

BS EN 89:2015



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Gas-fired storage water heaters for the production of domestic hot water

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National foreword

This British Standard is the UK implementation of EN 89:2015. It supersedes BS EN 89:2000 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GSE/29, Gas-fired central heating boilers (domestic and non-domestic) and domestic gas-fired water heaters.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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English Version

Gas-fired storage water heaters for the production of domestic hot water

Appareils de production d'eau chaude par accumulation
pour usages sanitaires utilisant les combustibles gazeux

Gasbeheizte Vorrats-Wasserheizer für den sanitären
Gebrauch

This European Standard was approved by CEN on 29 November 2014.

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (EN 89:2015) has been prepared by Technical Committee CEN/TC 48 "Domestic gas-fired water heaters", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2015 and conflicting national standards shall be withdrawn at the latest by November 2015.

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

This document supersedes EN 89:1999.

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, Annex ZB or Annex ZC, which are integral parts of this document.

The present standard deals with:

- safety;
- rational use of energy;
- fitness for purpose.

It gives specific requirements relative to:

- appliances with burners with a fan;
- combustion products discharge orifice closure devices;
- type C water heaters with a fan incorporated in the combustion air supply circuit or in the combustion products evacuation circuit;
- condensing water heaters;
- measurement of NO_x emissions of water heaters;
- the metallic, plastic and other non-metallic materials that are used in water heaters and which come into contact with water intended for human consumption. It is intended to ensure that products of this kind complying with these requirements meet current technological development and requirements with regard to the service life of the water heaters and their physiological suitability;
- the growth of microorganism on materials in contact with drinking water.

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

1 Scope

This European Standard defines the specifications and test methods for the construction, safety, rational use of energy and fitness for purpose, environment and classification and marking of gas-fired storage water heaters for domestic hot water uses, hereafter called “appliance”.

This European Standard applies to appliances:

- of selected types B₁, B₂, B₃, B₅, C₁, C₂, C₃, C₄, C₅, C₆, C₇, C₈, C₉ according to CEN/TR 1749;
- fitted with atmospheric burners;
- using one or more combustible gases corresponding to the three gas families and the pressures indicated in EN 437;
- of nominal heat input not exceeding 150 kW (net calorific value);
- fitted with electrically operated mechanical flue dampers that are positioned downstream of the heat exchanger.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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, *Pressure regulators and associated safety devices for gas appliances — Part 1: Pressure regulators for inlet pressures up to and including 50 kPa*

EN 125, *Flame supervision devices for gas burning appliances — Thermoelectric flame supervision devices*

EN 126, *Multifunctional controls for gas burning appliances*

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

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

EN 437, *Test gases — Test pressures — Appliance categories*

EN 513, *Unplasticized polyvinylchloride (PVC-U) profiles for the fabrication of windows and doors — Determination of the resistance to artificial weathering*

EN 549, *Rubber materials for seals and diaphragms for gas appliances and gas equipment*

EN 573-1, *Aluminium and aluminium alloys — Chemical composition and form of wrought products — Part 1: Numerical designation system*

EN 1057, *Copper and copper alloys — Seamless, round copper tubes for water and gas in sanitary and heating applications*

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

EN 1490, *Building valves — Combined temperature and pressure relief valves — Tests and requirements*

CEN/TR 1749 *European scheme for the classification of gas appliances according to the method of evacuation of the combustion products (types)*

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

EN 10088-1, *Stainless steels — Part 1: List of stainless steels*

EN 10226-1, *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 13203-1, *Gas-fired domestic appliances producing hot water — Appliances not exceeding 70 kW heat input and 300 l water storage capacity — Part 1: Assessment of performance of hot water deliveries*

EN 13203-2, *Gas-fired domestic appliances producing hot water — Appliances not exceeding 70 kW heat input and 300 l water storage capacity — Part 2: Assessment of energy consumption*

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

EN 13501-1, *Fire classification of construction products and building elements — Part 1: Classification using data from reaction to fire tests*

EN 13611:2007+A2:2011, *Safety and control devices for gas burners and gas burning appliances — General requirements*

EN 14241-1:2013, *Chimneys — Elastomeric seals and elastomeric sealants — Material requirements and test methods — Part 1: Seals in flue liners*

EN 14459, *Control functions in electronic systems for gas burners and gas burning appliances — Methods for classification and assessment*

EN 14471:2013, *Chimneys — System chimneys with plastic flue liners — Requirements and test methods*

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

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

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

EN ISO 178, *Plastics — Determination of flexural properties (ISO 178)*

EN ISO 179-1, *Plastics — Determination of Charpy impact properties — Part 1: Non-instrumented impact test (ISO 179-1)*

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

EN ISO 527-1, *Plastics — Determination of tensile properties — Part 1: General principles (ISO 527-1)*

EN ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics (ISO 527-2)*

EN ISO 1183 (all parts), *Plastics — Methods for determining the density of non-cellular plastics (ISO 1183)*

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

EN ISO 9969, *Thermoplastics pipes — Determination of ring stiffness (ISO 9969)*

ISO 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 188, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

ISO 262, *ISO general purpose metric screw threads — Selected sizes for screws, bolts and nuts*

ISO 301, *Zinc alloy ingots intended for castings*

ISO 815-1, *Rubber, vulcanized or thermoplastic — Determination of compression set — Part 1: At ambient or elevated temperatures*

ISO 1817, *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*

ISO 2781, *Rubber, vulcanized or thermoplastic — Determination of density*

ISO 6914, *Rubber, vulcanized or thermoplastic — Determination of ageing characteristics by measurement of stress relaxation in tension*

ISO 7005, *Pipe flanges*

ISO 7619, *Rubber — Determination of indentation hardness by means of pocket hardness meters*

3 Terms and definitions

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

3.1

water heater

3.1.1

storage water heater

appliance which heats and stores a quantity of water contained in a vessel at a pre-set temperature and which has the heating source located inside the vessel

3.1.2

fixed temperature storage water heater

appliance fitted with a non-adjustable thermostat which controls the water temperature to a given setting

3.1.3

adjustable temperature storage water heater

appliance fitted with a thermostat controlling the water temperature with the set point value of this device being adjustable between two values, one being the minimum and the other the maximum

