Non-domestic direct gas-fired forced convection air heaters for space heating not exceeding a net heat input of 300 kW

ICS 97.100.20

National foreword

This British Standard is the UK implementation of EN 525:2009. It supersedes BS EN 525:1998 which is withdrawn.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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English Version

Non-domestic direct gas-fired forced convection air heaters for space heating not exceeding a net heat input of 300 kW

Générateurs d'air chaud à chauffage direct et à convection forcée utilisant les combustibles gazeux pour le chauffage de locaux à usage non-domestique, de débit calorifique sur Hi inférieur ou égal à 300 kW

Gasbefeuerte Warmlufterzeuger ohne Wärmetauscher mit erzwungener Konvektion zum Beheizen von Räumen für den nicht-häuslichen Gebrauch mit einer Nennwärmebelastung nicht über 300 kW

This European Standard was approved by CEN on 30 April 2009.

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Foreword

This document (EN 525:2009) has been prepared by Technical Committee CEN/TC 180 “Domestic and non-domestic 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of an identical text or by endorsement, at the latest by November 2009, and conflicting national standards shall be withdrawn at the latest by November 2009.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 525:1997.

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

Other European Standards covering gas-fired air heaters are:

EN 621 *Non-domestic gas-fired forced convection air heaters for space heating not exceeding a net heat input of 300 kW, without a fan to assist transportation of combustion air and/or combustion products*

EN 778 *Domestic gas-fired forced convection air heaters for space heating not exceeding a net heat input of 70 kW, without a fan to assist transportation of combustion air and/or combustion products*

EN 1020 *Non-domestic gas-fired forced convection air heaters for space heating not exceeding a net heat input of 300 kW, incorporating a fan to assist transportation of combustion air and/or combustion products*

EN 1196 *Domestic and non-domestic gas-fired air heaters - Supplementary requirements for condensing air heaters*

EN 1319 *Domestic gas-fired forced convection air heaters for space heating, with fan-assisted burners not exceeding a net heat input of 70 kW*

EN 12669 *Direct gas-fired hot air blowers for use in greenhouses and supplementary non-domestic space heating*

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 90/396/EEC.

For relationship with EC Directive 90/396/EEC, see informative Annex ZA, which is an integral part 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 safety of non-domestic direct gas-fired forced convection air heaters having fully automatic control systems, hereafter referred to as "appliances".

This European Standard applies to appliances of Type A_2 and Type A_3 with heat input based on the net calorific value of 300 kW or less fitted with integral burners intended for use other than in residential dwellings. It also applies to appliances designed for outdoor installation. For indoor appliances provision of the heated air may be by means of ducting or may be directly into the heated space.

This standard does not apply to:

a) appliances intended for use in residential dwellings;

b) portable or transportable forced convection appliances;

c) appliances fitted with gas boosters;

d) appliances fitted with air/gas ratio controls;

e) appliances which incorporate a main burner having more than one section under a common burner control, of which one or more sections may be extinguished whilst another section remains in operation.

This European Standard is applicable to appliances which are intended to be type tested.

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

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, *Multifuctional controls for gas burning appliances*

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

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

EN 298:2003, *Automatic burner control systems for 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 60335-1:2002, *Safety of household and similar electrical appliances - Part 1: General requirements*

EN 60335-2-102:2006, *Electrical equipment of non-electric heating appliances for household and similar appliances*

EN 60529:1991, *Degrees of protection provided by enclosures (IP code)*

EN 60730-1:2000, *Automatic electrical controls for household and similar use - Part 1: General requirements*

EN 60730-2-1:1997, *Automatic electrical controls for household and similar use - Part 2: Particular requirements for electrical controls for electrical household appliances*

EN 60730-2-9:2002, *Automatic electrical controls for household and similar use - Part 2: Particular requirements for temperature-sensing controls*

EN 61058-1:2002, *Switches for appliances - Part 1: General requirements*

EN 61558-2-6:1997, *Safety of power transformers, power supply units and similar – Part 2-6:. Particular requirements for safety isolating transformers for general use*

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 the calorific value, density, relative density and Wobbe index from composition (ISO 6976:1995 including Corrigendum 1:1997, Corrigendum 2:1997 and Corrigendum 3:1999)*

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*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 Appliance and its constituent parts

3.1.1
non-domestic air heater
appliance designed for the heating and/or ventilation of a building other than a residential dwelling

3.1.2
forced convection air heater
appliance designed to provide space heating from a central source by distributing heated air, by means of an air moving device, either through ducting or directly into the heated space

3.1.3
direct fired forced convection air heater
forced convection air heater in which the products of combustion mix with the heated air being supplied to the space

3,1,4
high temperature direct fired forced convection air heater

direct fired forced convection air heater designed to operate with an air temperature rise through the appliance greater than 60 K

3.1.5
low temperature direct fired forced convection air heater
direct fired forced convection air heater designed to operate with a maximum air temperature rise through the appliance of 60 K or less

3.1.6
appliance with facility for downstream re-circulation of air
appliance in which a proportion of the heated air can be returned to the appliance at a point down stream of the burner and re-distributed

3.1.7
appliance with facility for upstream re-circulation of air
appliance in which a proportion of the heated air can be returned to the appliance at a point upstream of the burner and re-distributed.

3.1.8
profile plates
fixed or adjustable plates fitted for the purpose of setting the air flow velocity across the burner

3.1.9
gas inlet connection
part of the appliance intended to be connected to the gas supply

3.1.10
combustion chamber
part of the appliance in which the principal combustion process takes place

3.1.11
mechanical joint
mechanical means of obtaining soundness
means of ensuring the soundness of an assembly of several (generally metallic) parts without the use of liquids (e.g. pastes and tapes)

EXAMPLE Metal to metal joints; conical joints; toroidal sealing rings (“O” rings); or flat joints.

3.1.12
gas circuit
part of the appliance that conveys or contains the gas between the appliance gas inlet connection and the burner(s)

3.1.13
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

3.1.14
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.

3.1.15
setting an adjuster
immobilizing a gas rate adjuster (by some means such as e.g. a screw) after the gas rate has been adjusted by the manufacturer or installer

3.1.16
sealing an adjuster
setting of an adjuster using a material such that any attempt to change the adjustment breaks the sealing material and makes the interference with the adjuster apparent

NOTE 1 The adjuster is then said to be "sealed" in its adjustment position.

NOTE 2 A factory sealed adjuster is considered to be non-existent.

NOTE 3 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 pressures corresponding to the appliance category.

3.1.17
putting an adjuster or a control out of service
adjuster or a control (e.g. of temperature or pressure) is said to be “put out of service” if it is put out of action and sealed in this position

NOTE The burner unit then functions as if this device has been removed.

3.1.18
injector
component that admits the gas into a burner

3.1.19
main burner
burner that is intended to assure the thermal function of the appliance and is generally called the burner

3.1.20
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

NOTE This device can operate intermittently or permanently

3.1.21
ignition burner
burner whose flame is intended to ignite another burner

3.1.22
aeration adjuster
device enabling the air to be set at the desired value according to the supply conditions

NOTE The action of adjusting this device is called "adjusting the aeration".

3.1.23
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

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

3.2 Adjustment, control and safety devices

3.2.1
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 [EN 298:2003].

3.2.2
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

NOTE The programming unit follows a predetermined sequence of actions and always operates in conjunction with a flame detector device [EN 298:2003].

3.2.3
programme
sequence of control operations determined by the programming unit involving switching on, starting up, supervising and switching off the burner

NOTE Safety actions such as safety shut down and lock out are also part of the programme [EN 298:2003].

3.2.4
flame supervision
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

3.2.5
flame detector device
device by which the presence of a flame is detected and signalled

NOTE It can consist of a flame sensor, an amplifier and a relay for signal transmission. These parts, with the possible exception of the actual flame sensor, may be assembled in a single housing for use in conjunction with a programming unit [EN 298:2003].

3.2.6
flame signal
signal given by the flame detector device, normally when the flame sensor senses a flame [EN 298:2003]

3.2.7
flame simulation
condition which occurs when the flame signal indicates the presence of a flame when in reality no flame is present [EN 298:2003]

3.2.8
pressure regulator
device which maintains the outlet pressure constant independent of the variations in inlet pressure and/or flow rate within defined limits

3.2.9
adjustable pressure regulator
regulator provided with means for changing the outlet pressure setting

3.2.10
volume regulator
device which maintains the gas rate constant within a given tolerance, independent of the upstream pressure

3.2.11
automatic shut-off valve
valve designed to open when energized and to close automatically when de-energized

3.2.12
control thermostat
device controlling the operation of the appliance (by on/off, high/low or modulating control) and enabling the temperature to be kept automatically, within a given tolerance, at a predetermined value

3.2.13
overheat cut-off device
device that shuts off and locks out the gas supply before the appliance is damaged and/or before safety is compromised and which requires manual intervention to restore the gas supply

NOTE This device is preset and sealed by the appliance manufacturer.

3.2.14
temperature sensing element; temperature sensor
component that detects the temperature of the environment to be supervised or controlled

3.2.15
modulating control
automatic control by which the heat input of the appliance can be varied in a continuous manner between the nominal heat input and a minimum value

3.2.16
high/low control
automatic control which permits an appliance to operate either at the nominal heat input or at a fixed reduced heat input.

3.2.17
vent valve
normally open automatic valve fitted between two automatic shut-off valves and intended to vent any small leakages of gas

3.2.18
air flow proving device
device which monitors and proves the existence of an adequate flow of air for combustion and, where appropriate, for dilution

3.2.19
proof of closure indicator
device fitted to a Class A, B or C automatic shut-off valve with mechanical overtravel which proves the valve to be in the closed position

3.2.20
closed position indicator
device fitted to a Class A, B or C automatic shut-off valve which indicates when the valve is in the nominally closed position

3.2.21
valve proving system
system to check the effective closure of the start gas or main gas safety shut-off valves, and which is capable of detecting small gas leakage rates (e.g. by means of a pressure or vacuum proving system)

3.3 Appliance operation

3.3.1
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]

3.3.2
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]

3.3.3
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]

3.3.4
nominal heat input
Q_n
value of the heat input (kW) declared by the manufacturer

3.3.5
flame stability
characteristic of flames which remain on the burner ports or in the flame reception zone intended by the construction

3.3.6
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

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

3.3.7
light-back
entry of a flame into the body of the burner

3.3.8
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

3.3.9
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

3.3.10
yellow tipping
yellowing of the tip of the blue cone of an aerated flame

3.3.11
first safety time
interval between the ignition burner gas valve, the start gas valve or main gas valve, as applicable, being energized and the ignition burner gas 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

NOTE Where there is no second safety time, this is called the safety time.

3.3.12
second safety time
where there is a first safety time to either a ignition burner or start gas flame only, 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

3.3.13
start gas
gas that is supplied at the start gas rate to establish the start gas flame

3.3.14
start gas rate
restricted gas flow rate admitted either to a separate ignition burner or to the main burner during the first safety time

3.3.15
start gas flame
flame established at the start gas rate either at the main burner or at a separate ignition burner

3.3.16
start gas flame proving period
interval between the end of the first safety time and the beginning of the second safety time which is used to prove that the start gas flame is stable

3.3.17
running condition
condition of the system in which the burner is in normal operation under the supervision of the programming unit and its flame detector device

3.3.18
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 [EN 298:2003]

3.3.19
safety shut-down
process which is effected immediately following the response of a protection device or a fault in the automatic burner control system and puts the burner out of operation

NOTE The resulting state of the system is defined by deactivatioed terminals for the gas shut-off valves and the ignition device [EN 298:2003].

3.3.20
Lock-out

3.3.20.1
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 [EN 298:2003]

3.3.20.2
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 electrical supply and its subsequent restoration [EN 298:2003]

3.3.21
spark restoration
process by which, after disappearance of the flame signal, the ignition device is energized again without the gas supply having been totally interrupted

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 non-volatile lock-out.

3.3.22
automatic recycling
process by which, after loss of flame during the running condition or accidental interruption of the operation of the appliance, the gas supply is interrupted and the complete start sequence is automatically re-initiated

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 been removed, with non-volatile lock-out.

3.3.23
extinction safety time
time interval between extinction of the supervised flame and the gas supply to the main burner and/or to the ignition burner being shut off

3.3.24
no-air condition
condition of the air proving device in which the device is checked for correct operation at zero air flow

3.3.25
proved air flow
minimum air flow at which the air proving device indicates the presence of air flow

3.3.26
safe-start check
check provided by a protective circuit on start up leading to safety shut-down or non-volatile lockout if a fault condition is present

3.4 Gases

3.4.1
test gases
gases intended for the verification of the operational characteristics of appliances using combustible gases. They comprise the reference and the limit gases [EN 437:2003]

3.4.2
reference gases
test gases with which appliances operate under nominal conditions when they are supplied at the corresponding normal pressure [EN 437:2003]

3.4.3
limit gases
test gases representative of the extreme variations in the characteristics of the gases for which appliances have been designed [EN 437:2003]

3.4.4
gas pressure
static pressure, relative to the atmospheric pressure, measured at right angles to the direction of flow of the gas

NOTE Test pressures are expressed in mbar or bar.

3.4.5
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 mbar = 10^2 Pa) [EN 437:2003]

3.4.6
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]

3.4.7
limit pressure
(maximum limit pressure p_{max} and minimum limit pressure p_{min})

NOTE Pressures representative of the extreme variations in the appliance supply conditions [EN 437:2003].

3.4.8
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 the higher pressure corresponds only to gases of low Wobbe index, and the lower pressure corresponds to gases of high Wobbe index [EN 437:2003]

3.4.9
relative density
d
ratio of the masses of equal volumes of dry gas and dry air under the same conditions of temperature and pressure.

3.4.10
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

NOTE 1 A distinction is made between the gross calorific value H_s in which the water produced by combustion is assumed to be condensed, and the net calorific value H_i in which the water produced by combustion is assumed to be in the vapour state.

NOTE 2 The calorific value is expressed either in MJ/m^3 of dry gas at the reference conditions or in MJ/kg of dry gas [EN 437:2003].

3.4.11
Wobbe index (gross Wobbe index: Ws; net Wobbe index: Wi)
ratio of the calorific value of a gas per unit volume and the square root of its relative density under the same reference conditions.

NOTE 1 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 2 The Wobbe index is expressed either in MJ/m^3 of dry gas at the reference conditions or in MJ/kg of dry gas [EN 437:2003].

3.5 Conditions of operation and measurement

3.5.1 Reference conditions

3.5.1.1 **For calorific values**, temperature 15 °C

3.5.1.2 **For gas and air volumes dry**, brought to 15 °C and to an absolute pressure of 1 013,25 mbar

3.5.2
cold condition
condition of the appliance required for some tests and obtained by allowing the unlit appliance to attain thermal equilibrium at room temperature

3.5.3
hot condition
condition of the appliance required for some tests and obtained by heating to thermal equilibrium at the nominal heat input specified by the manufacturer, any thermostat remaining fully open

3.5.4
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 Marking of the appliance and packaging

3.6.1
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

NOTE 1 At the time of putting the appliance on the market and/or of installation, the appliance needs to be capable of operating, without adjustment or modification, with one of the gases distributed in the country concerned, at the appropriate supply pressure.

NOTE 2 More than one country can be specified if the appliance, in its current state of adjustment, can be used in each of these countries.

3.6.2
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

NOTE Subsequent modification or adjustment is essential in order that it can be utilized safely and correctly in this country.

4 Classification

4.1 Classification of gases

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 — Classification of gasses

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		39,1	54,7
	H	45,7	54,7
	L	39,1	44,8
	E	40,9	54,7
Third		72,9	87,3
	B/P	72,9	87,3
	P	72,9	76,8
	B	81,8	87,3

4.2 Classification of appliance

4.2.1 Classification according to the gases capable of being used

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

   1) **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

   1) **Category I_{2H}** : Appliances using only gases of Group H of the second family at the prescribed supply pressures.

   2) **Category I_{2L}** : Appliances using only gases of Group L of the second family at the prescribed pressures.

   3) **Category I_{2E}** : Appliances using only gases of Group E of the second family at the prescribed pressures.

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

4.2.1.1.1 Appliances designed for use on 3rd family gases only

a) **Category $I_{3B/P}$:** Appliances capable of using the third family gases (propane and butane) at the prescribed supply pressure.

b) **Category I_{3+}**: Appliances capable of using the third family (propane and butane) and operating with a pressure couple without adjustment of the appliance other than a possible adjustment of the primary air in order to change from butane to propane and vice versa. No operational pressure regulating device is permitted on the appliance.

c) **Category I_{3P}:** Appliances using only gases of Group P of the third family (propane) at the prescribed supply pressure.

4.2.1.2 Category II

Appliances of Category II are designed for use on gases of two families.

4.2.1.2.1 Appliances designed for use on gases of the first and second families

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 for Category I_{2H}.

