



BSI Standards Publication

Gas-fired overhead radiant strip heaters and multi-burner continuous radiant tube heater systems for non-domestic use — Safety and energy efficiency

National foreword

This British Standard is the UK implementation of EN 17175:2019. Together with BS EN 416:2019, it supersedes BS EN 416-1:2009 and BS EN 416-2:2006.

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

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

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English Version

**Gas-fired overhead radiant strip heaters and multi-burner
continuous radiant tube heater systems for non-domestic
use - Safety and energy efficiency**

Bandes radiantes et systèmes à tubes radiants continus
à brûleurs multiples suspendus à usage non
domestique utilisant les combustibles gazeux - Sécurité
et efficacité énergétique

Gasbefeuerte Strahlungsheizstreifen und
Dunkelstrahlersysteme mit mehreren Brennern für
gewerbliche und industrielle Anwendungen -
Sicherheit und Energieeffizienz

This European Standard was approved by CEN on 26 August 2019.

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 17175:2019) has been prepared by Technical Committee CEN/TC 180 “Decentralized gas heating”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by month year of DOP, and conflicting national standards shall be withdrawn at the latest by month year of DOW.

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

This document supersedes EN 416-1:2009, EN 416-2:2006 and EN 777-4:2009.

In comparison with the previous editions, the following technical modifications have been made:

- aspects of safety and energy efficiency of appliances are brought together;
- incorporation recent state of art of overhead radiant strips heaters and multi-burner continuous radiant tube heater systems;
- unique and more detailed description of method to determine radiant factor;
- incorporating terms and calculation scheme of Ecodesign Regulation (EU) No. 2015/1188;
- minimum requirements of an optional flue gas heat exchanger.

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).

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

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This document specifies the requirements and test methods for the construction, safety, classification, marking and efficiency of non-domestic gas-fired overhead radiant strips heaters and multi-burner continuous radiant tube heater systems (referred to in the body of the text as the “system”) with each burner unit under the control of an automatic burner control system.

For radiant strip heaters incorporating a single burner, this standard is applicable to Type B₂₂, B₂₃, B₅₂, B₅₃, C₁₂, C₁₃, C₃₂, C₃₃, C₅₂ and C₅₃ appliances intended for use in other than domestic dwellings, in which the supply of combustion air and/or the evacuation of the products of combustion is achieved by mechanical means.

For multi-burner continuous radiant tube heater systems this standard is applicable to type B₂₂, B₅₂, and C₅₂ appliances intended for use in other than domestic dwellings, in which the supply of combustion air and/or the evacuation of the products of combustion is achieved by mechanical means.

This document also includes appliances incorporating a secondary heat exchanger in the flue system.

This document is not applicable to:

- a) appliances designed for use in domestic dwelling;
- b) outdoor appliances;
- c) radiant strip heaters where the heat input is in excess of 300 kW (based on the net calorific value of the appropriate reference test gas);
- d) continuous radiant tube heater systems where the heat input of any individual burner unit is in excess of 70 kW (based on the net calorific value of the appropriate reference test gas);
- e) appliances having combustion products evacuation ducts that are non-metallic in the flue system – except ducts downstream of a possible additional condensing exhaust gas heat exchanger.

In addition, for heater systems incorporating multiple tube heaters this standard is not applicable to:

- f) appliances that are designed for continuous condensation within the flue system under normal operating conditions – except downstream a possible additional exhaust gas heat exchanger.

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

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 88-1:2011+A1:2016, *Pressure regulators and associated safety devices for gas appliances - Part 1: Pressure regulators for inlet pressures up to and including 50 kPa*

EN 126:2012, *Multifunctional controls for gas burning appliances*

EN 161:2011+A3:2013, *Automatic shut-off valves for gas burners and gas appliances*

EN 257:2010, *Mechanical thermostats for gas-burning appliances*

EN 298:2012, *Automatic burner control systems for burners and appliances burning gaseous or liquid fuels*

EN 437:2003+A1:2009, *Test gases - Test pressures - Appliance categories*

EN 1057:2006+A1:2010, *Copper and copper alloys - Seamless, round copper tubes for water and gas in sanitary and heating applications*

EN 1106:2010, *Manually operated taps for gas burning appliances*

EN 1856-1:2009, *Chimneys - Requirements for metal chimneys - Part 1: System chimney products*

EN 1859:2009+A1:2013, *Chimneys - Metal chimneys - Test methods*

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

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

EN 12067-2:2004, *Gas/air ratio controls for gas burners and gas burning appliances - Part 2: Electronic types*

EN 13216-1:2004, *Chimneys - Test methods for system chimneys - Part 1: General test methods*

EN 13410:2001, *Gas-fired overhead radiant heaters - Ventilation requirements for non-domestic premises*

EN 14459:2015, *Safety and control devices for burners and appliances burning gaseous or liquid fuels - Control functions in electronic systems - Methods for classification and assessment*

EN 14597:2012, *Temperature control devices and temperature limiters for heat generating systems*

EN 14800:2007, *Corrugated safety metal hose assemblies for the connection of domestic appliances using gaseous fuels*

EN 60335-1:2012, *Household and similar electrical appliances - Safety - Part 1: General requirements (IEC 60335-1:2010)*

EN 60335-2-102:2016, *Household and similar electrical appliances - Safety - Part 2-102: Particular requirements for gas, oil and solid-fuel burning appliances having electrical connection (IEC 60335-2-102:2004)s*

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

EN 60584-1:2013, *Thermocouples - Part 1: EMF specifications and tolerances (IEC 60584-1:2013)*

EN 60730-2-9:2010, *Automatic electrical controls for household and similar use - Part 2-9: Particular requirements for temperature sensing controls (IEC 60730-2-9:2008)*

EN 60751:2008, *Industrial platinum resistance thermometers and platinum temperature sensors (IEC 60751:2008)*

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

EN ISO 3166-1:2014, *Codes for the representation of names of countries and their subdivisions - Part 1: Country codes (ISO 3166-1:2013)*

ISO 7-1, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 7005-1:2011, *Pipe flanges — Part 1: Steel flanges for industrial and general service piping systems*

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

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

3 Terms, definitions and symbols

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 System and its constituent parts

3.1.1

radiant strip

gas fired appliance intended for installation above head level which is designed to heat the space beneath by radiation by means of a strip or large tubes with diameters from 105 – 400 mm, heated by the internal passage of recirculated combustion products, producing a max. surface temperature of the radiant strip tube of 400°C, the radiant strip tubes being thermally insulated on the top with a suitable and durable thermal isolation and thermally protected on the side

3.1.2

single burner heater

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

3.1.3

multi-burner continuous radiant tube heater system

any of the following:

- 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; or
- multi-burner continuous radiant tube heaters which employ two or more, in series and/or parallel connected, fully premixed gas/air burner units with each unit incorporating independent flame monitoring; or
- heaters in which individual units without fans are connected to a common duct with a fan. One or more burner units are situated in each branch tube (see Annex B)

Note 1 to entry: 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.

3.1.4

radiant strip tube

strip or large tubes with diameters from 105 – 400 mm in which one burner unit is situated and which only contains the products of combustion generated by this burner

3.1.5

continuous radiant tube heater branch tube

tube in which one or more burner units is/are situated and which only contains the products of combustion generated by this, or these, burners

3.1.6

burner and recirculation unit (radiant strips)

unit equipped with a main burner, and if appropriate, an ignition burner, a fan that sucks the exhausted products of combustion at the end of the radiant strips, recirculating a part of them another time in the radiant strip

Note 1 to entry: The remaining part of the exhaust products will be evacuate through a flue outlet.

Note 2 to entry: A combustion chamber protects the burner head from the recirculation flow and permits the mixing of the hot recirculating combustion products with new produced combustion products. The section of the recirculation, between the fan and the combustion chamber of the recirculation unit, may have a fixed or adjustable section.

3.1.7

individual burner unit (multi-burner continuous radiant tube heater systems)

unit comprising a main burner and, if appropriate, an ignition burner

Note 1 to entry: In addition, such components which are necessary to ignite the burner(s), monitor the flame and control the gas supply to the burner(s) are included in the unit

3.1.8

inlet connection

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

3.1.9

mechanical joint

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

3.1.10

gas circuit

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

3.1.11

restrictor

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

3.1.12

gas rate adjuster

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

Note 1 to entry: Adjustment can be progressive (screw adjuster) or in discrete steps (by changing restrictors).

Note 2 to entry: The adjusting screw of an adjustable regulator is regarded as a gas rate adjuster.

Note 3 to entry: The action of adjusting this device is called "adjusting the gas rate".

Note 4 to entry: A factory sealed gas rate adjuster is considered to be non-existent.

Note 5 to entry: Immobilizing a gas rate adjuster by means as e.g. a screw is called “setting an adjuster”.

Note 6 to entry: 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 is called “sealing an adjuster”.

Note 7 to entry: A gas rate adjuster 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.

Note 8 to entry: Putting an adjuster or a control (of temperature, pressure, etc.) out of action and sealing it in this position is called “putting an adjuster or a control out of service”; the appliance functions as if the adjuster or control had been removed.

