BRITISH STANDARD

BS EN
12669:2000

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

The European Standard EN 12669:2000 has the status of a British Standard

ICS 64.040.30; 97.100.20

National foreword

This British Standard is the official English language version of EN 12669:2000.

The UK participation in its preparation was entrusted by Technical Committee GSE/20, Non-domestic space heaters (gas), to Subcommittee GSE/20/4, Air heaters (gas), which has the responsibility to:

— aid enquirers to understand the text;

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

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

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

Cross-references

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

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 76, an inside back cover and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

This British Standard, having been prepared under the direction of the Engineering Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 August 2000

ISBN 0 580 34023 6

Amendments issued since publication

Amd. No.	Date	Comments

EUROPEAN STANDARD NORME EUROPÉENNE EUROPÄISCHE NORM

EN 12669

June 2000

ICS 97.100.20

English version

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

Générateurs-pulseurs d'air chaud à chauffage direct utilisant les combustibles gazeux pour les applications horticoles et le chauffage d'appoint des locaux à usage non-domestique

Direkt gasbefeuerte Heißluftgebläse für Gewächshäuser und als Zusatzheizung von nicht-häuslichen Räumen

This European Standard was approved by CEN on 3 November 1999.

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

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

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 12669:2000 E

CONTENTS

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 179, Gas-fired air heaters, the Secretariat of which is held by NNI.

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 December 2000, and conflicting national standards shall be withdrawn at the latest by December 2000.

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

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this standard.

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

The Directive makes no specification in respect of the maximum rating of the appliances falling within its scope. However, the scope of this standard has been limited to appliances having heat inputs not exceeding 180 kW.

The reasons for this are:

– due to the intended application for such appliances whereby they will be installed to heat only one room or space, present practice indicates that the limit stated is adequate for the purpose;

– appliances sized up to 180 kW constitute the major market share.

The test gases, test pressures and appliance categories given in this European Standard are in accordance with those specified in EN 437:1993 + A1:1997.

> NOTE For countries requesting special categories (specified in EN 437:1993 + A1:1997), the absence of specific information concerning A.3.3 and A.3.4 implies that the general requirements described in the body of the standard (clauses 4.1.1, 4.2.2, 4.2.3 and 4.2.5) also apply to these special categories.

No specific requirements concerning the rational use of energy have been included in this standard since the design of non-domestic direct gas-fired forced convection air heaters is such that all the heat generated by combustion of the gas is transferred directly into the heated space.

Other European Standards covering gas-fired air heaters are as follows.

EN 525	Non-domestic direct gas fired forced convection air heaters for space heating not exceeding a net heat input of 300 kW
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

1 Scope

This European Standard specifies the requirements and test methods for the safety of direct gas-fired hot air blowers for greenhouses, agriculturalized or supplementary space heating, hereinafter called "appliances".

"Supplementary" in this standard means to make up a deficiency, i.e. for the temporary heating of spaces intended for agricultural or commercial use:

– workshops, sheds, stables, poultry houses, barns, cattle pens, etc.;

– factories, workshops, warehouses, storage sheds, mills, hangers, drying of buildings, temporary site accommodation, etc.

This standard applies to appliances of type A_3 with heat input 180 kW or less, based on the net calorific value, fitted with integral burners, including appliances designed for outdoor installation. Provision of the heated air will be directly into the heated space.

This standard does not apply to:

– appliances intended for use in residential dwellings;

– appliances fitted with gas boosters;

– appliances fitted with air/gas ratio controls;

– appliances fitted with forced draught package burners;

– 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;

– mobile and transportable dedicated LPG appliances.

This standard does not cover the requirements relating to third family gas cylinders, their regulators and their connection.

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

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 88:1991	Pressure governors for gas appliances for inlet pressures up to 200 mbar
EN 125:1991	Flame supervision devices for gas burning appliances - Thermo-electric flame supervision devices
EN 126:1995	Multifunctional controls for gas burning appliances
EN 161:1991	Automatic shut-off valves for gas burners and gas burning appliances + A1:1996 + A2:1997
EN 257:1992	Mechanical thermostats for gas-burning appliances
EN 298:1993	Automatic gas burner control systems for gas burners and gas burning appliances with or without fans
EN 437:1993 + A1:1997	Test gases - Test pressures - Appliance categories
EN ISO 3166-1:1997	Codes for the representation of names of countries and their subdivisions - Part 1: Country codes (ISO 3166-1:1997)
EN 50165:1997	Electrical equipment of non-electric heating appliances for household and similar purposes - Safety requirements
EN 60335-1:1988	Safety of household and similar electrical appliances - Part 1: General requirements
EN 60529:1991	Degrees of protection provided by enclosures (IP code)

EN 60584-1:1995	Thermocouples - Part 1: Reference tables (IEC 584-1:1995)
EN 60584-2:1993	Thermocouples - Part 2: Tolerances (IEC 584-2:1982 + A1:1989)
EN 60730-1:1992	Automatic electrical controls for household and similar use - Part 1: General requirements
EN 60730-2-1:1992	Automatic electrical controls for household and similar use - Part 2: Particular requirements for electrical controls for electrical household appliances
EN 60730-2-9:1995	Automatic electrical controls for household and similar use - Part 2: Particular requirements for temperature-sensing controls
EN 60742:1995	Isolating transformers and safety isolating transformers – Requirements (IEC 60742:1983 + A1:1992, modified)
EN 61058-1:1992	Switches for appliances - Part 1: General requirements
ISO 7-1:1994	Pipe threads where pressure-tight joints are made on the threads - Part 1: Dimensions, tolerances and designation
ISO 228-1:1994	Pipe threads where pressure-tight joints are not made on the threads - Part 1: Dimensions, tolerances and designation
ISO 6976:1995	Natural gas – Calculation of calorific values, density, relative density and Wobbe index from composition
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 Definitions

For the purposes of this standard the following definitions apply.

3.1 Appliance and its constituent parts

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

3.1.2 forced convection air heater: An 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 gas-fired hot air blower: A non-domestic direct gas-fired forced convection air heater in which the products of combustion mix with the heated air being supplied to the space without any kind of ducting of the delivered air directly connected to the appliance.

3.1.4 gas inlet connection: The part of the appliance intended to be connected to the gas supply.

3.1.5 mechanical joint; mechanical means of obtaining soundness: A means of assuring the soundness of an assembly of several (generally metallic) parts without the use of liquids, pastes, tapes, etc.

There are, for example:

– metal to metal joints;

– conical joints;

– toroidal sealing rings ("O" rings);

– flat joints.

3.1.6 gas circuit: The part of the appliance that conveys or contains the gas between the appliance gas inlet connection and the burner(s).

3.1.7 restrictor: A 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.

3.1.8 gas rate adjuster: A component permitting the setting of the gas rate of the burner to a predetermined value according to the supply conditions.

Adjustment may be progressive (screw adjuster) or in discrete steps (by changing restrictors).

The adjusting screw of an adjustable governor is regarded as a gas rate adjuster.

The action of adjusting this device is called "adjusting the gas rate".

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

3.1.9 setting an adjuster: Immobilization of an adjuster by some means such as a screw after the manufacturer or installer has adjusted it. The adjuster is said to be "set" in this position.

3.1.10 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. The adjuster is said to be "sealed" in its adjustment position.

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

A governor 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.

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

3.1.12 injector: A component that admits the gas into a burner.

3.1.13 burner: A component that allows the gas to burn.

3.1.14 main burner: A burner that is intended to assure the thermal function of the appliance.

3.1.15 ignition device: Any means (flame, electrical ignition device or other device) used to ignite the gas at the ignition burner or at the main burner. This device can operate intermittently or permanently.

3.1.16 ignition burner: A burner whose flame is intended to ignite another burner.

3.1.17 aeration adjuster: A device enabling the excess air ratio to be set at the desired value according to the supply conditions. The action of adjusting this device is called "adjusting the primary aeration".

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

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

3.1.19 combustion chamber: A part of the appliance in which combustion of the air gas mixture takes place.

NOTE The combustion chamber of a hot air blower is normally totally or partially opened for a free outlet of the combustion products.

3.2 Adjusting, control and safety devices

3.2.1 automatic burner control system: A system comprising at least a programming unit and all the elements of a flame detector device. The various functions of an automatic burner control system may be in one or more housings.

3.2.2 programming unit: A 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. It follows a predetermined sequence of actions and always operates in conjunction with a flame detector device.

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

3.2.4 flame supervision system: A system 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: A device by which the presence of a flame is detected and signalled. It can consist of a flame sensor, an amplifier and a relay for signal transmission. These parts, with the possible exception of the actual flame sensor, may be assembled in a single housing for use in conjunction with a programming unit.

3.2.6 flame signal: The signal given by the flame detector device, normally when the flame sensor senses a flame.

3.2.7 flame simulation: A condition which occurs when the flame signal indicates the presence of a flame when in reality no flame is present.

3.2.8 pressure governor: A device which maintains the downstream pressure constant to within fixed limits independent of variations, within a given range, of the upstream pressure.

3.2.9 adjustable pressure governor: A pressure governor fitted with a means of adjusting the loading on the diaphragm and thus the downstream pressure.

3.2.10 volume governor: A device which maintains the gas rate constant within a given tolerance, independent of the upstream pressure.

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

3.2.12 control thermostat: A 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: A 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.

This device is pre-set and sealed by the appliance manufacturer.

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

3.2.15 modulating control: An automatic control by means of 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: An automatic control which permits an appliance to operate either at the nominal heat input or at a fixed reduced heat input.

3.2.17 air flow proving device: A device which monitors and proves the existence of an adequate flow of air for combustion and, where appropriate, for dilution.

3.2.18 CO_2 safety device: A device which monitors the CO_2 concentration in the installed space and shuts off the burner before the concentration exceeds a specified value.

3.3 Operation of the appliance

3.3.1 heat input: The quantity of energy used in unit time corresponding to the volumetric and mass flow rates, the calorific value used being the net or gross calorific value.

Symbol: *Q*

Unit: kilowatts (kW)

[3.13 of EN 437:1993 + A1:1997]

3.3.2 nominal heat input: The value of the heat input declared by the manufacturer.

Symbol: Q_n

Unit: kilowatt (kW)

[3.14 of EN 437:1993 + A1:1997]

3.3.3 mass flow rate: The mass of gas consumed by the appliance in unit time during continuous operation.

Symbol: *M*

Unit: kilogram per hour (kg/h), or gram per hour (g/h)

[3.15 of EN 437:1993 + A1:1997]

3.3.4 volumetric flow rate: The volume of gas consumed by the appliance in unit time during continuous operation.

Symbol: *V*

Unit: cubic metre per hour (m^3/h), litre per minute (l/min), cubic decimetre per hour (dm^3/h), or cubic decimetre per second (dm^3/s)

[3.16 of EN 437:1993 + A1:1997]

3.3.5 nominal mass rate: The mass rate stated by the manufacturer.

3.3.6 flame stability: The characteristic of flames which remain on the burner ports or in the flame reception zone intended by the construction.

3.3.7 flame lift: The total or partial lifting of the base of the flame away from the burner port or the flame reception zone provided by the design. Flame lift may cause the flame to be extinguished.

3.3.8 light-back: The entry of a flame into the body of the burner.

3.3.9 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.

3.3.10 sooting: A 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.

3.3.11 yellow tipping: The yellowing of the tip of the blue cone of an aerated flame.

3.3.12 first safety time: The 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, the 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.

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

3.3.14 start gas: Gas that is supplied at the start gas rate to establish the start gas flame.

3.3.15 start gas rate: The restricted gas flow rate admitted either to a separate ignition burner or to the main burner during the first safety time.

3.3.16 start gas flame: A flame established at the start gas rate either at the main burner or at a separate ignition burner.

3.3.17 running condition: The 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 automatic burner system: A burner system in which, when starting from the completely shut-down condition, the gas is ignited and the flame is detected and proved without manual intervention.

3.3.19 non-automatic burner system: A burner system with an ignition burner which is ignited under manual supervision and which remains on during ignition and operation of the main burner.

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

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

3.3.22 Lock-out

3.3.22.1 non-volatile lock-out: The safety shut-down condition of the system, such that a restart can only be accomplished by a manual reset of the system and by no other means.