4.2.1.2.2 Appliances designed for use on gases of the second and third families

a) **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 $I_{3B/P}$.

b) **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 I_{3+}.

c) **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}.

d) **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 $I_{3B/P}$.

e) **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}.

f) **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 $I_{3B/P}$.

g) **Category II_{2E+3+}:** 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_{3+}.

h) **Category II_{2E+3P}:** Appliances capable of using gases of Group E 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_{2E+}. The third family gases are used under the same conditions as for Category I_{3P}.

4.2.1.3 Category III

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

This category is not in general use.

Category III appliances admitted in certain countries are given in A.3.

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

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

This standard applies to:

a) 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;

b) Type A_1: A Type A appliance without a fan;

c) Type A_2: A Type A appliance with a fan downstream of the combustion chamber;

d) Type A_3: A Type A appliance with a fan upstream of the combustion chamber.

5 Construction and design requirements

5.1 General

5.1.1 Conversion to different gases

5.1.1.1 General

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 appliance category.

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

5.1.1.2 Category I

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

b) **Category $I_{3B/P}$** : no modification to the appliance;

c) **Category I_{3+}** : replacement of injectors or calibrated orifices but only in order to convert from one pressure couple to another (e.g. from 28-30 mbar/37 mbar to 50 mbar/67 mbar or vice versa). In addition, it is permissible to adjust the primary air in order to change from butane to propane and vice versa;

d) **Category I_{3P}** : no modification to the appliance relative to a change of gas. For a change of pressure, replacement of injectors and adjustment of gas rates.

5.1.1.3 Category II

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

a) adjustment of the gas rate with, if necessary, a change of injector, restrictor or regulator;

b) adjustment of the gas rate of the ignition burner(s), either by using an adjuster or by a change of injector or restrictor and, if necessary, a change of the complete ignition burner(s) or of some of its/their parts;

c) a change, if necessary, of the automatic shut-off valve(s);

d) putting the gas rate adjuster(s) out of service under the conditions of 5.2.2.

The adjustments or component changes are only acceptable when converting from a gas of the 1st family to a gas of the 2nd family or vice versa.

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

a) adjustment of the gas rate with, if necessary, a change of injector, restrictor or regulator;

b) adjustment of the gas rate of the ignition burner(s), either by using an adjuster or by a change of injector or restrictor and, if necessary, a change of the complete ignition burner(s) or of some of its/their parts;

c) a change, if necessary, of the automatic shut-off valve(s);

d) putting the regulator out of service in accordance with the requirements of 5.2.6;

e) putting the gas rate adjuster(s) out of service under the conditions given in 5.2.2.

These adjustments or component changes are only acceptable when:

f) converting from a gas of the 2nd family to a gas of the 3rd family or vice versa;

g) converting from one butane/propane pressure couple to another (e.g. 28-30 mbar/37 mbar to 50 mbar/67 mbar and vice versa).

5.1.1.4 Category III

Category III appliances that are permitted in certain countries are given in A.3.3 and A.3.4.

5.1.2 Materials and method of construction

The quality and thickness of materials used in the construction of the appliance and the method of assembling the various parts shall be such that the constructional and performance characteristics do not alter significantly during a reasonable life and under normal conditions of installation and use.

In particular, when the appliance is installed according to accepted practice, all components shall withstand the mechanical, chemical and thermal conditions to which they may be subjected in the course of normal operation.

Copper shall not be used for gas-carrying parts where its 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

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

It shall be possible to clean the parts in contact with combustion products without using special tools unless these are supplied as necessary accessories with the appliance.

All parts required to be operated during normal use of the appliance (e.g. handles and buttons), shall be accessible without it being necessary to remove any part of the case. For this purpose, the opening of a door or access panel is permitted.

Constructional parts accessible during use and maintenance shall be free from sharp edges and corners that might cause damage or personal injury during use or maintenance.

Panels that are normally removed for servicing shall be fitted with a means of retention where the appliance is intended to be installed more than 1,8 m above floor level, measured from the underside of the appliance. This requirement shall be deemed to be satisfied if suitable hinges are fitted.

5.1.4 Thermal insulation

Any thermal insulation shall retain its insulating properties under the influences of heat and ageing. The insulation shall withstand the thermal and mechanical stresses expected during normal operation. The

insulation shall be non-combustible and securely located. It shall be protected against mechanical damage, the effects of condensate and attacks from vermin.

5.1.5 Gas connection

The appliance gas connection shall be accessible.

The clearance around the connection, after removing the case if necessary, shall be adequate to allow easy use of the tools required to make the connection. It shall be possible to make all the connections with commercially available tools.

If the appliance has a threaded connection, this thread shall comply with the requirements of EN ISO 228-1:2003, EN 10226-1:2004 or EN 10226-2:2005. Where threads complying with the rewuirements of EN ISO 228-1:2003 are used, the end of the appliance inlet connection shall be sufficiently flat to allow the use of a sealing washer.

If flanges are used, they shall comply with the requirements of ISO 7005-1:1992, ISO 7005-2:1988 or ISO 7005-3:1988, as appropriate, and the manufacturer shall provide the counterflanges and sealing gaskets.

The conditions of connections prevailing in the various countries are given in A.6.

5.1.6 Soundness of the gas circuit

Holes for screws, studs, etc. intended for the assembly of parts shall not open into gasways. The wall thickness between drillings and gasways shall be at least 1 mm. This requirement shall not apply to orifices provided for measurement purposes.

The soundness of parts and assemblies making up the gas circuit and likely to be dismantled for routine maintenance in situ shall be achieved only by means of mechanical joints (e.g. metal-to-metal joints, gaskets, or O-ring joints). Sealing materials such as tape, paste or liquid shall not be used for other than permanent assemblies. Such sealing materials shall remain effective under normal conditions of appliance use.

5.1.7 Supply and distribution of air for space heating

5.1.7.1 Air inlets

Where the inlet air is intended to be ducted to the heater, the appliance shall be equipped with suitable means to facilitate connection of ductwork or flexible connections (e.g. flanges or spigots).

NOTE The manufacturer may supply a suitable adaptor in order to meet this requirement.

5.1.7.2 Air outlets

Where a ductless appliance is fitted with directional louvres, the louvres shall be supplied by the manufacturer and shall be capable of adjustment between horizontal discharge and discharge at an angle of at least 45° downwards from the horizontal.

When the louvres are in the position of maximum closure as marked and specified by the manufacturer, the appliance shall continue to operate satisfactorily (i.e. safety devices shall not operate).

Ducted air heaters shall have air outlets equipped with a suitable means to facilitate connection of ductwork or flexible connections (e.g. flanges or spigots).

NOTE The manufacturer may supply a suitable adaptor in order to meet this requirement.

5.1.8 Checking the state of operation

The installer shall be able to observe visually the ignition and correct operation of the burner(s). A door may be opened or a panel removed provided that the operation of the appliance is not disturbed.

If the means of observation is a viewing port, it shall, when located in an area of high temperature, be covered with a transparent material such as heat resistant, toughened, glass and sealed with a heat resistant sealant.

When the main burner is fitted with its own flame detector, an indirect means of observation (e.g. an indicator light) may be used. This indirect means shall be used only for indicating presence of a flame following a successful ignition or absence of a flame due to failure to ignite or the failure of the flame detector to detect a flame.

It shall be possible for the user, perhaps after opening a door or removing an access panel, to check at any time that the appliance is operating, either by visual observation of the flame or by some other indirect means.

5.1.9 Electrical equipment

The electrical equipment of the appliance shall comply with the relevant requirements of EN 60335-2-102:2006, EN 60730-1:2000 and EN 61058-1:2002.

Safety isolating transformers and switch contact elements in switches shall comply with the requirements of EN 61558-2-6:1997.

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 a data plate this shall comply with EN 60529:1991:

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.

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

Interruption and subsequent restoration of the mains voltage electrical supply to the appliance at any time during the starting up and operation of the appliance shall result in:

a) continued safe operation; or

b) safety shut-down; or

c) lock-out.

Interruption and subsequent restoration of the electrical supply to the appliance shall not override any non-volatile lock-out condition.

NOTE Requirements and test methods relating to the continued and safe operation of the appliance in the event of normal and abnormal fluctuation of auxiliary energy are specified in 6.5.3 and 7.3.5.3.

5.1.11 Motors and fans

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

Lubrication points, if provided, shall be readily accessible.

The direction of rotation of fans shall be clearly marked.

Motors, fans and belt drives shall be protected by suitable guards, shields or screens of adequate size, strength and durability such that they are not liable to be touched accidentally (see EN 60529:1991, Class IP 20). Removal of such guards, shields or screens shall be possible only with the use of a key or commercially available tools.

Means shall be provided to facilitate adjustment of belt tension. Adjustment of such means shall be possible only by the use of commercially available tools.

Means shall be provided to prevent large objects from entering the fan, to minimize the risk of blockage and to prevent accidental injury to personnel. This requirement shall be deemed to be met if entry of the standard test fingers specified in EN 60335-1:1988 is prevented.

5.2 Adjusting, control and safety devices

5.2.1 General

All the devices specified in 5.2.2.1, 5.2.2.2 and 5.2.2.3, or the multifunctional control in which they might be fitted, shall be capable of removal or exchange if this is necessary for cleaning or replacement of the device. Adjusters for these devices shall not be interchangeable.

When there are several control knobs (e.g. taps and thermostats), they shall not be interchangeable if this could lead to confusion.

Gas-carrying controls shall be sited externally to the air duct so as to prevent ingress of gas into the appliance air stream.

Where gas-carrying connections are enclosed in a separate compartment, the compartment shall be ventilated by means of equal sized openings situated near the top and at the bottom of the compartment.

The ventilation openings shall have a total free open area equal to, or greater than, 2 % of the area of the largest plane surface of the compartment.

The ventilation openings shall be so sited that they cannot be obstructed by foreign matter (e.g. birds).

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

5.2.2 Gas rate adjusters and range-rating devices

5.2.2.1 General

Gas rate adjusters and range-rating devices shall be designed so that they are protected against accidental maladjustment by the installer or user once the appliance has been installed and put into service. It shall be possible to seal them (e.g. with paint) after adjustment. The sealing material used shall be resistant to the temperature conditions to which it may be subjected during normal operation of the appliance.

The adjusting screws of gas rate adjusters and range-rating devices shall be located so that they cannot fall into the gasways.

The soundness of the gas circuit shall not be affected by the presence of gas rate adjusters and range-rating devices.

5.2.2.2 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 of these categories except category 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 the 1st family gases.

For appliances in categories II_{2H3+} and II_{2E+3+} having a gas rate adjuster, it shall be possible to put these devices out of service when these appliances are supplied with a 3rd family gas. This also applies to appliances in category II_{1a2H} when supplied with a 2nd 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 2nd family gas.

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

The instructions for conversion to different gases shall specify that all sealing of devices shall be restored after the gas conversion operation.

5.2.2.3 Range-rating devices

A range-rating device on an appliance is optional.

For appliances in category 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 2nd family gas, the gas rate adjuster or its sealed part shall not be used by the installer as a range-rating device.

5.2.3 Profile plate

Where a profile plate is fitted the air proving device(s) required by 5.4 shall cause safety shut-down if the air flow across the burner, as declared by the manufacturer, is not achieved.

Where an adjustable profile plate is used, it shall be capable of being locked in position to avoid inadvertent movement.

5.2.4 Aeration adjusters

Any means of adjusting the primary aeration shall be preset and sealed by the manufacturer to discourage unauthorized interference.

5.2.5 Manual controls

5.2.5.1 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, where they are not integral with the appliance, be specified in the manufacturer's installation instructions.

5.2.5.2 Manual isolation valves

Manual isolation valves shall be of the 90° turn type.

Manual isolation 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 shall be readily distinguishable.

When a manual isolating valve is provided 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 accessible.

Manual isolation 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 the requirements of EN 88-1:2007.

For an appliance burning 1st or 2nd 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 a multifunctional control.

For an appliance burning 3rd family gases, the fitting of a regulator is optional.

However for appliances in categories I_{2E+} and I_{2E+3+}, 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).

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 unauthorized interference with the adjustment difficult.

5.2.7 Automatic shut-off valves

5.2.7.1 General requirements

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

Multifunctional valves shall comply with the requirements of EN 126:2004.

5.2.7.2 Application

Each main gas supply shall be under the control of two automatic shut-off valves in series such that at least one valve is of Class A capability and the other valve is at least of Class B capability.

Where the main flame establishment is by means of a start gas flame, the start gas supply shall either:

a) be under the control of the downstream main gas automatic shut-off valve incorporating a start gas rate control and a device to enable the start gas rate to be set such that the energy available during the start gas flame ignition period cannot exceed the values given in 5.6; or,

b) be under the control of two automatic shut-off valves of which one shall be at least of Class A capability.

Where the downstream main gas automatic shut-off valve incorporates a start gas rate control, it shall not be possible to adjust the start gas rate to a level exceeding 50 % of the fully open flow rate at the same differential pressure.

Where the start gas rate is greater than 10 % of the main gas rate, the start gas automatic shut-off valves shall be at least of the same class as the main gas automatic shut-off valves.

NOTE These requirements should be read in conjunction with 5.6.

5.2.7.3 Shut-down

The flame supervision system and the overheat cut-off device shall effect closure of all automatic shut-off valves in all systems specified. On shut-down the air fan shall not be switched off before the start gas and main gas automatic shut-off valves have been de-energized.

5.2.7.4 Restart

Following safety shut-down due to the operation of any overheat cut-off device, restart shall be possible only after manual intervention.

5.2.8 Automatic burner control systems

5.2.8.1 General

Automatic burner control systems shall comply with the requirements of EN 298:2003.

5.2.8.2 Manually operated devices

Manually operated devices (e.g. operating push buttons and switches) which are operated 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 the rapid (on and off) operation of any start-up and shut-down devices shall not produce a hazardous condition.

5.2.8.3 Gas strainers

A strainer shall be fitted at the inlet of any system incorporating an 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 be not greater than 1,5 mm and the mesh shall not permit the passage of a 1 mm diameter pin gauge.

In multiple valve shut-off systems, only one strainer need be fitted, provided it gives adequate protection to all valves.

Where a regulator is fitted upstream of the shut-off system, the strainer may be fitted upstream of the regulator.

5.2.8.4 Air strainers and filters

An air filter if fitted shall be placed upstream of the heat exchanger/combustion chamber in the appliance air stream.

A fixed strainer shall be fitted on the air inlet to the appliance. The strainer hole shall not permit the entry of a ball of diameter 16 mm applied with a force of 5 N.

Where an air filter is fitted it shall be readily accessible for cleaning or replacement and may be of the cleanable or throw-away type.

5.3 Ignition devices

5.3.1 General

It shall be possible to put the appliance into service from a readily accessible position by means of a switch.

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 an ignition device for direct ignition.

5.3.3 Ignition burners

If different ignition burners are used for different gases, they shall be marked, easy to substitute for one another and easy to fit. This requirement also applies to injectors where only they have to be changed. Injectors shall carry an indelible means of identification and shall be removable only with the aid of a commercially available tool.

Ignition burners shall be protected against blockage by gas-borne particulate matter (see 5.2.9).

5.4 Combustion and dilution air, pre-purge and post-purge

The appliance shall be fitted with a device(s) for proving adequate combustion and dilution air flow during pre-purge, ignition and operation.

Where separate fans provide combustion and/or dilution air an air proving device for each fan shall be fitted.

Air flow failure at any time during the pre-purge, ignition or operation of the appliance shall cause safety shut-down or non-volatile lock-out.

If safety shut-down occurs there shall be a maximum of 5 automatic re-start attempts after which non-volatile lock-out shall occur.

The air proving device(s) shall be proved in the "no air" condition prior to start up. Failure to prove the device(s) in the "no air" condition shall prevent start-up or cause non-volatile lock-out. Proof of adequate air flow may be achieved by:

a) differential pressure sensing, where it can be shown that it provides satisfactory and reliable proof of air flow during the pre-purge, ignition and operation of the appliance; or

b) flow sensing.

Where the setting of the air proving device is not essential to the commissioning of the appliance, the device shall be pre-set by the manufacturer and factory sealed.

Where the setting of the air proving device is essential to the commissioning of the appliance, the commissioning instructions shall provide information as to the correct setting of the device and the means of sealing or locking of the device after setting.

Any means of locking or sealing the set position of the air proving device shall be such as to ensure that unauthorized interference cannot occur, or is evident.

Immediately before any attempt at ignition or the opening of gas shut-off valves, the appliance shall be purged. The pre-purge period shall be either:

c) a minimum of 20 s at the full air rate, or pro rata longer periods at lower air rates; or,

d) at least 5 volume changes of the appliance and its ductwork.

NOTE For the purposes of this requirement "ductwork" is taken to be a length of ducting equal to three times the major dimension of the appliance outlet connection.

The flame safeguard safe-start check shall continue throughout the pre-purge period.

The purge air shall be proved to be at the required rate. If the pre-purge air flow falls below the required rate at any time during the pre-purge period, then either:

e) the burner shall go to non-volatile lock-out; or

f) the burner shall go to safety shut-down; or

g) the purge may be continued on restoration of the required air rate provided that the air flow does not fall below 25 % of the full air rate and that the total purge time at the required air rate is not reduced.

