

Multi-burner gas-fired overhead radiant tube heater systems for non-domestic use —

Part 2: System E, safety

The European Standard EN 777-2:1999, with the incorporation of amendments A1:2001, A2:2001 and A3:2002, has the status of a British Standard

ICS 97.100.20

National foreword

This British Standard is the official English language version of EN 777-2:1999, including amendments A1:2001, A2:2001 and A3:2002.

The UK participation in its preparation was entrusted to Technical Committee GSE/20, Non-domestic space 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 committee can be obtained on request to its secretary.

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Summary of pages

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English version

**Multi-burner gas-fired overhead radiant tube heater systems for
non-domestic use – Part 2: System E, safety
(includes amendments A1:2001 A2:2001 and A3:2002)**

Tubes radiants suspendus à multi-brûleurs utilisant les
combustibles gazeux à usage non-domestique – Partie 2:
Système E, sécurité
(inclut les amendements A1:2001 A2:2001 et A3:2002)

Gasgeräte-Heizstrahler Dunkelstrahlersysteme mit
mehreren Brennern mit Gebläse für gewerbliche und
industrielle Anwendung – Teil 2: System E, Sicherheit
(enthält Änderungen A1:2001 A2:2001 und A3:2002)

This European Standard was approved by CEN on 15 November 1998. Amendment A1:2001 was approved by CEN on 2000-11-27. Amendment A2:2001 was approved by CEN on 2001-06-09 Amendment A3:2002 was approved by CEN on 2002-03-05.

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

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 180, Non-domestic gas-fired overhead radiant heaters, the Secretariat of which is held by BSI.

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 March 2000, and conflicting national standards shall be withdrawn at the latest by March 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

Other parts of EN 777 covering multi-burner gas-fired overhead radiant tube heater systems for non-domestic use are as follows:

Part 1: System D, Safety

Part 3: System F, Safety

Part 4: System H, Safety

Many requirements of EN 416-1, *Single burner gas-fired overhead radiant tube heaters for non-domestic use — Part 1: Safety*, are also applicable to EN 777-2, *Multi-burner gas-fired overhead radiant tube heater systems for non-domestic use — Part 2: System E, safety*.

In order to facilitate the reading of EN 777-2, it was decided that instead of using cross references it would be preferable to reproduce the parts of the text of EN 416-1 which apply also for multi-burner systems. These parts are reproduced without change.

Test methods for rational use of energy are dealt with in European Pre-standards ENV 1259-1, ENV 1259-2 and ENV 1259-3.

The test gases, test pressures and appliances categories given in this European Standard are in accordance with those specified in EN 437:1993 + A1:1997 + A2:1999, *Test gases — Test pressures — Appliance categories*.

Foreword to amendment A1

This amendment EN 777-2:1999/A1:2001 to EN 777-2:1999 has been prepared by Technical Committee CEN/TC 180, Non-domestic gas-fired overhead radiant heaters, the Secretariat of which is held by BSI.

This amendment to the European Standard EN 777-2:1999 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2001, and conflicting national standards shall be withdrawn at the latest by August 2001.

This amendment to the European Standard EN 777-2:1999 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).

This amendment modifies EN 777-2:1999. It has been prepared to incorporate requirements and test methods concerning NO_x emissions of non-domestic multi-burner gas-fired overhead radiant tube heater systems.

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, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Foreword to amendment A2

This amendment EN 777-2:1999/A2:2001 to EN 777-2:1999 has been prepared by Technical Committee CEN/TC 180, Non-domestic gas-fired overhead radiant heaters, the Secretariat of which is held by BSI.

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 January 2002, and conflicting national standards shall be withdrawn at the latest by January 2002.

This amendment to the European Standard EN 777-2:1999 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).

This amendment modifies EN 777-2:1999. It has been prepared to incorporate the general amendments to EN 777-2:1999 and EN 437:1993 + A1:1997 + A2:1999.

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.

Foreword to amendment A3

This document EN 777-2:1999/A3:2002 has been prepared by Technical Committee CEN/TC 180, Non-domestic gas-fired overhead radiant heaters, the Secretariat of which is held by BSI.

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 October 2002, and conflicting national standards shall be withdrawn at the latest by October 2002.