3.3.22.2 volatile lock-out: The 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.

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

3.3.24 automatic recycling: The 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.

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.

3.3.25 ignition opening time: The time interval between ignition of the supervised flame and the moment when the valve is held open.

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

3.3.27 no-air condition: A condition of the air proving device in which the device is checked for correct operation at zero air flow.

3.3.28 proved air flow: The minimum air flow at which the air proving device indicates the presence of air flow.

3.4 Gases

3.4.1 test gases: Gases intended for the verification of the operational characteristics of appliances using combustible gases. They comprise reference gases and limit gases. [3.2 of EN 437:1993 + A1:1997]

3.4.2 reference gases: Test gases on which appliances operate under nominal conditions, when they are supplied at the corresponding normal pressure. [3.3 of EN 437:1993 + A1:1997]

3.4.3 limit gases: Test gases representative of the extreme variations in the characteristics of the gases for which appliances have been designed. [3.4 of EN 437:1993 + A1:1997]

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

Unit: millibar or bar.

3.4.5 test pressures: Gas pressures used to verify the operational characteristics of appliances using combustible gases. They consist of normal and limit pressures.

Unit: millibar (mbar).

NOTE: 1 mbar = 10^2 Pa.

[3.5 of EN 437:1993 + A1:1997]

3.4.6 normal pressure: The pressure under which the appliances operate in nominal conditions, when they are supplied with the corresponding reference gas.

Symbol: p_n

[3.6 of EN 437:1993 + A1:1997]

3.4.7 limit pressures: Pressures representative of the extreme variations in the appliance supply conditions.

Symbols:

maximum pressure: p_{max}

minimum pressure: p_{min}

[3.7 of EN 437:1993 + A1:1997]

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.

[3.8 of EN 437:1993 + A1:1997]

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

Symbol: d

[3.10 of EN 437:1993 + A1:1997]

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

A distinction is made between:

– the gross calorific value in which the water produced by combustion is assumed to be condensed. Symbol: H_s

– the net calorific value in which the water produced by combustion is assumed to be in the vapour state. Symbol: H_i

Unit: either:

– megajoule per cubic metre (MJ/m^3) of dry gas at the reference conditions; or

– megajoule per kilogram (MJ/kg) of dry gas.

[3.11 of EN 437:1993 + A1:1997]

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

Symbols:

gross Wobbe index: W_s

net Wobbe index: W_i

Unit: either:

– megajoule per cubic metre (MJ/m^3) of dry gas at the reference conditions; or

– megajoule per kilogram (MJ/kg) of dry gas at the reference conditions.

[3.12 of EN 437:1993 + A1:1997]

3.5 Conditions of operation and measurement

3.5.1 reference conditions:

– for calorific values: temperature 15 °C;

– 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: A 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: A 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.

3.6 Country of destination

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

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

3.7 Classification

3.7.1 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 gases used in this standard.

Table 1 - Classification of gases

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

3.7.2 Classification of appliances

3.7.2.1 General

Appliances can be classified according to:

– the gases capable of being used;

– the mode of evacuation of the combustion products.

3.7.2.2 Classification according to the gases capable of being used

3.7.2.2.1 Category I

Appliances of category I are designed exclusively for the use of gases of a single family or of a single group.

3.7.2.2.1.1 Appliances designed for use on first family gases only

Category I_{1a}: Appliances using only gases of group a of the first family at the prescribed supply pressure. (This category is not used)

3.7.2.2.1.2 Appliances designed for use on second family gases only

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

Category I_{2L}: Appliances using only gases of group L of the second family at the prescribed supply pressures.

Category I_{2E}: Appliances using only gases of group E of the second family at the prescribed supply pressures.

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

3.7.2.2.1.3 Appliances designed for use on third family gases only

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

Category I_{3+}: Appliances capable of using gases of the third family (propane and butane) and operating with a pressure couple without adjustment of the appliance. However, for certain types of appliance specified in the particular standards, adjustment of the primary combustion air may be permitted when changing from propane to butane and vice versa. No gas pressure regulating device is permitted on the appliance.

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

Category I_{3B}: Appliances using only gases of group B of the third family (butane) at the prescribed supply pressure.

3.7.2.2.2 Category II

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

3.7.2.2.2.1 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}.

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

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

Category II_{2H3+}: Appliances capable of using gases of group H of the second family and gases of the third family. The second family gases are used under the same conditions as for category I_{2H}. The third family gases are used under the same conditions as for category I_{3+}.

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

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

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

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

Category II_{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+}.

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}.

3.7.2.2.3 Category III

Category III appliances are designed for use on gases of the three families. This category is not in general use.

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

3.7.2.3 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.

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, including appliances designed to be installed outdoors.

Type A_3: A Type A appliance with a fan upstream of the combustion chamber/heat exchanger.

4 Construction and design requirements

4.1 General

4.1.1 Conversion to different gases

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

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

4.1.1.1 Category I

Category I_{2H}, I_{2L}, I_{2E}, I_{2E+}: No modification to the appliance.

Category $I_{3B/P}$: No modification to the appliance.

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.

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.

4.1.1.2 Category II

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

– Adjustment of the gas rate with, if necessary, a change of injector, restrictor or governor;

– 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;

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

– putting the gas rate adjuster(s) out of service under the conditions of 4.2.2.

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

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

– Adjustment of the gas rate with, if necessary, a change of injector, restrictor or governor;

– 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;

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

– putting the governor out of service in accordance with 4.2.6;

– putting the gas rate adjuster(s) out of service under the conditions given in 4.2.2.

These adjustments or component changes are only acceptable when:

– converting from a gas of the second family to a gas of the third family or vice versa;

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

4.1.1.3 Category III

Adjustment of the gas rate with, if necessary, a change of injectors or restrictors.

Adjustment of the rate of ignition burners, either by using an adjuster or by a change of injectors or restrictors and, if necessary, a change of complete ignition burners or of some of their parts.

These operations are acceptable when converting from a gas of one family to a gas of another family and, for the first and second families, from a gas of one group to a gas of the other group.

Within the third family a change of parts is also acceptable for converting from one pressure couple to another (e.g. 28-30 mbar/37 mbar to 50 mbar/67 mbar and vice versa).

4.1.2 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.

Condensation produced at the start and/or during use shall not affect the safety of the appliance.

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. Hard solder containing cadmium in its formulation shall not be used.

4.1.3 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 handles, buttons etc. required to be operated during normal use of the appliance, 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.

4.1.4 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 condensation and attacks from vermin.

4.1.5 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.

It shall be possible to connect the appliance by rigid metallic means to the gas supply.

If the appliance has a threaded connection, this thread shall comply with ISO 228-1:1994 or ISO 7-1:1994. Where threads complying with ISO 228-1:1994 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 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.5.

4.1.6 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 does 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.

4.1.7 Supply and distribution of air

4.1.7.1 Air inlets

Where inlet air (combustion air and/or dilution air) is intended to be ducted to the appliance, 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.

4.1.7.2 Air outlets

Where an 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.

4.1.8 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.

4.1.9 Electrical equipment

Electrical equipment shall comply with the relevant requirements of EN 50165:1997, EN 60730-1:1992 and EN 61058-1:1992.

Safety isolating transformers and switch contact elements in switches shall comply with the requirements of EN 60742:1995.

The manufacturer shall specify the nature of the electrical protection of the appliance on a data plate, and this information shall comply with EN 60529:1991:

– to give the degree of personal protection against contact with dangerous electrical components inside the appliance case;

– to give the degree of electrical protection, inside the appliance case, against harmful actions due to water penetration.

4.1.10 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 5.5.3 and 6.3.5.3.

4.1.11 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, if fitted, 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 IP20). 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.

4.2 Adjusting, control and safety devices

4.2.1 General

All the devices specified in 4.2.2.1, 4.2.2.2 and 4.2.2.3, 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 (taps, thermostats etc.), 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 functioning of any safety device shall not be overruled by that of any control device.

4.2.2 Gas rate adjusters and range-rating devices

4.2.2.1 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.

4.2.2.2 Gas rate adjusters

Appliances in categories I_{2H}, I_{2L}, I_{2E}, I_{2E+}, I_{3B}, $I_{3B/P}$, I_{3P}, $II_{2H3B/P}$, II_{2H3+}, II_{2H3P}, $II_{2L3B/P}$, $II_{2E3B/P}$, II_{2E3+}, $II_{2E+3B/P}$, II_{2E+3+} and II_{2E+3P} shall not be fitted with gas rate adjusters. However, governed 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 governor.

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

For appliances in categories II_{2H3+} and II_{2E3+} having an adjusting screw on the gas governor, it shall be possible to put these devices out of service when these appliances are supplied with a third family gas. This also applies to appliances in category II_{1a2H} having a gas rate adjuster, when supplied with a second family gas. For appliances in category II_{2E+3P} having a gas rate adjuster, it shall be possible to put these devices out of service fully or partially (see 4.2.5) when these appliances are supplied with a second 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.

4.2.2.3 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 second family gas, the gas rate adjuster or its sealed part shall not be used by the installer as a range-rating device.

4.2.3 Aeration adjusters

Any means of adjusting the primary aeration shall be pre-set and sealed by the manufacturer.

4.2.4 Manual controls

4.2.4.1 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.

4.2.4.2 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.

4.2.5 Governors

Governors shall comply with the requirements of EN 88:1991.

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

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

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

The design and accessibility of the governor 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.

4.2.6 Multifunctional controls

Any multifunctional control shall comply with the requirements of EN 126:1995.

4.2.7 Flame supervision devices

Heat sensitive flame supervision devices shall comply with the requirements of EN 125:1991.

4.2.8 Automatic shut-off valves

4.2.8.1 General

Automatic shut-off valves shall comply with the requirements of EN 161:1992 + A1:1996 + A2:1997.

4.2.8.2 Application

4.2.8.2.1 Appliances with a start gas flame

All gas supplies shall be under the control of automatic shut-off valves connected to the gas line in series, of a class according to Table 2. These automatic shut-off valves may be integrated in a multifunctional gas control.

Table 2 - Valving requirements

Input	Main gas valves required		Start gas valves required	
	Non-automatic systems	Automatic systems	Non-automatic systems	Automatic systems
135 kW and below	1x class C plus 1x class J	1x class B plus 1x class C	1x class C[1)]	1x class B[2)] plus 1x class C[3)]
Between 135 kW and 180 kW	1x class B plus 1x class C	1x class B plus 1x class C	1x class B[2)]	1x class B[2)] plus 1x class C[3)]

1) This valve may be the start gas valve component integral with a thermoelectric valve or multifunctional control conforming to the requirements of EN 125:1991 or EN 126:1995, as appropriate.

2) This valve may be the class B valve controlling the main gas supply.

3) For start gas rates less than 0,6 kW or 1 % of the nominal heat input of the main burner this additional class C valve need not be fitted.

4.2.8.2.2 Appliances with direct main burner ignition (see 4.7.2)

Such appliances shall be fitted with two automatic shut-off valves in series. One of these shall be of at least class B and the other of at least class C. These automatic shut-off valves may be integrated in a multifunctional gas control.

4.2.8.3 Action of the flame supervision system and overheat cut-off device

The flame supervision system and the overheat cut-off device shall effect closure of all shut-off valves in the systems specified except for non-automatic systems.

In the case of non-automatic systems the flame supervision system and the overheat cut-off device shall effect closure of the class C valve but need not effect closure of other valves.

4.2.8.4 Restart

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

4.2.9 Automatic burner control systems

4.2.9.1 General

Automatic burner control systems shall comply with the requirements of EN 298:1993.

4.2.9.2 Manually operated devices

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

Under the test conditions described in 6.2.1 the rapid (on and off) operation of any start-up and shut-down devices shall not produce a hazardous condition.

4.2.10 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 1,0 mm diameter pin gauge. If a class J valve is used, the strainer shall be such that it does not pass a 0,2 mm pin gauge.

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

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

4.2.11 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 a filter is fitted, it shall be readily accessible for cleaning or replacement and may be of the cleanable or disposable type.

4.3 Ignition devices

4.3.1 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.

4.3.2 Ignition device for the main burner

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

4.3.3 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 4.2.10).