3.1.13

injector

component that admits the gas into a burner

3.1.14

main burner

burner that is intended to ensure the thermal function of the appliance

Note 1 to entry: Main burner is generally called “the burner”

3.1.15

ignition device

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

Note 1 to entry: This device can operate intermittently or permanently.

3.1.16

ignition burner

burner whose flame is intended to ignite another burner

3.1.17

fully pre-mixed gas/air burner

pre-aerated burner system in which gas is mixed in a pre-determined and adjustable ratio with all of the air necessary for combustion

3.1.18

aeration orifice

device in a burner unit enabling a volume of combustion air to enter the burner or point of combustion consistent with the gas flow through the gas orifice and variable with downstream negative pressure

3.1.19

primary aeration adjuster

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

3.1.20

System aeration adjuster

one or more devices enabling the air flow condition within a branch tube or common duct to be set to design values

3.1.21

flue gas heat exchanger

heat exchanger directly mounted in the flue system to transfer heat from the combustion products to a heat sink

3.2 Combustion circuit

3.2.1

combustion products circuit

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

3.2.2

air supply and combustion products evacuation ducts

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

Note 1 to entry: A fitting piece is not utilized by appliances of Type C₁ or of Type C₃. It is necessary to distinguish between:

- a) completely surrounded ducts where the combustion products evacuation duct is surrounded by combustion air throughout its length; and
- b) separate ducts where the combustion products evacuation duct and the combustion air supply duct are neither concentric nor completely surrounded ducts.

3.2.3

combustion chamber

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

3.2.4

flue outlet

part of a Type B or C system that connects with a flue to evacuate the products of combustion

3.2.5

terminal

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

3.2.6

terminal guard

device that protects the terminal from mechanical damage from outside influences

3.2.7

POCED

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

3.3 Adjusting, control and safety devices

3.3.1

automatic burner control system

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

Note 1 to entry: The various functions of an automatic burner control system may be in one or more housings.

3.3.2**programming unit**

device which executes the programme reacting to signals from control and safety devices, gives control commands, controls the start-up sequence, supervises the burner operation and causes controlled shut-down, and if necessary safety shut-down and lock-out

Note 1 to entry: The programming unit follows a predetermined sequence of actions and always operates in conjunction with a flame detector device. Such a sequence of operations involving switching on, starting up, supervising and switching off the burner is called “programme”.

3.3.3**flame detector**

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

Note 1 to entry: 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

3.3.4**flame signal**

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

3.3.5**pressure regulator**

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

3.3.6**adjustable pressure regulator**

regulator provided with means for changing the outlet pressure setting

3.3.7**volume regulator**

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

3.3.8**flame supervision device**

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

3.3.9**flame simulation**

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

3.3.10**range-rating device**

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

Note 1 to entry: This adjustment may be progressive (e.g. by use of a screw adjuster) or in discrete steps (e.g. by changing restrictors).

3.3.11

zero regulator

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

3.3.12

automatic vacuum regulator

device which maintains a constant negative pressure at a specified position within the tube both at start-up and at thermal equilibrium conditions

3.3.13

automatic shut-off valve

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

3.4 Operation of the appliance

3.4.1

heat input

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

Note 1 to entry: The heat input is expressed in kW

[SOURCE: EN 437:2003+A1:2009]

3.4.2

nominal heat input

$Q_{in, nom}$
value of the heat input (kW) declared by the manufacturer

Note 1 to entry: The heat input is expressed in kW

[SOURCE: EN 437:2003+A1:2009]

3.4.3

volume flow rate

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

Note 1 to entry: The volume flow rate is expressed in m³/h, l/min, dm³/h or dm³/s

[SOURCE: EN 437:2003+A1:2009]

3.4.4

mass flow rate

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

Note 1 to entry: The mass flow rate is expressed in kg/h or g/h

[SOURCE: EN 437:2003+A1:2009]

3.4.5**start gas**

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

3.4.6**start gas rate**

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

3.4.7**start gas flame**

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

3.4.8**flame stability**

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

3.4.9**flame lift**

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

Note 1 to entry: flame lift may cause the flame to blow out i.e. extinction of the air-gas mixture

3.4.10**light-back**

entry of a flame into the body of the burner

3.4.11**light-back at the injector**

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

3.4.12**sooting**

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

3.4.13**yellow tipping**

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

3.4.14**purge**

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

3.4.14.1**pre-purge**

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

3.4.14.2

post-purge

purge which takes place immediately following shut-down

3.4.15

first safety time

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

Note 1 to entry: where there is no second safety time, this is called the safety time.

3.4.16

second safety time

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

Note 1 to entry: The first safety time being applicable to either an ignition burner or start gas flame only.

3.4.17

extinction safety time

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

3.4.18

start-gas flame

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

3.4.19

running condition of the appliance or system

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

3.4.20

controlled shut-down

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

3.4.21

safety shut-down

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

3.4.22

non-volatile lock-out

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

3.4.23**volatile lock-out**

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

3.4.24**spark restoration**

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

Note 1 to entry: This process ends with the restoration of the running condition or if there is no flame signal at the end of the safety time, with volatile or non-volatile lock-out.

3.4.25**automatic recycling**

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

Note 1 to entry: This process ends with the restoration of the running condition or, if there is no flame signal at the end of the safety time, or if the cause of the accidental interruption has not disappeared, with volatile or non-volatile lock-out.

3.5 Gases**3.5.1****calorific value**

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

Note 1 to entry: A distinction is made between:

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

Note 2 to entry: The calorific value is expressed either in MJ/m³ of dry gas at the reference conditions; or in MJ/kg of dry gas

[SOURCE: EN 437:2003+A1:2009]

3.5.2**relative density**

d

ratio of densities of dry gas and dry air at the same conditions of temperature and pressure

3.5.3

wobbe index

gross Wobbe index: W_g and net Wobbe index: W_i

ratio of the calorific value of a gas per unit volume and the square root of its relative density under the same reference conditions

Note 1 to entry: The Wobbe index is said to be gross or net according to whether the calorific value used is the gross or net calorific value.

Note 2 to entry: The Wobbe index is expressed in MJ/m³ of dry gas at the reference conditions or in MJ/kg of dry gas

[SOURCE: EN 437:2003+A1:2009]

3.5.4

test pressure

gas pressures used to verify the operational characteristics of appliances using combustible gases, consisting of normal and limit pressures

Note 1 to entry: Test pressures are expressed in mbar. 1 mbar = 10² Pa

[SOURCE: EN 437:2003+A1:2009]

3.5.5

normal pressure

p_n

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

[SOURCE: EN 437:2003+A1:2009]

3.5.6

limit pressure

maximum limit pressure p_{max} and minimum limit pressure p_{min}

pressures representative of the extreme variations in the appliance supply conditions

Note 1 to entry: Limit pressures are expressed in mbar. 1 mbar = 10² Pa

[SOURCE: EN 437:2003+A1:2009]

3.5.7

pressure couple

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

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

Note 1 to entry: Pressures are expressed in mbar. 1 mbar = 10² Pa

[SOURCE: EN 437:2003+A1:2009]

3.6 Conditions of operation and measurement

3.6.1

reference conditions

reference conditions applying, which are:

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

3.6.2

cold condition

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

3.6.3

hot condition

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

3.6.4

equivalent resistance

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

3.6.5

thermal equilibrium

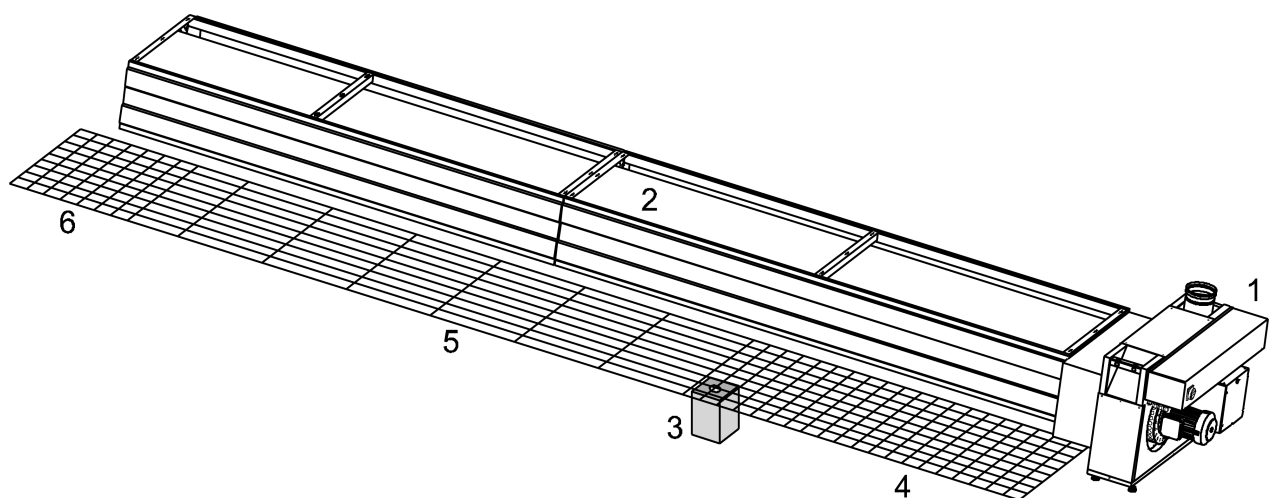
operating state of the system corresponding to a particular setting of the input in which the flue gas temperature does not change by more than ± 2 % (in °C) over a period of 10 min

