

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

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Summary of pages

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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.

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

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CONTENTS

	Page
FOREWORD	5
1 SCOPE	6
2 NORMATIVE REFERENCES	6
3 DEFINITIONS	7
3.1 APPLIANCE AND ITS CONSTITUENT PARTS	7
3.2 ADJUSTING, CONTROL AND SAFETY DEVICES	8
3.3 OPERATION OF THE APPLIANCE	9
3.4 GASES	11
3.5 CONDITIONS OF OPERATION AND MEASUREMENT	12
3.6 COUNTRY OF DESTINATION	13
3.7 CLASSIFICATION	13
3.7.1 <i>Classification of gases</i>	13
3.7.2 <i>Classification of appliances</i>	13
4 CONSTRUCTION AND DESIGN REQUIREMENTS	15
4.1 GENERAL	15
4.1.1 <i>Conversion to different gases</i>	15
4.1.2 <i>Materials and method of construction</i>	16
4.1.3 <i>Accessibility for maintenance and use</i>	16
4.1.4 <i>Thermal insulation</i>	17
4.1.5 <i>Gas connection</i>	17
4.1.6 <i>Soundness of the gas circuit</i>	17
4.1.7 <i>Supply and distribution of air</i>	17
4.1.8 <i>Checking the state of operation</i>	18
4.1.9 <i>Electrical equipment</i>	18
4.1.10 <i>Operational safety in the event of fluctuation, interruption, and restoration of the auxiliary energy</i>	18
4.1.11 <i>Motors and fans</i>	18
4.2 ADJUSTING, CONTROL AND SAFETY DEVICES	19
4.2.1 <i>General</i>	19
4.2.2 <i>Gas rate adjusters and range-rating devices</i>	19
4.2.3 <i>Aeration adjusters</i>	20
4.2.4 <i>Manual controls</i>	20
4.2.5 <i>Governors</i>	20
4.2.6 <i>Multifunctional controls</i>	20
4.2.7 <i>Flame supervision devices</i>	20
4.2.8 <i>Automatic shut-off valves</i>	21
4.2.9 <i>Automatic burner control systems</i>	21
4.2.10 <i>Gas strainers</i>	22
4.2.11 <i>Air strainers and filters</i>	22
4.3 IGNITION DEVICES	22
4.3.1 <i>General</i>	22
4.3.2 <i>Ignition device for the main burner</i>	22
4.3.3 <i>Ignition burners</i>	22
4.4 COMBUSTION AND DILUTION AIR, PRE-PURGE AND POST-PURGE	22
4.5 FLAME SUPERVISION SYSTEM	23
4.5.1 <i>Appliances with non-automatic burner systems</i>	23
4.5.2 <i>Appliances with automatic burner systems</i>	24
4.6 START-GAS FLAME ESTABLISHMENT	24
4.6.1 <i>Appliances with non-automatic burner systems</i>	24
4.6.2 <i>Appliances with automatic burner systems</i>	24
4.7 MAIN FLAME ESTABLISHMENT	25
4.7.1 <i>Establishment by means of a start gas flame</i>	25
4.7.2 <i>Direct establishment of the main flame</i>	25

4.8	MAIN BURNER	25
4.9	FACILITY FOR REMOTE CONTROL	25
4.10	THERMOSTATS AND CONTROL OF AIR TEMPERATURE	25
4.10.1	General	25
4.10.2	Control of delivered air temperature	26
4.10.3	Overheat cut-off device	26
4.10.4	Sensors	26
4.11	GAS PRESSURE TEST POINTS	26
4.12	FACILITIES FOR COMMISSIONING AND TESTING	26
4.12.1	General	26
4.12.2	Appliances having reduced start gas rates	26
4.13	ADDITIONAL REQUIREMENTS FOR APPLIANCES DESIGNED FOR PERMANENT OUTDOOR INSTALLATION OR WHERE AUTOMATIC IRRIGATION SYSTEMS ARE USED	27
4.13.1	General	27
4.13.2	Air inlets (outdoor appliances)	27
4.13.3	Access panels and doors	27
4.13.4	Dimensions of openings	27
4.13.5	Fixing screws	27
5	OPERATIONAL REQUIREMENTS.....	27
5.1	SOUNDNESS OF THE GAS CIRCUIT	27
5.2	HEAT INPUTS.....	28
5.2.1	Nominal heat input	28
5.2.2	Start gas heat input	28
5.2.3	Effectiveness of gas rate adjusters	28
5.2.4	Effectiveness of the gas governor	28
5.2.5	Effectiveness of the range-rating device	28
5.3	LIMITING TEMPERATURES	28
5.3.1	Temperatures of parts that have to be touched during normal use	28
5.3.2	Temperatures of the appliance casing	29
5.3.3	Component temperatures	29
5.3.4	Fan motor winding temperatures	29
5.3.5	Maximum temperature of the delivered air	29
5.4	IGNITION, CROSS-LIGHTING, FLAME STABILITY	29
5.4.1	Ignition and cross-lighting	29
5.4.2	Flame stability	29
5.5	COMBUSTION	29
5.5.1	Appliances designed to be used in greenhouses	29
5.5.2	Other appliances	30
5.5.3	Combustion air proving device(s)	30
5.5.4	CO ₂ safety device	30
5.5.5	Auxiliary energy variations	30
5.6	OVERHEAT CUT-OFF DEVICE	30
5.7	WATER RESISTANCE	30
6	TEST METHODS	31
6.1	GENERAL	31
6.1.1	Characteristics of test gases: reference and limit gases	31
6.1.2	Conditions for preparation of the test gases	31
6.1.3	Practical application of test gases	33
6.1.4	Test pressures	35
6.1.5	Test procedures	36
6.1.6	General test conditions	36
6.2	CONSTRUCTION AND DESIGN	37
6.2.1	Automatic burner control systems (manually operated devices)	37
6.2.2	Ignition opening time	37
6.2.3	Ignition of the ignition burner with the downstream main gas automatic shut-off valve open	37
6.2.4	Combustion air proving device(s)	38