4.4 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 as follows:

– by 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;

– by 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 long enough to allow at least 5 volume changes of the appliance.

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:

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

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

c) 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.

4.5 Flame supervision system

4.5.1 Appliances with non-automatic burner systems

The burner shall be fitted with a flame supervision device.

The ignition opening time shall not exceed 20 s. This is verified under the test conditions of 6.2.2.

Upon flame failure the control system shall cause volatile or non-volatile lock-out. The extinction safety time shall not be more than 60 s for appliances of heat input up to 135 kW having a permanent ignition burner supervised by a thermoelectric flame supervision system, and shall not be more than 3 s for all other appliances.

Flame supervision devices shall be designed such:

a) that the failure of the sensor causes safe shut down of the burner (e.g. thermoelectric type), or

b) as to prevent any automatic shut-off valve opening and/or any ignition attempt occurring if a flame or flame-simulating condition is signalled when the burner is started from the completely shut-down condition.

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

Where thermoelectric flame supervision devices are used in conjunction with electric ignition, the control system shall incorporate a restart interlock. For the purposes of this clause a piezo-electric device is not regarded as electric ignition.

4.5.2 Appliances with automatic burner systems

The burner shall be fitted with a flame supervision device.

When the burner is started from the shut-down condition, the flame supervision system shall prevent any attempt at ignition or the opening of any gas valve if a fault or flame simulating condition is present. This safe-start check shall last for more than 5 s and shall cease not more than 5 s prior to any attempt at ignition. Where the flame supervision system incorporates thermionic valves etc. requiring warm-up time, the safe-start check shall last for at least 5 s longer than the maximum warm-up time.

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

Upon flame failure the control system shall cause safety shut-down. However, in the case of control systems which incorporate hot surface ignition, safety shut-down and lock-out shall result following flame failure.

The extinction safety time for the flame supervision system to detect the absence of flame and shut down the burner(s) shall not exceed 3 s.

4.6 Start-gas flame establishment

4.6.1 Appliances with non-automatic burner systems

For appliances of heat input not exceeding 60 kW, the gas rate of a start-gas burner shall not exceed 0,6 kW. For an appliance of heat input greater than 60 kW, the gas rate of a start-gas burner shall not exceed 1 % of the gas rate of the main burner or 1,3 kW, whichever is the lower rate.

Provision shall be made to establish the ignition burner flame safely and easily, either manually or by means of an ignition device incorporated in the appliance. Where an ignition device is incorporated in the appliance it shall also be possible to ignite the ignition burner gas by manual means.

The main gas valve shall not admit gas to the burner until the ignition burner gas flame has been detected by the flame supervision system.

If the start gas flame is established at a separate ignition burner, the flame detector, under all conditions of operation, shall detect the ignition burner flame only at rates which will ignite the main gas reliably and smoothly.

4.6.2 Appliances with automatic burner systems

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

A start gas rate of 100 % of the main burner is permitted.

Where the start gas flame is established at a separate ignition burner, the ignition burner rate shall not exceed 10 % of the main burner rating.

The ignition source shall not be energized before a safe-start check has been made of the flame supervision system and shall be de-energized at, or before, the end of the first safety time. Where a hot surface ignition system is used the ignition system shall be so energized that the ignition source is capable of igniting incoming gas before the gas valves are opened.

If the start gas flame has not been detected by the end of the first safety time, safety shut-down and lock-out shall result.

The ignition burner or start-gas ignition period (or for appliances with automatic burner control systems, the first safety time) shall not be more than 10 s, except that for ignition burners with gas rates not exceeding 1,3 kW the ignition burner period shall be not more than 15 s.

In the event of start gas flame failure after establishment of the start gas flame but before the main gas automatic shut-off valves have been signalled to open, either safety shut-down or a single immediate attempt at re-ignition by direct spark restoration is permitted.

If re-ignition is attempted and the start gas flame is not detected within the start-gas ignition period (or for appliances with automatic burner control systems, the first safety time) safety shut-down and lock-out shall result.

4.7 Main flame establishment

4.7.1 Establishment by means of a start gas flame

4.7.1.1 Appliances with non-automatic burner systems

Main gas shall not be admitted to the burner until the start gas flame has been detected by the flame supervision system and manual intervention has occurred (e.g. release of a push-button).

4.7.1.2 Appliances with automatic burner systems

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

Flame failure at any time after the main gas automatic shut-off valves have been signalled to open shall lead to safety shut-down.

4.7.2 Direct establishment of the main flame

The ignition source (e.g. spark ignition, hot surface igniter) shall not be energized before a safe-start check has been made of the flame supervision system and shall be de-energized at, or before, the end of the safety time. Where a hot surface ignition system is used the ignition system shall be so energized that the ignition source is capable of igniting incoming gas before the gas valves are opened.

If the flame has not been detected before the end of the safety time, safety shut-down and lock-out shall result.

This safety time shall not exceed 10 s.

4.8 Main burner

The section 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.

4.9 Facility for remote control

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

4.10 Thermostats and control of air temperature

4.10.1 General

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

Electrical thermostats shall comply with the requirements of EN 60730-2-1:1992.

4.10.2 Control of delivered air temperature

The appliance shall be equipped with a device to control the maximum temperature of the delivered air. This shall be in addition to the overheat cut-off device.

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 maximum air temperature control (see 5.6).

The means of control may be the air proving device/devices (see 4.4).

4.10.3 Overheat cut-off device

Overheat cut-off devices shall comply with Type 2K requirements of EN 60730-2-9:1995.

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 (see 5.6).

Where flame detection is achieved other than by means of a direct-acting thermoelectric heat sensitive type device, 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, or in the line supply from a programming unit to any automatic shut-off valve. Such devices shall not operate during the normal cyclic action of the appliance, e.g. as a consequence of room thermostat or timed control.

The operating temperature of the overheat cut-off device shall be set and sealed by the manufacturer.

4.10.4 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.

4.11 Gas pressure test 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 ($9\ ^{0}_{-0,5}$) 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.

4.12 Facilities for commissioning and testing

4.12.1 General

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 governor inlet and outlet pressures and the burner manifold pressure.

Connections or test points shall be provided for measurement of the flame detector signal on all appliances except those fitted with thermoelectric flame supervision devices.

Test points shall be provided to facilitate the measurement of combustion air flow rates, e.g. by means of differential pressures.

4.12.2 Appliances having reduced start gas rates

For appliances with automatic burner systems, 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 any of the following means:

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.

4.13 Additional requirements for appliances designed for permanent outdoor installation or where automatic irrigation systems are used

4.13.1 General

Such appliances shall be so constructed that they are fully protected against the rigours of the environmental conditions under which they are expected to operate.

4.13.2 Air inlets (outdoor appliances)

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.

4.13.3 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.

4.13.4 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.

4.13.5 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.

5 Operational requirements

5.1 Soundness of the gas circuit

The gas circuit shall be sound.

External soundness is assured if, under the conditions specified in 6.3.1, 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.

5.2 Heat inputs

5.2.1 Nominal heat input

When measured under the conditions specified in 6.3.2.2, the heat input obtained at normal pressure shall be within ± 5 % of the nominal heat input.

5.2.2 Start gas heat input

When measured under the conditions specified in 6.3.2.3, 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.

5.2.3 Effectiveness of gas rate adjusters

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

– shall be not less than the nominal heat input, under the conditions given in test no. 1 of 6.3.2.4;

– shall not exceed the nominal heat input, under the conditions given in test no. 2 of 6.3.2.4.

5.2.4 Effectiveness of the gas governor

For appliances with an adjustable gas governor, the rate shall not differ by more than + 7,5 % and - 10 % for first family gases, and by more than ± 5 % for second and third family gases, from the rate obtained at the adjustment pressure specified in 6.3.2.5, when the upstream pressure is varied between the minimum and maximum values stated in 6.1.4 for the reference gases of the appliance category concerned.

5.2.5 Effectiveness of the range-rating device

For appliances fitted with a range-rating device, as distinct from a gas rate adjuster:

– 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;

– 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 %.

5.3 Limiting temperatures

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

The surface temperatures of all parts of the appliance that have to be touched during normal use, e.g. control knobs, measured only in the zones intended to be touched, and under the conditions stated in 6.3.3.1, shall not exceed the ambient temperature by more than:

– 35 K for metals;

– 45 K for porcelain or similar materials;

– 60 K for plastics.

5.3.2 Temperatures of the appliance casing

The temperature of the appliance casing, 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 6.3.3.2.

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 when installed as stated in the manufacturer's instructions.

5.3.3 Component temperatures

When the appliance is tested under the conditions stated in 6.3.3.3, the maximum temperature of the appliance components shall not exceed the maximum temperature specified by the individual component manufacturer.

5.3.4 Fan motor winding temperatures

When tested under the conditions of 6.3.3.4, the maximum temperature rise of the motor windings shall not exceed the maximum temperature rise stated by the motor manufacturer.

5.3.5 Maximum temperature of the delivered air

When tested in accordance with 6.3.3.5, the temperature of the delivered air (including the combustion products), at a distance from the air outlet of the appliance as specified by the manufacturer, shall not exceed the inlet air temperature by more than 55 K.

If this distance is greater than 1,5 m, the manufacturer shall indicate on the appliance the distance that it should be installed away from walls, floor and ceiling, and clearance distances required to ensure personal safety.

5.4 Ignition, cross-lighting, flame stability

5.4.1 Ignition and cross-lighting

Under the test conditions described in 6.3.4.1, 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 6.3.4.2 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 6.3.4.3, the appliance shall be safe on ignition. In addition the appliance shall not sustain any damage likely to cause personal hazard or affect its own safe operation.

5.4.2 Flame stability

Under the test conditions described in 6.3.4.4, 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.

5.5 Combustion

5.5.1 Appliances designed to be used in greenhouses

When the appliance is tested under the conditions specified in 6.3.5.1, 6.3.5.2 and 6.3.5.3, the concentrations in the dry air free combustion products shall not exceed:

– CO (carbon monoxide) 60×10^{-6} *V*/*V*

– C_2H_4 (ethene) $0{,}6 \times 10^{-6}$ *V*/*V*

– NO_2 (nitrogen dioxide) 25×10^{-6} *V*/*V*

– NO (nitrogen oxide) 100×10^{-6} *V*/*V*

NOTE The test involves the determination of each of the components listed. The control of the C_2H_4 concentration is of particular importance for crop protection.

The above applies to tests numbers 1 and 2 given in 6.3.5.2. For test number 3, incomplete combustion gas, a CO figure of 120×10^{-6} *V*/*V* shall not be exceeded.

5.5.2 Other appliances

When the appliance is tested under the conditions specified in 6.3.5.1, 6.3.5.2 and 6.3.5.3, the concentrations in the dry, air free combustion products attributable to the appliance shall not exceed:

– CO (carbon monoxide) $1\ 000 \times 10^{-6}$ *V*/*V*

– NO_2 (nitrogen dioxide) 100×10^{-6} *V*/*V*

– NO (nitrogen oxide) 500×10^{-6} *V*/*V*

The above applies for tests numbers 1 and 2 given in 6.3.5.2. For test number 3, incomplete combustion gas, a CO figure of $2\ 000 \times 10^{-6}$ *V*/*V* shall not be exceeded.

5.5.3 Combustion air proving device(s)

When tested in accordance with 6.2.4, the air proving device(s) shall cause the appliance to proceed to safety shut-down or non-volatile lock-out when the emission levels given in 5.5.1 or 5.5.2, as appropriate, are exceeded.

5.5.4 CO_2 safety device

If fitted, and when tested in accordance with 6.3.5, the CO_2 safety device shall shut down the gas supply to the burner before the CO_2 concentration in the installed space exceeds the value stated in the manufacturer's installation instructions or 1 %, whichever is the lower.

5.5.5 Auxiliary energy variations

When supplied with reference gas at normal pressure and the supply voltage is varied under the conditions given in 6.3.5.3, the appliance shall ignite and continue to operate and the oxides of carbon and nitrogen in the delivered air, measured on the dry basis, attributable to the appliance shall not exceed the values given in 5.5.1 or 5.5.2, as appropriate.

5.6 Overheat cut-off device

Under the conditions specified in 6.3.6, test No. 1, the overheat cut-off device shall not operate.