3.1.4

open storage water heater

appliance with a vent to the atmosphere

3.1.5

closed storage water heater

appliance which has no vent to the atmosphere

3.1.6

condensing storage water heater

appliance in which under normal operating conditions and for normal inlet water temperatures the water vapour of the combustion products is partially condensed in order to use the latent heat of this water vapour to produce hot water

3.2

characteristics of the gas and electricity supplies

3.2.1

reference condition

these correspond to 15 °C, 1 013, 25 mbar, unless otherwise specified

[SOURCE: EN 437:2003+A1:2009, 3.9]

3.2.2

test gas

gases intended for the verification of the operational characteristics of gas appliances. They consist of reference gases and limit gases

[SOURCE: EN 437:2003+A1:2009, 3.2]

3.2.2.1

reference gas

test gases with which appliances operate under nominal conditions when they are supplied at the corresponding normal pressure

[SOURCE: EN 437:2003+A1:2009, 3.3]

3.2.2.2

limit gases

test gases representative of the extreme variations in the characteristics of the gases for which appliances have been designed

[SOURCE: EN 437:2003+A1:2009, 3.4]

3.2.3

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

A distinction is made between:

- the gross calorific value H_s : the water produced by combustion is assumed to be condensed;
- the net calorific value H_i : the water produced by combustion is assumed to be in the vapour state

Note 1 to entry: The calorific value is expressed:

- either in megajoules per cubic metre (MJ/m³) of dry gas under the reference conditions;
- or in megajoules per kilogram (MJ/kg) of dry gas.

[SOURCE: EN 437:2003+A1:2009, 3.11]

3.2.4

relative density

d

ratio of the masses of equal volumes of dry gas and dry air under the same conditions of temperature and pressure: 15 °C or 0 °C and 1 013, 25 mbar

[SOURCE: EN 437:2003+A1:2009, 3.10]

3.2.5

Wobbe number

gross Wobbe index W_g ; net Wobbe index W_i

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

Note 1 to entry: The Wobbe indices are expressed:

- either in megajoules per cubic metre (MJ/m³) of dry gas under the reference conditions
- or in megajoules per kilogram (MJ/kg) of dry gas.

[SOURCE: EN 437:2003+A1:2009, 3.12, modified]

3.2.6

gas pressure

p

Note 1 to entry: Unit: millibar (mbar).

Note 2 to entry: 1 mbar = 10² Pa.

Note 3 to entry: A the pressures are static pressures of the moving gas, relative to the atmospheric pressure, measured at right angles to the direction of flow of the gas.

3.2.6.1

test pressure

gas pressures used to verify the operational characteristics of gas appliances. They consist of normal and limit pressures

Note 1 to entry: The gas pressures used are expressed in millibars (mbar) 1 mbar = 10² Pa.

[SOURCE: EN 437:2003+A1:2009, 3.5]

3.2.6.2

normal pressure

p_n

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

[SOURCE: EN 437:2003+A1:2009, 3.6]

3.2.6.3

limit pressure

maximum pressure: p_{max} ; minimum pressure: p_{min} pressures representative of the extreme variations in the appliance supply conditions

[SOURCE: EN 437:2003+A1:2009, 3.7]

3.2.6.4

pressure couple

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

- the highest pressure corresponds only to the low Wobbe index;
- the lowest pressure corresponds to the high Wobbe index

[SOURCE: EN 437:2003+A1:2009, 3.8]

3.2.7

rated voltage

voltage or range of voltages at which the appliance will operate normally

3.3

composition of the gas circuit

3.3.1

gas circuit

all the parts of the appliance conveying or containing the combustible gas, included between the appliance gas supply connection and the burner(s)

3.3.2

restrictor

device (with one or more orifices, if any) which is placed in the gas circuit so as to create a pressure drop and thus bring the gas pressure at the burner to a predetermined value for a given supply pressure and given rate

3.3.3

injector

component that admits gas into an atmospheric burner

3.3.4

gas pressure governor

device that maintains the downstream pressure between fixed limits independent of variations, within a given range, of the upstream pressure and the gas rate

3.3.5

gas volume governor

device that maintains a rate between fixed limits independent of variations, within a given range, of the upstream and downstream pressures

3.3.6

preset gas rate adjuster

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

Note 1 to entry: The action of operating this component is called “adjustment of the gas rate”.

3.3.7

locking a preset adjuster

immobilization of the preset gas rate adjuster by some means (e.g. by a screw) in a position after adjustment

3.3.8

sealing a preset adjuster

arrangements made to make evident any change to the adjustment

EXAMPLE Breakage of the device or sealing material.

3.3.9

putting a preset adjuster or a control out of service

putting out of operation a preset adjuster or a control (of rate, pressure, etc.) and sealing it in this position

Note 1 to entry: The appliance functions as if this device had been made inoperative.

3.4

control and safety devices

3.4.1

control knob

component intended to be moved by hand in order to act on operate an appliance control (tap, thermostat, etc.)

3.4.2

manual shut-off valve

component that permits manual interruption of the gas rate to the burner and ignition burner (if any)

3.4.3

automatic shut-off valve

valve designed to open when energized by an electrical current and which closes automatically in the absence of the current

3.4.4

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

3.4.5

programming unit

device that reacts to impulses from control and safety systems, gives control commands, controls the start-up programme, supervises the burner operation and causes controlled shutdown, safety or lockout if necessary

Note 1 to entry: The programming unit follows a predetermined sequence of actions, in conjunction with the flame detector.

3.4.6

automatic burner control system

system that comprises at least a programming unit and all the elements that make up a flame supervision device

3.4.7

combustion products discharge safety device

device that causes at least safety shutdown of the main burner, when an unacceptable spillage of combustion products is detected at the draught diverter of the water heaters (type B_{11BS})

3.4.8

water overhear safety device

device which causes a non-volatile lockout before the water heater can be damaged and the safety of/or the user endangered

3.4.9

combustion products temperature limiter

device in the combustion circuit that causes shut-down with non-volatile lockout when the preset combustion products temperature is reached

3.4.10

vent

orifice which permits atmospheric pressure to be maintained in a compartment of variable volume

3.4.11

device for monitoring air supply or evacuation of combustion products

device designed to switch the appliance to the shut-down position in the event of abnormal air intake or combustion products evacuation conditions

3.5

stages of operational and safety sequence

3.5.1

program

sequence of the operations determined by the programming unit to assure the start-up, supervision and shutdown of the burner

3.5.2

spark restoration

automatic process by which, following disappearance of the flame failure signal, the ignition device is switched on again without total interruption of the gas supply

3.5.3

recycling

automatic process by which, after loss of flame at steady state, the gas supply is interrupted and the full start procedure is re-initiated automatically

3.5.4

controlled shutdown

process by which a control device (internal or external to the appliance) immediately cuts off the gas supply to the burner

Note 1 to entry: The appliance returns to its start position.