Post-purge is optional.

5.5 Flame supervision system

The burner shall be fitted with a flame supervision system.

The flame supervision system shall be so designed or arranged that it cannot detect the ignition source as a false flame signal.

The flame supervision system shall incorporate a means to provide safety shut-down or non-volatile lock-out if the flame detector signals flame presence at any time during the pre-purge.

If the duration of the safe-start check is less than 5 s, detection of a flame or flame simulating condition during the pre-purge shall cause non-volatile lock-out.

If the duration of the safe-start check is more than 5 s, detection of a flame or flame simulating condition during the pre-purge shall cause safety shut-down or non-volatile lock-out.

However, if a flame-simulating condition lasts for 5 s or more, non-volatile lock-out shall occur.

NOTE Care should be taken to prevent electrical interference from giving rise to flame detection signals that falsely indicate the presence of a flame.

Upon flame failure the flame supervision system shall cause non-volatile lock-out. There shall be no automatic attempt at re-ignition by spark restoration, automatic recycling or other means. A restart cycle shall only occur after manual reset.

The time for the flame supervision system to de-energize the burner automatic safety shut-off valves upon flame failure shall be not more than 1 s.

Where a self checking flame supervision system is used, the time for the system to de-energize the safety shut-off valves upon flame failure shall be not more than 1 s during normal operation, and not more than 2 s where a check is made at the same time.

5.6 Start-gas flame establishment

Where the main flame establishment is by means of a start gas flame, the start gas rate shall not exceed 180 kW. The start gas flame shall be established either at the main burner or at a separate burner.

The first safety time shall be not more than 5 s and preferably should not be less than 2 s.

There shall be a start gas flame proving period, the duration of which shall be specified by the manufacturer.

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.

The start-gas flame proving period shall establish that the flame is stable on its own. If the flame fails during this period, safety shut-down and non-volatile lock-out shall result.

The energy released during the first safety time shall be limited in such a way that any explosive pressure rise resulting from a delayed ignition will not cause damage to the appliance or associated ducting. This requirement shall be deemed to be satisfied when the start gas rate does not exceed:

a) 20 % of the stoichiometric gas rate for the proved air flow rate through the combustion chamber for 1st and 3rd family gases;

b) 33 % of the stoichiometric gas rate corresponding to the proved air flow rate through the combustion chamber for 2nd family gases.

On appliances with a heat input rating of 180 kW and above and on which the start gas supply is taken from between the main gas automatic shut-off valves, means shall be provided to ensure that the downstream main gas shut-off valve is closed prior to start-up.

NOTE 1 A valve proving system or a proof of closure switch is deemed to satisfy this requirement.

If the valve is not proved to be closed start-up shall be prevented.

On appliances with a heat input rating of less than 180 kW and on which the start gas supply is taken from between the main gas automatic shut-off valves either:

c) a means shall be provided to prove closure of the downstream main gas shut-off valve. If the valve is not proved to be closed start-up shall be prevented: or;

d) ignition at the full main gas rate under the condition of 7.3.4.4 shall not give rise to a hazardous situation.

NOTE 2 A valve proving system or a proof of closure switch is deemed to satisfy the requirements of 5.6a).

Where the start gas rate is controlled by a start gas rate position contained within the downstream main gas automatic shut-off valve, this valve shall comply with EN 161:2002. In addition, any means of adjustment of the start gas rate or of the operating position of an interlock, if fitted, shall be pre-set and sealed by the manufacturer.

On appliances with a heat input of 180 kW and above and where the start gas position of the valve is controlled by an interlock, the interlock shall be proved in the correct state throughout the first safety time and the start gas flame proving period.

If the interlock indicates that the start gas rate has been exceeded, the time taken to de-energize the valve shall be not more than 1 s and the appliance shall proceed to non-volatile lock-out.

Where the start gas rate is controlled by a start gas rate position contained within the downstream main gas automatic shut-off valve and without an interlock controlling the start gas position it shall be verified that ignition of the ignition burner under the test conditions given in 7.3.4.4 does not give rise to a hazardous situation.

5.7 Main flame establishment

5.7.1 Establishment by means of a start gas flame

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 proved.

The main flame shall ignite reliably and smoothly from the start gas flame.

If the start gas flame has been ignited and proved at a separate ignition burner flame, the second safety time shall be not more than 5 s and not less than 2 s, at the end of which the ignition burner flame shall be extinguished and supervision of the main flame alone shall begin. If the main flame is not detected after this period, safety shut-down and non-volatile lock-out shall result.

Where the separate ignition burner flame remains in use during the main burner operation, separate flame detectors may be fitted to monitor the ignition and main burner flames. In this case the main flame detector shall be so positioned that it cannot in any circumstances detect the ignition burner flame. In addition the safe-start check required by 5.5 shall continue to be carried out on the main flame detector during the first safety time and the start gas proving period.

If the start gas flame is established at a separate ignition burner, the flame detector shall, under the conditions of operation, detect the start gas flame only at gas flow rates at which it will light the main flame reliably and smoothly. The need to protect against flame diminution, detector drift or maladjustment, gas pressure reduction and dimensional instability shall be taken into account.

5.7.2 Establishment by direct ignition

5.7.2.1 Application

Direct ignition of the main flame shall be used only with appliances having heat inputs less than 180 kW and where the gas rate at the time of ignition does not exceed:

a) 20 % of the stoichiometric gas rate for the proved air flow rate through the combustion chamber for 1st and 3rd family gases;

b) 33 % of the stoichiometric gas rate corresponding to the proved air flow rate through the combustion chamber for 2nd family gases.

5.7.2.2 Requirements

For the main burner:

a) the ignition source shall not be energized before the completion of the pre-purge period;

b) the gas valves shall not be energized before the ignition source is energized. Where a hot surface ignition system is used, the ignition system shall be so energized such that the ignition source is capable of igniting gas before the gas valves are opened;

c) the first safety time shall be not more than 5 s and not less than 2 s, at the end of which the ignition source shall be de-energized;

d) if the flame is not detected before the end of the first safety time a non-volatile lock-out shall result.

5.8 Main burner

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

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 appliance from its installed position. However, injectors shall only be removable with the aid of commercially available tools.

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.

5.9 Facility for remote control

Where the appliance is capable of being controlled remotely (e.g. by means of thermostats or a time control), electrical connection of these controls shall be possible without disturbing any internal connections in the appliance other than a link designed exclusively for this purpose.

5.10 Thermostats and control of air temperature

5.10.1 General requirements

Integral mechanical thermostats shall comply with the requirements of EN 257:1992.

Electrical thermostats shall comply with the requirements of EN 60730-2-1:1997.

Overheat cut-off devices shall be of Type 2K and comply with the requirements of EN 60730-2-9:2002.

5.10.2 Control of air temperature

The appliance shall be provided, either integral with the appliance or separately, with a device to control the temperature of the delivered air.

If the air temperature control is not integral with the appliance, this device shall be supplied by the appliance manufacturer and the installation instructions shall include details of its installation.

When the appliance is installed in accordance with the manufacturer's instructions, no hazardous condition or damage to the appliance shall occur as a result of failure of the means of air temperature control.

5.10.3 Overheat cut-off device

An overheat cut-off device shall be fitted to the appliance to cause shut-down and non-volatile lock-out in the event of an overheat condition occurring. The lock-out action shall not rely on the operation of the flame detection circuits. In particular, the overheat cut-off device shall not be wired in series with the flame sensor.

5.10.4 Sensors

Control thermostats and overheat cut-off devices may have the same sensor if such controls are mechanical in operation and failure of the sensor results in non-volatile lock-out of the appliance.

With an electronic system, thermostats and overheat cut-off devices shall not have the same sensor unless it is break-safe.

5.11 Gas pressure points

The appliance shall be fitted with at least two gas 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 selected so as to permit measurements to be made.

The test points shall have an external diameter of $\left(9\frac{0}{-0,5}\right)$ mm and a useful length of at least 10 mm to enable a tube to be fitted. At the point of its minimum cross-section, the diameter of the bore shall not exceed 1,0 mm.

5.12 Facilities for commissioning and testing

To facilitate commissioning, permanent means shall be provided to prevent gas flowing at rates other than the start gas flow rate.

This requirement may be accomplished by:

a) a manual valve downstream of the main gas automatic shut-off valve; or

b) a removable air-break electrical link other than a disconnection of the electrical wiring in the electrical supply to the main gas automatic shut-off valves or the main gas control function within an automatic shut-off valve; or

c) an air-break switch requiring the use of a tool for its operation to isolate the electrical supply to the main gas automatic shut-off valves or the main gas control function within an automatic shut-off valve; or

d) an air-break switch not requiring the use of a tool for its operation to isolate the electrical supply to the main gas automatic shut-off valves or the main gas control function within an automatic shut-off valve.

In this particular case, where the main gas valve(s) is/are fitted with a closed position indicator switch, or a proof of closure switch, then the switch shall be checked for correct position throughout the first safety time and subsequent period of main gas isolation. Failure to prove correct positioning shall cause safety shut-down.

NOTE 1 A multifunctional control incorporating the facility required by a) is deemed to meet the requirement.

NOTE 2 Additional circuitry over and above that provided by the control box may be necessary to satisfy requirement d).

NOTE 3 Designers should be aware that the intention of this requirement is to prevent inadvertent release of the main gas supply at all times that the commissioning engineer is setting or checking the start gas flame.

The appliance shall be provided with such manual valves as are essential for the normal operation and commissioning of the appliance.

Means shall be provided for checking the gas soundness of automatic shut-off valves.

Means shall be provided for checking the regulator inlet and outlet pressures and the burner manifold pressure.

Connections or test points shall be provided for the measurement of the flame detector signal.

Test points shall be provided to facilitate the measurement of differential air pressure across the burner and/or profile plate.

5.13 Additional requirements for appliances designed for permanent outdoor installation

5.13.1 General

Appliances designed for permanent outdoor installation shall be so constructed that they are fully protected against the rigours of the environmental conditions under which they are expected to operate.

5.13.2 Air inlets

Air inlets shall be provided such that their lowest edge is at least 500 mm above the base of the appliance, or will reach 500 mm above floor level when installed in accordance with the manufacturer's instructions.

5.13.3 Access panels and doors

Access panels and doors and such insulation as needs to be removed during normal servicing shall be so designed that repeated removal and replacement does not damage the insulation or impair the waterproofing of the appliance.

5.13.4 Dimensions of openings

No dimension of any opening (e.g. electrical wiring points) from the inside of the appliance to the outside air shall permit the entry of a ball of diameter 16 mm applied with a force of 5 N.

5.13.5 Fixing screws

External panels intended to be removed for maintenance and servicing shall be fixed using only hexagon headed screws, except in the case of user access panels which may be fixed by means of hinges and door catches.

6 Operational requirements

6.1 Soundness of the gas circuit

The gas circuit shall be sound.

External soundness is assured if, under the conditions specified in 7.3.1, the air leakage rate does not exceed 100 cm^3/h regardless of the number of valves fitted in series or in parallel on the appliance.

6.2 Heat inputs

6.2.1 Nominal heat input

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

6.2.2 Start gas heat input

When measured under the conditions specified in 7.3.2.3, the start gas heat input obtained at normal pressure shall be within ± 5 % of the start gas heat input declared by the manufacturer where the injector has a diameter greater than 0,5 mm.

Where the injector diameter is 0,5 mm or less the start gas heat input shall be within ±10 % of the manufacturer's declared value.

6.2.3 Effectiveness of gas rate adjusters

For an appliance without a gas regulator but with a gas rate adjuster, the heat input obtained after adjustment of the device:

a) shall be not less than the nominal heat input, under the conditions given in Test 1 of 7.3.2.4;

b) shall not exceed the nominal heat input, under the conditions given in Test 2 of 7.3.2.4.

6.2.4 Effectiveness of the gas regulator

For appliances with an adjustable gas regulator, the rate shall not differ by more than + 7,5 % and - 10 % for 1st family gases, and by more than ± 5 % for 2nd and 3rd family gases, from the rate obtained at the adjustment pressure specified in 7.3.2.5, when the upstream pressure is varied between the minimum and maximum values stated in 7.1.4 for the reference gases of the appliance category concerned.

6.2.5 Effectiveness of the range-rating device

For appliances fitted with a range-rating device, as distinct from a gas rate adjuster, and under the conditions specified in 7.3.2.6 :

a) the nominal heat input shall be obtained to within ± 5 % of the nominal heat input stated by the manufacturer with the range-rating device in the position giving the maximum rate;

b) the minimum heat input shall be obtained to within ± 5 % of the minimum heat input stated by the manufacturer with the range-rating device in the position giving the minimum rate.

For appliances of category I_{2L} and I_{2H} fitted with a range-rating device not distinct from a gas rate adjuster, the minimum and maximum of the manufacturer's declared range of heat input shall be obtained to within ± 5 %.

6.3 Limiting temperatures

6.3.1 Temperatures of parts that have to be touched during normal use

The surface temperatures of control knobs and of all parts that have to be touched during normal use of the appliance, measured only in the zones intended to be gripped, and under the conditions stated in 7.3.3.1, shall not exceed the ambient temperature by more than:

a) 35 K for metals;

b) 45 K for porcelain or similar materials;

c) 60 K for plastics.

6.3.2 Temperatures of the side walls, front and top of the appliance

The temperature of the side walls, front and top of the appliance, excluding those parts that are associated with the transmission of heat, shall not exceed the ambient temperature by more than 80 K when measured under the conditions stated in 7.3.3.2.

Parts of the appliance which are intended to be placed in close proximity to the floor or to other surfaces shall not reach temperatures which present a danger in the surrounding area, as stated in the manufacturer's installation instructions.

6.3.3 Component temperatures

When the appliance is tested under the conditions stated in 7.3.3.3 the maximum temperature of the appliance components shall not exceed the maximum temperature specified by the individual component manufacturer.

6.3.4 Fan motor winding temperatures

When tested under the conditions of 7.3.3.4 the maximum temperature rise of the motor windings shall not exceed the maximum temperature rise stated by the motor manufacturer.

6.4 Ignition, cross-lighting, flame stability

6.4.1 Ignition and cross-lighting

Under the test conditions described in 7.3.4.1, correct and smooth ignition and cross-lighting shall be obtained.

When the gas rate of any ignition burner is reduced under the test conditions described in 7.3.4.2 to the minimum required to hold open the gas supply to the main burner, correct and smooth ignition of the main burner without undue noise shall be obtained.

Under the test conditions described in 7.3.4.3 the appliance shall be safe on ignition. In addition the appliance shall not sustain any damage likely to affect its safe operation.

6.4.2 Flame stability

Under the test conditions described in 7.3.4.5, the flames shall be stable. A slight tendency to lift at the moment of ignition is acceptable but the flames shall be stable during normal operation.

6.5 Combustion

6.5.1 Low temperature air heaters

When the appliance is tested under the conditions specified in 7.3.5.1, 7.3.5.2 and 7.3.5.3, the concentrations of oxides of carbon and nitrogen in the discharged air attributable to the appliance (concentration in discharged air minus concentration in the inlet air), measured on the dry basis, shall not exceed those given in Table 2.

Table 2 — Limiting emission concentrations

Component	Limiting concentration (C_L)	
	10^{-6} *V/V*	% *V/V*
Carbon monoxide CO	10	0,001
Carbon dioxide CO_2	2 500	0,25
Nitric oxide NO	5	0,000 5
Nitrogen dioxide NO_2	1	0,000 1

6.5.2 High temperature air heaters

Under the test conditions described in 7.3.5.1, 7.3.5.2 and 7.3.5.3, the measured concentrations of oxides of carbon and nitrogen, attributable to the appliance, in the discharged air shall be such that the limiting concentrations calculated using Equation 1 do not exceed the values specified in Table 2.

$$C_{\mathrm{m}} \times \frac{V_{\mathrm{a}}}{V_{\mathrm{a}} + V_{\mathrm{s}}} \leq C_{\mathrm{L}} \qquad (1)$$

where

C_L is the limiting concentration of component x10^{-6} or in per cent;

C_m is the measured concentration of component x10^{-6} or in per cent;

V_a is the maximum volume flow (in m^3/s) of fresh air supplied through the appliance corresponding to the maximum rated heat input;

V_s is the minimum volume flow (in m^3/s) of additional fresh air specified by the manufacturer to be supplied to the heated space and corresponding to the maximum rated heat input.

6.5.3 Auxiliary energy variations

When supplied with reference gas at normal pressure and the supply voltage is varied under the conditions given in 7.3.5.3, the appliance shall ignite and continue to operate and the oxides of carbon and nitrogen in the discharged air, measured on the dry basis, attributable to the appliance shall not exceed the values given in Table 2.