3.6.6

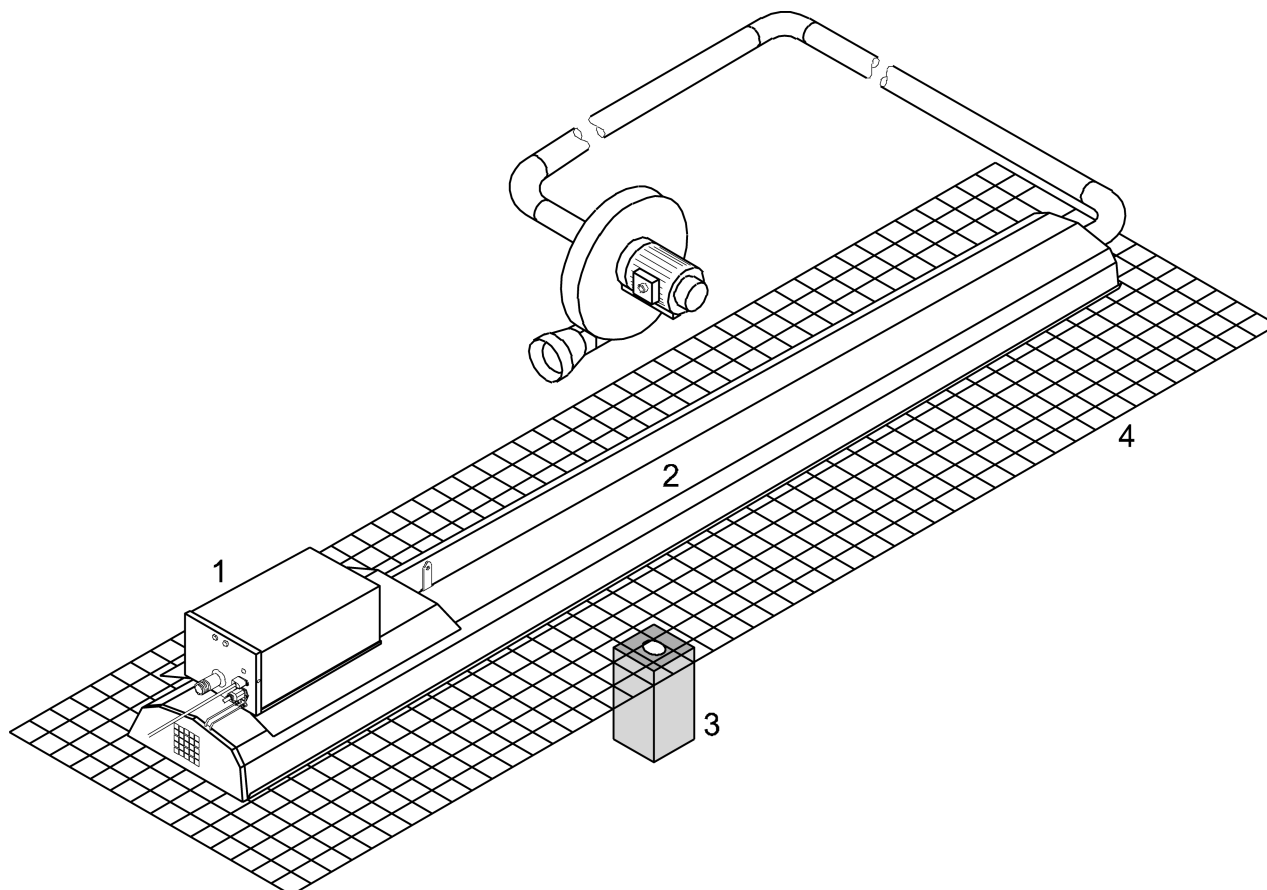
radiant output

radiant power that is passing the measuring plane – parallel and 10 cm under the reference plane of the heater

Note 1 to entry: See Figure 1a and 1b.



a) radiant strip heater systems



b) multi-burner continuous radiant tube heater systems

Key

- 1 heater
 - 2 radiant strip or tubes
 - 3 radiometer
 - 4 measuring grid on the first 10 m of the radiant strips or tubes (10×10 cm)
 - 5 measuring grid in straight areas of strips or tubes downstream the first 10 m (10×100 cm)
 - 6 measuring grid under bends or 180° tube ends of radiant strips or tubes (10×10 cm)
- vertical distance from RRP (Radiant Reference Plane) to MP (Measuring Plane) = 10 cm

Figure 1 — Position of measuring plane (MP)

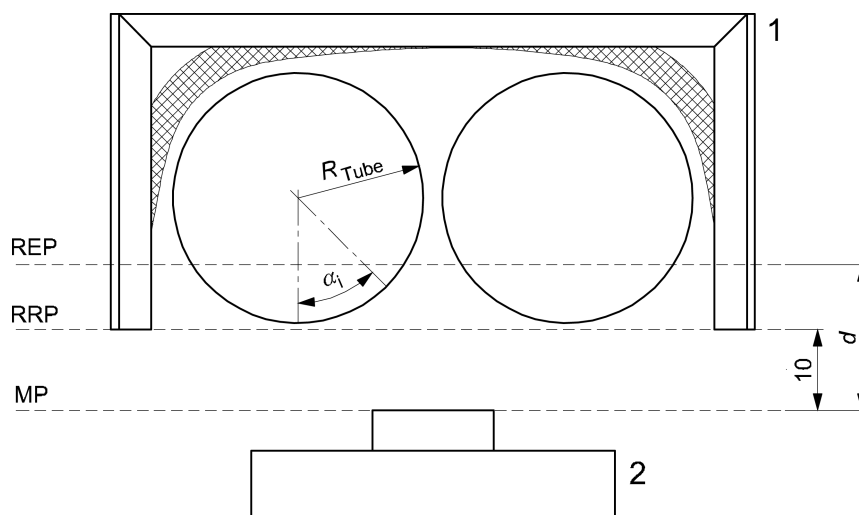
3.6.7

radiation reference plane

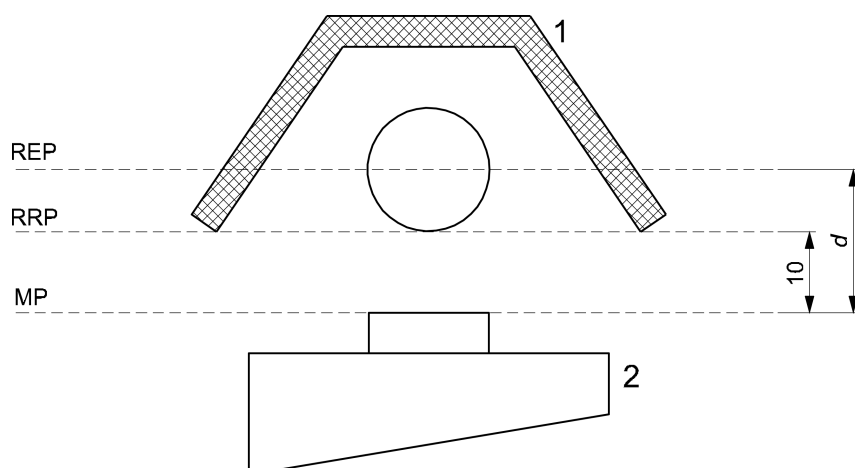
RRP

flat horizontal surface bound by the lower edge of the reflector or housing or, in case radiant parts project below this lower edge of the reflector, the flat horizontal surface touching the lowest radiant part

Note 1 to entry: See Figure 2a and 2b.



a) radiant strip heater systems



b) multi-burner continuous radiant tube heater systems

Key

REP Radiation emitter plane

RRP Radiation reference plane

MP Measuring plane

 R_{Tube} Radius of the radiant tube of the radiant strip in (cm) d Vertical distance between radiation emitter plane and measuring plane in (cm) to calculate the d parameter see to Equation L.3, Annex L α_i Angle (0° to 90°) to calculate the C parameter in to Equation L.3, Annex L

1 Radiant strip or continuous radiant tube

2 Pyrometer

Figure 2 — Identification of radiation reference plane (RRP) and radiation emitter plane (REP)**3.6.8****radiation emitter plane****REP**

flat horizontal plane defined by the axis of the radiant tubes of the radiant strip heaters and/or continuous radiant heaters

Note 1 to entry: See Figure 2a and 2b.