3.5.5

safety shutdown

process which is effected immediately following the response of a protection device or the detection of a fault and puts the burner out of operation

Note 1 to entry: The resulting state of the system is defined by deactivated terminals for the shut-off valves and the ignition device.

Note 2 to entry: See EN 298:2012, 3.17.

3.5.6

locking out

complete interruption of the gas supply with lockout

3.5.7

non-volatile lockout

shutdown condition such that a restart can only be accomplished by a manual reset

3.5.8

volatile lockout

shutdown condition such that a restart can only be accomplished by restoration of the electrical supply after its loss

3.5.9

ignition lockout (thermoelectric device only)

device that prevents the ignition system from functioning for as long as the main gas circuit is open

3.5.10

restart lockout (thermoelectric device only)

device that prevents restoration of the gas flow to the main burner or to the main burner and the ignition burner until the end of the extinction delay time

3.5.11

prepurging

operation consisting of introducing forced air into the combustion circuit in order to evacuate any air/gas mixtures remaining; this takes place between the start-up command and the activation of the ignition device

3.6

burner and ignition device

3.6.1

burner

component that provides the air-gas mixture and ensures the combustion of the gas

3.6.2

main burner

burner that is intended to assure the thermal function of the appliance and is generally called “the burner”

3.6.3

ignition device

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

3.6.3.1

manual ignition device

device by means of which the burner is ignited following manual intervention

3.6.3.2

automatic ignition device

automatic device which ignites the ignition burner or the main burner directly

3.6.4

ignition burner

burner intended to ignite a main burner

3.6.4.1

permanent ignition burner

ignition burner that operates continuously throughout the whole period that the appliance is in use

3.6.4.2

alternating ignition burner

ignition burner that is extinguished as soon as ignition of the main burner is effected and re-igniting at the main burner flame just before the latter extinguishes

3.6.4.3

intermittent ignition burner

ignition burner that is ignited and extinguished at the same time as the main burner

3.6.4.4

interrupted ignition burner

ignition burner that operates only during the ignition sequence

3.6.4.5

intermittent safety ignition burner

ignition burner functioning while water is being delivered and during the extinction safety time

Note 1 to entry: The intermittent safety ignition burner is ignited by an automatic ignition device when delivery commences.

3.6.5

total premix burner

burner in which the gas and a quantity of air, corresponding to the quantity which is at least equal to the theoretical value necessary for complete combustion, are mixed before pilot flame-formation orifices

3.7

combustion circuit

circuit from the air inlet to the combustion products outlet of the appliance

Note 1 to entry: This will include combustion chamber and heat exchanger and depending on the type includes the air supply duct, the combustion products evacuation duct, the fitting piece, the connection to the terminal, the inlet terminal, the outlet terminal.

3.7.1

combustion chamber

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

3.7.2

flue outlet

part of a type B appliance that is intended to be connected to the flue evacuating the combustion products

3.7.3

draught diverter

part of a type B₁ appliance placed in the combustion products circuit to reduce the influence of updraught and to prevent that of downdraught on the stability of the burner flames and on combustion

3.7.4

ducts support

accessory used to fix, or transfer the load of, air supply and combustion product evacuation ducts to structural elements (building, etc.)

3.7.5

overheat combustion products temperature

maximum temperature of the combustion products in case of overheat, at the exit of the appliance where it is intended to be connected to a duct, flue or chimney

3.7.6

condensing operation mode of flue system

operation mode where, under normal operation conditions, flue gas condensate is available

3.7.7

terminal

device fitted to the outside of the building, to which are connected:

- the air supply and combustion products evacuation ducts for type C₁ and C₃ water heaters (one or two devices);
- the air supply duct on the one hand and the combustion products evacuation duct on the other hand for type C₅ water heaters (two devices);
- the air supply duct for type C₈ water heaters (one device)

3.7.8

fitting piece

device which allows the fitting of:

- the air supply and combustion products evacuation ducts to a single shared duct for type C₂ appliances;
- the air supply and combustion products evacuation ducts to two ducts of a shared duct system for type C₄ appliances;
- type C₆ appliances to a system for air supply and combustion products evacuation that is approved and marketed independently from the appliance;
- the combustion products evacuation duct to a chimney that is part of the building for type C₈ appliances.
- the air supply duct to a chimney that is part of the building for type C₉ appliances;
- type B₂ appliances to a system for combustion products evacuation that is approved and marketed independently from the appliance;
- the combustion products evacuation duct to a shared duct system for type B₃ appliances

3.7.9

duct adapter

device for type C appliances which allows the air supply and combustion products evacuation ducts of the appliance to be fitted to an independent air supply and combustion products evacuation system

3.7.10

condensate

liquid formed from the combustion products during the condensation process

3.7.11

air intake and combustion products evacuation ducts

device used for transporting combustion air and combustion products from the appliance to the terminal or to the duct adapter

Note 1 to entry: The following should be noted:

- ducts completely surrounded: the combustion products evacuation duct is surrounded by combustion air along its whole length;
- separated ducts: the combustion products evacuation duct and the combustion air intake duct are neither concentric nor completely surrounded.

3.7.12

electrically operated mechanical flue damper

device having a closure member which virtually blocks the flue gas passage when the main burner is off

Note 1 to entry: The closure member is opened automatically, actuated by an electrical signal.