6.6 Overheat cut-off device

Under the conditions specified in 7.3.6:

a) the gas supply to the burner shall be cut off to prevent :

1) a hazardous condition;

2) any damage to the appliance;

3) in the case of low temperature appliances, the mean temperature of the air at the appliance outlet exceeding a temperature of 100 °C or, for multi-outlet appliances, the mean temperature at any one outlet exceeding 125 °C;

4) in the case of high temperature appliances, the mean temperature of the air at the appliance outlet exceeding a temperature of 200 °C.

NOTE This temperature applies to the air delivered at the appliance outlet and before further dilution for distribution to the heated space.

b) the overheat cut-off device shall not operate during the normal cyclic action of the appliance (e.g. as a consequence of room thermostat or timed control);

c) flame stability shall be satisfactory throughout the test.

6.7 Air proving device(s)

The air proving device(s) shall cause the appliance to proceed to safety shut-down or non-volatile lock-out under the conditions given in 7.3.7.

6.8 Weather resistance

Under the test conditions described in 7.3.8, an appliance designed for outdoor installation shall continue to function normally, with the main and ignition burner(s) operating normally.

In addition, with access doors or panels in place, no water shall accumulate in any part of the appliance such that normal functioning is affected.

7 Test methods

7.1 General

7.1.1 Test gas characteristics, 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 pressures 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 3 and 4. The values in Table 3, measured and expressed at 15 °C, are derived from EN ISO 6976:2005.

7.1.2 Conditions for preparation of the test gases

The composition of gases used for the tests shall be as near as possible to those given in Table 3.

For the constitution of the gases:

a) the Wobbe number of the gas used shall be within ±2 % of the value in Table 6 (this tolerance includes the errors of the measuring equipment);

b) the gases used to constitute the mixtures shall have minimum degrees of purity as :

1) nitrogen N_2 99 %;

2) hydrogen H_2 99 %;

3) methane CH_4 95 % with a total concentration of H_2, CO and O_2 below 1 %;

4) propene C_3H_6 95 % and a total concentration of N_2 and CO_2 below 2 %;

5) propane C_3H_8 95 %;

6) butane[1)] C_4H_{10} 95 %.

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 preceding conditions. It is acceptable, in order to make up a mixture, to start with a gas already containing, in suitable proportions, several components of the final mixture.

For gases of the second family:

c) 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 6 for the corresponding reference gas;

d) for preparation of the limit gases, another gas may be used as the base gas instead of methane:

1) for limit gases G 21, G 222, and G 23, a natural gas of Group H may be used;

2) for limit gases G 27 and G 231, a natural gas of Group H or of Group L or of Group E may be used;

3) for the limit gas G 26, a natural gas of Group L may be used.

In all cases the final mixture obtained by adding propane or nitrogen shall have a Wobbe index within ± 2 % of the value given in Table 3 for the corresponding limit gas and the hydrogen concentration of the final mixture shall be as given in Table 3.

1) Any mixture of iso-butane and n-butane can be used.

Table 3 — Test gas characteristics[a] (gas dry at 15 °C and 1 013,25 mbar)

Gas family and group	Test gases	Designation	Composition volume % [e]	W_i MJ/m^3	H_i MJ/m^3	W_s MJ/m^3	H_s MJ/m^3	d
Gases of the first family[b]								
Group a	Reference gas Incomplete, combustion flame lift and Sooting limit gases	G 110	CH_4 = 26 H_2 = 50 N_2 = 24	21,76	13,95	24,75	15,87	0,411
	Light back limit gas	G 112	CH_4 = 17 H_2 = 59 N_2 = 24	19,48	11,81	22,36	13,56	0,367
Gases of the second family								
Group H	Reference gas	G 20	CH_4 = 100	45,67	34,02	50,72	37,78	0,555
	Incomplete combustion Sooting limit gas	G 21	CH_4 = 87 C_3H_8 = 13	49,60	41,01	54,76	45,28	0,684
	Light back limit gas	G 222	CH_4 = 77 H_2 = 23	42,87	28,53	47,87	31,86	0,443
	Flame lift limit gas	G 23	CH_4 = 92,5 N_2 = 7,5	41,11	31,46	45,66	34,95	0,586
Group L	Reference gas and Light back limit gas	G 25	CH_4 = 86 N_2 = 14	37,38	29,25	41,52	32,49	0,612
	Incomplete combustion and Sooting limit gas	G 26	CH_4 = 80 C_3H_8 = 7 N_2 = 13	40,52	33,36	44,83	36,91	0,678
	Flame lift limit gas	G 27	CH_4 = 82 N_2 = 18	35,17	27,89	39,06	30,98	0,629
Group E	Reference gas	G 20	CH_4 = 100	45,67	34,02	50,72	37,78	0,555
	Incomplete combustion and Sooting limit gas	G 21	CH_4 = 87 C_3H_8 = 13	49,60	41,01	54,76	45,28	0,684
	Light back limit gas	G 222	CH_4 = 77 H_2 = 23	42,87	28,53	47,87	31,86	0,443
	Flame lift limit gas	G 231	CH_4 = 85 N_2 = 15	36,82	28,91	40,90	32,11	0,617
Gases of the third family[c]								
Third family and Groups 3B/P and 3B	Reference gas, Incomplete combustion and Sooting limit gas	G 30	nC_4H_{10} =50 iC_4H_{10} =50	80,58	116,09	87,33	125,81	2,075
	Flame lift limit gas	G 31	C_3H_8 = 100	70,69	88,00	76,84	95,65	1,550
	Light back limit gas	G 32	C_3H_6 = 100	68,14	82,78	72,86	88,52	1,476
Group 3P	Reference gas, Incomplete combustion Sooting[d] and flame lift limit gas	G 31	C_3H_8 = 100	70,69	88,00	76,84	95,65	1,550
	Light back and Sooting limit gas[d]	G 32	C_3H_6 = 100	68,14	82,78	72,86	88,52	1,476

[a] For gases used nationally or locally, see A.5.

[b] For other groups, see A.5.

[c] also see Table 7.

[d] see 7.1.2 footnote 4).

[e] also see Annex A

Table 4 — Calorific values of third family test gases

Test gas designation	H_i MJ/kg	H_s MJ/kg
G 30	45,65	49,47
G 31	46,34	50,37
G 32	45,77	48,94

7.1.3 Practical application of test gases

7.1.3.1 Choice of test gases

Gases required for the tests described in 7.3.2, 7.3.4 and 7.3.5 shall be as specified in 7.1.1 and made up in accordance with the requirements of 7.1.2.

For the tests described in other clauses, it is permissible, in order to facilitate testing, to replace the reference gas by a gas actually distributed, provided that its Wobbe index is within ± 5 % of that of the reference gas.

When an appliance can use gases of several groups or families, test gases selected from those listed in Table 3 and in accordance with the requirements of 7.1.5.1, are used. The selected gases, for each appliance category, are listed in Table 5.

Table 5 — Test gases corresponding to the appliance categories

Category	Reference gas	Incomplete combustion limit gas	Light back limit gas	Lift limit gas	Sooting limit gas
I_{2H}	G 20	G 21	G 222	G 23	G 21
I_{2L}	G 25	G 26	G 25	G 27	G 26
I_{2E}, I_{2E+}	G 20	G 21	G 222	G 231	G 21
$I_{3B/P}$, I_{3+}	G 30	G 30	G 32	G 31	G 30
I_{3P}	G 31	G 31	G 32	G 31	G 31, G 32
II_{1a2H}	G 110, G 20	G 21	G 112	G 23	G 21
$II_{2H3B/P}$, II_{2H3+}	G 20, G 30	G 21	G 222, G 32	G 23, G 31	G 30
II_{2H3P}	G 20, G 31	G 21	G 222, G 32	G 23, G 31	G 31, G 32
$II_{2L3B/P}$	G 25, G 30	G 26	G 32	G 27, G 31	G 30
II_{2L3P}	G 25, G 31	G 26	G 32	G 27, G 31	G 31, G 32
$II_{2E3B/P}$, II_{2E+3+}	G 20, G 30	G 21	G 222, G 32	G 231, G 31	G 30
II_{2E+3P}	G 20, G 31	G 21	G 222, G 32	G 231, G 31	G 31, G 32
NOTE Tests with the limit gases are carried out with the injector and adjustment corresponding to the reference gas of the group to which the limit gas used for the test belongs.					

7.1.3.2 Conditions of supply and adjustment of the burners

7.1.3.2.1 Initial adjustment of appliance

Before all tests that are required to be carried out, the appliance shall be fitted with the appropriate equipment (injector(s)) corresponding to the gas family or gas group to which the specified test gas belongs (see Table 5). Any gas rate adjusters are set in accordance with the manufacturer's instructions using the appropriate reference gas(es) (see 7.1.5.1) and the corresponding normal pressure(s) given in 7.1.4.

This initial adjustment of the appliance is subject to the limitations given in 5.1.1.

7.1.3.2.2 Supply pressures

Except where an adjustment of the supply pressure is necessary (see 7.1.3.2.3 and 7.1.3.2.4) the normal, minimum and maximum supply pressures to be used for testing purposes shall be in accordance with the requirements given in 7.1.4.

Unless otherwise specified, the initial adjustment of the appliance is not altered.

7.1.3.2.3 Adjustment of heat inputs

For tests requiring adjustment of the burner to the nominal or another specified heat input, it shall be ensured that the pressure upstream of the injectors is such that the heat input obtained is within ± 2 % of that specified (by altering the preset adjusters or the appliance regulator, if adjustable, or the appliance supply pressure).

The specified heat input shall be calculated in accordance with the requirements of 7.3.2 and with the appliance supplied with the appropriate reference gas(es).

7.1.3.2.4 Corrected pressures

Where, in order to obtain the nominal heat input within ± 2 %, it is necessary to use a supply pressure, p, different from the normal pressure p_n, then those tests normally carried out at the minimum or maximum pressures p_{min} and p_{max} shall be carried out at the corrected pressures p' and p'' where :

$$\frac{p'}{p_{\min}} = \frac{p''}{p_{\max}} = \frac{p}{p_n}$$

7.1.4 Test pressures

The test pressures (i.e. the pressures required at the gas inlet connection of the appliance) are given in Tables 6 and 7.

These pressures and the corresponding injectors are used in accordance with the special national conditions given in Annex A, for the country in which the appliance is to be installed.

Table 6 — Test pressures where no pressure couple exists [a]

Appliance categories having as index	Test gas	p_n mbar	p_{min} mbar	p_{max} mbar
1st family: 1a	G 110, G 112	8	6	15
2nd family: 2H	G 20, G 21, G 222, G 23	20	17	25
2nd family: 2L	G 25, G 26, G 27	25	20	30
2nd family: 2E	G 20, G 21, G 222, G 231	20	17	25
3rd family: 3B/P	G 30, G 31, G 32	29[b]	25	35
	G 30, G 31, G 32	50	42,5	57,5
3rd family: 3P	G 31, G 32	37	25	45
	G 31, G 32	50	42,5	57,5

a For test pressures corresponding to gases distributed nationally or locally, refer to Table A.5.
b Appliances of this category may be used, without adjustment, at the specified supply pressures of 28 mbar to 30 mbar.

Table 7 — Test pressures where a pressure couple exists

Appliance categories carrying as index	Test gas	p_n mbar	p_{min} mbar	p_{max} mbar
2nd family: 2E+	G 20, G 21, G 222	20	17 [b)]	25
	G 231	(25) [a)]	17 [b)]	30
3rd family: 3+ (28-30/37 couple)	G 30	29 [c)]	20	35
	G 31, G 32	37	25	45
3rd family: 3+ (50-67 couple)	G 30	50	42,5	57,5
	G 31, G 32	67	50	80
a)This pressure corresponds to the use of low Wobbe index gas but in principle no test is carried out at this pressure; b)See Annex D; c)Appliances of this category may be used, without adjustment, at the specified supply pressures of 28 mbar to 30 mbar.				

7.1.5 Test procedures

7.1.5.1 Tests requiring the use of reference gases

The tests, specified in 7.3.2, 7.3.4 and 7.3.5 shall be carried out with each of the reference gases appropriate to the country in which the appliance is to be installed, according to the information given in A.1.

The other tests are carried out with only one of the reference gases of the appliance category (see 7.1.1) at one of the normal test pressures required in 7.1.4 for the selected reference gas, hereafter referred to as "the reference gas".

However, the test pressure shall be one of those stated by the manufacturer and the appliance shall be fitted with the appropriate injector(s).

7.1.5.2 Tests requiring the use of limit gases

These tests shall be carried out with the limit gases appropriate to the appliance category (see Table 5) and with the injector(s) and the adjustments corresponding to the reference gas of the group, or family, to which each limit gas belongs.

7.1.6 Test conditions

7.1.6.1 Test room

The appliance is installed in a well-ventilated, draught-free room which has an ambient temperature of 20 °C ± 5 °C. A wider temperature range is permissible provided that the effect on the test results can be taken into account.

The air in the test room, and any external air supply, shall contain not more than 500×10^{-6} (0,05 %) of carbon dioxide, 10×10^{-6} (0,001 %) of carbon monoxide, $0{,}5 \times 10^{-6}$ (0,000 05 %) of nitric oxide or $0{,}5 \times 10^{-6}$ (0,000 05 %) of nitrogen dioxide.

7.1.6.2 Test installation

The appliance shall be installed in accordance with the manufacturer's instructions, due account being taken of minimum clearances around the appliance specified by the manufacturer.

The air flow rate shall be adjusted to give the manufacturer's specified air flow rate corresponding to each input rate.

7.1.6.3 Influence of thermostats

Precautions shall be taken to prevent thermostats or other controls from operating and affecting the gas rate, unless this is necessary for the test.

7.1.6.4 Electrical supply

The appliance shall be connected to an electrical supply at the nominal voltage.

7.1.6.5 Range rated appliances

For appliances that are designed to be range rated, all tests shall be carried out at the maximum and minimum nominal heat inputs.

7.2 Automatic burner control systems (manually operated devices)

The appliance shall be installed as described in 7.1.6 and supplied with an appropriate reference gas (see Table 5) at the nominal heat input in accordance with the requirements of 7.1.3.2.

Where the start-up and shut-down are controlled by a single device, this device is operated manually, at intervals of 5 s, until it has been operated 10 times.

Where the start-up and shut-down are controlled by separate devices, these devices are operated alternately, at intervals of 5 s, until each has been operated 5 times.

It is checked that the requirements of 5.2.8.2 are met.

7.3 Safety of operation

7.3.1 Soundness of the gas circuit

For appliances using 1st and/or 2nd family gases only, the tests are carried out with an air inlet pressure of 50 mbar; however the inlet shut-off valve is tested with an air pressure of 150 mbar.

For appliances using 3rd family gases at pressure couples other than 112mbar to 148 mbar, the tests are carried out with an air pressure of 150 mbar.

Any regulator may be locked in its maximum open position to avoid damage.

Compliance with 6.1 is checked with all gas valves open except the last valve in the start gas and in the main gas circuits.

Where the design of any ignition burner is such that its gas outlet cannot be sealed, this test is carried out with the gasway to the ignition burner sealed at a convenient place. In this case an additional test is also carried out, using an appropriate leak detection fluid, to verify that there is no leakage from the part of the gasway downstream of the previously tested section when the ignition burner is operating at its normal working pressure.

For the determination of the leakage rate a volumetric method is used which gives a direct reading of the leakage rate and which is of such accuracy that the error in its determination does not exceed 100 cm^3/h.

These tests are carried out when the appliance is first delivered and again on completion of all the tests in the standard and after any assembly in the gas circuit that has a gas-tight joint whose removal is provided for in the manufacturer's instructions has been removed and replaced 5 times.

7.3.2 Heat inputs

7.3.2.1 General

For the purposes of this standard all heat inputs are determined from the volumetric rate (V_o) or mass rate (M_o) which relate to the rate obtained with reference gas under reference test conditions (dry gas, 15 °C, 1 013,25 mbar). The heat input (Q_o) in kW is given by one of Equations 2, 3, 4 or 5.

Q_o = 0,278 M_o x H_s; or (2)

Q_o = 0,278 M_o x H_i; or (3)

Q_o = 0,278 V_o x H_s; or (4)

Q_o = 0,278 V_o x H_i. (5)

where

M_o is the mass rate in kg/h obtained at reference conditions;

V_o is the volume rate in m^3/h obtained at reference conditions;

H_i is the net calorific value of the reference gas in MJ/kg or in MJ/m^3 (dry gas, 15 °C, 1 013,25 mbar), as appropriate;

H_s is the gross calorific value of the reference gas in MJ/kg or in MJ/m^3 (dry gas, 15 °C, 1 013,25 mbar), as appropriate.

The mass and volumetric flow rates correspond to a measurement and to a flow of reference gas, under reference conditions, in other words assuming the gas to be dry, at 15 °C and under a pressure of 1 013,25 mbar. In practice, the values obtained during the tests do not correspond to these reference conditions so they shall then be corrected so as to bring them to the values that would actually have been obtained if these reference conditions had existed at the injector outlet during the test.