3.6.9

measuring plane

MP

plane parallel to the radiation reference plane and (100 ± 3) mm below where the top surface of the radiometer is moved on the measuring plane on the measuring grid

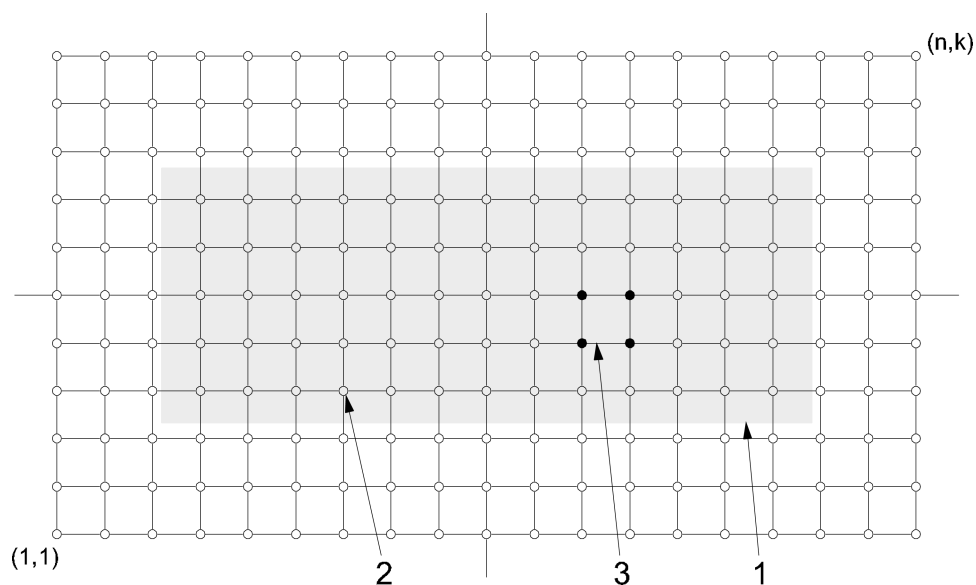
Note 1 to entry: See Figure 1a and 1b.

3.6.10

measuring grid

regular arrangement in the measuring plane of straight lines running parallel and perpendicular to the longitudinal axis, the nodal points of the measuring grid are located at the points of intersection of these lines the distance between these points being determined by the requirements in Clause 7

Note 1 to entry: See Figure 3.



Key

- 1 heater
- 2 nodal point
- 3 measuring cell F_{ij}

Figure 3 — Measuring grid

3.6.11

Irradiance

E

radiant power per unit area (W/m^2) incident upon a surface

3.7 Energy efficiency

3.7.1

radiant factor

RF

ratio of the radiant heat output emitted by the appliance through the radiation reference plane compared to the net heat input of the appliance driven with reference test gas

3.7.2

seasonal radiant factor

RF_s

annually weighted radiant factor, calculated as proportion of the radiant factor of the appliance at nominal net heat input and the radiant factor of the appliance at minimum net heat input (in case of appliances with heat input adaptation)

3.7.3

seasonal heat emission efficiency

$\eta_{s,RF}$

annually weighted efficiency of the heat emission performance of the appliance, taking into account the impact of the radiant output resp. radiant factor on the demanded room temperature

3.7.4

thermal efficiency NCV

$\eta_{th,NCV}$

combustion efficiency NCV

ratio of the thermal heat output of the combustion system of the appliance compared to the net heat input of the appliance driven with test gas

3.7.5

thermal efficiency GCV

$\eta_{th,GCV}$

combustion efficiency GCV

ratio of the thermal heat output of the combustion system of the appliance compared to the gross heat input of the appliance driven with test gas

3.7.6

seasonal thermal efficiency GCV

$\eta_{s,th}$

annually weighted thermal efficiency GCV, calculated as proportion of the thermal efficiency of the appliance at nominal gross heat input and the thermal efficiency of the appliance at minimum gross heat input (in case of appliances with heat input adaptation), corrected by a possible envelope loss factor F_{env} in case the burner of the heater is placed outside the building envelope

Note 1 to entry: A possible correction calculation is defined by Ecodesign Regulation 2015/1188 Annex III.

3.7.7

seasonal space heating energy efficiency GCV

η_s

annually weighted combined thermal and heat emission efficiency, corrected by correction factors accounting the contribution of the heat output adaptation capability of the appliance, the contribution of the auxiliary energy consumption of the appliance and the contribution of the energy consumption of a possible permanent pilot flame of the appliance

3.7.8**envelope loss factor** **F_{env}**

energy loss factor accounting energy losses of the appliance in case the burner (heat generator) of the appliance is positioned outside the envelope of the heated building

3.7.9**auxiliary energy consumption**

amount of auxiliary energy use of the appliance – namely electrical energy – to drive components of the appliance like fans, valves and controls

3.8 Country of destination**3.8.1****direct country of destination**

country for which the appliance has been certified and which is specified in the technical documentation as the intended country of destination

Note 1 to entry: More than one country can be specified if the appliances, in its current state of adjustment, can be used in each of these countries.

3.8.2**indirect country of destination**

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

3.9 Symbols

For the purposes of this documents, the symbols given in Table 1 apply.

Table 1 — Main symbols and abbreviations

Symbol	Dimension	Explanation
C_1	MJ/(m ³ .K)	mean specific heat of dry products of combustion
C_{pd}	MJ/kg.K	specific heat of dry products of combustion
C_{ps}	MJ/kg.K	specific heat of secondary fluid
C_{pw}	MJ/kg.K	specific heat of water vapour
CO_{meas}	ppm	measured CO concentration (dry, air free)
d	-	relative density of dry gas to dry air
d_h	-	relative density of wet gas relative to dry air
d_r	-	relative density of reference gas to dry air
D	mm	nominal diameter of appliance outlet
el	kW	electrical power consumption
el_{max}	kW	electrical power consumption at nominal heat input
el_{min}	kW	electrical power consumption minimum heat input
el_{sb}	kW	electrical power consumption in standby mode
E	W/m ²	irradiance

Symbol	Dimension	Explanation
E_{ij}	W/m ²	Irradiance at node
$\overline{E_{ij}}$	W/m ²	average irradiance of cell
F_{ij}	m ²	area of measurement cell
F_{env}	-	envelope loss factor
h	m	path length (mean beam length) between heater and Ulbricht sphere
h_m	g/kg	humidity during the measurement of NO _x
H_i	MJ/m ³ (or MJ/kg)	Net calorific value of gas
H_s	MJ/m ³ (or MJ/kg)	Gross calorific value of gas
k		number of rows
L	m ³ /m ³	quantity of air in flue gas
L_{min}	m ³ /m ³	air requirement per volume of flue gas
L_{H2O}	MJ/kg	latent heat of water vapour
m_{cond}	kg/m ³	quantity of condensate from secondary heat exchanger per volume of flue gas
m_{CO2}	kg/m ³	quantity of CO ₂ per volume of flue gas
m_{H2O}	kg/m ³	quantity of water vapour per volume of flue gas
m_{N2}	kg/m ³	quantity of N ₂ per volume of flue gas
m_{O2}	kg/m ³	quantity of O ₂ per volume of flue gas
m_{HXS}	kg/s	mass flow of secondary fluid in secondary heat exchanger
m_w	kg/s	mass flow of water vapour in flue products after secondary heat exchanger
M_{fg}	kg/s	flue gas mass flow rate
M_{meas}	kg/h	mass flow rate obtained under test conditions
M_o	kg/h (or g/h)	mass flow rate of gas under reference conditions
n	-	number of grid columns
NO_{x1}	mg/kWh	NO _x value at neutral combustion conditions dry gas at 0 % O ₂
NO_{x5}	mg/kWh	NO _x value at x % O ₂ dry gas converted from neutral combustion conditions
NO_{xm}	mg/kWh	NO _x measured at h_M and t_M
$NO_{x_{min}}$	mg/kWh	measured NO _x at minimum heat input
$NO_{x_{nom}}$	mg/kWh	measured NO _x at nominal heat input
$NO_{x_{ref}}$	mg/kWh	value of NO _x corrected to reference conditions
$NO_{x_{seas,GCV}}$	mg/kWh	seasonal weighted NO _x value based on GCV
$NO_{x_{seas,NCV}}$	mg/kWh	seasonal weighted NO _x value based on NCV
p	mbar	burner unit inlet pressure

Symbol	Dimension	Explanation
p_a	mbar	atmospheric pressure
p_g	mbar	gas supply pressure at the gas meter
p_n	mbar	normal pressure
p_{H_2O}	mbar	partial pressure of water vapour
p_{max}	mbar	maximum limit pressure
p_{min}	mbar	minimum limit pressure
p'_{max}	mbar	corrected maximum test pressure
p'_{min}	mbar	corrected minimum test pressure
p_w	mbar	saturation vapour pressure of test gas
P	kW	power
q_1	kW	heat of dry products of combustion
q_2	kW	heat of water vapour contained in products of combustion
Q	kW	heat
Q_{HXc}	MJ/m ³	Thermal energy in condensate
Q_{HXd}	MJ/m ³	thermal energy reduction in dry products of combustion
Q_{HXf}	kW	thermal energy in flue products in secondary heat exchanger
Q_{HXs}	kW	thermal energy gain in secondary fluid in secondary heat exchanger
Q_{HXw}	MJ/m ³	thermal energy in remaining water vapour
Q_{in}	kW	heat input
$Q_{in,heater\ i}$	kW	heat input of tube segment (NCV)
$Q_{in,system\ i}$	kW	heat input of complete tube system (NCV)
$Q_{in,nom}$	kW	nominal heat inputs
$Q_{in,min}$	kW	minimum heat input
Q_o	kW	corrected heat input
$Q_{out,em}$	kW	heat emission output by radiation
$Q_{out,gen}$	kW	heat generation output by combustion system
Q_L	%	flue loss
Q_{L1}	%	heat of dry products of combustion
Q_{L2}	%	heat of water vapour in products of combustion
Q_m	kW	actual heat input with respect to actual net calorific value
Q_{Pilot}	kW	pilot flame heat consumption
$Q_{(R)C}$	W	radiant output at reference conditions
$Q_{(R)M}$	W	measured radiant output
rh	-	relative humidity