Under the conditions specified in 6.3.6, test No. 2, the following requirements shall be satisfied:

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

   – a hazardous condition;

   – any damage to the appliance;

   – the temperature of the delivered air exceeding the temperature rise limit specified in 5.3.5 by more than 50 K (i.e. to limit the overall temperature rise to 105 K).

b) flame stability shall be satisfactory throughout the test.

5.7 Water resistance

Under the test conditions described in 6.3.7, appliances specified in 4.13 shall continue to operate normally, with the main and ignition burner(s) operating correctly.

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

The above requirements shall be deemed to be met if the appliance is protected in accordance with the requirements for IP44 as specified in EN 60529:1991.

6 Test methods

6.1 General

6.1.1 Characteristics of test gases: reference and limit gases

Appliances are intended for use with gases of various 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 and for the pressures for which it is designed, if necessary using the adjusting devices.

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 ISO 6976:1995.

6.1.2 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 the following rules shall be observed:

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

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

nitrogen	N_2	... 99 %	
hydrogen	H_2	... 99 %	
methane	CH_4	... 95 %	) with a total concentration of H_2, CO and
propene	C_3H_6	... 95 %	) O_2 below 1 % and a total concentration
propane	C_3H_8	... 95 %	) of N_2 and CO_2 below 2 %.
butane	C_4H_{10}	... 95 %	)

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

However, these requirements are not mandatory for each of the constituent gases, provided that the final mixture has a composition identical with that of a mixture that would have resulted from using the above constituents. To make up a mixture, a gas may be used which already contains, in convenient proportions, several constituents of the final mixture.

Moreover, for gases of the second family:

– for 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 given value in the table for the corresponding reference gas;

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

  – for limit gases G 21, G 222 and G 23 a natural gas of group H may be used;

  – for limit gases G 27 and G 231 a natural gas of group H or group L or group E may be used;

  – 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, where appropriate, shall be as given in Table 3.

Table 3 - Characteristics of the test gases[1] - Gas dry at 15 °C and 1 013,25 mbar

Gas family and group	Test gases	Desig-nation	Compo-sition by volume %	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[2]								
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[2]								
Group H	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 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 N_2 = 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

(continued)

Table 3 (concluded)

Gas family and group	Test gases	Desig-nation	Compo-sition by volume %	W_i MJ/m^3	H_i MJ/m^3	W_s MJ/m^3	H_s MJ/m^3	d
Gases of the third family[3]								
Third family and groups 3B/P and 3B	Reference gas Incomplete combustion and sooting limit gases	G 30	n-C_4H_{10}= 50 i-C_4H_{10}= 50[4]	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 and flame lift limit gas	G 31	C_3H_8 = 100	70,69	88,00	76,84	95,65	1,550
	Light back limit gas Sooting limit gas	G 32	C_3H_6 = 100	68,14	82,78	72,86	88,52	1,476

1) For gases used nationally or locally, see A.4.
2) For other groups, see A.4.
3) See also Table 4.
4) Any mixture of iso/normal butane can be used.

The calorific values of the third family test gases, expressed in MJ/m^3 in Table 3, may also be expressed in MJ/kg, as shown in Table 4.

Table 4 - Calorific values of the test gases of the third family

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

6.1.3 Practical application of test gases

6.1.3.1 Choice of test gases

Gases required for the tests described in 6.3.2, 6.3.4 and 6.3.5 shall be as specified in 6.1.1 and made up in accordance with 6.1.2.

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 number 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 6.1.5.1, 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
I_{3B}	G 30	G 30	G 32	G 31	G 30
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_{2E3+}, 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.					

6.1.3.2 Conditions of supply and adjustment of the appliance

6.1.3.2.1 Initial adjustment of the appliance

Before all the 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 3). Any gas rate adjusters are set in accordance with the manufacturer's instructions, using the appropriate reference gas(es) (see 6.1.5.1) and the corresponding normal pressure(s) given in 6.1.4.

This initial adjustment of the appliance is subject to the limitations given in 4.1.1.

6.1.3.2.2 Supply pressures

Except where an adjustment of the supply pressure is necessary (as described in 6.1.3.2.3 and 6.1.3.2.4), the normal, minimum and maximum supply pressures to be used for testing purposes shall be in accordance with the requirements given in 6.1.4.

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

6.1.3.2.3 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 injector(s) is such that the heat input obtained is within ± 2 % of that specified (by altering the pre-set adjuster(s) or the appliance governor, if adjustable, or the appliance supply pressure).

The specified heat input shall be determined in accordance with 6.3.2 and with the appliance supplied with the appropriate reference gas(es).

6.1.3.2.4 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:

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

6.1.4 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 [1])

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 [2)]	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

1) For test pressures corresponding to gases distributed nationally or locally, refer to Table A.4.

2) 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	25
	G 231	(25) [1)]	17 [2)]	30
3rd family: 3+ (28-30/37 couple)	G 30	29 [3)]	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

1) This pressure corresponds to the use of low Wobbe index gas but in principle no test is carried out at this pressure.

2) See Annex D.

3) Appliances of this category may be used, without adjustment, at the specified supply pressures of 28 mbar to 30 mbar.

6.1.5 Test procedures

6.1.5.1 Tests requiring the use of reference gases

The tests specified in 6.3.2, 6.3.4 and 6.3.5 shall be carried out with each of the reference gases for the appliance category appropriate to the country in which the appliance is to be installed, according to the information given in Table A.1.1.

The other tests are carried out with only one of the reference gases of the appliance category (see 6.1.1) at one of the normal test pressures required in 6.1.4 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).

6.1.5.2 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 and the adjustments corresponding to the reference gas of the group, or family, to which each limit gas belongs.

6.1.6 General test conditions

The following test conditions shall be generally applicable except where otherwise specified in particular clauses.

6.1.6.1 Test room

The appliance shall be installed in a well-ventilated, draught-free room which has an ambient temperature of (20 ± 5) °C.

NOTE A wider temperature range is permissible provided that the effect on the test 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 % by volume) of carbon dioxide, 10×10^{-6} (0,001 % by volume) of carbon monoxide, $0,5 \times 10^{-6}$ (0,000 05 % by volume) of nitric oxide or $0,5 \times 10^{-6}$ (0,000 05 % by volume) of nitrogen dioxide.

6.1.6.2 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.

6.1.6.3 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.

6.1.6.4 Electrical supply

The appliance shall be connected to an electrical supply at the nominal voltage, except where otherwise stated in the clause concerned.

6.1.6.5 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.

6.2 Construction and design

6.2.1 Automatic burner control systems (manually operated devices)

The appliance is installed as described in 6.1.6 and supplied with an appropriate reference gas (see Table 5) at the nominal heat input in accordance with 6.1.3.2.

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 4.2.9.2 are met.

6.2.2 Ignition opening time

With the appliance in the cold condition, the gas supply is turned on and the ignition burner is lit. 20 s after ignition of the ignition burner, manual intervention is withdrawn and it is checked that the ignition burner remains alight.

It is checked that the requirements of 4.5.1 are met.

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

This test is necessary where 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 6.1.6.

The appliance is initially adjusted in accordance with 6.1.3.2.1 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.

6.2.4 Combustion air proving device(s)

The test is carried out with the appliance installed in accordance with 6.1.6. The appliance is adjusted in accordance with the requirements of 6.1.3.2.1 and supplied with an appropriate reference gas (see Table 5) at nominal heat input.

The CO concentration of the distributed air which is attributable to the appliance is determined in accordance with 6.3.5. The air inlet to the appliance is then gradually restricted and the CO concentration of the distributed air monitored.

It is checked that the air proving device causes safety shut-down or non-volatile lock-out in order to meet the requirements of 5.5.3.

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.

This test may be carried out by reducing the electrical supply voltage to the fan. For appliances that incorporate a separate fan for the combustion air, the test is carried out on this fan only.

6.3 Safety of operation

6.3.1 Soundness of the gas circuit

For appliances using first and/or second 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 third family gases, the tests are carried out with an air pressure of 150 mbar.

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

Compliance with 5.1 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 soap solution, 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 at the commencement of the test schedule 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.

6.3.2 Heat inputs

6.3.2.1 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 kilowatts is given by one of the following expressions:

$Q_o = 0{,}278\ M_o \cdot \mathrm{Hs}$; or

$Q_o = 0{,}278\ M_o \cdot H_i$; or

$Q_o = 0{,}278\ V_o \cdot H_s$; or

$Q_o = 0{,}278\ V_o \cdot H_i$

where:

M_o is the mass rate in kilograms per hour obtained at reference conditions;

V_o is the volume rate in cubic metres per hour obtained at reference conditions;

H_i is the net calorific value of the reference gas in megajoules per kilogram or in megajoules per cubic metre (dry gas, 15 °C, 1 013,25 mbar), as appropriate;

H_s is the gross calorific value of the reference gas in megajoules per kilogram or in megajoules per cubic metre (dry gas, 15 °C, 1 013,25 mbar), as appropriate.

The mass and volume rates correspond to a measurement and to a flow of reference gas under reference conditions. 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.

Depending on whether the mass rate or the volume flow is determined, the corrected mass rate is calculated from the following formulae:

a) Determination by mass

$$M_o = M \sqrt{\frac{1\,013{,}25 + p}{p_a + p} \cdot \frac{273{,}15 + t_g}{288{,}15} \cdot \frac{d_r}{d}}$$

b) Determination from volume rate

$$V_o = V \sqrt{\frac{1\,013{,}25 + p}{1\,013{,}25} \cdot \frac{p_a + p}{1013{,}25} \cdot \frac{288{,}15}{273{,}15 + t_g} \cdot \frac{d}{d_r}}$$

The corrected mass rate is calculated by the formula:

$$M_o = 1{,}226\, V_o \cdot d$$

where:

M_o is the mass rate under reference conditions;

M is the mass rate obtained under test conditions;

V_o is the volume rate under reference conditions;

V is the volume rate obtained under test conditions;

p_a is the atmospheric pressure in millibars;

p is the gas supply pressure in millibars;

t_g is the temperature of the gas at the measuring point in degrees Celsius;

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

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

These formulae are used to calculate, from the mass input, M, or volume input, V, measured during the test, the corresponding rates M_o or V_o which would have been obtained under the reference conditions. These formulae are applicable if the test gas used is dry.

If a wet gas meter (water-filled) is used or if the gas used is saturated, the value d (density of dry gas in relation to dry air) is replaced by the value of the density of the wet gas d_h given by the following formula:

$$d_h = \frac{(p_a + p - p_s) \cdot d + 0{,}622 \cdot p_s}{p_a + p}$$

where p_s is the saturation vapour pressure of the test gas expressed in millibars at the temperature t_g.

6.3.2.2 Nominal heat input

The tests are carried out at the pressure specified by the manufacturer in accordance with 6.1.4.

The appliance is adjusted in accordance with 6.1.3.2.1 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 5.2.1.

6.3.2.3 Start gas heat input

The tests are carried out at the pressure specified by the manufacturer in accordance with 6.1.4, using an arrangement which allows operation of the start gas flame on its own.

The appliance is adjusted in accordance with 6.1.3.2.1 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 5.2.2.

6.3.2.4 Effectiveness of the gas rate adjusters

These tests are only applicable to appliances fitted with gas rate adjusters which are not put out of action.

Test no. 1: The heat input is measured with the adjuster fully open and with the minimum supply pressure given in 6.1.4 for the particular reference gas.

Test no. 2: The heat input is measured with the adjuster fully closed and with the maximum supply pressure given in 6.1.4 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.

6.3.2.5 Effectiveness of the gas governor

If the appliance has an adjustable governor, 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 6.1.4 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 first family, for which the governor is not put out of action. For first family gases, the test is carried out by varying the supply pressure between the normal pressure and the maximum pressure.

6.3.2.6 Effectiveness of the range-rating device

The tests are carried out as described in 6.3.2.2 for the two extreme positions of the range-rating device.

6.3.3 Limiting temperatures

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

The appliance is 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.

If the appliance is fitted with air discharge louvres, these are set at the position of maximum closure as specified and marked by the manufacturer.