If the corrected mass flow rate (M_o) is determined using the mass flow rate (M), Equation 6 is used :

$$M_0 = M\sqrt{\frac{1013{,}25+p}{p_a+p}\times\frac{273+t_g}{288}\times\frac{d_r}{d}} \quad (6)$$

where

M_o is the corrected mass flow rate (kg/h), obtained under test conditions;

M is the mass flow rate (kg/h), obtained under test conditions;

p_a is the atmospheric pressure (mbar);

p is the gas supply pressure (mbar);

t_g is the temperature of the gas at the measuring point (°C);

d is the density of dry gas relative to dry air;

d_r is the density of the reference gas relative to dry air.

If the corrected volumetric flow rate (V_o) is determined using the volumetric flow rate (V), Equation 7 is used:

$$V_0 = V\sqrt{\frac{1013{,}25+p}{1013{,}25}\times\frac{p_a+p}{1013{,}25}\times\frac{288}{273+t_g}\times\frac{d}{d_r}} \quad (7)$$

where

V_o is the corrected volumetric flow rate (m^3/h), under reference conditions;

V is the volumetric flow rate (m^3/h), obtained under test conditions;

p_a is the atmospheric pressure (mbar);

p is the gas supply pressure (mbar);

t_g is the temperature of the gas at the measuring point (°C);

d is the density of dry gas relative to dry air;

d_r is the density of the reference gas relative to dry air.

The corrected mass flow rate (M_o), under reference conditions is calculated using Equation 8.

$$M_0 = 1{,}226\ V_0 \times d \tag{8}$$

where

M_o is the corrected mass flow rate (kg/h), obtained under test conditions;

V_o is the corrected volumetric flow rate (m^3/h), under reference conditions;

d is the density of dry gas relative to dry air;

Equations 6 and 7 are used to calculate, from the mass flow rate (M) or volumetric flow rate (V) measured during the test, the corresponding corrected flow rates M_o or V_o which would have been obtained under the reference conditions.

Equations 6 and 7 are applicable if the test gas used is dry.

If a wet meter is used or if the gas used is saturated, the value d is replaced by the value of the density of the wet gas (d_h) and is given by Equation 9.

$$d_h = \frac{d\left(p_a + p - p_w\right) + 0{,}622 + p_w}{p_a + p} \tag{9}$$

where

d_h is the density of the wet gas relative to dry air;

d is the density of dry gas relative to dry air;

p is the gas supply pressure (mbar);

p_a is the atmospheric pressure (mbar);

p_w is the saturation vapour pressure of the test gas (mbar) at temperature t_g.

7.3.2.2 Nominal heat input

The tests are carried out at the pressure specified by the manufacturer in accordance with the requirements of 7.1.4.

The appliance is adjusted in accordance with the requirements of 7.1.3.2.1 and the heat input is determined for each reference gas.

The measurements are taken with the appliance at thermal equilibrium and with any thermostat put out of action.

The heat input obtained Q_o is compared with the nominal heat input Q_n in order to verify the requirements of 6.2.1.

7.3.2.3 Start gas heat input

The tests are carried out at the pressure specified by the manufacturer in accordance with the requirements of 7.1.4, using an arrangement which allows operation of the start gas flame on its own.

The appliance is adjusted in accordance with the requirements of 7.1.3.2.1 and the heat input is determined for each reference gas.

The measurements are taken after ignition of the start gas flame.

The heat input obtained is compared with the start gas heat input declared by the manufacturer in order to verify the requirements of 6.2.2.

7.3.2.4 Effectiveness of the gas rate adjusters

The tests described in 7.3.2.4.1 are only applicable to appliances fitted with gas rate adjusters which are not put out of action.

a) Test 1

Measure the heat input with the adjuster fully open and with the minimum supply pressure given in 7.1.4 for the particular reference gas;

b) Test 2

Measure the heat input with the adjuster fully closed and with the maximum supply pressure given in 7.1.4 for the particular reference gas.

The tests are carried out for each reference gas for the appliance category with the exception of cases where the adjuster has been set by the manufacturer in a given position. In this case, the adjuster is regarded as non-existent.

7.3.2.5 Effectiveness of the gas regulator

If the appliance has an adjustable regulator, this is adjusted if necessary to give the volumetric rate corresponding to the nominal heat input with reference gas at the normal pressure given in 7.1.4 and corresponding to this gas. Keeping the initial adjustment, the supply pressure is varied between the corresponding minimum and maximum values. This test is carried out for all the reference gases, except those of the 1st family, for which the regulator is not put out of action. For 1st family gases, the test is carried out by varying the supply pressure between the normal pressure and the maximum pressure.

7.3.2.6 Effectiveness of the range-rating device

The tests are carried out as described in 7.3.2.2 for the two extreme positions of the range-rating device.

7.3.3 Limiting temperatures

7.3.3.1 Temperatures of parts that have to be touched during normal operation

The appliance shall be operated with any reference gas for the appliance category at the nominal heat input, the minimum circulated air rate specified by the manufacturer and the thermostat at maximum setting.

NOTE For ductless appliances, the air discharge louvres are set at the position of maximum closure as marked and specified by the manufacturer.

The temperatures of the parts specified in 6.3.1 shall be measured at thermal equilibrium to an accuracy of ± 2 K using a suitable means (e.g. contact thermocouples).

7.3.3.2 Temperatures of the side walls, front and top of the appliance

The test is carried out when the appliance has reached thermal equilibrium.

The temperatures of the side walls, front and top of the appliance are measured by a suitable means having an accuracy of ± 2 K (e.g. contact thermocouples).

7.3.3.3 Component temperatures

Component temperatures are measured when thermal equilibrium has been reached in the test described in 7.3.3.1 and after the appliance has been turned off at the end of the test.

The component temperatures are measured by means of attached thermocouples having thermoelectric junctions with an accuracy of ± 2 K. An alternative means having a similar accuracy is acceptable.

However, if an electrical component is itself likely to cause a rise in temperature (e.g. automatic shut-off valves) the temperature of the component is not measured. In this case, the temperature measuring probes are placed so as to measure the air temperature around the device.

The temperature measurements of the components are deemed to be satisfactory if the requirements of Equation 10 are met.

$$t_m \leq (t_s + t_a) - 25\ °C \qquad (10)$$

where

t_m is the maximum temperature measured in the test in °C;

t_s is the maximum temperature specified by the component manufacturer in °C;

t_a is the ambient room temperature in °C.

NOTE If the maximum temperature of the component is specified for an ambient temperature other than 25 °C, this should be used.

7.3.3.4 Fan motor winding temperatures

The appliance is installed in accordance with the requirements of 7.1.6 and supplied with electricity by means of a device that enables the voltage to be varied from 85 % of the minimum to 110 % of the maximum of the voltage range declared by the manufacturer (e.g. a variable voltage transformer).

The test is carried out with the appliance adjusted to its nominal input, using an appropriate reference gas (see Table 5). The voltage is adjusted to the most unfavourable value between the above limits.

Temperature measurements are made when the appliance has reached thermal equilibrium and after the appliance has been switched off by the normal means of control.

The resistance of the windings is measured as soon as possible after switching off and then at short intervals so that a curve of the resistance against time from switch-off can be plotted, in order to determine the maximum resistance value.

The temperature rise of the windings is calculated using Equation (11).

$$\Delta t = \frac{(R_2 - R_1)}{R_1}(C + t_1) - (t_2 - t_1) \quad (11)$$

where

Δt is the temperature rise in K;

R_1 is the resistance at the beginning of the test in ohms;

R_2 is the maximum resistance at the end of the test in ohms;

t_1 is the room temperature at the beginning of the test in °C;

t_2 is the room temperature at the end of the test in °C;

C is a constant equal to 234,5 °C for copper.

7.3.4 Ignition, cross-lighting and flame stability

These tests are carried out with the appliance installed in accordance with the requirements of 7.1.6, in the cold condition and at thermal equilibrium unless otherwise stated.

7.3.4.1 Ignition and cross-lighting

7.3.4.1.1 Test 1

Supply the appliance with the appropriate reference and limit gases (see Table 5) at the normal pressure in accordance with the requirements of 7.1.4.

Under these supply conditions it is checked that ignition of the main burner or the ignition burner occurs correctly and that ignition of the main burner by the ignition burner as well as cross-lighting of the various parts of the burner occurs correctly.

This test is repeated at the minimum heat input at which ignition is possible under these conditions during normal operation in accordance with the manufacturer's instructions for use.

7.3.4.1.2 Test 2

For this test the initial main and ignition burner adjustments are not altered and the appliance is supplied with reference gas with the pressure at the appliance inlet reduced to 70 % of the normal pressure or the minimum pressure given in 7.1.4, whichever is the lower.

Under these supply conditions it is checked that ignition of the main burner or the ignition burner occurs correctly and that ignition of the main burner by the ignition burner as well as cross-lighting of the various parts of the burner occurs correctly.

This test is repeated at the minimum heat input at which ignition is possible under these conditions during normal operation in accordance with the manufacturer's instructions for use.

7.3.4.1.3 Test 3

Without altering the initial main and ignition burner adjustment, the appropriate flame lift and light-back limit gases are substituted successively for the reference gas and the pressure is reduced at the appliance inlet to the minimum pressure given in 7.1.4.

Under these supply conditions it is checked that ignition of the main burner or the ignition burner occurs correctly and that ignition of the main burner by the ignition burner as well as cross-lighting of the various parts of the burner occurs correctly.

This test is repeated at the minimum heat input at which ignition is possible under these conditions during normal operation in accordance with the manufacturer's instructions for use.

7.3.4.2 Ignition burner flame reduction

The appliance is initially adjusted in accordance with the requirements of 7.1.3.2.1 and supplied with the appropriate reference gases (see Table 5) at nominal heat input.

The ignition burner gas rate is then reduced to the minimum required to hold open the gas supply to the main burner.

The necessary reduction in the ignition burner gas rate may be achieved either:

a) by the adjustment of the ignition burner gas rate adjuster, if this exists; or

b) by means of an adjuster inserted into the ignition burner gas supply for this purpose.

Correct ignition of the main burner by the ignition burner is then checked.

7.3.4.3 Delayed ignition

The appliance is initially adjusted in accordance with the requirements of 7.1.3.2.1 and supplied with the appropriate reference gases (see Table 5) at nominal heat input.

Ignition of the ignition burner or the main burner if this is ignited directly is checked. The test is repeated, progressively delaying the ignition up to a maximum of 50 % longer than the safety time declared by the manufacturer.

In order to delay ignition, it will generally be necessary to provide independent control of the main gas valves and the operation of the ignition device. A suitable arrangement is to provide a voltage supply independently of the burner control system to the main gas safety shut-off valves and to the ignition device.

NOTE For safety reasons the ignition delay should be increased in stages.

7.3.4.4 Ignition of the ignition burner with the downstream main gas automatic shut-off valve open

This test is carried out where the gas line is designed such that the gas supply to the ignition burner is taken from between the two main burner shut-off valves, and the downstream main gas valve is not provided with means to prove that it is closed during ignition of the ignition burner.

The test is carried out with the appliance installed in accordance with the requirements of 7.1.6.

The appliance is initially adjusted in accordance with the requirements of 7.1.3.2.1 and supplied with the appropriate reference gases (see Table 5) at the nominal heat input.

With the downstream main gas automatic shut-off valve kept open artificially, it is checked that ignition of the ignition burner does not give rise to a hazardous situation.

7.3.4.5 Flame stability

7.3.4.5.1 Test 1

Without altering the initial main burner or ignition burner adjustment, the appropriate light-back gas is substituted successively for the reference gas and the pressure is reduced at the appliance inlet to the minimum pressure given in 7.1.4.

Under these conditions it is checked that the flames are stable.

This test is then repeated at the minimum input given by the controls at which the appliance can operate normally in accordance with the manufacturer's instructions.

7.3.4.5.2 Test 2

Without altering the initial main burner or ignition burner adjustment, the appropriate flame lift and light-back limit gases are substituted successively for the reference gas and the pressure is increased at the appliance inlet to the maximum given in 7.1.4.

Under these conditions it is checked that the flames are stable.

This test is then repeated at the minimum input given by the controls at which the appliance can operate normally in accordance with the manufacturer's instructions.

7.3.5 Combustion

7.3.5.1 General

The appliance is installed in accordance with the requirements of 7.1.6 and initially adjusted in accordance with the requirements of 7.1.3.2.1 and supplied with the appropriate reference gases (see Table 5) at the nominal heat input.

The distributed air shall be collected in such a manner as to ensure a representative sample is taken using a suitable sampling probe, and the concentration of carbon monoxide, carbon dioxide and oxides of nitrogen shall be determined as:

a) Carbon monoxide

   The carbon monoxide concentration in the discharged air shall be measured by means of a suitably sensitive analyzer or by any other method giving at least an equivalent accuracy. The carbon monoxide concentration shall be determined to an accuracy of ± 10 % of the actual reading;

b) Carbon dioxide

   The carbon dioxide concentration in the discharged air shall be measured by means of a suitably sensitive analyzer or by any other method giving at least equivalent accuracy. The carbon dioxide concentration shall be determined to an accuracy of ± 6 % of the actual reading;

c) Oxides of nitrogen

   The concentration of oxides of nitrogen in the products of combustion shall be determined by means of a method based on chemiluminescent effects or other means giving at least equivalent accuracy. The concentration of oxides of nitrogen shall be determined to an accuracy of ± 10 % of the actual reading.

Where the appliance does not have the facility for recirculated air, the combustion tests shall be carried out under the conditions specified in 7.3.5.2 and 7.3.5.3 with the air flow rate adjusted to give the manufacturer's specified air flow rate corresponding to the nominal heat input.

Where the appliance does have the facility for recirculated air, the combustion tests shall be carried out under the conditions specified in 7.3.5.2 and 7.3.5.3 and:

d) the temperature of the recirculated air shall be maintained during the tests within the limits given in 7.1.6.1;

e) where the manufacturer specifies a fixed level of recirculated air, the combustion tests shall be carried out with the recirculation air damper set to give the specified air recirculation rate;

f) where the air circulation rate is specified to be variable up to a maximum level the combustion tests shall be carried out with the recirculation air damper set to give the maximum and minimum air recirculation rates;

g) where the level of recirculated air is not specified the combustion tests shall be carried out with any recirculation air damper set in the fully open position and in the fully closed position;

h) if the recirculated air intake is upstream of the burner, the recirculated air shall be vitiated with products of combustion such that the concentration of CO_2 is 2 800 x 10^{-6}.

In order to maintain the temperature of vitiated recirculated air within the specified limits, it may be necessary to dilute the recirculated air with vitiated air having a lower heat content than that of the delivered air (e.g. by means of a gas-fired boiler). In this event, additional room ventilation will be required.

If it is difficult to adjust the level of vitiation in the recirculated air exactly, tests shall be made at a sufficient number of CO_2 concentrations in the recirculated air to determine the combustion performance at the specified CO_2 concentration of 2 800 x 10^{-6}. No extrapolation shall be made.

7.3.5.2 Test procedures

7.3.5.2.1 General

The combustion performance is checked under the conditions for conformity shown in 6.5.1 or 6.5.2 as appropriate.

7.3.5.2.2 Test 1

Without altering the initial burner adjustment the appliance is supplied with the appropriate reference gas(es) (see Table 5) according to its category and the pressure at the appliance inlet increased to the maximum pressure given in 7.1.4.

7.3.5.2.3 Test 2

For appliances without modulating or high/low control, without altering the initial burner adjustment, the appliance is supplied with the appropriate reference gas(es) (see Table 5) according to its category with the pressure at the appliance inlet reduced to 70 % of the normal pressure or the minimum pressure given in 7.1.4, whichever is the lower.

For appliances with modulating or high/low controls this test is carried out either at the minimum heat input provided by the controls, at 70 % of the normal pressure or at the minimum pressure, whichever condition provides the minimum gas rate to the burner.

7.3.5.2.4 Test 3

Without altering the initial burner adjustment, the appropriate incomplete combustion limit gas(es) are substituted successively for the reference gas and the pressure at the appliance inlet increased to the maximum pressure given in 7.1.4.

7.3.5.3 Auxiliary energy variations

Without altering the initial burner adjustment, the appliance is supplied with the appropriate reference gas(es) (see Table 5) according to its category and operated at the nominal heat input.

The test is carried out with the appliance supplied with electricity at a voltage of 85 % of the minimum and then at a voltage of 110 % of the maximum of the voltage range stated by the manufacturer.

It is checked that the requirements of 6.5.3 are met.

7.3.6 Overheat cut-off device

The appliance is installed as described in 7.1.6 and supplied with the reference test gas corresponding to the appliance category at normal pressure.

In addition, the outlet air spigot of a ducted appliance is fitted with ducting of the same shape and of length six times the major dimension of the outlets.

The air temperature control and any air proving device are rendered inoperative.

The appliance is operated from cold at the maximum nominal heat input and the air flow is progressively reduced until the overheat cut-off device operates to cut off the gas supply to the main burner. The appliance is then made to cycle, after manual reset, on the overheat cut-off device for sufficient time to ensure that the worst condition has been reached.