3.7.13

total passage

flue way's cross-sectional area that would be available to the flue gases if the closure member were removed

3.7.14

terminal guard

device that protects the terminal from mechanical damage from outside influences

3.7.15

secondary flue

part of the flue of a type C₇ water heater between the draught diverter/air inlet in the loft and the combustion products outlet above the roof

3.7.16

roof space (this is sometimes called loft)

ventilated part of a building between the uppermost habitable space of the building and the roof

3.8

water circuit

3.8.1

hydraulic safety group

the hydraulic safety group comprises all or some of the following items (in accordance with EN 1487) in a single unit in the normal direction of the water flow:

- a check valve;
- a pressure tapping for monitoring the check valve;
- an isolating valve¹⁾;
- a safety valve;
- a drain device;
- an air break to drain;
- a pressure tapping¹⁾

3.8.2

combined temperature and pressure relief valve

valve, in accordance with EN 1490, activated both:

- by temperature, opening automatically to prevent the water in the appliance from exceeding 100 °C;
- and by pressure, to discharge the water and prevent the pressure in the appliance from exceeding the maximum working pressure

3.8.3

water temperature thermostat

device allowing the water temperature to be maintained automatically at a pre-determined value

3.8.4

adjustable water temperature thermostat

water temperature thermostat that permits the user to adjust the set point temperatures between the maximum and minimum values

3.8.5

water supply pressure

relative static pressure measured at the water inlet connection of the appliance with the appliance in operation

Note 1 to entry: Unit: bar

Note 2 to entry: 1 bar = 10⁵ Pa.

¹⁾ These are optional, in accordance with EN 1487.

3.9

soundness

3.9.1

external soundness

soundness, with respect to the atmosphere, of an enclosure containing gas

3.9.2

internal soundness

soundness of a closure member in the closed position and isolating an enclosure containing gas from another enclosure or from the outlet of the valve

3.10

operation

3.10.1

gas rates

3.10.1.1

volumetric rate

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

Note 1 to entry: Symbols:

— V expressed under the test conditions;

— V_r expressed under the reference conditions.

Note 2 to entry: Unit: cubic meters per hour (m^3/h).

3.10.1.2

mass rate

M

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

Note 1 to entry: Unit: kilograms per hour (kg/h).

3.10.2

heat inputs

3.10.2.1

heat input

Q

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

Note 1 to entry: Unit: kilowatt (kW).

3.10.2.2

nominal heat input

Q_n

value of the heat input declared by the manufacturer

Note 1 to entry: Unit: kilowatt (kW).

3.10.2.3

corrected heat input

Q_c

heat input that would be obtained if the appliance were supplied with dry reference gas at the normal supply pressure and a temperature of $15\text{ }^\circ\text{C}$, with an atmospheric pressure of $1\,013,25\text{ mbar}$ (see 6.3.1.2)

Note 1 to entry: Unit: kilowatt (kW).

3.10.2.4

ignition heat input

Q_{IGN}

the mean heat input during the ignition safety time

Note 1 to entry: Unit: kilowatt (kW).

3.10.2.5

minimum heat input

Q_{m}

heat input stated in the technical instructions corresponding to the minimum heat input of an appliance

Note 1 to entry: Unit: kilowatt (kW).

3.10.3

efficiency

η_{u}

ratio of the heat output to the heat input, expressed in percent (%)

3.10.4

gas combustion

3.10.4.1

flame stability

characteristics of flames which remain on the burner ports or in the flame retention zone

3.10.4.2

flame lift

phenomenon characterized by a total or partial lifting of the base of the flames from the burner ports or the flame retention zone

3.10.4.3

lightback

phenomenon characterized by the entry of a flame into the body of a burner

3.10.4.4

yellow tipping

phenomenon characterized by the yellowing of the tip of the blue cone of an aerated flame

3.10.4.5

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

3.10.5

response times

3.10.5.1

ignition opening time

T_{IA}

time that elapses between ignition of the supervised flame and the moment when the valve is held open by the flame signal

Note 1 to entry: Unit: second (s).

3.10.5.2

extinction delay time

T_{IE}
for a thermoelectric flame supervision device, the time which elapses between extinction of the supervised flame and interruption of the gas supply concerned

Note 1 to entry: Unit: second (s).

3.10.5.3

ignition safety time

T_{SA}
time that elapses between the order to open and the order to close the gas supply to the burner in the event of ignition not taking place

Note 1 to entry: Unit: second (s).

3.10.5.4

maximum ignition safety time

T_{SAmax}
ignition safety time measured under extreme operating conditions of temperature and supply voltage

Note 1 to entry: Unit: second (s).

3.10.5.5

extinction safety time

T_{SE}
time that elapses between extinction of the supervised flame and the gas supply at least to the main burner being shut off

Note 1 to entry: Unit: second (s).

3.11

appliance characteristics

3.11.1

nominal capacity

volume of water in the appliance stated in the technical instructions

Note 1 to entry: Unit: litre (l).

3.11.2

maintenance consumption

q
heat input necessary to maintain a given difference between the water temperature and the ambient temperature

Note 1 to entry: Unit: watt (W).

3.11.3

heating up time

time necessary to attain a given rise in the water temperature under the conditions specified by the test procedure

3.11.4 specific rate

D

domestic hot water rate corresponding to a mean temperature rise of 30 K that the appliance can supply in two successive delivery periods

Note 1 to entry: *D* is expressed in litre per minute (l/min).

[EN 13203-1]

3.12 standby mode

operating state in which the appliance can provide domestic hot water at any time

Note 1 to entry: In the case of an appliance with a control cycle for keeping components and/or the tank (if any) of the domestic hot water circuit at predetermined temperature level no tapping is made.

4 Classification of storage water heaters

4.1 General

Storage water heaters are classified:

- into categories, according to the gases capable of being used, as given in EN 437;
- into types, according to the modes of supply of the combustion air and evacuation of the combustion products.

4.2 Classification of gases

The gases are classified according to EN 437.

4.3 Appliance categories

Appliances are classified into categories defined according to the gases and pressures for which they are designed and in accordance to EN 437.

4.4 Mode of supply of the combustion air and evacuation of the combustion products (appliance types)

Appliances are classified into several types according to the mode of evacuation of the combustion products and admission of the combustion air, and in accordance to CEN/TR 1749.

5 Construction requirement

5.1 Introduction

Except where otherwise stated the constructional safety is verified by inspection of the appliance and its technical literature.

5.2 General

5.2.1 Conversion to different gases

The following operations are permitted when converting from a gas of one group or family to a gas of another group or family (see 4.3, 5.3.3, 5.3.4, 5.3.6.2.2 and 5.4):

- adjustment of the gas rate of the main burner;
- change of injectors or restrictors;
- change of ignition burner or its components;
- change of system which modulates this gas rate;
- putting out of service and sealing of an adjuster and/or a governor.

