not detected by the end of the safety time, volatile or non-volatile lock-out shall result.

5.2.12.7 Safety and controlled shut-down

When controlled or safety shut-down has been signalled, this shall result in closure of all automatic shut-off valves. On shut-down the fan shall not be de-energized before the automatic shut-off valves. Post-purging is optional.

5.2.12.8 Facility for remote control

Where the appliance is capable of being controlled remotely by means of thermostats or a time control, electrical connection of these controls shall be possible without disturbing any internal connection in the appliance, except for purpose made links.

5.3 Ignition devices

5.3.1 General

When installed in accordance with manufacturer's instructions, it shall be possible to light the appliance from an easily accessible position by means of an electrical or other convenient ignition device incorporated in the appliance.

Ignition burners and ignition devices shall be protected by design and position against diminution or extinction resulting from e.g. draughts, products of combustion, overheating, condensation, corrosion or matter falling from above.

Ignition burners, ignition devices and their mountings shall be so designed that they can only be located rigidly and correctly in relation to every component and burner with which they are designed to operate.

5.3.2 Ignition device for the main burner

The main burner shall be fitted with an ignition burner or other ignition device for direct ignition.

5.3.3 Ignition burners

If different ignition burners are used when the appliance is converted from one gas to another, they shall be marked, easy to substitute for one another and easy to fit. The same applies to injectors where only they have to be changed. Injectors shall carry an indelible means of identification and shall only be removable with the aid of a tool.

Ignition burners shall be protected against blockage by gas-borne particulate matter.

5.4 Main burner

The cross-sectional area of the flame ports shall not be adjustable.

The burner shall be so located and arranged that misalignment cannot occur. It shall not be possible to remove the burner assembly without the use of tools.

5.5 Pressure test points

The appliance shall be fitted with at least two pressure test points. One shall be fitted upstream of the first control and safety device and the other downstream of the last gas flow rate control and in a position carefully selected so as to permit measurements to be made.

For appliances only burning third family gases not fitted with a regulator, a single pressure test point may be fitted.

The test points shall have an external diameter of $(9_{-0,5}^0)$ mm and a useful length of at least 10 mm to enable a tube to be fitted. The minimum diameter of the bore shall not exceed 1 mm.

5.6 Injectors

Every injector and removable restrictor shall carry an indelible means of identification. It shall be possible to change injectors and restrictors without having to move the tube assembly from its installed position. However, injectors shall only be removable with the aid of a tool.

6 Operational requirements

6.1 Soundness

6.1.1 Soundness of the gas circuit

The gas circuit shall be sound. It is deemed to be sound if, under the conditions described in 7.3.1.1, the leakage of air does not exceed $100 \text{ cm}^3/\text{h}$ irrespective of the number of components, whether mounted in series or parallel on the appliance.

6.1.2 Soundness of the combustion circuit and correct evacuation of the combustion products

6.1.2.1 Correct evaluation of combustion products (Type B₁₂ and Type B₁₃ appliances)

When the appliance is tested under the conditions of 7.3.1.2.1 all products of combustion shall be evacuated through the flue.

6.1.2.2 Soundness of the combustion circuit (Type B₂₃ appliances)

When the appliance is tested under the conditions of 7.3.1.2.2, the air leakage rate shall not exceed 0,05 m³/h per kW of the nominal heat input of the appliance.

6.1.2.3 Soundness of the combustion circuit (Type B₅₂ and B₅₃ appliances)

When tested under the conditions of 7.3.1.2.3, the air leakage rate from any part of the combustion circuit, including its POCED, that is downstream of the fan shall not exceed 0,10 m³/h per kW of the nominal heat input.

6.1.2.4 Soundness of the combustion circuit (Type C₁ and C₃ appliances)

When tested under the conditions of 7.3.1.2.4, the leakage from the appliance together with its air supply and combustion products evacuation ducts and all their joints, shall not exceed 0,5 m³/h per kW of the nominal heat input of the appliance.

6.2 Heat inputs

6.2.1 Nominal heat input

When measured under the conditions of 7.3.2.2, the heat input obtained at the normal pressure shall be within ± 5 % of the nominal heat input.

6.2.2 Start gas heat input

When measured under the conditions of 7.3.2.3 the heat input obtained at normal pressure shall be within ± 5 % of the start gas heat input declared by the manufacturer.

However, this tolerance is extended to within ± 10 % where the injector has a diameter of 0,5 mm or less.