When the appliance has reached thermal equilibrium, the temperatures of the parts specified in 5.3.1 are measured to an accuracy of ± 2 K using a suitable means, e.g. contact thermocouples.

6.3.3.2 Temperatures of the appliance casing

The test is carried out with the appliance operating at its normal heat input. All the measurements are taken when thermal equilibrium has been reached.

The temperatures of the appliance casing are measured by a suitable means having an accuracy of ± 2 K, e.g. contact thermocouples.

6.3.3.3 Component temperatures

Component temperatures are measured when thermal equilibrium has been reached in the test described in 6.3.3.1 and after the appliance has been turned off at the end of the test. The temperatures are monitored immediately after the appliance has been turned off and the maximum temperatures are recorded.

The component temperatures are measured by means of attached thermocouples having thermoelectric junctions with an accuracy of ± 2 K. Thermocouples shall be used in accordance with EN 60584-1:1995 with the limits of accuracy of the thermoelectric voltage used in accordance with class 2 of EN 60584-2:1993.

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:

$$t_m \leq t_s + t_a - t_A$$

where:

t_m is the maximum temperature measured during the test in degrees Celsius;

t_s is the maximum temperature specified by the component manufacturer in degrees Celsius;

t_a is the ambient room temperature in degrees Celsius;

t_A is the maximum ambient temperature specified by the component manufacturer, in degrees Celsius; if not specified, t_A is equal to 25 °C.

6.3.3.4 Fan motor winding temperatures

The appliance is installed in accordance with 6.1.6 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 from the formula:

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

where:

Δt is the temperature rise in kelvins;

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 degrees Celsius;

t_2 is the room temperature at the end of the test in degrees Celsius;

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

6.3.3.5 Delivered air temperature

The appliance is operated with any reference gas for the appliance category at the normal heat input, the minimum circulated air rate as specified by the manufacturer and the thermostat set at its maximum setting.

The temperature of the delivered air (including the products of combustion) as specified in 5.3.5 at the hottest point around and in front of the appliance is measured as described in 6.3.3.5.2.

6.3.3.5.1 Apparatus

The apparatus consists of a wooden board of at least 1 200 mm in length by 1 000 mm in width and 25 mm thick painted dull black. The board is mounted so that it can be positioned at any point around the appliance air discharge outlet (see figure 1).

Thermocouples are embedded in the board at 100 mm centres. The thermocouples enter the board on the side remote from the appliance, the junctions being fixed 3,0 mm from the surface of the board adjacent to the appliance.

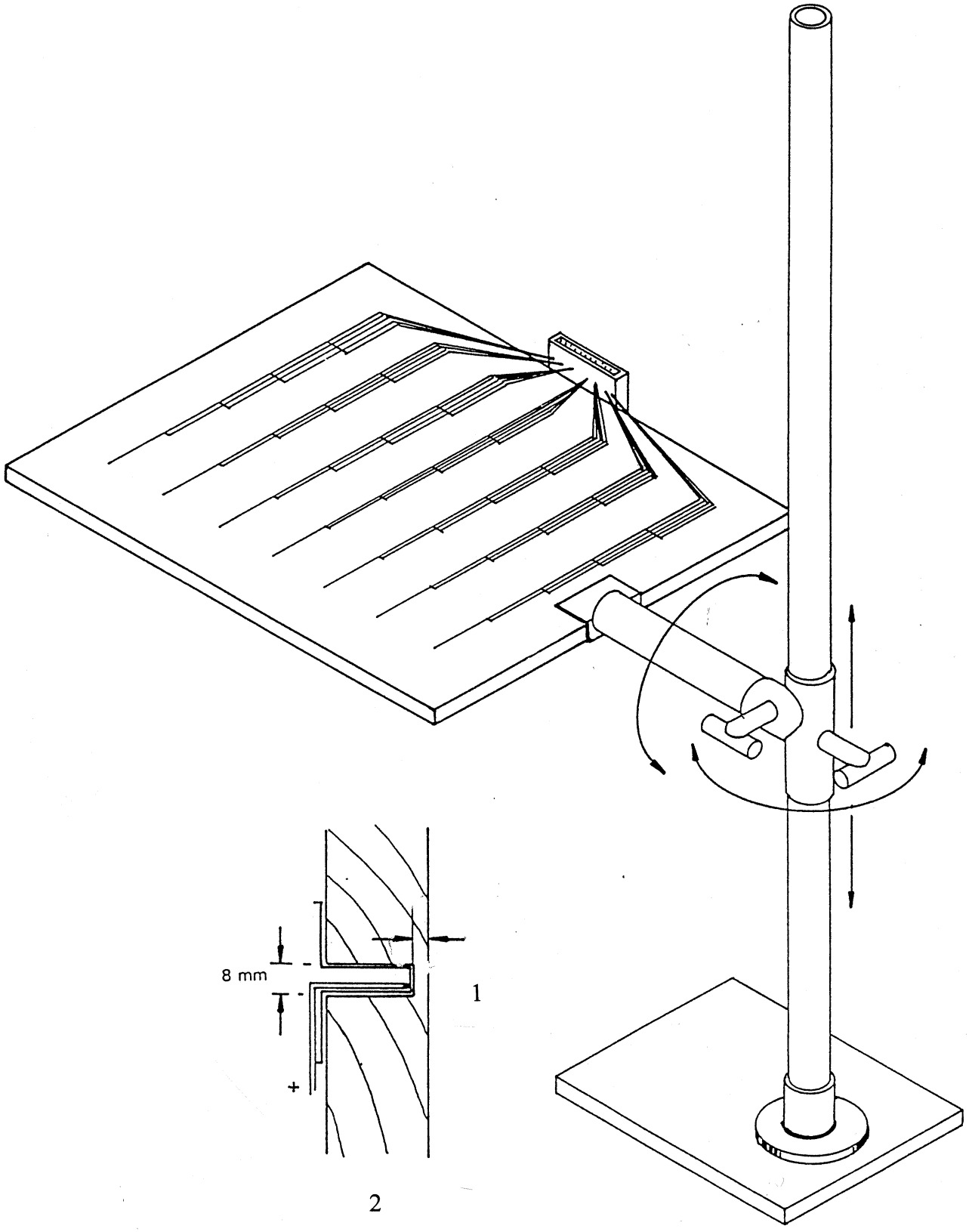
6.3.3.5.2 Procedure

The appliance is set up in accordance with the manufacturer's instructions regarding clearances and the board is centred at the distant point producing the maximum heating effect within the zone(s) specified by the manufacturer in the installation instructions.

Sufficient tests are carried out at appropriate positions around the appliance to verify that the temperatures specified in 5.3.5 are not exceeded, i.e. wall and floor.

The temperature of the test room throughout the duration of the tests should be maintained ± 2 K.

If the appliance is designed for greenhouse use, the clearances necessary to prevent scorching of plants are also verified according to the temperature limits advised by the appliance manufacturer.



Key

1 Face of wall

2 Section at thermocouple

Figure 1 - Apparatus for measuring the delivered air temperature

6.3.4 Ignition, cross-lighting and flame stability

These tests are carried out with the appliance installed in accordance with 6.1.6, in the cold condition and at thermal equilibrium unless otherwise stated.

6.3.4.1 Ignition and cross-lighting

Test no. 1

The appliance is supplied with the appropriate reference and limit gases (see Table 5) at the normal pressure in accordance with 6.1.4.

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.

Test no. 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 6.1.4, 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.

Test no. 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 6.1.4.

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.

6.3.4.2 Ignition burner flame reduction

The appliance is initially adjusted in accordance with 6.1.3.2.1 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 can be achieved either:

– by the adjustment of the ignition burner gas rate adjuster, if this exists, or, if this is not possible,

– 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.

6.3.4.3 Delayed ignition

The appliance is initially adjusted in accordance with 6.1.3.2.1 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.

6.3.4.4 Flame stability

Test no. 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 6.1.4.

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.

Test no. 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 6.1.4.

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.

6.3.5 Combustion

6.3.5.1 General

The appliance is installed in accordance with 6.1.6 and initially adjusted in accordance with 6.1.3.2.1 and supplied with the appropriate reference gases (see Table 5) at the nominal heat input.

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

Carbon monoxide: The carbon monoxide concentration in the delivered air is measured by means of a suitably sensitive analyser 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.

Carbon dioxide: The carbon dioxide concentration in the delivered air is measured by means of a suitably sensitive analyser 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.

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

Where the appliance does not have the facility for recirculated air, the combustion tests are carried out under the conditions specified in 6.3.5.2 and 6.3.5.3 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 are carried out under the conditions specified in 6.3.5.2 and 6.3.5.3 and under the following conditions:

a) The temperature of the recirculated air shall be maintained during the tests within the limits given in 6.1.6.1.

b) 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.

c) 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.

d) Where the level of recirculated air is not specified, the combustion tests are carried out with any recirculation air damper set in the fully open position and in the fully closed position.

e) 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 does not exceed the maximum specified by the manufacturer.

   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 are made at a sufficient number of CO_2 concentrations in the recirculated air to determine the combustion performance at the CO_2 concentration specified by the manufacturer. Extrapolation is not permitted.

6.3.5.2 Test procedures

The combustion performance is checked under the following conditions for conformity with 5.5.1 or 5.5.2, as appropriate.

Test no. 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 6.1.4.

Test no. 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 6.1.4, 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.

Test no. 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 6.1.4. It is verified that the CO values meet the requirement of 5.5.1 or 5.5.2, as appropriate.

6.3.5.3 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.

6.3.6 Overheat cut-off device

6.3.6.1 General

The appliance is installed as described in 6.1.6 and supplied with the reference test gas corresponding to the appliance category at normal pressure.

6.3.6.2 Test No. 1

6.3.6.2.1 Appliances incorporating thermally activated maximum air temperature control devices

Any air proving device controlling the supply of dilution air is rendered inoperative.

The appliance is operated from cold at the maximum nominal heat input and the dilution air flow is progressively reduced until the maximum air temperature control (see 4.10.2) operates to cut off the gas supply to the main burner. The appliance is then made to cycle, after manual or automatic reset, on the maximum air temperature control for sufficient time to ensure that the worst condition has been reached.

In the case of manual reset, the reset mechanism is operated after the first cut-off and at regular intervals thereafter until the maximum air temperature control permits reset.

It is checked that the overheat cut-off device does not operate.

6.3.6.2.2 Appliances relying on the air proving device to limit the maximum air temperature

The appliance is operated from cold at the maximum nominal heat input and the dilution air flow is progressively reduced until the air proving device operates to cut off the gas supply to the main burner. The air flow rate is then increased until the air proving device permits restart, and the appliance is operated for sufficient time to ensure that the worst condition has been reached.

It is checked that the overheat cut-off device does not operate.

6.3.6.3 Test No. 2 (all appliances)

Any maximum air temperature control and any air proving device controlling the supply of dilution air are rendered inoperative.

The appliance is operated from cold at the maximum nominal heat input and the dilution 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-off and at regular intervals thereafter until the overheat cut-off device permits reset.

The temperatures of the delivered air (including the products of combustion) are monitored during the test in accordance with the method of test specified in 6.3.3.5. It is checked that the maximum temperature rise of the delivered air attained during the test does not exceed the limit specified in 5.6.