The manual reset mechanism is operated after the first cut-out and at regular intervals thereafter until the cut-off device permits reset.

7.3.7 Air flow proving device

The test is carried out with the appliance installed in accordance with the requirements of 7.1.6.

The appliance is adjusted in accordance with the requirements of 7.1.3.2.1 and supplied with an appropriate reference gas (see Table 5) at nominal heat input.

The CO_2 concentration of the distributed air which is attributable to the appliance is determined in accordance with the requirements of 7.3.5.

The air inlet to the appliance is then gradually restricted and the CO_2 concentration of the distributed air monitored.

It is checked that the air flow proving device causes safety shut-down or non-volatile lock-out before the CO_2 concentration attributable to the appliance exceeds 1,25 times the value obtained under normal operating conditions.

For the purposes of this test it may be necessary to override the function of any air temperature control and of the overheat cut-off device.

7.3.8 Weather resistance

Two independent sets of adjustable spray units, each as shown in Figures 1 and 2, are used. Each spray unit is adjustable in height from 2 m to 3 m above the floor and in any lateral direction.

The two spray units are placed in opposition with the spray heads equidistant from the floor and from the appliance under test.

The appliance is installed as described in 7.1.6 on a test platform of such size as to accommodate the appliance easily and supplied with one of the reference gases corresponding to the appliance category at the normal pressure.

The spray heads are set to operate at 350 mbar and adjusted to varying elevations and horizontal distances from the appliance to determine the most critical location. Exposure at the location chosen as the most critical by observation is maintained throughout the test.

After adjustment of the spray heads, any ignition burner is ignited and the test applied for a period of 15 min. The main burners are then ignited and the test continued for a further 15 min.

The test is repeated with the appliance located in any other position relative to the spray heads as may be considered appropriate.

8 Marking and instructions

8.1 General

The appliance, its packaging and other relevant components shall be marked with the relevant information specified in 8.3, 8.4, 8.5 and 8.6.

The symbols to be used for identifying the country, or countries, of destination of the appliance shall be as specified in Annex B.

8.2 Description

Appliances are described by their:

a) category;

b) nominal heat input, or range of adjustable input;

c) principle of distributing the warm air;

d) design temperature rise.

8.3 Data plate

The appliance shall carry one or more data plates and/or labels that are firmly and durably attached to the appliance such that the information given is visible to, and can be read by, the installer after installation, possibly after part of the case has been removed. The data plate(s) and/or label(s) shall provide in indelible[2)] characters at least:

a) manufacturer's[3)] name and address;

b) nominal heat input and, where necessary, the range of input for an appliance with an adjustable input (in kw) and, where applicable, in kilograms per hour;

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2) The indelibility of the marking is checked by a test carried out in accordance with the requirements of 7.14 of EN 60335-1:2002.

3) "Manufacturer" means the person, organization or company who assumes responsibility for designing and manufacturing a product with a view to placing it on the market on their own behalf within the EU.

c) appliance category or categories; if more than one appliance category is specified, each of these categories shall be identified in relation to the appropriate direct country or countries of destination;

d) trade name of the appliance;

e) PIN (Product Identification Number) of the notified body;

f) serial number of the appliance;

g) commercial identification of the appliance;

h) where the appliance has been assessed to the requirements of this standard for outdoor use, this shall be marked on the appliance together with its IP rating;

i) type of gas in relation to the pressure and/or the pressure couple, for which the appliance has been adjusted; any pressure indication shall be identified in relation to the corresponding category index; if an intervention is necessary on the appliance in order to change from one pressure to the other within a pressure couple of the third family, only the pressure corresponding to the current adjustment of the appliance shall be indicated;

j) nature and voltage of the current used and the maximum electrical input power used (in volts, amperes, frequency and kilowatts) for all intended electrical supply conditions.

k) direct country or countries of destination of the appliance;

l) external air pressure;

m) design air flow rate;

n) design temperature rise.

No other information shall be included on the appliance if this could lead to confusion with regard to the current state of adjustment of the appliance, the corresponding appliance category (or categories) and the direct country (or countries) of destination;

For an appliance with an adjustable nominal heat input, there shall be room for the installer to durably mark the nominal heat input value for which it has been adjusted on commissioning.

8.4 Other marking

The appliance shall be marked with:

> "This appliance must be installed in accordance with the rules in force, and used only in a well-ventilated space. Consult instructions before installation and use of this appliance."

The appliance shall also carry all necessary information relating to any electrical equipment, particularly the voltage and the current to be used and the appropriate insulation code in accordance with the requirements of EN 60529:1991.

Permanent warning notices shall be provided in a readily visible position on the appliance requiring the appliance to be switched off and the gas supply isolated before carrying out any servicing operation.

Provision shall be made on the appliance or the data plate for fixing the CE marking.

8.5 Marking on the packaging

The packaging shall be marked with:

a) the type of gas in relation to the pressure and/or pressure couple for which the appliance has been adjusted; any pressure indication shall be identified in relation to the corresponding appliance category index; if an intervention is necessary on the appliance in order to change from one pressure to the other within a pressure couple of the third family, only the pressure corresponding to the current adjustment of the appliance shall be indicated;

b) the direct country or countries of destination of the appliance;

c) the appliance category or categories; if more than one appliance category is specified, each of these categories shall be identified in relation to the appropriate direct country or countries of destination;

In addition it shall be marked with the text:

"This appliance must be installed in accordance with the rules in force, and used only in a well-ventilated space. Consult instructions before installation and use of this appliance."

No other information shall be included on the packaging if this could lead to confusion with regard to the current state of adjustment of the appliance, the corresponding appliance category (or categories) and the direct country (or countries) of destination.

8.6 Profile plate

Where the appliance is fitted with a profile plate, the position of the plate corresponding to the optimum air velocities for satisfactory combustion for the nominal heat input or range of heat inputs shall be clearly and permanently marked on the plate.

If the manufacturer permits adjustment of the profile plate when the appliance is commissioned the manufacturer's commissioning instructions shall specify details for the marking of the correct position of the plate in a clear and permanent fashion.

8.7 Instructions

8.7.1 General

Installation, and if appropriate commissioning, servicing, and user instructions and, if appropriate, instructions for converting the appliance for use with other gases shall be provided by the manufacturer.

The instructions shall specify any restrictions on the use of the appliance.

The instructions shall stress that a qualified installer is required to install, commission, adjust and, where applicable, convert the appliance for use with other gases.

The instructions shall indicate the need for ventilation if the appliance is designed such that all of the required ventilation air is not passed through the appliance.

The instructions shall state the minimum amount of fresh air to meet the requirements of 6.5.1 and 6.5.2 as appropriate.

NOTE Annex C provides guidance for calculation of fresh air required as well as examples of typical installations possible based upon reference gas G 20.

8.7.2 Technical instructions for installation and adjustment

The technical instructions shall state:

> "Before installation, check that the local distribution conditions, nature of gas and pressure, and the current state of adjustment of the appliance are compatible".

The technical instructions for installation and adjustment shall explain the installation conditions for the appliance (e.g. on a floor or wall) and its accessories (e.g. room thermostat); they shall state the minimum distance necessary between the appliance surfaces and any nearby walls, and also any precautions to be taken to avoid overheating the floor, walls or ceiling if these are made from combustible materials.

They shall also give all relevant information for adjusting the gas and air rates. They shall also include a table for the appliance category, giving the various calorific values and the gas rate settings, in m^3/hr in relation to the average conditions of use (15 °C, 1 013,25 mbar) or in kg/hr, together with the instructions about how to adjust the air rate.

They shall explain that it is necessary for the installer to refer to the appliance data plate for information specific for the air flow rates and gas rates for the particular appliance being installed.

They shall specify the maximum and minimum pressure differential across any profile plate.

If the appliance is not fitted with an air temperature control, the instructions shall specify the location, installation and setting of the air temperature control supplied by the manufacturer in accordance with the requirements of 5.10.2.

They shall provide guidance for the installer to ensure that the limits of exposure to emission of carbon dioxide (CO_2) in the space to be heated are maintained in accordance with local requirements for emission limitations.

NOTE 1 Annex C provides guidance for calculations based upon reference gas Type G 20. Values for CO_2 and combustion air requirements for other gases are given in Table C.1.

NOTE 2 Emission limits of other gases contained in the products will not be exceeded if the CO_2 limit is maintained.

They shall deal with the assembly of parts which are likely to be replaced, and with the greasing of taps, the electric motor and the fan, and with cleaning.

To aid understanding, the technical instructions shall contain a description of the appliance and of the exchangeable or conversion parts with an illustration and, where necessary, a numbered key for the main parts to be cleaned, serviced or replaced.

8.7.3 Instructions for conversion

The conversion instructions shall provide technical information on the procedures to be followed when converting the appliance from use on one gas in a family to use on a gas in another family, or from gas to gas within a family.

In particular, they shall explain the operations and adjustments to be carried out and the markings on the parts and injectors supplied for each of the gases which may be used.

8.7.4 Instructions for servicing

The servicing instructions shall indicate the frequency of servicing and the scope of the service programme recommended by the manufacturer. They shall also specify such special tools as are necessary for any servicing procedure. The procedure for removing or gaining access to parts or components to be serviced, together with the recommended service work and associated procedures, shall be clearly defined.

The instructions shall also include complete electrical functional and wiring diagrams and a short list of appliance parts and part numbers of those items that the manufacturer considers may be required for replacement purposes during the life of the appliance.

Reference shall also be made to the necessity for consulting the appliance manufacturer before using parts for replacement other than those specified or recommended in the servicing instructions.

A fault-finding chart shall be incorporated as an aid to servicing. The servicing instructions shall also include a line or block diagram showing the arrangement of the gas controls.

The servicing instructions shall contain any specific recommendations for emergency servicing under wet conditions, including the provision of weatherproof covers, of appliances designed for permanent outdoor installation.

The servicing instructions shall draw attention to the necessity for re-commissioning the appliance after servicing.

8.7.5 Instructions for use and maintenance

These instructions, which are intended for the user, shall provide all the necessary information for the safe and sensible use of the appliance.

In particular, they shall deal with the operations of ignition and extinction, the use of the various controls with which the appliance may be fitted, simple cleaning and maintenance of the appliance, together with details concerning the nature of the cleaning products recommended.

8.7.6 Presentation

All the information specified in 8.7.2, 8.7.3, 8.7.4 and 8.7.5 shall be given in the official language(s) of the direct country, or countries, of destination.

Annex A
(informative)

National situations

A.1 General

In each country in which this standard applies, appliances may be marketed only if they comply with the particular national supply conditions of that country.

In order to permit, both at the time of testing the appliance and at the time of its sale, the correct choice to be made from all the situations covered, the various national situations are summarized in A.2, A.3, A.4, A.5 and A.6.

A.2 Categories listed in the body of the standard and marketed in different countries

Tables A.1 and A.2 give the national situations concerning the marketing in the various countries of the appliance categories listed in the body of the standard.

The information given in Table A.1 indicates only that these categories may be sold throughout the whole of the country concerned and A.3 should be consulted for confirmation.

In all cases of doubt the local gas supplier should be consulted in order to identify the precise category applicable.

Table A.1 — Category I (single categories) marketed

Country	I_{2H}	I_{2L}	I_{2E}	I_{2E+}	I_{2N} [a)]	I_{2R} [a)]	$I_{3B/P}$	I_{3+}	I_{3P}	I_{3B}	I_{3R} [a)]
AT	X						X				
BE				X				X	X		
BG											
CH	X						X	X	X		
CY [b]											
CZ	X						X		X		
DE			X				X		X		
DK	X						X				
EE [b]											
ES	X							X	X		
FI	X						X				
FR	X [c]	X [c]		X			X [d]	X	X		
GB	X							X	X		
GR	X							X	X		
HU [b]	X						X		X	X	
IE	X							X	X		
IS											
IT	X							X			
LT [b]											
LU			X								
LV [b]											
MT [b]											
NL	X [c]	X					X		X		
NO							X				
PL [b]											
PT	X							X	X		
SE	X						X				
SI [b]											
SK [b]											

[a] Category to be deleted if it is not selected by any country.
[b] Information on categories to be supplied by new CEN member.
[c] Categories applicable only to certain types of appliance, submitted to on site EC verification procedure, Annex II, article 6 of the Gas Appliance Directive (90/396/eec). (France and Netherlands to clarify if applicable here).
[d] Categories applicable only to certain types of appliance specified in the individual standards (France to specify if applicable here)

Table A.2 — Double categories marketed

Country	II_{1a2H}	$II_{2H3B/P}$	II_{2H3+}	II_{2H3P}	II_{2H3B}	$II_{2L3B/P}$	II_{2L3P}	$II_{2E3B/P}$	$II_{2E3+B/P}$	II_{2E+3+}	II_{2E+3P}	II_{2R3R} [a]
AT		X										
BE												
BG												
CH		X	X	X								
CY [b]												
CZ		X		X								
DE								X				
DK	X	X										
EE [b]												
ES			X [c]	X								
FI		X										
FR				X [d]			X [d]		X [e]	X	X	
GB			X	X								
GR		X	X	X								
HU [b]		X		X	X							
IE			X	X								
IS												
IT	X		X									
LT [b]												
LU												
LV [b]												
MT [b]												
NL						X	X					
NO												
PL [b]												
PT			X	X								
SE	X	X										
SI [b]												
SK [b]												

[a] Category to be deleted if it is not selected by any country.
[b] Information on categories to be supplied by new CEN member.
[c] Appliances of this category set for Group H gases of the second family may use air and commercial propane gas mixtures where the gross wobbe index (at 15°C and 1 013,25 mbar) is between 46 MJ/m^3 and 51,5 MJ/m^3 a, at the same supply pressure, without additional tests.
[d] Categories applicable only to certain types of appliance, submitted to on site EC verification procedure, Annex II, article 6 of the Gas Appliance Directive (90/396/eec). (France to clarify if applicable here).
[e] Categories applicable only to certain types of appliance specified in the individual standards (France to specify if applicable here).

A.3 Appliance supply pressures corresponding to the categories given in A.2

Table A.3 gives the conditions in the various countries concerning the supply pressures to appliances in the categories given in A.2

Other, higher supply pressures may be necessary and such pressures may be provided after consultation with the appropriate gas supplier(s) in the country(ies) concerned.

Table A.3 — Normal supply pressures

Gas	G 110	G 20	G 25		G 20 + G 25	G 30		G 31			G 30 + G 31	
Pressure (mbar)	8	20	20	25	Couple 20/25	30 28-30	50	30	37	50	Couple 28-30/37	Couple 50/67
Country												
AT		X					X			X		
BE					X					x[a]	X	X
BG												
CH		X					X			X	X	
CY [b]												
CZ		X[c]					X[d]	X	X	X[e]		
DE		X	X			X	X			X		
DK	X	X						X				
EE [b]												
ES		X				X			X	X[a]	X	
FI		X				X		X				
FR					X	X	X[a]		x	X[a]	X	
GB		X[f]				X			X	X	X	
GR		X				X		X	X	X	x	
HU [b]		X[g]				X	X	X		x		
IE		X				X			X		X	
IS												
IT	X	X									X	
LT [b]												
LU		X										
LV [b]												
MT [b]												
NL				X				X		X		
NO						X		X				
PL [b]												
PT		X				X			X		X	
SE	X	X				X		X				
SI [b]												
SK [b]												

[a] Only for certain types of non-domestic appliances. (Countries to clarify)
[b] Information on supply pressures to be supplied by new CEN member.
[c] Currently 18 mbar.
[d] For certain types of industrial appliances. (CZ to clarify).
[e] For certain types of appliances. (CZ to clarify)
[f] Normal supply pressure for this appliance: 17,5 mbar.
[g] Pressures of 25mbar and 85 mbar.

A.4 Special categories marketed nationally or locally

A.4.1 General

The national or local conditions of gas distribution (gas composition and supply pressures) lead to the definition of special categories which are marketed nationally or locally in certain countries, as shown in Table A.4.