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

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, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

This amendment modifies EN 777-2:1999. It has been prepared to align the requirements for automatic shut-off valves with those in EN 416-1:1999/A3:2002.

1 Scope

This European Standard specifies the requirements and test methods for the construction, safety, classification and marking of non-domestic gas-fired overhead radiant tube heaters incorporated into a multi-burner system (called system E and referred to in the body of the text as the 'system') with each burner unit under the control of an automatic burner control system.

This standard is applicable to Type B₂₂ and Type B₂₃ systems (see 4.3) intended for use in other than domestic dwellings, in which the supply of combustion air and/or the evacuation of the products of combustion is achieved by mechanical means.

This standard is not applicable to:

- systems designed for use in domestic dwellings;
- outdoor systems;
- systems in which the heat input of an individual burner unit exceeds 120 kW (based on the net calorific value of the appropriate reference test gas);
- systems having a draught diverter incorporated between the exhaust fan and the flue duct;
- systems having fully pre-mixed gas and air burners in which:
 - either the gas and all the combustion air are brought together just before the level of the combustion zone;
 - or the pre-mixing of the gas and all combustion air is carried out in a part of the burner upstream of the combustion zone.

This European Standard is applicable to systems which are intended to be type tested. Requirements for systems which are not intended to be type tested would need to be subject to further consideration.

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

2 Normative references

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 126:1995, *Multifunctional controls with thermo-electric flame failure devices for gas burning appliances*

EN 161:1991, *Automatic shut-off valves for gas burners and gas appliances*

EN 257:1992 + A1:1996, *Mechanical thermostats for gas burning appliances*

EN 298:1993, *Automatic burner control systems for gas burners and gas burning appliances with or without fans*

EN 437:1993 + A1:1997 + A2:1999, *Test gases — Test pressures — Appliance categories*

EN 23166:1993, *Codes for the representation of names of countries* (ISO 3166:1993)

EN 50165:1997 + A1:2001, *Electrical equipment of non-electrical heating appliances for household and similar purposes, safety requirement*

EN 60335-1:1988, *Safety of household and similar electrical appliances — Part 1: General requirements* (IEC 335-1:1983)

EN 60529:1991, *Degrees of protection provided by enclosures (IP Code)* (IEC 529:1989)

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

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

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

IEC 479, *Effects of current on human beings and livestock*

IEC 479-1:1994, *Part 1: General aspects*

IEC 479-2:1987, *Part 2: Special aspects*

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

ISO 6976: 1995, *Natural gas — Calculation of the 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 flanges and composite flanges*

3 Definitions

For the purposes of this standard the following definitions apply:

3.1 system and its constituent parts

3.1.1

overhead radiant tube heater

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

3.1.2

multi-burner systems

those radiant tube heater systems which employ two or more burner units with each unit incorporating independent flame monitoring. The units may be located in one or more sections of tubing. One or more fans may be used to assist in the evacuation of products of combustion or the supply of combustion air

System E: A system in which individual units with a fan are connected to a common duct without a fan. Only one burner unit is situated in each branch tube. The fan may be at either end of the branch tube (see 4.3 and Annex A)

3.1.3

branch tube

for the purposes of this part, a tube in which only one burner unit is situated and which only contains the products of combustion generated by this burner

3.1.4

common duct

a duct which receives products of combustion from two or more branch tubes for the purposes of evacuation to the outside

3.1.5

individual burner unit

a unit comprising a main burner and, if appropriate, an ignition burner. In addition, such components as are necessary to ignite the burner(s), monitor the flame and control the gas supply to the burner(s) are included in the unit

3.1.6

inlet connection

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

3.1.7

mechanical joint (mechanical means of obtaining soundness)

a means of ensuring the soundness of an assembly of several (generally metallic) parts without the use of liquids, pastes, tapes, etc.

NOTE For example the following:

- metal to metal joints;
- conical joints;
- toroidal sealing rings ("O" rings);
- flat joints.

3.1.8

gas circuit

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

3.1.9

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

3.1.10

gas rate adjuster

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

NOTE Adjustment can 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.

3.1.11

setting an adjuster

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

3.1.12

sealing an adjuster

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

NOTE A factory sealed adjuster, i.e. an adjuster sealed by the system manufacturer, is considered to be non-existent.