Symbol	Dimension	Explanation
RF	-	radiant factor
$RF_{min,i}$	-	radiant factor per tube segment at minimum heat input
$RF_{nom,i}$	-	radiant factor per tube segment at nominal heat input
RFs	-	seasonal weighted radiant factor
R_1	ohm	fan motor winding resistance at start of test
R_2	ohm	fan motor winding resistance at end of test
S	$\mu V/W/m^2$	radiometer sensitivity
t_a	$^{\circ}C$	ambient temperature
$t_{a,comb}$	$^{\circ}C$	temperature of combustion air
$\overline{t_{a,comb}}$	$^{\circ}C$	average temperature of combustion air
$t_{comp,max}$	$^{\circ}C$	maximum component temperature
$t_{comp,meas}$	$^{\circ}C$	measured component temperature
t_{flue}	$^{\circ}C$	flue gas temperature
$\overline{t_{flue}}$	$^{\circ}C$	average flue gas temperature
t_g	$^{\circ}C$	gas temperature
t_{HXfin}	$^{\circ}C$	secondary heat exchanger flue gas inlet temperature
t_{HXfout}	$^{\circ}C$	secondary heat exchanger flue gas outlet temperature
t_{HXins}	$^{\circ}C$	secondary heat exchanger fluid inlet temperature
t_{HXouts}	$^{\circ}C$	secondary heat exchanger fluid outlet temperature
t_{rad}	$^{\circ}C$	radiant reference surface temperature
t_{rm}	$^{\circ}C$	room temperature
$t_{rm,1}$	$^{\circ}C$	room temperature at start of fan test
$t_{rm,2}$	$^{\circ}C$	room temperature at end of fan test
U	μV	radiometer sensor voltage
$U_{(c)}$	μV	correction voltage for each nodal point
$U_{c(x)}$	μV	grid column correction
V_{corr}	m^3/s	corrected volumetric flow rate
V	m^3/s	measured volumetric gas rate expressed under conditions at the meter
V_{at}	m^3/m^3	quantity of dry flue gas
V_{af}	m^3/m^3	quantity of wet flue gas
$V_{CO,M}$	%	measured CO concentration
$V_{CO,N}$	%	CO concentration (dry, air free)

Symbol	Dimension	Explanation
$V_{CO_2, M}$	%	measured CO ₂ concentration
$V_{CO_2, N}$	%	CO ₂ concentration (dry, air free)
V_o	m ³ /s (or l/min, dm ³ /min, dm ³ /s)	volumetric flow rate of gas under reference conditions
$V_{O_2, M}$	%	measured oxygen concentration (dry, air free)
V_f	m ³	Volume of dry products of combustion per unit volume of gas in m ³
V_{meas}	m ³ /s	volumetric flow rate under test conditions
V_{nom}	m ³ /s	gas flow rate at nominal heat input
V_t	m ³ /s	quantity of dry flue gas
V_X	%	reference level of O ₂ dry gas (%) (e.g. 3 % O ₂)
V_Y	%	content of water vapour in dried sample gas
W_i	MJ/m ³ (or MJ/kg)	Net Wobbe index
W_s	MJ/m ³ (or MJ/kg)	Gross Wobbe index
α	°	Opening angle of the Ulbricht sphere (85°)
λ	-	excess air ratio in flue gas
η_{HX}	%	thermal efficiency of condensing heat exchanger
η_{th}	%	thermal efficiency
$\eta_{th, min}$	%	thermal efficiency at minimum heat input
$\eta_{th, nom}$	%	thermal efficiency at nominal heat input
$\eta_{th, GCV}$	%	combustion efficiency GCV
$\eta_{th, NCV}$	%	combustion efficiency NCV
η_s	%	seasonal space heating energy efficiency
$\eta_{s, th}$	%	seasonal thermal efficiency
$\eta_{s, RF}$	%	seasonal heat emission efficiency
$\eta_{s, on}$	%	seasonal space heating energy efficiency
τ_{total}	-	total transmission coefficient

4 Classification of appliances

4.1 Classification according gases and categories

Gases are classified into three families, groups and ranges in accordance with EN 437:2003+A1:2009.

Appliances are classified into categories in accordance with EN 437:2003+A1:2009.

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

4.2.1 General

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

NOTE Further informations on appliance types is given in CEN/TR 1749:2014.

4.2.2 Type B appliance

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

The variations of Type B appliances relevant to this standard are:

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

For radiant strips heaters, this standard applies to:

- 1) Type B₂₂: a Type B₂ appliance incorporating a fan downstream of the combustion chamber/heat exchanger;
- 2) Type B₂₃: a Type B₂ appliance incorporating a fan upstream of the combustion chamber/heat exchanger;
- 3) Type B₅₂: a Type B₅ appliance incorporating a fan downstream of the combustion chamber/heat exchanger;
- 4) Type B₅₃: a Type B₅ appliance incorporating a fan upstream of the combustion chamber/heat exchanger.

See Annex B 1.1 for the types of appliance identified above, in which the combustion air is supplied and/or in which the products of combustion are evacuated by mechanical means.

For multi-burner continuous radiant tube heater systems, this standard applies to:

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:

- i) Type B₂₂: a Type B₂ system incorporating a fan downstream of the combustion chamber/heat exchanger;
- ii) Type B₅₂: a Type B₅ system incorporating a fan downstream of the combustion chamber/heat exchanger (this type is covered by this standard);

4.2.3 Type C appliance

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

The variations of Type C appliances relevant to this document are:

- a) Type C₁: a Type C appliance that is designed for connection via its ducts to a horizontal terminal, which at the same time admits fresh air to the burner and discharges the products of combustion to

the outside through orifices that are either concentric or close enough to come under similar wind conditions;

- b) Type C₃: a Type C appliance that is designed for connection via its ducts to a vertical terminal, which at the same time admits fresh air to the burner and discharges the products of combustion to the outside through orifices that are either concentric or close enough to come under similar wind conditions.
- c) Type C₅: a type C appliance connected via its separate ducts to separate terminals for the supply of combustion air and the evacuation of the products of combustion. These ducts may terminate in zones of different pressure.

This document applies to:

- d) Type C₁₂: a Type C₁ appliance incorporating a fan downstream of the combustion chamber/heat exchanger;
- e) Type C₁₃: a Type C₁ appliance incorporating a fan upstream of the combustion chamber/heat exchanger;
- f) Type C₃₂: a Type C₃ appliance incorporating a fan downstream of the combustion chamber/heat exchanger;
- g) Type C₃₃: a Type C₃ appliance incorporating a fan upstream of the combustion chamber/heat exchanger
- h) Type C₅₂: a type C₅ appliance incorporating a fan downstream of the combustion chamber/heat exchanger.
- i) Type C₅₃: a type C₅ appliance incorporating a fan upstream of the combustion chamber/heat exchanger.

See Annex B 1.2 for the types of appliance identified above, in which the combustion air is supplied and/or in which the products of combustion are evacuated either by natural draught or mechanical means.

5 Constructional requirements

5.1 General

5.1.1 Conversion to different gases

5.1.1.1 General

For converting the appliance 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 only the operations given below for each category are allowed.

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

5.1.1.2 Category I

For conversions within category I to other gases or to other gas supply pressures or to other gas pressure couples, only the following actions or combination of actions are allowed:

- a) replacement of injectors or orifices or restrictors;

- b) replacement or adjustment of primary air adjusters or venturi inserts;
- c) adjustment of burner pressure;
- d) replacement of regulator spring or replacement of regulator;
- e) adjustment of gas/air ratio on gas/air ratio controllers;
- f) changes of configuration parameters by data exchange according to the requirement of EN 14459:2015.

No other modifications to the appliance are allowed.

5.1.1.3 Category II and III

In addition to the requirements in 5.1.1.2 only the following additional operations or combination of operations are acceptable for conversions within categories of appliance designed for use with gases of the first and second families, and categories of appliance designed for use with gases of the first, second and third families.

- a) 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.
- b) a change, if necessary, of the automatic shut-off valves(s).
- c) adjustment of the low pressure cut –off level of the pressure switch, if any.
- d) putting the regulator out of service under the conditions of 5.2.7.
- e) putting the gas rate adjuster(s) out of service under the conditions of 5.2.2 if applicable.

No other modifications to the appliance are allowed.

5.1.2 Materials and method of construction

The quality and thickness of the materials used in the construction of the appliances including its POCED and the method of assembling the various parts, shall be such that the constructional and operational characteristics are not significantly altered during a reasonable lifetime and under normal conditions of installation and use.

In particular, all parts of the appliance and the combustion circuit shall withstand the mechanical, chemical and thermal conditions to which they may be subjected when the appliance is used normally.

Materials used in the appliance shall be non-combustible.

The use of materials containing asbestos, cadmium or chromium VI is forbidden.

Hard solder containing cadmium shall not be used in the construction of the appliances. Solder that has a melting point below 450 °C after application shall not be used for gas-carrying parts.