6.3	SAFETY OF OPERATION	38
6.3.1	<i>Soundness of the gas circuit</i>	38
6.3.2	<i>Heat inputs</i>	38
6.3.3	<i>Limiting temperatures</i>	40
6.3.4	<i>Ignition, cross-lighting and flame stability</i>	44
6.3.5	<i>Combustion</i>	45
6.3.6	<i>Overheat cut-off device</i>	46
6.3.7	<i>Water resistance</i>	47
7	MARKING AND INSTRUCTIONS	50
7.1	GENERAL	50
7.2	DESCRIPTION	50
7.3	DATA PLATE AND LABELLING	50
7.4	OTHER MARKING	51
7.5	MARKING ON THE PACKAGING	51
7.6	UTILIZATION OF SYMBOLS ON THE APPLIANCE AND PACKAGING	51
7.6.1	<i>Electrical supply</i>	51
7.6.2	<i>Type of gas</i>	52
7.6.3	<i>Gas supply pressure</i>	52
7.6.4	<i>Country of destination</i>	52
7.6.5	<i>Category</i>	53
7.6.6	<i>Other information</i>	53
7.7	INSTRUCTIONS	54
7.7.1	<i>General</i>	54
7.7.2	<i>Technical instructions for installation and adjustment</i>	55
7.7.3	<i>Instructions for conversion</i>	56
7.7.4	<i>Instructions for servicing</i>	56
7.7.5	<i>Instructions for use and maintenance</i>	56
7.7.6	<i>Presentation</i>	56
	ANNEX A (INFORMATIVE) NATIONAL SITUATIONS	57
A.1	CATEGORIES LISTED IN THE BODY OF THE STANDARD AND MARKETING IN THE DIFFERENT COUNTRIES	58
A.2	APPLIANCE SUPPLY PRESSURES CORRESPONDING TO THE CATEGORIES GIVEN IN A.1	60
A.3	SPECIAL CATEGORIES MARKETING NATIONALLY OR LOCALLY	61
A.4	TEST GASES AND TEST PRESSURES CORRESPONDING TO THE SPECIAL GASES GIVEN IN A.3	65
A.5	GAS CONNECTIONS IN THE VARIOUS COUNTRIES	67
	ANNEX B (INFORMATIVE) GUIDANCE FOR LIMITATIONS OF APPLICATION OF DIRECT-FIRED AIR HEATERS IN BUILDINGS	68
B.1	GENERAL PRINCIPLES	68
B.2	SAFE OPERATING EMISSION LEVELS	68
B.3	ASSESSMENT OF CONCENTRATIONS	68
B.4	CASE STUDIES	69
	ANNEX C (INFORMATIVE) A-DEVIATIONS	72
	ANNEX D (NORMATIVE) SPECIAL NATIONAL CONDITIONS	73
	ANNEX ZA (INFORMATIVE) CLAUSES OF THIS EUROPEAN STANDARD ADDRESSING REQUIREMENTS OR PROVISIONS OF EU DIRECTIVES	74

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 A₃ 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 CO₂ safety device: A device which monitors the CO₂ 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 I₃₊: Appliances capable of using gases of the third family (propane and butane) and operating with a pressure couple without adjustment of the appliance. However, for certain types of appliance specified in the particular standards, adjustment of the primary combustion air may be permitted when changing from propane to butane and vice versa. No gas pressure regulating device is permitted on the appliance.

Category I_{3P}: Appliances using only gases 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 I₃₊.

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

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

Category II_{2L3P}: Appliances capable of using 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 I₃₊.

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 A₃: 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 I₃₊: 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.