6.2.3 Effectiveness of the range-rating device

For appliances fitted with a range-rating device distinct from a gas rate adjuster, it shall be checked under the conditions described in 7.3.2.4 that:

- a) with the range-rating device in the position giving the maximum rate, the nominal heat input is obtained to within ± 5 %; and
- b) with the range-rating device in the position giving the minimum rate, the heat input is within ± 5 % of the minimum heat input stated by the manufacturer; and
- c) for appliances burning third family gases, with the range-rating device in the position giving the maximum rate, the rate obtained shall be that with the device wide open and operative.

6.3 Limiting temperatures

6.3.1 Wall and ceiling temperatures

When the appliance is tested under the conditions of 7.3.3.1, the wall and ceiling temperatures shall not exceed the ambient temperature by more than 50 K.

6.3.2 Component temperatures

When the appliance is tested under the conditions of 7.3.3.2 the maximum temperature of the appliance components shall not exceed the maximum temperature specified by the individual component manufacturer.

6.3.3 Fan motor temperatures

When tested under the conditions of 7.3.3.3, the maximum temperature rise of the motor windings shall not exceed the maximum temperature rise specified by the manufacturer.

6.3.4 POCED (Type B₄, B₅, C₁ and C₃ appliances)

When the appliance is tested under the conditions of 7.3.3.4.1, the external temperature of any part of the POCED, which when installed in accordance with the manufacturer's instructions is capable of being less than 25 mm from combustible parts of the fabric of a building, shall not exceed the ambient temperature by more than 50 K.

If, in accordance with the manufacturer's installation instructions, the POCED is required to be enclosed within another duct, a sleeve or insulation when it passes through a combustible wall or ceiling, the external temperatures of this duct, sleeve or insulation shall not exceed the ambient temperature by more than 50 K under the conditions of 7.3.3.4.2.

6.4 Ignition, cross-lighting and flame stability

6.4.1 All appliances (still air conditions)

6.4.1.1 Ignition and cross-lighting

Under the test conditions described in 7.3.4.1.1, correct and smooth ignition and cross-lighting shall be assured.

When the gas rate of any ignition burner is reduced under the test conditions described in 7.3.4.1.2 to the minimum required to hold open the gas supply to the main burner, correct and smooth ignition of the main burner shall be assured without undue noise.

Where the gas line is designed such that the gas supply to the ignition burner is taken from between the main burner gas valves, it shall be verified that ignition of the ignition burner under the test conditions described in 7.3.4.1.3 does not give rise to a hazardous situation.

Under the test conditions described in 7.3.4.1.4 ignition of any ignition burner, or the main burner where this is ignited directly, shall be safe and without undue noise when ignition is delayed by up to 50 % longer than the safety time declared by the manufacturer.

The appliance shall not sustain any damage likely to affect its safe operation.

6.4.1.2 Flame stability

Under the test conditions described in 7.3.4.2 the flames shall be stable. A slight tendency to lift at the moment of ignition is acceptable but the flames shall be stable in normal operation.

6.4.2 Supplementary tests for Type B₁₂, B₁₃, B₄₂ and B₄₃ appliances

The flames shall be stable under the test conditions described in 7.3.6.3.1.

6.4.3 Supplementary tests for Type C₁ and C₃ appliances

Under the test conditions of 7.3.4.3, ignition of the ignition burner, ignition of the main burner by the ignition burner or direct ignition of the main burner, complete cross-lighting of the main burner and also stability of the ignition burner when it alone is alight or of the ignition burner and main burner operating simultaneously shall be assured. Slight flame disturbance is permitted but there shall be no flame extinction.

6.5 Pressure regulator

When tested in accordance with the conditions given in 7.3.5 the rate shall not differ by more than + 7,5 % and - 10 % for first family gases and by more than ± 5 % for second and third family gases from the initial rate obtained under those conditions.

6.6 Combustion

6.6.1 All appliances (still air conditions)

When tested as described in 7.3.6.2:

- a) Test No. 1, the CO concentration in the dry, air-free products of combustion shall not exceed 0,1 %.
- b) Test No. 2, the CO concentration in the dry, air-free products of combustion shall not exceed 0,2 %.
- c) Test No. 3, the CO concentration in the dry, air-free products of combustion shall not exceed 0,2 %.

In addition, when supplied with the sooting limit gas under the same conditions and the appliance is operated for 3 cycles of 30 min on and 30 min off, there shall be no significant deposit of soot on the inside of the radiant tube.

- d) Test No. 4, the CO concentration in the dry, air-free products of combustion shall not exceed 0,2 %.

Under these conditions, it shall be verified that the appliance ignites and continues to operate.

- e) Test No. 5, the CO concentration in the dry, air-free products of combustion shall not exceed 0,2 %.