6.3.7 Water resistance

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

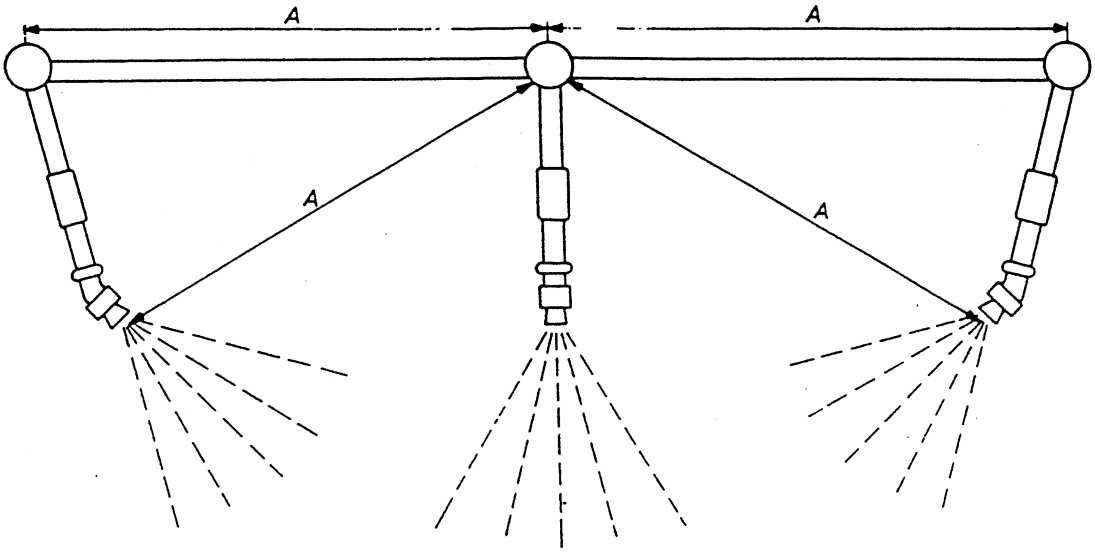
The two spray units are placed in opposition with the spray heads equidistant from the floor and from the appliance under test.

The appliance is installed as described in 6.1.6 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.

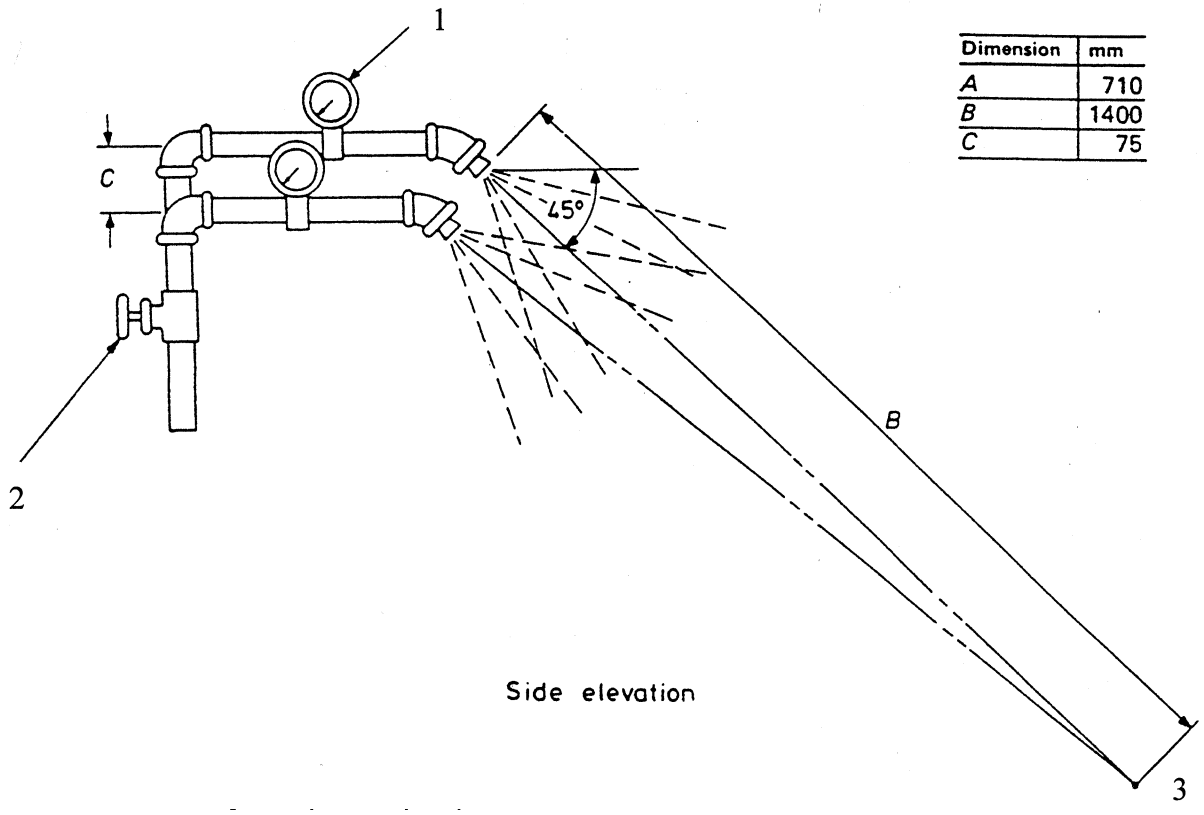
The spray heads are set to operate at 350 mbar and adjusted to varying elevations and horizontal distances from the appliance to determine the most critical location. Exposure at the location chosen as the most critical by observation is maintained throughout the test.

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 if considered appropriate.



Plan view



Dimension	mm
A	710
B	1400
C	75

Side elevation

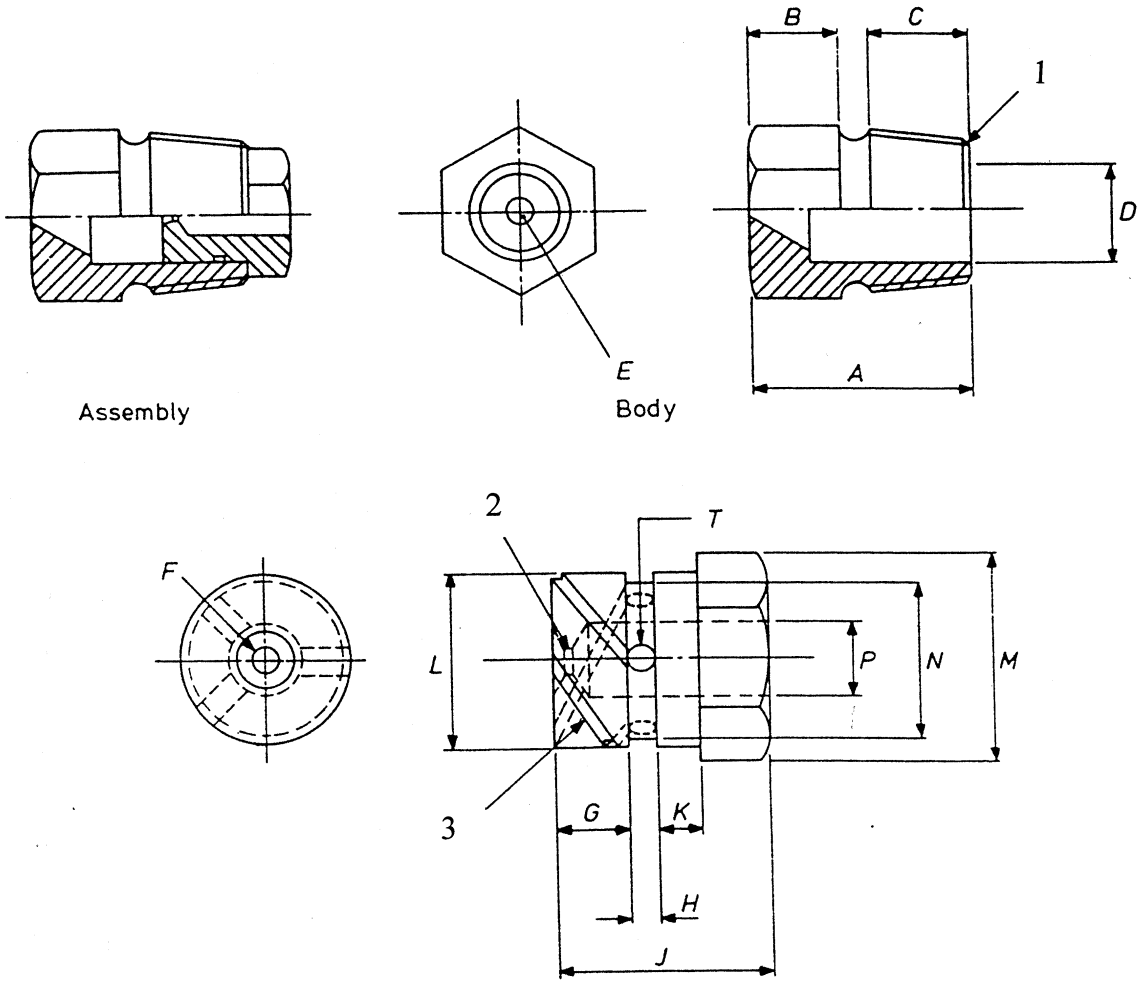
Key

1 Water pressure gauge for each spray head

2 Control valve for each spray head

3 Focal point

Figure 2 - Arrangement of spray heads and associated piping for the water resistance test



Dimension	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T
mm	31.0	11.0	14.0	14.7	5.0	2.5	6.4	2.4	18.3	4.0	14.6	16.0	11.5	6.4	1.5	1.5	2.8

Key

1 1/2 in B.S.P. taper

2 Straight throat, not more than 0,8 mm long. Drill relief 115°, 0,8 mm deep

3 3 square section slots: *R* wide, *S* deep; equally spaced (120°); 60° helix; leading edges tangential to radial edges

Figure 3 - Detail of spray head assembly and construction

7 Marking and instructions

7.1 General

The appliance, its packaging and other relevant components shall be marked with the relevant information specified in 7.3, 7.4, 7.5, 7.6 and 7.7.

7.2 Description

Appliances are described by their:

– category;

– nominal heat input, or range of adjustable input;

– principle of distributing the warm air.

7.3 Data plate and labelling

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 at least the following information in indelible characters:

– the manufacturer's name, or authorized representative, and address;

– the nominal heat input and, where necessary, the range of input for an appliance with an adjustable input, expressed in kilowatts and, where applicable, in kilograms per hour;

– 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;

– the trade name of the appliance;

– the PIN (product identification number of the notified body);

– the serial number of the appliance;

– the commercial identification of the appliance;

– where the appliance has been assessed to the requirements of this standard for outdoor use, this shall be marked on the appliance;

– where the appliance has been assessed to the requirements of this standard for use in greenhouses, this shall be marked on the appliance;

– the 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);

– the nature and voltage of the current used and the maximum electrical input power used (volts, amperes, hertz and kilowatts) for all intended electrical supply conditions;

– the direct country or countries of destination of the appliance;

– external air pressure;

– design air flow rate;

– design temperature rise;

– the IP code (see 4.1.9).

NOTE 1 The indelibility of the marking is checked by a test carried out in accordance with 7.14 of EN 60335-1:1988.

NOTE 2 “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.

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.

7.4 Other marking

On delivery the appliance shall carry in a prominent position, if possible near the data plate, a firmly fixed badge stating the nature and pressure of the gas family or group for which the appliance has been adjusted. This information may be put on the data plate.

In addition, the appliance shall carry a suitable plate or durable label indelibly marked with the following text:

"This appliance shall 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 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.

When the appliance is supplied to be used for greenhouse use the manufacturer shall affix a label indicating the distances to be maintained from the warm air outlet of the appliance and any vegetation (see 5.3.5).

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

7.5 Marking on the packaging

The packaging shall carry the following information:

– 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);

– the direct country or countries of destination of the appliance;

– 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 following text:

"This appliance shall 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.

7.6 Utilization of symbols on the appliance and packaging

7.6.1 Electrical supply

The marking concerning electrical values shall be in conformity with EN 60335-1:1988.

7.6.2 Type of gas

In order to represent all of the category indices corresponding to the adjustment of an appliance, the symbol of the reference gas shall be used which is common to all of these indices, in accordance with Table 8.

Table 8 - Gas type symbols

Symbol of the type of gas[1)]	**Corresponding category index**
First family:	
G 110	1a
G 120	1b
G 130	1c
G 150	1e
Second family:	
G 20	2H, 2E, 2E+, 2Esi[2)], 2Er[2)], 2ELL[2)], 2E(S)B[2)], 2E(S)B[2)]
G 25	2L, 2Esi[3)], 2Er[3)], 2ELL[3)], 2E(S)B[3)], 2E(S)B[3)]
Third family:	
G 30	3B/P, 3+[4)6)], 3B
G 31	3+[5)6)], 3P

1) If, in its current state of adjustment, the appliance may use gases from different groups, all the reference gases corresponding to these groups shall be indicated.

2) When the appliance is adjusted for G 20.

3) When the appliance is adjusted for G 25.

4) 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.