It shall be possible to carry out these operations without having to interfere with the connections of the appliance and its ducts (water, gas, combustion products evacuation).

5.2.2 Materials

5.2.2.1 General

When the appliances are installed according to the technical instructions, the quality and thickness of the materials used in their construction shall be such that, under normal conditions of use, maintenance and adjustment, these materials shall withstand the mechanical, chemical and thermal conditions to which they may be subjected during a reasonable life. Any anode is not subject to the requirement of this subclause.

Sheet metal parts, when they are not made of corrosion-resistant materials, shall be enameled or be coated with another effective protection against corrosion.

Zinc alloys may only be used in contact with gas if they are of quality ZnAl4, in accordance with ISO 301 and if the parts are not liable to be exposed to a temperature above 80 °C under the conditions of 6.5. Only external threads in accordance with EN ISO 228-1 are acceptable for principal inlet and outlet connections made of zinc alloy.

The use of asbestos-based materials is forbidden.

The use of cadmium containing solder is forbidden.

Moreover, parts in contact with water shall be made of materials of quality so that the water for domestic hot water use cannot be polluted.

For condensing appliances, all parts of the exchanger and other parts of the appliance likely to be in contact with the condensate shall be constructed of materials sufficiently resistant to corrosion or be coated so as to ensure the appliance has a reasonable life when installed, operated and maintained in accordance with the technical instructions.

5.2.2.2 Metallic materials

5.2.2.2.1 Corrosion resistance

Provided that the water heater is used in accordance with the technical instructions:

- the functioning of components manufactured from corrosion-resistant metallic materials shall not be affected by corrosion within the expected service life of the water heater and
- no special maintenance shall be required to keep the components in good working order.

5.2.2.2.2 Requirements

Materials that come into contact with water intended for human consumption shall withstand the mechanical, chemical and thermal stresses to which they are exposed during the service life of the water heater and shall not contaminate the water supplied.

Metallic materials shall be corrosion-resistant. Metallic materials are considered to satisfy the requirements with respect to corrosion protection:

- if the material used is enamelled (one or more layers) and equipped with cathodic corrosion protection, or
- where types of stainless steel containing a minimum of 16 % chrome are used, or
- where they are assessed as acceptable to the national regulations in force.

The selection of metallic materials (steel, copper and copper alloys) are given in J.2 and J.3 (see Annex J).

5.2.2.3 Enamelling - Physiological safety

The release of lead and cadmium ions or compounds into the water shall not exceed the following limit values:

Lead:

- cold water test: $0,3 \text{ mg}/(\text{m}^2 \cdot \text{d})$;
- hot water test: $0,3 \text{ mg}/(\text{m}^2 \cdot \text{h})$.

Cadmium:

- cold water test: $0,03 \text{ mg}/(\text{m}^2 \cdot \text{d})$;
- hot water test: $0,03 \text{ mg}/(\text{m}^2 \cdot \text{h})$.

A double parallel test with special specimen plates is carried out in cold and hot water. The cut edges of the specimen are covered with a coating of a material that does not contain lead or cadmium.

The cold water test shall be carried out using water at a temperature of $(18 \pm 5) ^\circ\text{C}$ and the hot water test using water at a temperature of $(90 \pm 5) ^\circ\text{C}$. Two parallel tests are carried out with special specimen plates. The cold water test is performed in 3 succeeding extractions of 72 h, the hot water test in 4 succeeding tests of 24 h. It is checked that the results obtained from the final extractions (cold and hot) satisfy the requirements of the given limits for lead and cadmium. The concentration is measured at each extraction. Concentrations of the successive extractions shall be not greater than that obtained at the preceding extractions.

5.2.2.4 Non-metallic materials

5.2.2.4.1 Plastic materials

Due to the many different types of plastic in components used in the drinking water sector, many different material properties need to be taken into consideration e.g. longitudinal expansion, joining and fixing techniques, temperature effects, effect of light (UV resistance), ageing, internal pressure, internal and external corrosion (for example as a result of using cleaning products) and also transport and storage conditions.

5.2.2.4.2 Requirements of plastic materials

In the manufacture of water heaters and their components, only those plastic materials that meet mechanical, chemical and thermal demands as well as physiological and hygiene requirements throughout the life of the equipment shall be used in contact with water intended for human consumption. This means they shall be suitable for coming into direct contact with food and not pose any health threat. Special attention shall be paid to microbiological properties of the plastic materials used and to the prevention of substances from leaching out.

Examples for the selection of the plastic materials are given in J.4 (see Annex J).

5.2.2.4.3 Other non-metallic operating and auxiliary materials

These materials include rubber, sealant, adhesives and also lubricants on moving parts that come into contact with the water intended for human consumption. These materials shall satisfy the physiological and hygiene requirements in force. Their use is to be limited to what is technically necessary.

5.2.2.4.4 Durability against corrosion of combustion product evacuation duct

The durability against corrosion of the combustion product evacuation duct is demonstrated by fulfilling either:

- the requirements in Table 1 or
- a corrosion test method from EN 1856-1:2009, Annex A.

Table 1 —Flue duct material specification

Material	Symbol	Minimum Nominal Thickness non- condensing b mm	Minimum nominal Thickness condensing b mm
EN 573–1 Aluminium designation			
EN AW – 4047A	EN AW Al Si 12 (A), and CU < 0,1 %, Zn < 0,15 % (cast aluminium)	0,5	1,5
EN AW – 1200A	EN AW-AL 99,0 (A)	0,5	1,5
EN AW-6060	EN AW-Al MgSi	0,5	1,5
EN 10088–1 Steel number	EN 10088–1 Steel name		
1.4401	X5CrNiMo 17–12–2	0,4	0,4
1.4404 ^a	X2CrNiMo 17–12–2	0,4	0,4
1.4432	X2CrNiMo 17–12–3	0,4	0,4
1.4539	X1NiCrMoCu 25–20–5	0,4	0,4
1.4401	X5CrNiMo 17–12–2	0,11 ^c	0,11 ^c

Material	Symbol	Minimum Nominal Thickness non- condensing _b mm	Minimum nominal Thickness condensing _b mm
1.4404 ^a	X2CrNiMo 17–12–2	0,11 ^c	0,11 ^c
1.4432	X2CrNiMo 17–12–3	0,11 ^c	0,11 ^c
1.4539	X1NiCrMoCu 25–20–5	0,11 ^c	0,11 ^c
^a Equivalent for material N° 1.4404 = 1.4571 (symbol X6CrNiMoTi 17–12–2). ^b The condensing column shall be used if, under normal operation conditions, condensate is produced in the combustion products circuit (according to 3.7.6). ^c Flexible liners (when installed in an existing chimney.			