Table A.4 — Test gases corresponding to categories marketed nationally or locally

Category	Reference gas	Incomplete combustion limit gas	Light back limit gas	Lift limit gas	Sooting limit gas	Country
I_{2Esi}, I_{2Er}	G 20, G 25	G 21	G 222	G 231	G 21	FR
$I_{2E(S)B}$	G 20, G 25	G 21	G 222	G 231	G 21	BE
$I_{2E(R)B}$	G 20, G 25	G 21	G 222	G 231	G 21	BE
I_{2ELL}	G 20,G 25	G 21	G 222	G 231, G 271	G 21	DE
I_{2S}	G 25.1	G 26.1	G 222	G 27.1	G 26.1	HU[a]
I_{2HS}	G 20, G 25.1	G 21 G 26.1	G 222	G 27.1	G 21, G 26.1	HU[a]
II_{2Esi3+} II_{2Er3+}	G 20, G 25 G 30	G 21	G 222 G 32	G 231 G 31	G 30	FR
II_{2Esi3P} II_{2Er3P}	G 20, G 25 G 31	G 21	G 222 G 32	G 231 G 271	G 31 G 32	FR
$II_{2ELL3B/P}$	G 20, G 25, G 30	G 21, G30	G 222, G 32	G 231 G 271	G 30	DE
$II_{2S3B/P}$	G 25.1, G 30	G 26.1, G 30	G 32	G 27.1 G31	G 26.1, G 30	HU[a]
II_{2S3P}	G25.1, G 31	G 26.1, G 30	G 32	G 27.1, G 31	G 26.1, G 31, G32	HU[a]
II_{2S3B}	G 25.1, G30	G 26.1, G30	G 32	G 27.1, G31	G 26.1, G 30	HU[a]
$II_{2HS3B/P}$	G 20, G 25.1 G 30	G 21, G26.1, G 30	G 222 G 32	G 23, G27.1, G 31	G 21, G 26.1, G 30	HU[a]
II_{2HS3P}	G 20, G 25.1 G 31	G 21, G 26.1, G 30	G 222 G 32	G 23, G 271, G 31	G 21, G 26.1, G 31, G 32	HU[a]
II_{2HS3B}	G 20, G 25.1 G 30	G 21, G 26.1, G 30	G 222 G 32	G 23, G 271, G 31	G 21, G 26.1, G 30	HU[a]
$III_{1a2H3B/P}$	G 110, G 20 G 30	G 21	G 112 G 222, G 32	G 23 G 31	G 30	DK, IT
$III_{1c2E+3+}$	G 130, G 20 G 30	G 21	G 132 G 222, G 32	G 231 G 31	G 30	FR
$III_{1c2E+3P}$	G 130, G 20 G 31	G 21	G 132 G 222, G 32	G 231 G 31	G 32	FR
$III_{1c2Esi3+}$ $III_{1c2Er3+}$	G 130, G 20 G 25, G 30	G 21	G 132 G 222, G 32	G 231 G 31	G 30	FR
$III_{1c2Esi3P}$ $III_{1c2Er3P}$	G 130, G 20 G 25, G 31	G 21	G 132 G 222, G 32	G 231 G 31	G 32	FR
$III_{1ab2H3B/P}$	G 110, G 120 G 20, G 30	G 21	G 112 G 222, G 32	G 23 G 31	G 30	SE

[a] Hungary to confirm selection.

A.4.2 Definition of special categories

The definitions of the special categories given in Table A.4 are derived in the same way as those categories listed in 4.2. The characteristics of the gases distributed regionally are given in A.5.

A.4.2.1 Category I

A.4.2.1.1 Appliances designed for the use of gases linked to the first family

Category I_{1b}: appliances using only gases of Group b linked to the first family, at a fixed supply pressure (this category is not used);

Category I_{1c}: appliances using only gases of Group c linked to the first family, at a fixed supply pressure (this category is not used).

Adjustment of the gas rate is optional for the replacement of a gas of one group to a gas of another group within the first family and of the gases which are linked to it.

A.4.2.1.2 Appliances designed for the use of gases of the second family and the gases linked to it

Category I_{2Esi}: appliances capable of using only gases of Group E of the second family, and operating under the appropriate pressure of a pressure couple. The replacement of a gas in the range Es of Group E (Wobbe index between 44,8 MJ/m^3 and 54,7 MJ/m^3) by a gas in the range Ei of Group E (Wobbe index in the range 40,9 MJ/m^3 and 44,8 MJ/m^3) or vice versa necessitates a modification to the burner setting and possibly a change of injectors, of calibrated orifices and of the atmosphere control device;

Category I_{2Er}: appliances capable of using only gases of Group E of the second family and being able to operate with a pressure couple without adjustment on the appliance. However, specific adjustment of the burner gas rate is optional for the replacement of a gas of the range Es of Group E (Wobbe index between 44,8 MJ/m^3 and 54,7 MJ/m^3) by a gas of the range Ei of Group E (Wobbe index between 40,9 MJ/m^3 and 44,8 MJ/m^3). If this adjustment has been carried out, a re-adjustment to the previous setting is then necessary in order to return to the use of a gas in the range Es of Group E;

Category I_{2LL}: appliances using only gases of Group LL linked to the second family, at a fixed supply pressure. On condition that the Wobbe index of the second family gas distributed does not exceed the upper limit of 43,7 MJ/m^3, the appliance may be adjusted according to a lower nominal value (this category is not used);

Category I_{2ELL}: appliances capable of using gases of Group E of the second family, and gases of Group LL linked to the second family. The gases of Group E of the second family are used under the same conditions as for Category I_{2E}. The gases of Group LL of the second family are used under the same conditions as for Category I_{2LL};

Category I_{2S}: appliances using only gases of Group S linked to the second family, at the defined supply pressure;

Category I_{2HS}: appliances using only gases of Group H of the second family and gases of Group S linked to the second family. The Group H second family gases are used under the same conditions as for Category I_{2H}. The Group S second family gases are used under the same conditions as for Category I_{2S};

A.4.2.2 Category II

A.4.2.2.1 Appliances designed to use gases of the first family or that are linked to it and gases of the second family or that are linked to it

Category II_{1c2H}: appliances capable of using gases of Group c linked to the first family and gases of Group H of the second family. The gases linked to the first family are used under the same conditions as for Category I_{1c}. The second family gases are used under the same conditions as for Category I_{2H}

A.4.2.2.2 Appliances designed to use of gases of the second family or that are linked to it and gases of the third family

Category II_{2Esi3+}: 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_{2Esi}. The third family gases are used under the same conditions as for Category I_{3+};

Category II_{2Esi3P}: appliances capable of using gases of Group E 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_{2Esi}. The gases of the third family are used under the same conditions as for Category I_{3P};

Category II_{2Er3+}: 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_{2Er}. The gases of the third family are used under the same conditions as for Category I_{3+};

Category II_{2Er3P}: appliances capable of using gases of Group E 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_{2Er}. The gases of the third family are used under the same conditions as for Category I_{3P};

Category $II_{2ELL3B/P}$: appliances capable of using gases of Group E of the second family, gases of Group LL linked to the second family and gases of the third family. The second family gases or the gases that are linked to it are used under the same conditions as for Category I_{2ELL}. Gases of the third family are used under the same conditions as for Category $I_{3B/P}$;

Category $II_{2S3B/P}$: appliances capable of using gases of Group S linked to the second family and gases of the third family. The gases linked to the second family are used under the same conditions as for Category I_{2S}. The third family gases are used under the same conditions as for Category $I_{3B/P}$;

Category II_{2S3P}: appliances capable of using gases of Group S linked to the second family and gases of Group P of the third family. The gases linked to the second family are used under the same conditions as for Category I_{2S}. The third family gases are used under the same conditions as for Category I_{3P};

Category II_{2S3B}: appliances capable of using gases of Group S linked to the second family and gases of Group B of the third family. The gases linked to the second family are used under the same conditions as for Category I_{2S}. The third family gases are used under the same conditions as for Category I_{3B};

Category $II_{2HS3B/P}$: appliances capable of using gases of Group H of the second family, gases of Group S linked to the second family and gases of the third family. Gases of the second family or gases linked to it are used under the same conditions as for Category I_{2HS}. The third family gases are used under the same conditions as for Category $I_{3B/P}$;

Category II_{2HS3P}: appliances capable of using gases of Group H of the second family, gases of Group S linked to the second family and gases of Group P of the third family. Gases of the second family or gases linked to it are used under the same conditions as for Category I_{2HS}. The third family gases are used under the same conditions as for Category I_{3P};

Category II_{2HS3B}: appliances capable of using gases of Group H of the second family, gases of Group S linked to the second family and gases of Group B of the third family. Gases of the second family or gases linked to it

are used under the same conditions as for Category I_{2HS}. The third family gases are used under the same conditions as for Category I_{3B}.

A.4.2.3 Category III

Category $III_{1a2H3B/P}$: appliances capable of using gases of Group a of the first family, gases of Group H of the second family and gases of the third 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 for Category I_{2H}. The third family gases are used under the same conditions as for Category $I_{3B/P}$;

Category $III_{1c2E+3+}$: appliances capable of using gases of Group c linked to the first family, gases of Group E of the second family and gases of the third family. The gases linked to the first family are used under the same conditions as for Category I_{1c}. 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_{3+};

Category $III_{1c2E+3P}$: appliances capable of using gases of Group c linked to the first family, gases of Group E of the second family and gases of Group P of the third family. The gases linked to the first family are used under the same conditions as for Category I_{1c}. 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};

Category $III_{1c2Esi3+}$: appliances capable of using gases of Group c linked to the first family, gases of Group E of the second family and gases of the third family. The gases linked to the first family are used under the same conditions as for Category I_{1c}. The second family gases are used under the same conditions as for Category I_{2Esi}. The third family gases are used under the same conditions as for Category I_{3+};

Category $III_{1c2Esi3P}$: appliances capable of using gases of Group c linked to the first family, gases of Group E of the second family and gases of the third family. The gases linked to the first family are used under the same conditions as for Category I_{1c}. The second family gases are used under the same conditions as for Category I_{2Esi}. The third family gases are used under the same conditions as for Category I_{3P};

Category $III_{1c2Er3+}$: appliances capable of using gases of Group c linked to the first family, gases of Group E of the second family and gases of the third family. The gases linked to the first family are used under the same conditions as for Category I_{1c}. The second family gases are used under the same conditions as for Category I_{2Er}. The third family gases are used under the same conditions as for Category I_{3+};

Category $III_{1c2Er3P}$: appliances capable of using gases of Group c linked to the first family, gases of Group E of the second family and gases of Group P of the third family. The gases linked to the first family are used under the same conditions as for Category I_{1c}. The second family gases are used under the same conditions as for Category I_{2Er}. The third family gases are used under the same conditions as for Category I_{3P};

Category $III_{1ab2H3B/P}$: appliances capable of using gases of Group a of the first family, gases of Group b linked to the first family, gases of Group H of the second family and gases of the third family. The first family gases or the gases linked to it are used under the same conditions as for categories I_{1a} and I_{1b}. 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 $I_{3B/P}$.

A.4.3 Gas rate adjusters, aeration adjusters and regulators

This clause has been included to enable CEN members to provide information equivalent to that given in 5.2.2, 5.2.3, 5.2.4 and 5.2.6 in relation to the special categories they have requested, detailed in A.4.1.

A.4.4 Conversion to different gases

This clause has been included to enable certain member states to provide information equivalent to that given in 5.1.1.2 in relation to the special appliance categories listed in A.4.1.

A.5 Test gases corresponding to the special categories given in A.4

The characteristics of the test gases corresponding to the gases distributed nationally or locally and the corresponding test pressures are given in Table A.5 (reference conditions only).

Mixtures of gases of Group a with gases of Groups c or e, where the Wobbe index is between 21,1 MJ/m^3 and 24,8 MJ/m^3 are also linked to Group a of the first family.

These mixtures may only be used without supplementary tests in appliances in multiple categories including Group a of the first family.

Table A.5 — Test gases corresponding to local situations

Gas family and group		Nature of gas	Desig-nation	Composition Volume %	W_i MJ/m3	H_i MJ/m3	W_s MJ/m3	H_s MJ/m3	d	Test Pressure mbar	Country
Gases linked to the first family	Group b	Reference Incomplete combustion Sooting	G 120	H_2 = 47 CH_4 = 32 N_2 = 21	24,40	15,68	27,64	17,77	0,4 13	p_n = 8 p_{min} = 6 p_{max} = 15	SE
		Light back	G 112	H_2 = 59 CH_4 = 17 N_2 = 24	19,48	11,81	22,36	13,56	0,3 67		
	Group c	Reference (Propane–air)	G 130	C_3H_8 = 26,9 Air[a] = 73,1	22,14	23,66	24,07	25,72	1,1 42	p_n = 8 p_{min} = 6 p_{max} = 15	FR
		Light back	G 132	C_3H_8 = 13,8 C_3H_6 = 13,8 Air[a] = 72,4	22,10	23,56	23,84	25,41	1,1 36		
Gases linked to the second family	Group LL	Reference	G 25[b]	CH_4 = 86 N_2 = 14	37,38	29,25	41,52	32,49	0,6 12	p_n = 20 p_{min} = 18 p_{max} = 25	DE
		Incomplete combustion Sooting	G 26	CH_4 = 80 C_3H_8 = 7 N_2 = 13	40,52	33,36	44,83	36,91	0,6 78		
		Flame lift	G 271	CH_4 = 74 N_2 = 26	30,94	25,17	34,36	27,96	0,6 62		
	Group S	Reference	G 25.1	CH_4 = 86 CO_2 = 14	35,25	29,30	39,11	32,51	0,6 91	p_n = 25 p_{min} = 20 p_{max} = 33	HU
		Incomplete combustion Sooting	G 26.1	CH_4 = 80 C_3H_8 = 6 CO_2 = 14	37,61	32,60	41,58	36,04	0,7 51	p_n = 85 p_{min} = 73 p_{max}= 100	
		Lift limit	G 27.1	CH_4 = 82 CO_2 = 18	32,70	27,94	36,29	31,00	0,7 30		
Gases of the second family	Range Es of Group E	Reference	G 20[2)]	CH_4 = 100	45,67	34,02	50,72	37,78	0,5 55	p_n = 20 p_{min} = 17 p_{max} = 25	FR
		Incomplete combustion Sooting	G 21	CH_4 = 87 C_3H_8 = 13	49,60	41,01	54,76	45,28	0,6 84		
		Light back	G 222	CH_4 = 77 H_2 = 23	42,87	28,53	47,87	31,86	0,4 43		
		Lift limit	G 26	CH_4 = 80 C_3H_8 = 7 N_2 = 13	40,52	33,36	44,83	36,91	0,6 78		
	Range Ei of Group E	Reference Light back	G 25[2)]	CH_4 = 86 N_2 = 14	37,38	29,25	41,52	32,49	0,6 12	p_n = 25 p_{min} = 20 p_{max} = 30	
		Incomplete combustion Sooting	G 26	CH_4 = 80 C_3H_8 = 7 N_2 = 13	40,52	33,36	44,83	36,91	0,6 78		
		Lift limit	G 231	CH_4 = 85 N_2 = 15	36,82	28,91	40,90	32,11	0,6 17		

[a] Composition of the air (%): 0_2 = 20,95; N_2 = 79,05.
[b] For the characteristics of the reference gases G 20 and G 25, see Table 3.

A.6 Gas connections in the various countries

Table A.6 shows the national situations concerning the various types of gas connection specified in 5.1.6.

Table A.6 — Permitted inlet connections

Country	Category I_{3+}, I_{3P}, I_{3B}, $I_{3B/P}$			Other categories		
	Threaded connections		Other connections	Threaded connections		Other connections
	EN 10226-1:2004 EN 10226-2: 2005	EN ISO 228-1: 2003		EN 10226-1:2004 EN 10226-2: 2005	EN ISO 228-1: 2003	
AT	Yes	—	Yes	Yes	—	—
BE	Yes	Yes	Yes	—	Yes	—
BG	—	—	—	—	—	—
CH	Yes	Yes	Yes	Yes	Yes	—
CY	—	—	—	—	—	—
CZ	—	—	—	—	—	—
DE	Yes	—	Yes	Yes	—	—
DK	Yes	Yes	Yes	—	Yes	—
EE	—	—	—	—	—	—
ES	—	—	—	—	—	—
FI	Yes	Yes	Yes	Yes	Yes	—
FR	—	Yes	Yes	—	Yes	—
GB	Yes	—	Yes	Yes	—	Yes
GR	Yes	—	Yes	Yes	—	—
HU	—	—	—	—	—	—
IE	Yes	—	Yes	Yes	—	Yes
IS	—	—	—	—	—	—
IT	Yes	—	Yes	Yes	—	—
LT	—	—	—	—	—	—
LU	—	—	—	—	—	—
LV	—	—	—	—	—	—
MT	—	—	—	—	—	—
NL	Yes	—	—	Yes	—	—
NO	Yes	Yes	Yes	—	—	—
PT	Yes	Yes	Yes	Yes	Yes	Yes
RO	—	—	—	—	—	—
SE	—	—	—	—	—	—
SI	—	—	—	—	—	—
SK	—	—	—	—	—	—

Annex B
(normative)

Identification of symbols used for marking

B.1 Designation of country of destination

In accordance with EN ISO 3166-1:2006, the names of countries shall be represented by the codes shown in Table B.1.

Table B.1 — Country codes

AT	Austria	IE	Ireland
BE	Belgium	IS	Iceland
BG	Bulgaria	IT	Italy
CH	Switzerland	LT	Lithuania
CY	Cyprus	LU	Luxembourg
CZ	Czech Republic	LV	Latvia
DE	Germany	NL	Netherlands
DK	Denmark	MT	Malta
EE	Estonia	NO	Norway
ES	Spain	PL	Poland
FI	Finland	PT	Portugal
FR	France	RO	Romania
GB	United Kingdom	SE	Sweden
GR	Greece	SI	Slovenia
HU	Hungary	SK	Slovakia

B.2 Category

The category may be identified solely by its designation in accordance with the requirements of EN 437:2003. Nevertheless, if an explanation is necessary the term "Category" shall be symbolised by "Cat."