5) Only applies to appliances which need an adjustment between G 30 and G 31, and which are adjusted for G 31.

6) 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.

7.6.3 Gas supply pressure

The gas supply pressure can be expressed uniquely by the numerical value using the unit (mbar). Nevertheless, if it is necessary to explain this value, the symbol "*p*" shall be used.

7.6.4 Country of destination

In accordance with EN ISO 3166-1:1997, the names of countries shall be represented by the following country codes:

AT Austria
BE Belgium
CH Switzerland
CZ Czech Republic
DE Germany
DK Denmark
ES Spain
FI Finland
FR France
GB United Kingdom
GR Greece
IE Ireland

IS Iceland
IT Italy
LU Luxembourg
NL Netherlands
NO Norway
PT Portugal
SE Sweden

7.6.5 Category

The category can be expressed uniquely by its designation in accordance with EN 437:1993 + A1:1997. Nevertheless, if it is necessary to explain it, the term "category" shall be symbolized by "Cat".

7.6.6 Other information

The symbols given below are not obligatory, but are recommended under the title "preferential", and to the exclusion of any other symbol, to avoid the use of many and different markings.

7.6.6.1 Nominal heat input of a burner: Q_n.

7.6.6.2 Nominal heat input of all appliance burners: ΣQ_n.

7.6.6.3 Additional indication related to the type of gas: as well as the symbol of the type of gas as given in 7.6.2, its declared means of identification (according to Table 9) may be added.

Table 9 - Means of identification of the types of gas in force in the various countries

Country	Gas type							
	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			Propan-Luft, Butan-Luft		Erdgas H		Butan	Propan
CZ								
DE					Erdgas [1)]	Erdgas [2)]	Flüssiggas B/P	
								Flüssiggas P
DK	Bygas				Naturgas		F-Gas	F-Gas
ES	Gas manufacturado		Aire propanado	Aire metanado	Gas natural		Butano	Propano
FI					Maakaasu, Naturgas		Butaani, Butan	Propaani, Propan
FR [3)]			Air propané/ Air butané		Gaz naturel Lacq	Gaz naturel Groningue	Butane	Propane
GB					Natural Gas		Butane	Propane
GR					Φυσικό ΄Αέριο		΄Υγραέριο Μείγμα	Προπάνιο
IE					Natural Gas		Butane	Propane
IS								
IT	Gas di Città				Gas naturale/ Gas metano		GPL	
LU								
NL						Aardgas	Butaan	Propaan
NO							Butan	Propan
PT					Gás Natural		Butano	Propano
SE								

1) Natural gases of Group H according to Worksheet DVGW G260;
Nominal Wobbe index $W_{s,n}$= 15,0 kWh/m^3, at 0 °C and 1 013 mbar.

2) Natural gases of Group L according to Worksheet DVGW G260;
Nominal Wobbe index $W_{s,n}$= 12,4 kWh/m^3, at 0 °C and 1 013 mbar.

3) The meaning of the symbol corresponding to the type of gas shall be explained in detail in the technical instructions. Concerning the appliance 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.

7.7 Instructions

7.7.1 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.

7.7.2 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 (on a floor or wall etc.) and its accessories (room thermostat etc.); 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 state the safe distances to be maintained in front of the appliance in the path of the delivered air to avoid scorching of vegetation (see 5.3.5).

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 cubic metres per hour in relation to the average conditions of use (15 °C, 1 013,25 mbar) or in kilograms per hour, together with the instructions about how to adjust the air rate.

They shall specify the maximum and minimum pressure differential of the combustion air.

If the appliance incorporates a CO_2 safety device, they shall include all necessary instructions on calibration and operation of the device (see 5.5.4).

The instructions shall state the minimum amount of fresh air to meet the requirements of 5.5.1 and 5.5.2 as appropriate.

They shall specify the ventilation requirements necessary to ensure compliance with the rules in force concerning air quality in the heated space. Where national or local regulations do not exist, these ventilation instructions shall describe how to ensure that the values given in Table 10 are not exceeded in the heated space.

For appliances installed in greenhouses where CO_2 is employed for crop fertilization purposes the instructions shall specify these limits together with the amount of ventilation required to maintain the levels stated.

Table 10 - Heated space conditions

Component	**Greenhouse appliances** % by volume	**Other appliances** % by volume
carbon dioxide (CO_2)	1	0,5
carbon monoxide (CO)	0,000 5	0,005
nitrogen dioxide (NO_2)	0,000 2	0,000 5
nitrogen oxide (NO)	0,000 5	0,002 5
ethene (C_2H_4)	0,000 005	not applicable

NOTE 1 Annex B 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 B.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 provide guidance for the distances required between the appliance warm air outlet and any materials that may become damaged or be regarded as a hazard (e.g. plants, combustible materials).

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 exchangeable or conversion parts with an illustration and, where necessary, a numbered key for the main parts to be cleaned, serviced or replaced.

7.7.3 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.

7.7.4 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 to consult 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 state the necessity to re-commission the appliance after servicing.

7.7.5 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, including restrictions of use for outdoor appliances and for indoor use where irrigation systems are employed in greenhouses.

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

7.7.6 Presentation

All the information specified in 7.7.2, 7.7.3, 7.7.4 and 7.7.5 shall be given in the official language(s) of the direct country, or countries, of destination.

Annex A (informative)
National situations

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.1, A.2, A.3, A.4 and A.5.

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

Tables A.1.1 and A.1.2 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 the table indicates only that these categories may be sold but not necessarily be installed throughout the whole of the country concerned and A.3 shall be consulted for confirmation.

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

Table A.1.1 - Single categories marketed

Country	I_{2H}	I_{2L}	I_{2E}	I_{2E+}	$I_{3B/P}$	I_{3+}	I_{3P}	I_{3B}
AT	X				X			
BE				X		X	X	
CH	X				X	X	X	
CZ (?)								
DE			X		X		X	
DK	X				X			
ES	X					X	X	X
FI	X				X			
FR	X[1)]	X[1)]		X		X	X	
GB	X					X	X	
GR (?)								
IR	X					X	X	
IS (?)								
IT	X					X		
LU			X					
NL	X[1)]	X			X		X	
NO					X			
PT	X					X	X	
SE	X				X			

The symbol (?) placed alongside the codes of the countries means that the country concerned has not indicated its choice of category.

1) Categories applicable only to appliances submitted to the on site EC verification procedure; Annex II, article 6 of the Gas Appliance Directive (90/396/EEC).

Table A.1.2 - Double categories marketed

Country	II_{1a2H}	$II_{2H3B/P}$	II_{2H3+}	II_{2H3P}	$II_{2L3B/P}$	II_{2L3P}	$II_{2E3B/P}$	II_{2E+3+}	II_{2E+3P}
AT		X							
BE									
CH	X	X	X	X					
CZ (?)									
DE							X		
DK	X	X							
ES	X		X	X				X	
FI		X							
FR				X[1)]		X[1)]		X	X
GB			X	X					
GR (?)									
IR			X	X					
IS (?)									
IT	X		X						
LU (?)									
NL					X	X			
NO									
PT			X	X					
SE	X	X							

The symbol (?) placed alongside the codes of the countries means that the country concerned has not indicated its choice of category.

1) Categories applicable only to appliances submitted to the on site EC verification procedure; Annex II, article 6 of the Gas Appliance Directive (90/396/EEC).

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

Table A.2 gives the conditions in the various countries concerning the supply pressures to appliances in the categories given in A.1.

Table A.2 - Normal supply pressures

Gas	G 110	G 20	G 25		G 20 + G 25	G 30		G 31			G 30 + G 31	
Pressure (mbar) / Country	8	20	20	25	couple 20/25	30 28-30	50	30	37	50	couple 28-30/37	couple 50/67
AT		X					X			X		
BE					X	X		X	X	X	X	X
CH	X	X					X			X	X	
CZ (?)												
DE		X	X				X			X		
DK	X	X				X		X				
ES	X	X				X			X	X	X	
FI		X				X		X				
FR		X		X	X[1)]	X			X		X	
GB		X[2)]							X		X	
GR (?)												
IR		X							X		X	
IS (?)												
IT	X	X									X	
LU		X										
NL				X		X		X		X		
NO						X		X				
PT		X				X			X		X	X
SE	X	X				X			X			

1) For special categories in France, see A.3.

2) Normal supply pressure for this appliance: 17,5 mbar.

The symbol (?) placed alongside the codes of the countries means that the country concerned has not indicated its choice of category.

A.3 Special categories marketed nationally or locally

A.3.1 Special categories

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.3.

Table A.3 - 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
$I_{2E(S)B}$, $I_{2E(R)B}$	G 20	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
II_{1c2E+}	G 130, G 20	G 21	G 132, G 222	G 231	G 21	FR
II_{1c2Esi}, II_{1c2Er}	G 130, G 20, G 25	G 21	G 132, G 222	G 231	G 21	FR
II_{2Esi3+}, II_{2Er3+}	G 20, G 25, G 30	G 21	G 222, G 32	G 231, G 31	G 30	FR
II_{2Er3P}, II_{2Esi3P}	G 20, G 25, G 31	G 21	G 222, G 32	G 231, G 31	G 31, G 32	FR
$II_{2ELL3B/P}$	G 20, G 25, G 30	G 21, G 30	G 222, G 32	G 231, G 271	G 30	DE
III_{1a2H3+}	G 110, G 20, G 30	G 21	G 112, G 222, G 32	G 23, G 31	G 30	IT
$III_{1a2H3B/P}$	G 110, G 20, G 30	G 21	G 110, G 222, G 32	G 23, G 31	G 30	DK
$III_{1c2E+3+}$	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_{1cEr3P}	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
$III_{1ce2H3+}$	G 130, G 150, G 20, G 30	G 21	G 132, G 222, G 32	G 23, G 31	G 30	ES
$III_{1ace2H3+}$	G 110, G 130, G 150, G 20, G 30	G 21	G 112, G 222, G 32	G 23, G 31	G 30	ES

A.3.2 Definition of special categories

The definitions of the special categories given in Table A.3 are derived in the same way as those categories listed in 3.7.2. The characteristics of the gases distributed regionally are given in Table A.4.

A.3.2.1 Category I

A.3.2.1.1 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).

Category I_{1e}: Appliances using only gases of group e linked to the first family (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.3.2.1.2 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 (gross Wobbe index between 44,8 MJ/m^3 and 54,7 MJ/m^3) by a gas in the range Ei of group E (gross 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 (gross Wobbe index between 44,8 MJ/m^3 and 54,7 MJ/m^3 by a gas of the range Ei of group E (gross 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 $I_{2E(S)B}$: Appliances using only gases of group E linked to the second family used under the same conditions as for category I_{2E+}. However, appliances are fitted with a pressure governor of gas, which is adjusted and sealed by the manufacturer in the setting corresponding to the use of G 20 at 20 mbar.

Category $I_{2E(R)B}$: Appliances using only gases of group E linked to the second family used under the same conditions as for category I_{2E+}. However, appliances are fitted with a pressure governor of gas, which is adjusted and sealed by the manufacturer in the setting corresponding to the use of G 20 at 20 mbar. Nevertheless, a specific setting, for G 25 at 25 mbar, may be carried out on site by the installer, unless appliances are installed permanently on a network supply with gas of the range Ei.

Category I_{2LL}: Appliances using only gases of group LL linked to the second family, at a fixed supply pressure. On condition that the gross 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}.

A.3.2.2 Category II

A.3.2.2.1 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_{1c2E+}: Appliances capable of using gases of group c linked to the first family and gases of group E 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_{2E+}.

Category II_{1c2Esi}: Appliance capable of using gases of group c linked to the first family and gases of group E 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_{2Esi}.

Category II_{1c2Er}: Appliances capable of using gases of group c linked to the first family and gases of group E 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_{2Er}.

A.3.2.2.2 Appliances designed for the 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 $I_{3B/P}$.

A.3.2.3 Category III

Category III_{1a2H3+}: 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_{3+}.

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 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_{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 $I_{3B/P}$.

Category $III_{1ce2H3+}$: Appliances capable of using gases of groups c and E linked to the first family, gases of group H 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 categories I_{1c} and I_{1e}. 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+}.