The actual minimum thickness of the materials shall always be greater than 90 % of the minimum nominal thicknesses

5.2.3 Design - Assembly - Strength

All the constituent parts shall be constructed and assembled in such a way that the operating characteristics of the appliance are not altered significantly during a reasonable life and under normal conditions of installation and use.

The screws of preset adjusters shall be arranged so that they cannot fall inside the pipes. In addition, their threads shall not deteriorate even after several successive manipulations.

The construction of the appliance shall be such that condensate which may be produced during start up or in operation does not affect safety.

5.2.4 Accessibility - Ease of maintenance - Fitting and removal

It shall be possible to clean the combustion circuit by following the technical instructions.

It shall not be possible to replace parts that have to be removed for maintenance in such a way that the operational safety of the appliance is compromised. In particular, the soundness of the combustion circuit shall be maintained after refitting following cleaning or maintenance operations.

Removable components, for example the burner or the heating body, shall be able to be removed with commercially available tools and with the appliance remaining in position.

It shall be easy to replace the corrosion protection anode, if any.

5.2.5 Gas and water pipe connections

5.2.5.1 General

The appliance connections shall be easily accessible. They shall be clearly identified in the technical instructions and, where appropriate, on the appliance. The space left around the connection shall be adequate to allow free movement of tools necessary for assembly after removal of the enclosure, if necessary. All connections shall be capable of being made without special tools.

5.2.5.2 Gas pipe connection

The appliance gas inlet connection shall permit rigid connection.

If the appliance has a threaded inlet connection, this shall comply with EN ISO 228-1 or EN 10226-1. In the first case (EN ISO 228-1), the end of the appliance inlet connection shall be sufficiently flat to allow the use of a sealing washer.

If flanges are used, they shall comply with ISO 7005.

If the inlet connection consists of a plain copper tube, it shall have a straight section at least 5 cm long and shall comply with EN 1057.

For the types of gas connection commonly used in the various countries, see Table A.1.

5.2.5.3 Water connections

Threaded connections shall comply with EN ISO 228-1 or EN 10226-1.

If copper connections are used, the end of the prepared tube shall comply with EN 1057.

If materials other than metallic materials are used, they shall be supplied with suitable justification of suitability for the conditions of use.

For water connection conditions in common use in the various countries, see Table A.1.

5.2.6 Means of achieving soundness

5.2.6.1 Soundness of the gas circuit

Holes for screws, fixing studs, etc., intended for the assembly of parts shall not open into gasways. Furthermore, it shall not be possible for water to penetrate into the gas circuit.

The soundness of parts located in the gas circuit and likely to be dismantled for normal maintenance shall be ensured by mechanical means, e.g. metal to metal joints or O-ring joints, i.e. excluding the use of all thread sealing materials (liquids, jointing pastes, tapes, etc.). This soundness shall be maintained even after dismantling and reassembly.

However, sealing materials may be used for permanent assemblies. The sealing materials shall remain effective under normal conditions of appliance use.

The soundness of unthreaded assemblies in the gas circuit shall not be achieved by means of soft soldering nor by means of adhesives.

Rubbers in contact with gas shall comply with the requirements of EN 549.

5.2.6.2 Soundness of the combustion circuit

5.2.6.2.1 Type B appliances

The soundness of the combustion circuit, up to the draught diverter, shall be achieved only by mechanical means, except for assemblies not intended to be dismantled during routine maintenance: these may be jointed using mastics or pastes in such a way that permanent soundness is ensured in continuous service under normal conditions of use.

5.2.6.2.2 Type C appliances

Parts which have to be removed during routine service and affect the soundness of the water heater 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 by the technical instructions, is permitted.

Where the water heater case forms part of the combustion circuit and it can be removed without the use of tools, either the water heater shall not operate, or there shall be no leakage of combustion products into the room where the water heater is installed when the case is replaced incorrectly.

However, parts of the assembly that are not intended to be dismantled for routine servicing 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 duct adapter of the combustion circuit 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 ensured after reassembly.

5.2.7 Supply of combustion air and evacuation of the combustion products

5.2.7.1 All appliances

It shall not be possible to adjust the cross-section of the air intake leading to the combustion chamber or the cross-section of the combustion products evacuation flue, in the case of appliances without fans.

Except where otherwise stated, the fan-assisted appliances may be fitted with an adjustment component in the combustion air intake or combustion products evacuation circuit, designed to adapt the appliance to installation conditions. This adjustment is carried out by calibrating orifices, or by predetermined positioning applying the detailed technical instructions.

Any appliances shall be designed so that the combustion air supply is ensured under normal conditions of use and maintenance.

5.2.7.2 Type B₁ appliances

Type B₁ appliances shall be fitted with a draught diverter, fixed rigidly to the appliance in compliance with the installation instructions.

The outlet connection of the draught diverter shall be female. The installation instructions shall specify clearly the conditions for connecting the adaptor permitting the connection between the draught diverter outlet and the flue to which the appliance is connected. The diameters of the flues in force in the various countries appear for information purposes in Table A.2.

It shall be possible to insert the flue to a depth of at least 15 mm vertically or 30 mm horizontally. When inserted as far as possible, the evacuation of the combustion products shall not be impaired.

5.2.7.3 Type C water heaters

5.2.7.3.1 General

All water heaters 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 by the technical instructions. A gas/air ratio control is permitted. Water heaters with a fan-assisted may be fitted with a means of adjustment in the combustion circuit intended to adapt the water heater 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.

5.2.7.3.2 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 water heater.

It shall be possible to connect the water heater, the air supply and combustion products evacuation ducts and the terminal or fitting piece using ordinary tools if necessary.

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 types C₁ and C₃ water heaters;
- may terminate in zones of different pressure for type C₅ water heaters, but not on opposite walls of the building.