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

If condensation takes place this shall not:

- a) affect the operational safety;
- b) drop outside the appliance. This requirement does not apply to the flow of condensate which is produced at the outlet of the combustion products evacuation duct or from a secondary heat exchanger in the POCED.

5.1.3 Accessibility for maintenance and use

Parts which are accessible during use and servicing, in accordance with the instructions for use and service, shall be free from sharp edges and corners that might cause damage or personal injury during use and servicing.

Components and controls shall be arranged such that any adjustment, maintenance or exchange is easy without removing the appliance 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 appliance and its controls.

Parts of the appliance or 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 Flexible gas connection

To accommodate the dynamic thermal expansion of radiant tube heaters a flexible gas connection shall be realized by the use of flexible gas hoses.

Flexible gas hoses used for the installation of radiant tube heaters shall be of stainless steel construction. The minimum diameter of the hose shall not be less than the diameter of the inlet connection. The minimum length of the flexible hose shall not be less than 0,5 m. The maximum length of the flexible hose including the fittings shall not be greater than 2 m.

If flexible gas hoses are supplied by the manufacturer as a part of the appliance, they shall meet the requirements of EN 14800:2007.

If flexible gas hoses are supplied by the installer they shall meet the applicable national standards and Codes of Practice in the destination country.

5.1.5 Soundness of the gas and combustion circuit

5.1.5.1 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 according to the instructions of use and service shall be ensured by means of mechanical joints (e.g. metal to metal joints, O-ring joints and packing) but excluding the use of any sealing compound (e.g. tape, mastic and paste). The soundness shall be maintained after dismantling and re-assembly.

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

5.1.5.2 Soundness of the combustion circuit

The combustion circuit, with exception of the burner and recirculation unit and the flue gas evacuation duct of radiant strip heaters, shall be kept constantly in depression.

5.1.5.3 Soundness of the combustion circuit (Type B appliances)

The soundness of the combustion circuit of the appliance 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 ensured under

normal conditions of use (see 6.2.1.2). Where there are common ducts and branch ducts, the means of sealing the connections shall be the same for both the common duct and any branch duct.

5.1.5.4 Soundness of the combustion circuit (Type C appliances)

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

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

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

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

5.1.6 Supply of combustion air and evacuation of combustion products

5.1.6.1 General

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

Fan assisted appliances shall be fitted with a means of adjustment in the combustion circuit intended to adapt the appliances to the pressure losses in the installed ducts, either by restrictors or by setting the means of adjustment to predetermined positions in accordance with detailed technical instructions.

The cross-section of the combustion circuit of multi-burner continuous radiant tube heater system, shall be adjustable by means of one or more dampers to permit individual sections of the appliance to be adjusted within prescribed limits of suction in the combustion circuit, as declared in the technical instructions for the correct operation of the system.

Where a damper is fitted it shall be capable of being locked and sealed in position.

For modulating multi-burner continuous radiant tube heater systems, the cross-section of the combustion circuit may be adjustable by means of one or more modulating dampers to permit the whole or individual sections of the system to be adjusted within prescribed limits of suction in the combustion circuit, as declared in the technical instructions for the correct operation of the system.

Where a modulating damper is fitted, it shall be capable of having mechanical stops locked at the maximum and minimum positions.

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.

If the appliance has a POCED that is capable of being installed in accordance with the installation instructions such that its outlet, when fitted with any terminal supplied with the appliance, or specified in the technical instructions, extends beyond the external surface of a building by more than 1,5 m, this duct, together with any associated air supply duct (Type C₁ and C₃ appliances), shall not undergo any permanent distortion when subjected to the wind load test specified in 4.3.2 of EN 1859:2009+A1:2013.

5.1.6.2 Air supply and combustion products evacuation ducts

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

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

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

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

5.1.6.3 Air inlets

All openings for the supply of air into the appliance or 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.

5.1.6.4 Appliance flue outlet

The cross-section of the flue outlet shall not be adjustable.

5.1.6.5 Type B₂₂ and Type B₂₃ appliances

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

NOTE 1 For information concerning connections see Annex A.3

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

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

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

5.1.6.6 Type B₅₂ and B₅₃ appliances

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

The technical instructions shall state the minimum and maximum equivalent resistance. The technical instructions shall give details for calculating the equivalent resistance, for e.g. the allowance to be made for bends.

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

5.1.6.7 Combustion circuit

5.1.6.7.1 Single burner gas-fired overhead radiant strip heaters

For all type of burners (single stage; two stage; modulating) the recirculation rate can be made adjustable by a suitable dampers.

The adjustment of dampers shall be made in a manner that uncontrolled displacement is avoided.

5.1.6.7.2 Multi-burner gas fired overhead continuous radiant tube heater system

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 in the technical instructions for the correct operation of the system.

Where a damper is fitted it shall be supplied by the manufacturer and once adjusted shall be capable of being locked and sealed in position.

For modulating multi-burner continuous radiant tube heater systems, the cross-section of the combustion circuit may be adjustable by means of one or more modulating dampers to permit the whole or individual sections of the system to be adjusted within prescribed limits of suction in the combustion circuit, as declared in the technical instructions for the correct operation of the system.

Where a modulating damper is fitted it shall be supplied by the manufacturer and once adjusted shall be capable of having mechanical stops locked at the maximum and minimum positions.

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.

5.1.7 Gas Inlet connections

- a) The gas connection shall be designed such that there will be no inappropriate passage of gas from the entry of air to the gas circuit. The gas connection shall be accessible.
- b) The clearance around the connection, after removing if necessary, shall be adequate to allow the use of tools required to make the connection. It shall be possible to make all the connections without special tools.

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

- c) a thread conforming to EN ISO 228-1:2003. In this case the end of the gas inlet connection shall have a flat annular surface at least 3 mm wide for thread sizes 1/2 and 3/8 and at least 2,5 mm wide for thread size 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 1/2, it shall be possible to insert a gauge of 12,3 mm diameter to a depth of at least 4 mm;
- d) a thread conforming to ISO 7-1;
- e) a thread conforming to EN 10226-1:2004 or EN 10226-2:2005;
- f) a compression fitting suitable for copper tube conforming to EN 1057:2006+A1:2010;
- g) 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 5.1.7 c;
- h) a flange conforming to ISO 7005-1:2011, ISO 7005-2:1988 or ISO 7005-3:1988.

NOTE The conditions of inlet connections prevailing in the various countries are given in A.2.

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

Appliances shall be provided with adequate means of support or suspension other than the gas supply pipe.

5.1.8 State 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 resistant glass or equivalent material and sealed with a suitable heat resistant sealant.

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

- a) mirrors or windows are used, their optical properties shall not have deteriorated at the completion of all the tests specified in this standard;
- b) indicator lights are used their purpose shall be clearly and permanently identified on the appliance, or on the plate or label required by 10.1.2. 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.

5.1.9 Electrical safety

The electrical equipment of the appliance shall be so designed and constructed as to obviate hazards of electrical origin and shall comply with the requirements of EN 60335-2-102:2016 which cover such hazards.

If the appliance or system is fitted with electronic components or electronic systems providing a safety function, these shall comply with the relevant requirements of EN 298:2012.

If the nature of the electrical protection of the appliance is specified on the data plate, this specification shall comply with EN 60529:1991.

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

Interruption and subsequent restoration of the electricity supply at any time during the starting up or operation of the appliance or system shall result in 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 appliance or system is intended to be reset by means of switching off and on the electricity supply to the appliance or 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 appliance or system condition.

NOTE Requirements relating to the continued and safe operation of the appliance or system in the event of normal and abnormal fluctuation of auxiliary energy is specified in 6.2.7.2 d. and 6.2.7.2 e.

5.1.11 Motors and fans

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

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

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

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

Lubrication points, if provided, shall be readily accessible.

5.2 Requirements for adjusting, control and safety devices

5.2.1 General

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

The failure of a safety, controlling or regulating device shall not lead to an unsafe situation.

Any parts of the appliance or of the system that are not intended to be altered by the user or the installer shall be protected in an appropriate manner. Paint may be used for this purpose provided that it withstands the temperature to which it is subjected during normal operation of the system.

The appliance 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

Gas rate adjusters shall be used for appliances using several groups of 1st family gas and optional for appliances of other gas groups.

An adjuster shall:

- a) be sealed if adjustment is made during production;
- b) be able to be sealed if adjustment is carried out as part of the installation or servicing procedure.

5.2.3 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 no longer be used by as a range-rating device.

5.2.4 Primary aeration adjuster

Primary aeration adjusters shall be pre-set and sealed in the positions during production appropriate for the gas for which the appliance has been adjusted.

5.2.5 Manual controls

5.2.5.1 Application

Manual valves, push buttons or electrical switches that are essential for normal operation and commissioning of the appliance shall be provided with the appliance.

5.2.5.2 Manual valves

Manual valves shall meet the requirements of EN 1106:2010.

Manual valve shall be of the 90° turn type unless it is incorporated in a flame supervision device.

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

When a manual valve is provided at the inlet of the appliance, 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 Air/gas ratio control for multiple-burner continuous radiant tube heater system

Means shall be provided to ensure that the ratio of gas to combustion air is maintained over the range of negative pressures within the combustion chamber as indicated in the technical instructions.