Category $III_{1ace2H3+}$: Appliances capable of using gases of group a of the first family, gases of groups c and E 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 that are linked to it are used under the same conditions as for categories I_{1a}, I_{1c} and I_{1e}. 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+}.

A.3.3 Gas rate adjusters, aeration adjusters and governors

This clause has been included to enable certain member states to provide information equivalent to that given in 4.2.2, 4.2.3 and 4.2.5 in relation to the special categories they have requested, detailed in A.3.1.

A.3.4 Conversion to different gases

This clause has been included to enable certain member states to provide information equivalent to that given in 4.1.1.3 in relation to the special categories they have requested, detailed in A.3.1.

A.4 Test gases and test pressures corresponding to the special gases given in A.3

The characteristics of the test gases corresponding to the gases distributed nationally or locally and the test pressures are given in Table A.4 (reference conditions, dry).

Table A.4

Gas family and group	Nature of gas	Designation	Composition by volume %	W_i MJ/m^3	H_i MJ/m^3	W_s MJ/m^3	H_s MJ/m^3	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	0,413	p_n = 8 p_{min} = 6 p_{max} = 15	DE SE
	Light back	G 112	H_2 = 59 CH_4 = 17 N_2 = 24	19,48	11,81	22,36	13,56	0,367		
Group c	Reference (Propane-air)	G 130	C_3H_8 = 26,9 Air[1)] = 73,1	22,14	23,66	24,07	25,72	1,142	p_n = 8 p_{min} = 6 p_{max} = 15	FR ES[3)]
	Light back	G 132	C_3H_8 = 13,8 C_3H_6 = 13,8 Air[1)] = 72,4	22,10	23,56	23,84	25,41	1,136		
Group E	Reference (methane-air)	G 150	CH_4 = 53 Air[1)] = 47	20,65	18,03	22,93	20,02	0,762	p_n = 8 p_{min} = 6 p_{max} = 15	ES[3)]
	Light back	G 152	CH_4 = 40 Air[1)] = 54 C_3H_6 = 6	19,03	17,26	21,07	19,10	0,822		
Gases linked to the second family										
Group LL	Reference	G 25	CH_4 = 86 N_2 = 14	37,38	29,25	41,52	32,49	0,612	p_n = 20 p_{min} = 18 p_{max} = 25	DE
	Incomplete combustion Sooting	G 26	CH_4 = 80 C_3H_3 = 7 N_2 = 13	40,52	33,36	44,83	36,91	0,678		
	Light back	G 222	CH_4 = 77 H_2 = 23	42,87	28,53	48,87	31,86	0,443		
	Flame lift	G 271	CH_4 = 74 N_2 = 26	30,94	25,17	34,36	27,96	0,662		

(continued)

Table A.4 (concluded)

Gas family and group	Nature of gas	Desig-nation	Composition by volume %	W_i MJ/m^3	H_i MJ/m^3	W_s MJ/m^3	H_s MJ/m^3	d	Test pressure mbar	Country
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	0,555	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	0,684		
	Light back	G 222	CH_4 = 77 H_2 = 23	42,87	28,53	48,87	31,86	0,443		
	Lift limit	G 26	CH_4 = 80 C_3H_8 = 7 N_2 = 13	40,52	33,36	44,83	36,91	0,678		
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	0,612	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	0,678		
	Lift limit	G 231	CH_4 = 85 N_2 = 15	36,82	28,91	40,90	32,11	0,617		

1) Composition of the air (%): O_2 = 20,95; N_2 = 79,05.

2) For the characteristics of the reference gases G 20 and G 25, see Table 3.

3) 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 for appliances in multiple categories including group a of the first family.

A.5 Gas connections in the various countries

Table A.5 shows the national situations concerning the various types of gas connection specified in 4.1.5.

Table A.5 - Inlet connections permitted

	Categories I_{3+}, I_{3P}, $I_{3B/P}$			**Other categories**		
	Threaded		Other connections	Threaded		Other connections
	ISO 7-1:1994	ISO 228-1:1994		ISO 7-1:1994	ISO 228-1:1994	
AT	X	X	X	X	X	
BE	X	X	X		X	
CH	X	X	X	X	X	
CZ						
DE	X		X	X		
DK	X	X	X		X	
ES						
FI	X	X	X	X	X	
FR		X	X		X	
GB	X		X	X		X
GR						
IR	X		X	X		X
IT	X		X	X		
LU						
NL	X			X		
NO						
PT	X	X	X	X	X	X
SE						

Annex B (informative)
Guidance for limitations of application of direct-fired air heaters in buildings

The examples given below 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.

B.1 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.

B.2 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.

B.3 Assessment of concentrations

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

Table B.1 - Maximum concentration values of CO_2 versus fresh air

Description	**Unit**	**Gas type**						
		G 110	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	11,70	12,20	11,50	11,80	14,00	13,70
Stoichiometric air requirement at 15 °C	m^3/m^3	3,67	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	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	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	37,8	40,4	37,8	39,3	47,3	45,7
NOTE 1 The above assumes 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.								

B.4 Case studies

B.4.1 General

This subclause describes two very brief case studies that show how the figure of 86 kJ per cubic metre of outside air given in Table B.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).

The following simplified equation is used to calculate the heat requirement, H (in MJ/h), of the incoming air:

$$H = A \cdot V \cdot C_v \cdot T \times 10^{-3}$$

where:

A is the number of air changes per hour;

V is the room volume in cubic metres;

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

T is the temperature difference in kelvins.

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

B.4.2 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:

$$264 + 456 = 720 \text{ MJ/h} \qquad \text{(B.1)}$$

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 accordingly is:

$$720 \times \frac{103}{100} \times \frac{110}{100} = 816 \text{ MJ/h} \qquad \text{(B.2)}$$

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:

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

By comparing (B.2) and (B.3) 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:

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

B.4.3 Case study 2

B.4.3.1 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:

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

The total heat requirement of the building is:

$264 + 68 = 332$ MJ/h (B.4)

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:

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

By comparing (B.4) and (B.5) 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:

$$232 \times \frac{100}{90} = 258 \text{ MJ/h} \quad \text{(B.6)}$$

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 (from (B.4)-(B.5)).

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

$$(332 \times \frac{10}{100} + 100) \times \frac{100}{75} = 178 \text{ MJ/h} \quad \text{(B.7)}$$

This gives a total connected heating appliance load of:

$258 + 178 = 436$ MJ/h (B.8)

B.4.3.2 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. The following equation then applies:

$$(\mathrm{L} + QC_{\mathrm{v}}T \times 10^{-3}) \times \frac{110}{100} \times \frac{103}{100} = NQ \times 10^{-3}$$

Rearranging:

$$Q = \frac{1\ 130\,L}{(N - 1{,}13\,C_{\mathrm{v}}T)}$$

where:

L is the structural heat loss in megajoules per hour;

Q (= AV) is the air change volume in cubic metres per hour;

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 kelvins.

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:

$$Q = \frac{1\ 130 \times 264}{86 - [1{,}13 \times 1{,}207 \times 20-(-1)]} = 5\,197\ m^3/h$$

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:

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

B.4.3.3 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 C (informative)
A-deviations

A-deviation: National deviation due to regulations, the alteration of which is for the time being outside the competence of the CEN/CENELEC member.

This European Standard falls under Directive 90/396/EEC on the approximation of the laws of Member States concerning gas appliances.

A-deviations in an EFTA country are valid instead of the relevant provisions of the European Standard in that country until they have been removed.

Switzerland

The Swiss law (Luftreinhalte-Verordnung, LRV) of 1985-12-16 (state on 1993-01-01) is applicable instead of the requirements of 5.5 regarding emissions of CO and NO_x.

Annex D (normative)
Special national conditions

Special national condition: National characteristic 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 conditions apply these provisions are normative, for other countries they are informative.

Belgium

Appliances of category I_{2E+}, $I_{2E(R)B}$ and $I_{2E(S)B}$ marketed in Belgium shall successfully undergo a test for ignition, cross-lighting and flame stability with the limit gas G 231 at the minimum pressure of 15 mbar.

Annex ZA (informative)
Clauses of this European Standard addressing requirements or provisions of EU Directives

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports Essential Requirements of EU Directive 90/396/EEC on the approximation of the laws of Member States concerning gas appliances.

WARNING Other requirements and other EU Directives may be applicable to the products falling within the scope of this standard.

The following clauses of this standard are likely to support requirements of EU Directive 90/396/EEC. Given the number of clauses to be referenced, they have been arranged in a table.

Table ZA.1 - Identification form on the compliance of EN 12669 with the essential requirements of the EU Directive 90/396/EEC on the approximation of the laws of Member States concerning gas appliances

Essential Requirement	Subject	Relevant Clauses in EN 12669
1	General conditions	↓
1.1	Safe design and construction	Whole standard
1.2	Instructions - installer - user Warning notices - appliance - packaging Official language	 7.7.1, 7.7.2, 7.7.3, 7.7.4 7.7.5 7.4 7.5 7.7.6
1.2.1	Installer's instructions contain: - type of gas used - gas supply pressure - fresh air for combustion - products dispersal	 7.7.2 7.7.2 7.7.1, 7.7.2 Not applicable
1.2.2	User instructions contain: - all instructions - restrictions on use	 7.7.5 7.7.1
1.2.3	Warning notices state: - type of gas - gas supply pressure restrictions on use	 7.4, 7.5 7.4, 7.5 7.4, 7.7.1
1.3	Fittings Instructions	Not applicable Not applicable
2	Materials	↓
2.1	Fitness for purpose	4.1.2, 4.1.4
2.2	Properties	1

(continued)

Table ZA.1 (continued)

Essential Requirement	Subject	Relevant Clauses in EN 12669
3	Design and Construction	↓
3.1	General	↓
3.1.1	Durability	4.1.2
3.1.2	Condensation	4.1.2
3.1.3	Explosion risk	4.1.2, 4.1.6
3.1.4	Air/water penetration	Not applicable
3.1.5	Normal auxiliary energy fluctuation - appliance - controls	 4.1.10, 5.5.3, 6.3.5.3 4.2.8.1, 4.2.9.1
3.1.6	Abnormal auxiliary energy fluctuation - appliance - controls	 4.1.10, 5.5.3, 6.3.5.3 4.2.8.1, 4.2.9.1
3.1.7	Electrical hazards	4.1.9
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 - combustion air proving device	 4.2.9 4.5 4.2.8 4.10 4.4
3.1.10	Overruling of safety devices	4.2.1
3.1.11	Pre-set adjuster protection	4.2.2.1
3.1.12	Levers and setting devices	4.2.4.2
3.2	Unburned gas release	↓
3.2.1	Gas leakage	4.1.6, 5.1
3.2.2	Gas release during - ignition - re-ignition - extinction	 4.5, 4.6.2, 4.7, 5.4 4.2.8.2, 4.6.2 4.5, 4.6, 4.7
3.2.3	Unburned gas accumulation	4.5, 7.4
3.3	Ignition - ignition and cross-lighting - re-ignition - extinction	 4.3.3, 4.6, 4.7, 4.8, 5.4.1 4.6.2 4.5
3.4	Combustion	↓
3.4.1	Flame stability Harmful substances	5.4.2 5.5
3.4.2	Combustion products release	Not applicable
3.4.3	Combustion products release	Not applicable
3.4.4	Flueless domestic appliances	Not applicable

(continued)

Table ZA.1 (concluded)

Essential Requirement	Subject	Relevant Clauses in EN 12669
3.5	Rational use of energy	Foreword
3.6	Temperatures	↓
3.6.1	Floor etc. temperatures	5.3.2, 5.6
3.6.2	Temperature of knobs/levers	5.3.1
3.6.3	Temperature of external parts	Not applicable
3.7	Foodstuffs and water	Not applicable
Annex II	Certification	1
Annex III	Data plate	7.3

Compliance with this standard provides one means of conforming with the specific essential requirements of the Directive concerned and associated EFTA regulations.

blank

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: 020 8996 9000. Fax: 020 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: 020 8996 9001. Fax: 020 8996 7001.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: 020 8996 7111. Fax: 020 8996 7048.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: 020 8996 7002. Fax: 020 8996 7001.

Copyright

BSI
389 Chiswick High Road
London
W4 4AL