5.2.7.3.3 Terminal

Terminals on water heaters without a fan should prevent the intrusion of external objects by having no opening in the external surfaces of the terminal which shall permit the entry of a 16 mm diameter ball when applied with a force of 5 N.

Any horizontal terminal for non-condensing water heaters shall be designed in such a way that any condensate is discharged outwards from the wall.

Any horizontal terminal for condensing water heaters shall be designed in such a way that condensate is directed towards the appliance.

5.2.7.3.4 Terminal guard

If the installation instructions specify a protective guard for the terminal for use when the outlets for evacuation of the combustion products open on to a walkway, the prescribed dimensions of the guard shall be such that the distance between any part of the guard and the terminal, except the wall plate, exceeds 50 mm. The guard shall not have any sharp edges likely to cause injury.

5.2.7.3.5 Fitting piece

For water heaters of types C₂, C₄ and C₈, the fitting piece shall be designed so that it is possible to obtain the distances specified in the installation instructions for the projection of the ends of the combustion air supply and combustion products evacuation ducts into the common duct, whatever the total thickness (flue and cladding) of the common duct.

5.2.7.3.6 Special requirements for certain components of water heaters with a fan

5.2.7.3.6.1 Fan

Direct access to the rotating parts of a fan shall be prevented. The parts of a fan in contact with combustion products shall be effectively protected against corrosion unless they are of corrosion resistant material; furthermore they shall withstand the temperature of the combustion products.

5.2.7.3.6.2 Air monitoring device

Requirements

Type B₁₂ and B₁₃ water heaters with fans shall be fitted with a system for air proving.

Before each fan start it shall be checked that there is no simulation of air flow in the absence of air flow.

The system for supervision of the combustion air rate or combustion products rate is activated directly by the flow of combustion air or combustion products.

This is also valid for water heaters with more than one fan speed in which the flows associated with each fan speed are monitored.

The supply of combustion air shall be checked by continuous supervision of the combustion air rate or combustion products rate.

Type C and other type B water heaters with fan shall be fitted with a system for air proving.

Except for water heaters with gas/air ratio controls, before each fan start it shall be checked that there is no simulation of air flow in the absence of air flow.

The system for supervision of the combustion air rate or combustion products rate is activated directly by the flow of combustion air or combustion products. This is also valid for water heaters with more than one fan speed in which the flows associated with each fan speed are monitored.

The supply of combustion air shall be checked by one of the following methods:

- a) continuous supervision of the combustion air rate or combustion products rate (as B_{12}/B_{13});
- b) gas /air ratio controls;
- c) start-up supervision of the combustion air rate or combustion products rate provided that:
 - the combustion products circuit is completely surrounded by the air supply circuit, or the leakage rate of the combustion products circuit meets the requirements of 6.2.2.3.2, and
 - there is a shutdown at least every 24 h²⁾, and
 - there is an indirect system for air proving (e.g. fan speed supervision) during operation.

5.2.7.3.6.3 Gas/air ratio controls

Gas/air ratio controls shall comply with the relevant requirements and tests of EN 88-1. Control tubes may be made of metal with suitable mechanical connections or of other materials with at least equivalent properties and in this case are considered immune to breakage, accidental disconnection and leakage after initial soundness checks.

Control tubes for air or combustion products shall have a minimum cross-sectional area of 12 mm² with a minimum internal dimension of 1 mm. They shall be located and fixed so that any retention 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. 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 shall be 5 mm².

2) Some water heaters will be used in a way that it is very likely they will shutdown at least once per 24 h without having a specific function to ensure this.

5.2.8 Checking the state of operation

The installer shall be able to observe visually the ignition and operation of the burner(s) and also the length of the flame(s) of the ignition burner, if any.

In addition, mirrors, sight glasses, etc., shall continue to retain their optical properties. However, when the main burner is fitted with its own flame detector, an indirect means of indication (e.g. an indicator light) is allowed.

The indication of flame presence shall not be used to indicate any fault, except for a fault in the operation of the means of checking the flame itself, which shall result in an indication that there is no flame.

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

5.2.9 Drainage

It shall be possible to drain the appliance easily without the aid of any tools other than a screwdriver or a spanner.

NOTE It is assumed that an appliance supplied with an hydraulic safety group defined in 3.8.1 fulfils this requirement.

5.2.10 Electrical safety

5.2.10.1 General

The water heater shall comply with the relevant requirements of EN 60335-2-102.

If the water heater is fitted with electronic components or electronic systems providing a safety function, these shall comply with the relevant requirements in 5.2.10.2.

If the data plate states the nature of the electrical protection of the water heater, this statement shall comply with EN 60529.

For water heaters intended to be installed in a partially protected place:

- a) the enclosure protection degree shall be at least IPX4D;
- b) the electrical and/or electronic equipment temperature range shall be suitable for the specified temperature range of the water heater.

5.2.10.2 Controls

5.2.10.2.1 General

In 5.2.10.2.2 controls requirements are specified by reference to existing controls standards. For some clauses, additional requirements and/or deletions are given in 5.2.10.2.2.

For water heater specific controls, approved for a specific water heater, some requirements can be waived, as these are covered by the water heater standard. See 5.2.10.2.2 for details on this.

5.2.10.2.2 Detailed specifications

Control and safety devices shall comply with the following standards:

- EN 88-1, *Pressure governors for gas appliances*;

- EN 125, *Thermo-electric flame supervision devices for gas burning appliances*;
- EN 126, *Multifunctional controls for gas burning appliances*;
- EN 161, *Automatic shutoff valves for gas burners and gas appliances*;
- EN 298, *Automatic gas burner control systems*;
- EN 13611, *Safety and control devices for gas burners and gas burning appliances - General requirements*;
- EN 14459, *Control functions in electronic systems for gas burners and burning appliances – Method for classification and assessment*.

In addition, for water heaters the following applies:

- a) valves using auxiliary fluids shall close automatically on reducing the actuating pressure to 15 % of the highest pressure specified in the technical instructions;
- b) a valve with pneumatic or hydraulic actuating mechanisms is energized at the maximum actuating pressure, and the actuating pressure is reduced slowly to 15 % of the maximum actuating pressure. At this point the valve shall have travelled to the closed position.