NOTE The symbols given below are not obligatory but are recommended as preferential and to the exclusion of any other symbol to avoid the use of many various markings:

a) nominal heat input of a burner Q_n;

b) nominal heat input of all appliance burners ΣQ_n.

B.3 Supplementary transitional information

The declared means of identification in use in the various CEN Member Countries shall be used in addition to the symbol shown in Table B.1. These additional means are given in Table B.2.

Table B.2 — Gas type symbol

Gas type symbol		Corresponding category index
First family[a]	G 110	1a
	G 120	1b
	G 130	1c
Second family	G 20	2H, 2E, 2E+, 2Esi[b] 2Er[b], 2ELL[b]
	G 25	2L, 2Esi[c], 2Er[c], 2ELL[c]
Third family	G 30	3B/P, 3+[d f], 3B
	G 31	3+[e f], 3P

[a] If, in its current state of adjustment, the appliance can use gases from different groups, all the reference gases corresponding to these groups shall be indicated.
[b] When the appliance is adjusted for G 20.
[c] When the appliance is adjusted for G 25.
[d] Only applies to appliances which do not need any adjustment between G 30 and G 31, or to appliances which need an adjustment and which are adjusted for G 30.
[e] Only applies to appliances which need an adjustment between G 30 and G 31, and which are adjusted for G 31.
[f] For the appliances which need an adjustment between G 30 and G 31, the label concerning the adjustment to the other gas and the other pressure of the pressure couple shall be supplied with the technical instructions.

Table B.3 — Means of identification of gas types in use in various countries

	Gas type							
Country code	G 110	G 120	G 130	G 150	G 20	G 25	G 30	G 31
AT					Erdgas		Flüssiggas	
BE					Aardgas, Gaz naturel	Aardgas, Gaz naturel	Butaan, Butane	Propaan, Propane
CH					Erdgas H		Butan	Propan
CY								
CZ								
DE					Erdgas E	Erdgas LL	Flüssiggas B/P	
					W_o,(12,0 – 15,7) kWh/m^3 0° C	W_o, (10,0 – 13,1) kWh/m^3 0° C	Butan	Propan
DK	Bygas				Naturgas		F-Gas	F-Gas
EE								
ES	Gas manufactura do		Aire propanado	Aire metanado	Gas natural		Butano	Propano
FI					Maakaasu, Naturgas		Butaani, Butan	Propaani, Propan
FR[a]			Air propané/ Air butané		Gaz naturel Lacq	Gaz naturel Groningue	Butane	Propane
GB					Natural Gas		Butane	Propane
GR					Φυσικὸ Αèριο		Υγραèριο Μείγμα	Προπανιο
HU								
IE					Natural Gas		Butane	Propane
IS								
IT	Gas di Città				Gas naturale/ Gas metano		GPL	
LT								
LU								
LV								
MT								
NL						Aardgas	Butaan	Propaan
NO							Butan	Propan
PL								
PT					Gás Natural		Butano	Propano
RO								
SE								
SK								
SL								

a The meaning of the symbol corresponding to the type of gas shall be explained in detail in the technical instructions. Concerning the system and its packaging, if an additional marking is intended by the manufacturer to explain the symbol, this text shall be in conformity with the description given in this table. In the case of pressure couples, the two descriptions of the family shall be mentioned.

Annex C
(informative)

Guidance for limitations of application of direct-fired air heaters in buildings

C.1 Introduction

The examples given are theoretical values for appliances supplied with reference gas of the categories indicated. Conditions vary due to the gas type used, appliance combustion performance, supply air quality, etc. The requirements stated by the manufacturer of the appliance should be followed; this annex is therefore provided for guidance only.

C.2 General principles

Where vapour and/or gases or airborne dusts are present which degrade to products that are potentially harmful to health when passed through the combustion zone of a flame, all the air to a direct-fired air heater should be outside air.

Recirculation, if practised, should be downstream of the burner combustion zone.

C.3 Safe operating emission levels

The total installation, that is the combination of heater or heaters and ventilation facilities of the space or spaces to be supplied with the heated air, should be designed and operated such that concentrations of carbon dioxide at positions where the air is likely to be inhaled by persons present does not exceed 0,28 % (*V*/*V*) (2 800 × 10^{-6}). This level may differ, depending on local requirements.

C.4 Assessment of concentrations

The specified maximum concentration of carbon dioxide can be assessed from the Table C.1.

Table C.1 — Maximum concentration values of CO_2 versus fresh air

Description	Unit	Gas type							
		G 110	G 130	G 20	G 21	G 25	G 26	G 30	G 31
Reference CO_2 concentration in the dry air-free products of (neutral) combustion	% (vol)	7,60	13,70	11,70	12,20	11,50	11,80	14,00	13,70
Stoichiometric air requirement at 15 °C	m^3/m^3	3,67	5,68	9,52	11,38	8,19	9,29	30,95	23,81
Volume of fresh air per volume of combustion products to limit space air concentration of CO_2 to 0,28 %	m^3/m^3	28,30	45,36	37,80	39,20	36,34	29,70	47,60	46,30
Volume of fresh air per volume of gas input to limit space air concentration of CO_2 to 0,28 %	m^3/m^3	102,7	315.0	396,9	503,3	341,2	402,5	1651,3	1215,2
Volume rate of fresh air per kW heat input to limit space air concentration of CO_2 to 0,28 %	$(m^3/h)/kW$	23,3	44.1	37,8	40,4	37,8	39,3	47,3	45,7
NOTE 1 These values assume fresh air contains 0,03 % CO_2. NOTE 2 Values stated are theoretical and based upon reference test gases. Consult manufacturer's instructions when calculating ventilation air requirements.									

C.5 Case studies

C.5.1 General

This subclause describes two very brief case studies that show how the figure of 86 kJ/m^3 of outside air given in Table C.1 is used when calculating the amount of direct-fired heating that can be permitted when related to the air change rates. For these studies it is assumed that a building :

a) has dimensions of 15 m × 30 m × 4 m and thus an internal volume of 1 800 m^3;

b) has a structural heat loss of 264 MJ/h;

c) is to be designed for a temperature of 20 °C based on a minimum outside temperature of -1 °C.

d) that the gas is natural gas (G 20).

Equation C.1 is used to calculate the heat requirement, *H* (in MJ/h), of the incoming air :

$$H = (A \times V \times C_v \times T)10^{-3} \quad \text{(C.1)}$$

where

A is the number of air changes per hour;

V is the room volume in m^3;

C_v is the heat capacity, volume basis, of air;

T is the temperature difference in K.

NOTE C_v is also known as the specific heat of air 1,207 (kJ/m^{3}K).

C.5.2 Case study 1

The building requires 10 fresh air changes per hour. The heat required to raise the temperature of the fresh air is:

$$H = 10 \times 1\,800 \times 1{,}207 \times (20-(-1)) \times 10^{-3} = 456 \text{ MJ/h}$$

The total heat requirement of the building is:

$$264 + 456 = 720 \text{ MJ/h} \qquad \text{(C.2)}$$

Next, the actual net total heat input of the appliance is calculated, making due allowance for case and duct losses. Allow 3 % for (e.g. a roof-mounted heater) and 10 % for fast heat-up.

Actual net input is:

$$720 \times \frac{103}{100} \times \frac{110}{100} = 816 \text{ MJ/h} \qquad \text{(C.3)}$$

But the maximum net heat output allowed by direct-firing is 86 kJ per cubic metre of fresh air change per hour, which for this building's air change rate is:

$$(86 \times 10^{-3}) \times 1\,800 \times 10 = 1\,548 \text{ MJ/h} \qquad \text{(C.4)}$$

By comparing (C.3) and (C.4) it can be seen that the building can be heated solely by a direct-fired system.

The gross heat input of the heater can now be calculated from an assumed ratio of net to gross calorific value of 90 : 100.

Gross heat input to appliance therefore is:

$$816 \times \frac{100}{90} = 907 \qquad \text{MJ/h}$$

C.5.3 Case study 2

C.5.3.1 Alternative criteria

Consider the same building as in case 1 but with only 1,5 air changes per hour.

The heat required to raise the temperature of the fresh air is:

$$H = 1{,}5 \times 180 \times 1{,}207 \times [20-(-1)] \times 10^{-3} = 68 \text{ MJ/h}$$

The total heat requirement of the building is:

$$264 + 68 = 332 \text{ MJ/h} \qquad \text{(C.5)}$$

But the maximum net heat output allowed by direct-firing is 86 kJ/m^3 of fresh air change per hour, which for this building's air change rate is:

$$(86 \times 10^{-3}) \times 1{,}5 \times 1\,800 = 232 \text{ MJ/h} \qquad \text{(C.6)}$$

By comparing (C.5) and (C.6) it can be seen that the building cannot be heated solely by direct-fired heating.

The maximum gross heat input to the direct-fired heater is calculated from the previously assumed ratio of net and gross calorific values.

The gross heat input to the appliance is therefore:

$$232 \times \frac{100}{90} = 258 \text{ MJ/h} \qquad \text{(C.7)}$$

The quantity of heat available will need to be supplemented to allow for fast heat-up and to make up the deficit of 100 MJ/h (given by (C.5)-(C.6)).

This total shortfall can be made up by indirect-fired heaters, of 75 % assumed efficiency, sized as follows:

$$\left(332 \times \frac{10}{100} + 100\right) \times \frac{100}{75} = 178 \text{ MJ/h} \qquad \text{(C.8)}$$

This gives a total connected heating appliance load of:

$$258 + 178 = 436 \text{ MJ/h} \qquad \text{(C.9)}$$

C.5.3.2 Alternative possibility

An alternative available to the designer is to increase the air change rate to such an extent that all the heating requirement is satisfied by direct-fired heaters. Equation C.10 then applies.

$$\left(L + \left(QC_v T \times 10^{-3}\right)\right) \times \frac{110}{100} \times \frac{103}{100} = NQ \times 10^{-3} \qquad \text{(C.10)}$$

Rearranging gives:

$$Q = \frac{1\ 130L}{\left(N - 1{,}13C_v T\right)}$$

where

L is the structural heat loss in mJ/h;

Q (= *AV*) is the air change volume in m^3/h;

N is the maximum heat output allowed (86 kJ/m^3);

C_v is the heat capacity, volume basis, of air;

T is the temperature difference in K;

The factor $\frac{110}{100}$ provides for a fast heat-up allowance of 10 %.

The factor $\frac{103}{100}$ provides for appliance case loss allowance of 3 %.

The air change volume in this case is therefore:

$$Q = \frac{1\ 130 \times 264}{86 - (1{,}13 \times 1{,}207 \times 20 - (-1))} = 5\ 179\ \text{m}^3/\text{h}$$

The air change rate per hour is therefore:

$$\frac{5\ 197}{1\ 800} = 3{,}0$$

The heat required to raise the temperature of the fresh air from -1 °C to 20 °C at 3,0 air changes per hour is:

3,0 × 1 800 × 1,207 × (21 × 10-3) = 137 MJ/h

Total building heat requirement is therefore:

264 + 137 = 401 MJ/h

Thus the gross heat input to the direct-fired heater would be:

$$401 \times \frac{100}{90} = 446\ \text{MJ/h}$$

C.5.3.3 Summary

The use of a direct-fired air heater giving an enhanced air change rate results in a connected load approximately 2 % greater than that required for a combination of direct- and indirect-fired air heaters.

However, the method of increasing air change rate should be used with caution, since for some installations it can increase unduly the fuel consumption and connected gas load.

Annex D
(normative)

Special national conditions

D.1 General

Special national conditions are National characteristics or practice that cannot be changed even over a long period (e.g. climatic conditions, electrical earthing conditions). If it affects harmonization, it forms part of the European Standard or Harmonization Document.

For the countries in which the relevant special national conditions apply these provisions are normative, for other countries they are informative.

D.2 Belgium

Appliances of categories $I_{2E+,}$ $I_{2E(R)B}$ and $I_{2E(S)B}$ marketed in Belgium have to undergo a test for ignition, crosslighting and flame stability with the limit gas G 231 at the minimum pressure of 15 mbar.

D.3 Italy

Appliances of categories $I_{3B/P,}$ $II_{2H3B/P}$ and $III_{1a2H3B/P}$ without pressure regulators marketed in Italy shall have successfully undergone a test for flame stability with the limit gas G 31 at the pressure of 45 mbar.

Annex E
(informative)

National solutions for countries whose national bodies are Affiliate Members of CEN

E.1 Categories, listed in the body of the standard and marketed in different countries

E.2 Appliance supply pressures, corresponding to the categories given in E.1

E.3 Special categories, marketed nationally or locally

E.4 Gases and test pressures, corresponding to the special categories given in E.3

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 90/396/EEC (Gas Appliance Directive)

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 90/396/EEC (Gas Appliance Directive).

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Table ZA — Correspondence between this European Standard and Directive (Add the reference and title of the Directive)

Clause(s)/sub-clause(s) of this EN	Essential Requirements (ERs) of Directive 90/396/EEC	Qualifying remarks/Notes
1	General conditions	↓
1.1	Safe design and construction	Whole standard
1.2	Instructions : - installer - user	 8.3, 8.7.2, 8.7.3, 8.7.4 8.7.5
	Warning notices : - appliance - packaging	 8.3, 8.4 8.5
	- Official language	8.7.6
1.2.1	Installer's instructions contain : - type of gas used - gas supply pressure - fresh air for combustion - product dispersal	 8.3, 8.4, 8.5, 8.7.1, 8.7.2 8.3, 8.4, 8.5, 8.7.1, 8.7.2 8.4, 8.5, 8.7.1, 8.7.2 Not applicable
1.2.2	User instructions contain : - all instructions - estrictions on use	 8.7.5 8.7.1
1.2.3	Warning notices state : - type of gas - gas supply pressure - restrictions on use	 8.3, 8.4, 8.5 8.3, 8.4, 8.5 8.3, 8.4, 8.7.1
1.3	Fittings - manual valves - regulators - automatic valves - automatic burner control systems - thermostats - Instructions	 5.2.5 5.2.6 5.2.7 5.2.8 5.10 Not applicable
2	Materials	↓
2.1	Fitness for purpose	5.1.2
2.2	Properties	1 (Note)
3	Design and Construction	↓
3.1	General	↓
3.1.1	Durability	5.1.2
3.1.2	Condensation	Not applicable

Table ZA *(continued)*

Clause(s)/sub-clause(s) of this EN	Essential Requirements (ERs) of Directive 90/396/EEC	Qualifying remarks/Notes
3.1.4	Air/water penetration	Not applicable
3.1.5	Normal auxiliary energy fluctuation : - appliance - controls	 5.1.10, 6.5.3, 7.3.5.3 5.2.7.1, 5.2.8.1
3.1.6	Abnormal auxiliary energy fluctuation : - appliance - controls	 5.5.1.10, 6.5.3, 7.3.5.3 5.2.7.1, 5.2.8.1
3.1.7	Electrical hazards	5.1.9
3.1.8	Deformation	Not applicable
3.1.9	Safety/control device failure : - automatic burner control systems - flame supervision device - automatic shut-off valves - thermostats/cut-off device - air proving device	 5.2.8 5.5 5.2.7 5.10 5.4
3.1.10	Overruling of safety devices	5.2.1
3.1.11	Pre-set adjuster protection	5.2.2.1
3.1.12	Levers and setting devices	5.2.5.2
3.2	Unburned gas release	↓
3.2.1	Gas leakage	5.1.6, 6.1
3.2.2	Gas release during : - ignition - re-ignition - extinction	 5.2.7, 5.4, 5.5, 5.6, 5.7, 6.4 Not applicable 5.5, 5.6, 5.7
3.2.3	Unburned gas accumulation	5.5, 8.4
3.3	Ignition : - ignition - re-ignition - cross-lighting	 5.3.3, 5.6, 5.7, 5.8, 6.4.1 Not applicable 5.7.1, 6.4.1
3.4	Combustion	↓
3.4.1	Flame stability Harmful substances	6.4.2 6.5
3.4.2	Combustion products release	Not applicable
3.4.3	Combustion products release	Not applicable
3.4.4	Flueless domestic appliances	Not applicable
3.5	Rational use of energy	Foreword
3.6	Temperatures	↓
3.6.1	Floor etc. temperatures	6.3.2
3.6.2	Temperature of knobs/levers	6.3.1
3.6.3.	External parts	Not applicable
3.7	Foodstuffs and water	Not applicable
Annex II	Certification	1 (Note)
Annex III	Data plate	8.3

Bibliography

[1] ISO 1182:1990, *Fire tests Building materials Non-combustibility test*

[2] CR 1404, *Determination of emissions from appliances burning gaseous fuels during type testing*

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