A governor is considered to be non-existent if it has been factory sealed, i.e. by the system manufacturer in a position such that it is not operational in the range of the normal supply pressure corresponding to the system category.

3.1.13

putting an adjuster or a control out of service

an adjuster or a control (of temperature, pressure, etc.) is said to be 'put out of service' if it is put out of action and sealed in this position. The burner unit then functions as if this device has been removed

3.1.14

injector

a component that admits the gas into a burner

3.1.15

main burner

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

3.1.16

ignition device

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

NOTE This device can operate intermittently or permanently.

3.1.17

ignition burner

a burner whose flame is intended to ignite another burner.

3.1.18

primary aeration adjuster

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

3.1.19 combustion products circuit

3.1.19.1

combustion chamber

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

3.1.19.2

flue outlet

the part of a type B system that connects with a flue to evacuate the products of combustion

3.1.19.3

draught diverter

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

3.1.20

range-rating device

a component on the burner unit intended to be used by the installer to adjust the heat input of the burner unit, 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).

3.1.21

zero governor

a device which maintains a specified downstream pressure between it and a gas orifice at zero pressure within fixed limits independent of variation within a given range of upstream pressure and negative pressure downstream of the gas orifice

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. The programming unit 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 detector

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.

3.2.5

flame signal

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

3.2.6

flame simulation

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

3.2.7

pressure governor¹⁾

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

3.2.8

adjustable pressure governor

a governor provided with means for changing the outlet pressure setting

3.2.9

flame supervision device

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

3.2.10

automatic shut-off valve

a device that automatically opens, closes or varies the gas rate on a signal from the control circuit and/or the safety circuit

3.3 operation of the system

3.3.1

heat input

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

Symbol: Q

Unit: kilowatt (kW).

[EN 437:1993 + A2:1999]

¹⁾ The term “governor” is used in this case and for a volume governor.

3.3.2

nominal heat input

the value of heat input declared by the manufacturer

Symbol: Q_n

Unit: kilowatt (kW)

[EN 437:1993 + A2:1999]

3.3.3

volume flow rate

the volume of gas consumed by the system 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).

3.3.4

mass flow rate

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

Symbol: M

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

3.3.5

flame stability

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

3.3.6

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 blow out, i.e. extinction of the air-gas mixture.

3.3.7

light-back

the entry of a flame into the body of the burner

3.3.8

light-back at the injector

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

3.3.9

sooting

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

3.3.10

yellow tipping

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

3.3.11

purge

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

pre-purge: The purge which takes place between the start signal and the energizing of the ignition device.

post-purge: The purge which takes place immediately following shut-down.

3.3.12

first safety time²⁾

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

3.3.13

second safety time

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

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

3.3.14**extinction safety time**

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

3.3.15**start-gas flame**

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

3.3.16**running condition of the system**

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

3.3.17**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

3.3.18**safety shut-down**

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

3.3.19 lock out**3.3.19.1****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

3.3.19.2**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 a failure of the mains electrical supply and its subsequent restoration

3.3.20**spark restoration**

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

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

3.3.21**automatic recycling**

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

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

3.4 gases**3.4.1****calorific value**

the quantity of heat produced by the complete combustion, at a constant pressure of 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 reference conditions, or
- megajoule per kilogram (MJ/kg) of dry gas. [EN 437:1993 + A2:1999]

3.4.2

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

3.4.3

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 said to be gross or net according to whether the calorific value used is the gross or net calorific value

Symbol: 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. [EN 437:1993 + A2:1999]

3.4.4

test pressures

gas pressures used to verify the operational characteristics of systems using combustible gases. They consist of normal and limit pressures

Unit: millibar (mbar).

NOTE 1 mbar = 10^2 Pa.

3.4.5

normal pressure

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

Symbol: p_n

3.4.6

limit pressures

pressures representative of the extreme variations in the system supply conditions

Symbol: maximum pressure: $p_{\max}$;
 minimum pressure: $p_{\min}$.