5.2.7 Regulators

Regulators shall comply with EN 88-1:2011+A1:2016.

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

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

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

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

5.2.8 Multifunctional controls

Multifunctional controls shall comply with EN 126:2012.

5.2.9 Automatic shut-off valves

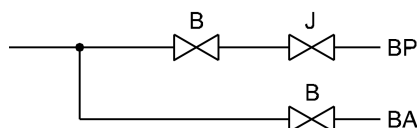
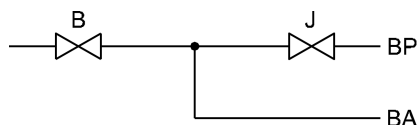
Automatic shut-off valves shall comply with EN 161:2011+A3:2013.

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

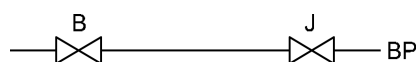
The start gas supply shall be under the control of one automatic shut-off valve of either Class A or Class B.

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

NOTE The arrangements shown in Figure 4 are given as examples. Any other arrangement giving at least an equivalent level of safety is permissible.



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



b) Appliance with direct ignition of the main burner

Key

BA ignition burner
BP main burner

Figure 4 — Automatic shut-off valve configuration

5.2.10 Gas strainers

A strainer shall be fitted at the inlet of any burner unit incorporating an automatic shut-off valve(s) to prevent the ingress of foreign matter.

NOTE The strainer can be integral with the upstream automatic shut-off valve.

The maximum strainer hole dimension shall not be greater than 1,5 mm and the mesh shall not permit a 1 mm pin gauge to pass through it.

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

For valves incorporating a shearing action (self-cleaning), and for valves of size 1/2 (or DN 15) and below, the strainer may be omitted.

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

5.2.11 Thermostats

Integral mechanical thermostats shall comply with EN 257:2010.

5.2.12 Air proving devices

5.2.12.1 General

The appliance shall incorporate air proving devices. Appliances with air / gas ratio control systems may employ other means of preventing a lack of combustion air.

5.2.12.2 Burner units

Each burner unit shall be fitted with a suitable device for proving adequate air flow during the pre-purge, ignition and operation of the appliance (see 6.2.6.2 e and 6.2.6.3).

The sensor shall be located at each burner unit and shall not rely on static pressure measurement.

The air proving device shall measure a differential pressure.

The air proving device shall be proved in the no air-flow state prior to startup of the system. Failure to prove the device in the no air-flow state shall prevent startup of the system.

Air-flow failure at any time during the pre-purge, ignition and operation of the burner shall cause non volatile lock-out, volatile lock-out or safety shut-down such that re-start may only take place following automatic recycling (see 5.2.12.3).

Indirect methods of air proving are not allowed.

5.2.12.3 Common duct

For multi-burner continuous radiant tube heater systems, the common duct or each branch tube shall be fitted with a suitable device for proving adequate air-flow during the pre-purge, ignition and operation of the system (see 6.2.6.2 e. and 6.2.7)

The sensor shall be located at a specified point in the common duct or at each branch tube inlet and shall not rely on static pressure measurement.

The air proving device shall measure a differential pressure.

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

When the air proving device is mounted in the common duct, air-flow failure at any time during the pre-purge, ignition and operation of the burner shall cause non-volatile lock-out of the system.

When the air proving device is mounted at the inlet to each branch tube, air-flow failure at any time during the pre-purge, ignition and operation of the burner shall cause non-volatile lock-out of the affected branch tube/s.

Indirect methods of air proving are not allowed.

5.2.13 Automatic system control

5.2.13.1 System operating sequence

For multi-burner continuous radiant tube heater systems, the following sequence of events shall occur to initiate the system:

- a) Stage 0: complete shutdown of the system;
- b) Stage 1:
 - 1) call for heat;
 - 2) all air proving switches checked in the no air-flow state;
 - 3) common duct fan on;
 - 4) check of adequate air-flow in the common duct.

c) Stage 2:

- 1) on a signal to operate a burner unit, check that the air proving switch on the burner is in the “insufficient air” state;
- 2) pre-purge and check that there is adequate air-flow through the branch tube;
- 3) ignition;
- 4) running condition.

Following a signal to shut down a burner unit in the course of normal operation, the burner unit shall return to a state of readiness between events 5.2.13.2 b4) and c1) above, or stage “0” as appropriate.

For multi-burner continuous radiant tube heater systems, the automatic burner control systems shall be designed so that either all burner units operate simultaneously or sequentially in accordance with the operating instructions. The automatic burner control systems shall be designed so that all burner units operate simultaneously. Zone control is allowed provided the system contains at least two radiant branches. A zone may contain multiple radiant branches and a radiant branch may contain one or more burners. However, individual burners within the same radiant branch cannot be zone controlled.

5.2.13.2 Automatic burner control system

5.2.13.2.1 General

Each burner unit shall be fitted with an automatic burner control system complying with EN 298:2012

5.2.13.2.2 Manually operated devices

The operation of manually operated devices e.g. push buttons and switches, incorrectly or out of sequence shall not adversely affect the safety of the automatic burner control system.

The system is installed as described in 6.1.6 and supplied with an appropriate reference gas (see Table 3) at the nominal heat input in accordance with 6.1.3.2.3. The start device is manually operated 10 times, once every 5 s. The rapid (on and off) operation of the start switch shall not set up a hazardous condition.

5.2.13.2.3 Pre-purging

Immediately before any attempt at ignition or the opening of automatic shut-off valves, the system shall be purged. The purge period shall be sufficient to purge at least one volume of the system, but at least 20 s. The purge period shall be declared in the technical instructions and this period shall be verified under the following test conditions.

The burner unit is ignited in accordance with the technical instructions, the time between when the full combustion air flow is signalled and the moment when the ignition system is energized is measured.

For multi-burner continuous radiant tube heater systems pre-purging is not required following the shut-down of a branch tube as a result of zone control if the fan is not shut-down between the stop and the restart of the branch and if another branch is still in operation during this time.

5.2.13.2.4 Flame detector

On each burner unit, the flame detector system shall incorporate a means to prevent the energization of any gas valve and of the ignition device if a flame or flame simulating condition is present during the start-up period.

Upon flame failure in the running condition the flame detector shall cause one of the following:

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

With the burner unit in the running condition, the gas supply to the main burner is isolated. The time between the moment when the main burner is extinguished and the signal for valve closure is given is measured. This time, which is the time for the flame detector system to de-energize the burner automatic shut-off valves upon flame failure, shall not exceed 2 s.

Notwithstanding this requirement, where a spark restoration system is used, this time may be extended to allow for the re-ignition attempt but shall not exceed the first safety time.

5.2.13.2.5 Start-gas flame establishment

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

The safety time for the start-gas flame establishment shall be specified by the technical instructions.

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

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

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

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

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

5.2.13.2.6 Direct main flame establishment

The safety time of the main burner flame establishment shall be specified in the technical instructions.

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

Where a hot surface ignition device is used, the ignition device shall be so energized that the ignition source is capable of igniting incoming gas before the gas valves are opened.

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

5.2.13.2.7 Safety and controlled shut-down

The flame detector device and the air proving device shall affect closure of all automatic shut-off valves in the burner unit concerned. On shut-down the fan shall not be de-energized before the automatic shut-off valves. Post-purging is optional.

5.2.13.2.8 Facility for remote control

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

5.2.13.3 Air / gas ratio controls

Air/gas ratio controls shall be designed and constructed so that reasonably foreseeable damage does not give rise to a change capable of affecting safety.

Where a pneumatic air/gas ratio control is used, this shall comply with the requirements of EN 88-1:2011+A1:2016.

Where an electronic air/gas ratio control is used, this shall comply with the relevant requirements of EN 12067-2:2004.

Control tubes shall be made of metal with suitable mechanical connections or other materials with at least equivalent properties and in this case are considered immune to breakage, accidental disconnection and leakage after soundness checks. If this requirement is met, they are not subject to the specific tests.

Control tubes for air and combustion products shall have a minimum cross-sectional area of 12 mm² with a minimum internal dimension of 1 mm. Provided that evidence is given and precautions are taken to avoid condensation in the control tubes, the minimum cross-sectional area of air control tubes may be 5 mm². All control tubes shall be located and fixed so that any stagnation of condensate is avoided and positioned such that creasing, leakage or breakage is prevented. Where more than one control tube is used the relevant connection position for each shall be obvious.

Air / gas ratio control shall be adjusted on production site and suitable provisions shall be taken to prevent other adjustments. In case adjustments in the field are allowed, instructions shall be given in the installation manual (see 10.2.2). In particular clear references shall be made to the method of adjustment, the settings, the equipment needed and the accuracy of the equipment needed. The impact of inaccurate adjustment shall be explained.

NOTE 1 The following examples are considered to be suitable additional provisions:

- a) Physical removal of the adjustment screws (or other method of rendering these inoperative);
- b) Physical preventing access to the adjustment screws (e.g. filling access holes);
- c) Addition of a suitably worded warning label affixed to the gas valve and/or in close proximity to the adjusting screws, this label shall be clearly visible to any gas operative whilst gaining access to the adjuster screws.