6.6.2 Supplementary tests under special conditions

6.6.2.1 Type B₁₂, B₁₃, B₄₂ and B₄₃ appliances

When tested as described in 7.3.6.3.1, the CO concentration in the dry-free products of combustion shall not exceed 0,1 %.

6.6.2.2 Type B₂₂, B₂₃, B₅₂ and B₅₃ appliances

When supplied with reference gas under the conditions of 7.3.6.3.2, the CO concentration in the dry air-free products of combustion shall not exceed 0,2 %.

When tested in accordance with 7.3.6.3.2 a) 1), at the point of shut off, the increase in pressure at the outlet of the appliance shall not be less than 0,75 mbar.

When tested in accordance with 7.3.6.3.2 b) 1), at the point of shut off, the increase in pressure at the outlet of the appliance shall not be less than 0,5 mbar.

6.6.2.3 Type C₁ and C₃ appliances

When supplied with reference gas under the conditions of 7.3.4.3, the CO concentration in the dry air-free products of combustion shall not exceed 0,2 %.

6.7 Prolonged performance

After the appliance has been tested under the conditions of 7.3.7, the following requirements shall be met:

- a) the requirements of 6.6.1 a);
- b) whilst the requirements in a) above are being verified, there shall be no significant deposition of soot or any appreciable distortion or disturbance of the flames;
- c) there shall be no sign of leakage of combustion products (e.g. from the combustion chamber or flue connections);
- d) there shall be no breakdown or distortion in any part of the appliance that could affect its safety;
- e) there shall be no significant deterioration in the external surface of the radiant tube for example flaking or excessive oxidation;
- f) there shall be no signs of other corrosion that will adversely affect the life of the appliance;
- g) following inspection at the end of the test there shall be no evidence of corrosion at the outlet bend and within any POCED.

6.8 Measurement of oxides of Nitrogen (NO_x)

The manufacturer shall declare the NO_x class in Table 2 that is applicable to the appliance.

When measured in accordance with the method of test given in 7.4.1, the NO_x concentration(s) in the dry, air free products of combustion shall be such that the weighted NO_x value, determined as appropriate in accordance with 7.4.2, does not exceed the maximum NO_x concentration of the NO_x class declared by the manufacturer.

Table 2 — NO_x classes

NO _x Class	Maximum NO _x concentration mg/kWh
1	260
2	200
3	150
4	100

7 Test methods

7.1 General

7.1.1 Characteristics of test gases (Reference and limit gases)

Appliances are intended for use with gases of different qualities. One of the aims of this standard is to check that the performance of an appliance is satisfactory for each family or group of gases for which it is designed and for the pressure for which it is designed, if necessary using the adjusting devices.

The test gases, test pressures and appliance categories given in this Standard are in accordance with those specified in EN 437:2003.

The characteristics of the reference and limit gases are given in Tables 4 and 5. The values in Table 4, measured and expressed at 15 °C, are derived from ISO 6976:2005.

7.1.2 Conditions for preparation of the test gases

The composition of gases used for the tests shall be as close as possible to those given in Table 4. For the preparation of the test gases:

- the Wobbe index of the gas used shall be within ± 2 % of the value indicated in Table 4 for the corresponding test gas (this tolerance includes the error due to measuring instruments);
- the constituents used for the preparation of the mixtures shall have at least the purity shown in Table 3:

Table 3 — Test gas purity

Gas	Purity %
Nitrogen (N ₂)	99
Hydrogen (H ₂)	99
Methane (CH ₄)	95 ^{a)}
Propene (C ₃ H ₆)	95 ^{a)}
Propane (C ₃ H ₈)	95 ^{a)}
Butane ⁴⁾ (C ₄ H ₁₀)	95 ^{a)}
^{a)} With a total concentration of H ₂ , CO and O ₂ below 1 % and a total concentration of N ₂ and CO ₂ below 2 %.	

However, these conditions are not obligatory for each of the components if the final mixture has a composition identical to that of a mixture which would have been made from components satisfying the conditions of Table 3. One can therefore, in order to make up a mixture, start with a gas already containing, in suitable proportions, several components of the final mixture.

For gases of the second family:

- for the tests carried out with reference gases G 20 or G 25, a gas belonging respectively to either Group H or Group L or Group E, may be used even if its composition does not satisfy the above conditions, provided that after the addition of either propane or nitrogen as appropriate, the final mixture has a Wobbe index within ± 2 % of the value given in Table 4 for the corresponding reference gas;

⁴⁾ Any mixture of iso/n butane can be used.