3.4.7

pressure couple

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

- the higher pressure corresponds only to gases of low Wobbe index;
- the lower pressure corresponds to gases of high Wobbe index.
[EN 437:1993 + A2:1999]

3.5 conditions of operation and measurement

3.5.1

reference conditions

in this standard the following reference conditions apply:

- 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 installation required for some tests and obtained by allowing the unlit burner unit to attain thermal equilibrium at room temperature

3.5.3

hot condition

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

3.5.4

equivalent resistance

the resistance to flow in millibar, measured at the outlet of the system, which is equivalent to that of the actual flue

3.5.5

thermal equilibrium

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

3.6 country of destination

3.6.1

direct country of destination

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

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

3.6.2

indirect country of destination

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

4 Classification of systems

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

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

Table 1 — Classification of gases

Gas families	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

4.2 Classification according to the gases capable of being used

4.2.1 Category I: Systems of category I are designed exclusively for the use of gases of a single family or of a single group.

a) Systems designed for use on first family gases only

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

b) Systems designed for use on second family gases only

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

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

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

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

c) Systems designed for use on third family gases only

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

Category I₃₊: Systems capable of using the third family gases (propane and butane) and operating with a pressure couple without adjustment of the system. However for certain types of system 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 system.

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

4.2.2 Category II: Systems of category II are designed for use on gases of two families.

a) Systems designed for use on gases of the first and second families

Category II_{1a2H}: Systems 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}.

b) Systems designed for use on gases of the second and third families

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

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

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

This category is not in general use.

Categories III Systems which are in certain countries are given in Annex B (see B.3).

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

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

Type B: A system intended for connection to a flue which evacuates the products of combustion to the outside of the room containing the system. The combustion air is drawn directly from the room.

Type B₂: A type B system without a draught-diverter.

For systems in which the combustion air is supplied and/or in which the products of combustion are evacuated by mechanical means, two types are identified.

Type B₂₂: A type B₂ system incorporating a fan downstream of the combustion chamber/heat-exchanger.

Type B₂₃: A type B₂ system incorporating a fan upstream of the combustion chamber/heat-exchanger.

5 Constructional requirements

5.1 General

5.1.1 *Conversion to different gases*

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

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

5.1.1.1 *Category I*

Categories I_{2H}, I_{2L}, I_{2E}, I_{2E+}: no modification to the system.

Category I_{3B/P}: no modification to the system.

Category I₃₊: replacement of injectors or calibrated orifices but only in order to convert from one pressure couple to another, (e.g. 28-30/37 mbar $\leq$ $\geq$ 50/67 mbar).

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

5.1.1.2 *Category II*

5.1.1.2.1 *Categories of systems 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, either by using an adjuster or by a change of injector or restrictor and, if necessary, a change of the complete ignition burner or of some of its parts.

Putting the governor out of service under the conditions of **5.2.6**.

Putting the gas rate adjuster(s) out of service under the conditions of **5.2.1** and **5.2.2** if applicable.

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

5.1.1.2.2 *Categories of systems 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, either by using an adjuster or by a change of injector or restrictor and if necessary, a change of the complete ignition burner or of some of its parts.

Putting the governor out of service under the conditions of **5.2.6**.

Putting the gas rate adjuster(s) out of service under the conditions given in **5.2.1** and **5.2.2** if applicable.

The 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. 28-30/37 mbar $\Leftrightarrow$ 50/67 mbar).

5.1.1.3 *Category III*

Category III systems admitted in certain countries are given in Annex B (see **B.3.2.3**).

5.1.2 *Materials and method of construction*

The quality and thickness of materials used in the construction of a system shall be:

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

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

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

Asbestos or materials containing asbestos shall not be used.

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

5.1.3 *Accessibility for maintenance and use*

Components and controls shall be arranged such that any adjustment, maintenance or exchange is easy without removing the radiant tube from the installed position. Where necessary access doors or removable panels shall be provided.

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

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

5.1.4 *Means of sealing*

5.1.4.1 *Soundness of the gas circuit*

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

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

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

5.1.4.2 *Soundness of the combustion circuit*

The soundness of the combustion circuit of the system shall be effected by mechanical means only, with the exception of those parts which do not require to be disconnected for routine maintenance, and which may be joined with mastic or paste in such a way that permanent soundness is assured under normal conditions of use. (See 8.2.2.1 c)). The means of sealing the connection shall be the same for both the common duct and the branch duct.

5.1.5 Supply of combustion air and evacuation of combustion products

5.1.5.1 Air inlets

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

5.1.5.2 Combustion circuit

The cross section of the combustion circuit shall be adjustable by means of one or more dampers to permit individual sections of the system to be adjusted within prescribed limits of suction in the combustion circuit, as declared by the manufacturer for the correct operation of the system.