NOTE 2 Gas/air controls have typically two adjustments ('throttle' and 'offset') and the requirements of this clause apply to both.

If the appliance installation instructions allow the adjustment of the gas/air ratio control, then the method for adjustment has to be described. If the gas valve of the gas/air ratio control has been adjusted on site, provisions shall be made to indicate that the valve settings have been changed.

NOTE 3 An example of a suitable provision is to use a paint spot on the adjusting device.

The appliance installation instructions shall include instructions on how the settings shall be checked if, at the time of installation or service, there is an indication that the gas/air ratio control settings have been altered. The appliance installation instructions shall indicate the action to be taken if the the settings are found to be incorrect.

If the appliance installation instructions allow the gas/air ratio controls to be adjusted then the method for adjustment shall be described

5.3 Ignition devices

5.3.1 General

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

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

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

5.3.2 Ignition device for the main burner

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

5.4 Main burners

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

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

5.5 Temperature controls

5.5.1 General requirements

To avoid the risk of overheating components of the appliance each burner and recirculation unit of radiant strip heaters shall be equipped with the follow indicated thermostats except appliances or systems that achieve to avoid overheating in case of any faults of dampers and adjustment by other means.

Integral mechanical thermostats shall comply with the requirements of EN 257:2010. Integral electrical and electronic thermostats shall comply with the requirements of EN 60730-2-9:2010.

Overheat cut-off devices shall comply with Type 2K requirements of EN 60730-2-9:2010.

5.5.2 Temperature limiter

Temperature sensing control which is intended to keep a temperature below one particular value during normal operating conditions and which may have provision for setting by the user

NOTE A temperature limiter can be of the automatic or of the manual reset type.

5.5.3 Overheat thermal cut-out

temperature sensing control device intended to keep a temperature below one particular value during abnormal operating conditions and which has no provision for setting by the user

5.5.4 Temperature limiter / Overheat thermal cut-out

The operating temperature of the overheat device shall be set and sealed.

Where flame detection is achieved other than by means of a direct-acting thermoelectric device, the non-volatile lock-out shall not rely on the operation of the flame detection circuits. In particular, the overheat limit device shall not be wired in series with the flame sensor or the line supply from a programming unit to any automatic shut-off valve.

5.6 Pressure test points

5.6.1 Gas pressure test point

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

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

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

5.6.2 Air pressure test point

For radiant strips heaters, a pressure test point shall be fitted on the burner and recirculation unit for the measurement of suction (see B.1).

For multi-burner continuous radiant tube heater systems a pressure test point shall be fitted in each single burner for the measurement of suction (see B.2).

5.7 Injectors

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

5.8 Exhaust gas heat exchanger

An exhaust gas heat exchanger may be fitted in the flue system. The heat exchanger shall be mounted either directly at the end of the radiant strip or continuous tube heater or at the end of a collected exhaust gas system (between exhaust gas output or common duct and chimney). The heat exchanger shall have two separated mass flows (media) with exhaust gas as the primary exothermic medium. The exchanged heat is transferred to a secondary medium that is fed by means of auxiliary energy to a heat sink.

The heat transfer may take place both as indirect or half-indirect and in following principles: parallel, counter, cross or cross-counter flow.

The requirements for exhaust gas heat exchangers are given in Annex R.

6 Operational requirements

6.1 Test methods

6.1.1 Characteristics of test gases (Reference and limit gases)

The test gases, test pressures and appliance categories given here are in accordance with those specified in EN 437:2003+A1:2009.

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

6.1.2 Conditions for preparation of the test gases

The requirements for the preparation of test gases are given in EN 437:2003+A1:2009.

6.1.3 Practical application of test gases

6.1.3.1 Choice of test gases

Gases required for the tests described in clause:

- 6.2.2 Heat Input
- 6.2.3 Limiting temperatures
- 6.2.4 Ignition, cross-lighting and flame stability
- 6.2.5 Pressure regulator
- 6.2.6 Air-gas ratio controls
- 6.2.7 Combustion
- 6.2.8 Air-proving devices
- 6.3 NO_x
- 7 Energy Efficiency

shall be as specified in EN 437:2003+A1:2009.

For those tests described in other clauses, it is permissible in order to facilitate testing to replace the test gas by a gas actually distributed. When an actual distributed gas is used for certain tests, this gas shall belong to the gas family and group to which the reference gas, which it replaces, belongs and the Wobbe index of the distributed gas shall be within $\pm 5\%$ of that of the reference gas.

When tests have to be carried out with only one of the reference gases, the priority according to the appliance category shall be G 20, G25, G 30 or G31.

6.1.3.2 Conditions of supply and adjustment of the burner unit

6.1.3.2.1 Initial adjustment of burner units

Before all the required tests are carried out the burner unit shall be fitted with the appropriate equipment (injector(s)) corresponding to the gas family or gas group to which the specified test gas belongs. Any gas rate adjuster(s) are set in accordance with the technical instructions using the appropriate reference gas(es) (see 6.1.5.1) and the corresponding normal pressure(s) given in 6.1.4.

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

6.1.3.2.2 Supply pressures

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

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

6.1.3.2.3 Adjustment of heat inputs

For tests requiring adjustment of the burner to the nominal heat input and/or any other heat input as specified in the technical instructions, it shall be ensured that the pressure upstream of the injector(s) is such that the heat input obtained is within $\pm 2\%$ of that specified (by altering the pre-set adjuster(s) or the burner unit regulator, if adjustable, or the burner unit supply pressure).

The specified heat input shall be determined in accordance with 6.2.2 and with the burner unit supplied with the appropriate reference gas (es).

6.1.3.2.4 Corrected pressures

Where, in order to obtain the nominal heat input within $\pm 2\%$, it is necessary to use a burner unit inlet pressure, p , different from the normal pressure p_n , then those tests normally carried out at the minimum or maximum test pressures $p_{\min}$ and $p_{\max}$ shall be carried out at the corrected test pressures $p'_{\min}$ and $p'_{\max}$.

The corrected test pressures are calculated using Formula (1).

$$\frac{p'_{\min}}{p_{\min}} = \frac{p'_{\max}}{p_{\max}} = \frac{p}{p_n} \quad (1)$$

where

- p_n is the normal test pressure;
- $p_{\min}$ is the minimum test pressure;
- $p_{\max}$ is the maximum test pressure;
- p is the burner unit inlet pressure;
- $p'_{\min}$ is the corrected minimum test pressure;
- $p'_{\max}$ is the corrected maximum test pressure.

6.1.4 Test pressures

The test pressures (i.e. the pressures required at the gas inlet connection of the burner unit) are given in Tables 2 and 3.

These pressures and the corresponding injectors are used in accordance with the national conditions given in EN 437:2003+A1:2009, Annex B, for the country in which the appliance is to be installed.

In case the technical instructions specify a normal pressure at the appliance inlet other than that given in Tables 2 and 3, the Formula (1) in article 6.1.3.2.4 shall be used to determine the corresponding values for $p_{\min}$ and $p_{\max}$ and the corresponding injector(s).

Table 2 — Test pressures where no pressure couple exists ^{a)}

Appliance categories having as index	Test gas	p_n	$p_{\min}$	$p_{\max}$
		mbar	mbar	mbar
First family: 1A	G 110, G 112	8	6	15
Second family: 2H	G 20, G 21, G 222, G 23	20	17	25

Appliance categories having as index	Test gas	p_n	p_{min}	p_{max}
		mbar	mbar	mbar
Second family: 2L	G 25, G 26, G 27	25	20	30
Second family: 2E	G 20, G 21, G 222, G 231	20	17	25
Third family: 3B/P	G 30, G 31, G 32	29 ^{b)}	25	35
	G 30, G 31, G 32	50	42,5	57,5
Third family: 3P	G 31, G 32	37	25	45
	G 31, G 32	50	42,5	57,5
Third family: 3Bc ^{c)}	G 30, G 31, G 32	29 ^{b)}	20	35
a) For test pressures corresponding to gases distributed nationally or locally, refer to EN 437:2003+A1:2009, Annex B. b) Appliances of this category may be used, without adjustment, at the specified supply pressures of 28 mbar to 30 mbar. c) The tests with G 31 and G 32 are carried out at the normal pressure only ($p_n = 29$ mbar), these test gases being more severe than any gas of Group 3B. This condition covers the normal variations in the gas supply.				

Table 3 — Test pressures where a pressure couple exists

Appliance categories having as index	Test gas	p_n	p_{min}	p_{max}
		mbar	mbar	mbar
Second family: 2E+	G 20, G 21, G 222	20	17 ^{b)}	25
	G 231	25 ^{a)}	17 ^{b)}	30
Third family: 3+	G 30	29 ^{c)}	20	35
(28–30/37 couple)	G 31, G 32	37	25	45
Third family: 3+	G 30	50	42,5	57,5
(50/67 couple)	G 31, G 32	67	50	80
Third family: 3+	G 30	112	60	140
(112/148 couple)	G 31, G 32	148	100	180
a) This pressure corresponds to the use of low Wobbe index gas but in principle no test is carried out at this pressure. b) See Annex F. c) Appliances of this category may be used without adjustment at the specified supply pressures of 28 mbar to 30 mbar.				