Each damper shall be supplied by the manufacturer and once adjusted shall be capable of being locked and sealed in position.

With the damper in its fully closed position, there shall be at least 2 % of the cross-sectional area of the tube open to permit the venting of any gas build up.

5.1.5.3 Flue outlet

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

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

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

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

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

5.1.6 Inlet connections

The burner unit inlet connection shall be one of the following types:

- a) a thread conforming to ISO 228-1: 1994. In this case the end of the gas inlet connection shall have a flat annular surface at least 3 mm wide for thread sizes $\frac{1}{2}$ and $\frac{3}{8}$ and at least 2,5 mm wide for thread size $\frac{1}{4}$, to allow the interposition of a sealing washer. Moreover, when the end of the gas inlet connection has a thread of nominal size $\frac{1}{2}$, it shall be possible to insert a gauge of 12,3 mm diameter to a depth of at least 4 mm;
- b) a thread conforming to ISO 7-1:1994;
- c) a compression fitting suitable for copper tube conforming to Table 2 of ISO 274:1975;
- d) a straight tube at least 30 mm long, the end of which is cylindrical, smooth and clean, to allow connection by means of a compression fitting as specified in c);
- e) a flange to ISO 7005-1:1992, ISO 7005-2:1988 or ISO 7005-3:1988.

NOTE conditions of inlet connections prevailing in the various countries are given in **B.5**.

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

5.1.7 Confirmation of operation

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

It shall at all times be possible for the user to ascertain visually whether a burner unit is in operation or has gone to volatile or non-volatile lock-out.

- a) Where mirrors or windows are used, their optical properties shall not have deteriorated at the completion of all the tests specified in this standard.
- b) Where indicator lights are used their purpose shall be clearly and permanently identified on the system, or on the plate or label required by **8.1.2**. The indicator lighting circuitry shall be so designed and arranged that;
 - 1) it indicates when a supervised flame is present and, in the case of a supervised ignition burner, it also indicates when the main burner is in operation;
 - 2) any failure arising in the indicator lighting circuitry shall either not affect the operation of any safety device or prevent the operation of the system.

5.1.8 *Electrical equipment*

The electrical equipment of the system shall be so designed and constructed as to obviate hazards of electrical origin and shall comply with the requirements of EN 50165:1997/A1:2001 which cover such hazards.

If the system is fitted with electronic components or electronic systems providing a safety function, these shall comply with the relevant requirements of EN 298:1993 with regard to electromagnetic compatibility immunity levels.

If the manufacturer specifies the nature of the electrical protection of the system on the data plate, this specification shall comply with EN 60529:1991.

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

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

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

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

NOTE Requirements relating to the continued and safe operation of the system in the event of normal and abnormal fluctuations of auxiliary energy is specified in **6.6.1.4**.

5.1.10 *Motors and fans*

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

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

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

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

Lubrication points, if provided, shall be readily accessible.

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

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

Lubrication points, if provided, shall be readily accessible.

5.2 Requirements for adjusting, control and safety devices

5.2.1 General

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

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

5.2.2 Gas rate adjusters

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

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

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

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

5.2.3 Range-rating devices

A range rating device on a system is optional.

For systems 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 system is supplied with a second family gas, the gas rate adjuster or its sealed part shall no longer be used by the installer as a range rating device.

5.2.4 Aeration adjusters

Aeration adjusters are not permitted.

5.2.5 Manual controls

5.2.5.1 Application

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

5.2.5.2 Manual valves

Manual valves shall be of the 90° turn type.

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

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

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

5.2.6 Governors

Governors shall comply with EN 88:1991.

Unless a zero governor is fitted, for a system 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 a system burning third family gases, the fitting of a governor is optional.

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.

However, for systems in categories I_{2E+}, II_{2E+3+} and II_{2E+3P} the gas governor, shall not be operational in the range of the two normal pressures of the second family pressure couple, i.e. 20 mbar to 25 mbar. For systems in categories II_{2E+3+} and II_{2E+3P} 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 mbar to 25 mbar.

5.2.7 Multifunctional controls

Multifunctional controls shall comply with EN 126:1995.