Water heater controls which have not been separately type tested shall be tested in combination with the water heater. In that case clauses of the above mentioned standards, which refer to the below mentioned aspects, can be waived:

- c) connections: as mentioned in EN 13611:2007+A2:2011, 6.4, 6.4.1, 6.4.2, 6.4.3, 6.4.4, 6.4.5 and 6.4.6;
- d) rated flow rate: as mentioned in EN 13611:2007+A2:2011, 7.6: (already covered in the nominal heat input/output tests);
- e) EMC/Electrical requirements: as mentioned in EN 13611:2007+A2:2011, 8.1 to 8.10;
- f) marking: as mentioned in EN 13611:2007+A2:2011, Clause 9;
- g) protection against environmental influences: as mentioned in EN 298:2012, 8.2 to 8.8;
- h) marking, installation and operating instructions: as mentioned in EN 298:2012, Clause 9.

NOTE Alternative clause numbers may apply when the product standard (e.g. EN 88–1 / EN 161) is used.

Water heater controls which have not been separately type tested shall be tested in combination with the water heater. In that case, the following additional aspects need to be considered:

- i) EN 13611:2007+A2:2011, 6.4.8, the strainer can also be in the water heater;
- j) EN 13611:2007+A2:2011, 7.1, the control shall work correctly taking into consideration the max. working pressure, as specified for the water heater, is used and for mounting position, the position of the control in the water heater is used;
- k) EN 13611:2007+A2:2011, 7.3, tests are limited to the pressures as defined for the water heater;
- l) EN 13611:2007+A2:2011, 7.4 and 7.5, tests are performed unless it is evident that the control will not have any bending and torque load, for example because of the way of construction or installation in the water heater;

- m) EN 88-1:2011, 7.101.5, correct function is demonstrated on the water heater according the requirements of this standard, comparable with a class C regulator, for the gases specified.

5.2.11 Operational safety in the event of failure or restoration of the auxiliary energy

If the appliance uses auxiliary energy, its design shall be such that no risk can occur in the event of failure of the auxiliary energy or following its restoration.

5.2.12 Mechanical resistance and stability of ducts, terminal and fitting pieces

5.2.12.1 General

Where the air supply and combustion product evacuation ducts are supplied or specified by the technical instructions, the ducts, terminal and fitting pieces shall meet requirements for mechanical resistance and stability.

5.2.12.2 Compressive strength

5.2.12.2.1 Duct sections and fittings

Requirements

Where compressive stresses occur in the air supply or combustion products evacuation ducts, due to the weight of the duct components, the ducts shall show no permanent deformation.

Test conditions

The longest vertical ducts, fitting pieces and terminal as specified by the technical instructions are installed. If this becomes impractical, length might be simulated by adding appropriate weight. The appliance itself is not included in this test set up if it is not specified by the technical instructions.

It is visually checked that the requirement is satisfied.

5.2.12.2.2 Ducts support

Requirements

When tested the maximum displacement of the ducts at the support shall not be greater than 5 mm in the direction of the load.

Test conditions

The longest vertical ducts, the fitting pieces and the terminal as specified by the technical instructions are installed including the necessary duct support. If this becomes impractical, length might be simulated by adding appropriate weight. The appliance itself is not included in this test set up if it is not specified by the technical instructions.

It is visually checked that the requirement is satisfied.

5.2.12.2.3 Vertical terminals

Requirements

When tested the terminal shall show no permanent deformation.

Test conditions

The terminal is installed in accordance with the installation instructions. A vertical load is evenly distributed to the top of the terminal. This load is maintained for 5 min. The load is $7 \times DN$, where DN is the internal diameter of the flue in mm, but not more than 750 N.

It is checked that the requirements are satisfied.

5.2.12.3 Lateral strength

5.2.12.3.1 Flexural tensile strength

Requirement

When specified in the technical instructions the air supply and combustion product evacuation ducts to be suitable for non-vertical installation, these ducts are tested in accordance the test conditions below.

The deflection of any part shall not be more than 2 mm per meter in distance between supports.

Test conditions

The ducts, fitting pieces and terminal are installed with the minimum inclination to the horizontal and the maximum distance between adjacent supports as specified in the installation instructions.

It is checked that the requirement is satisfied.

5.2.12.3.2 Components subject to wind load

Requirements

When the technical instructions specify a certain length of the air supply and combustion product evacuation ducts to be suitable for external installation, the ducts shall show no permanent deformations when tested in accordance with the test conditions below.

Test conditions

The terminal including the ducts penetrating the roof or wall with the maximum lengths of external ducts as specified in the technical instructions is installed.

An evenly distributed load is applied to the external part of the appliance duct and terminal and increased uniformly up to $1,5 \text{ kN/m}^2 \pm 2,5 \%$.

NOTE A method for applying an evenly distributed load is described in EN 1859:2009+A1:2013, Annex H. Other methods using a vertical assembly may also be used.

The test load is applied by a number of individual evenly distributed loads equally spaced from the freestanding end at not more than $0,2 \text{ m} \pm 0,01 \text{ m}$ intervals. The individual loads do not vary by more than 1 %.

It is checked that the requirement is satisfied.

5.3 Adjusting, control and safety devices

5.3.1 General

The operation of safety devices shall not be overridden by adjusting and control devices.

There shall be no shaft or lever capable of being operated outside the body that could prevent correct closure of the gas shut-off valve.

Screwed fastenings that have to be removed for servicing of the device shall have a metric thread complying with ISO 262 unless a different thread is essential for the correct functioning and adjustment of the device.

Thread-forming screws that form a thread and do not produce filings may be used. It shall be possible to replace them by metric machine screws complying with the above-mentioned ISO standard.

Self-tapping screws that cut a thread and produce filings shall not be used for the assembly of gas-carrying parts or of parts that may be removed for servicing.

The operation of moving parts (e.g. diaphragms, etc.) shall not be impaired by other components. Packing glands that are adjusted and sealed at the factory may be used for sealing moving parts.

Manually adjustable packing glands shall not be used.

A device to protect against dust shall be positioned before the first control or shut-off device at the gas inlet. The maximum dimension of the mesh of the strainer shall not exceed 1,5 mm; furthermore the mesh shall not allow passage of a 1 mm pin gauge. However, for protection of a class B or J automatic valve, the mesh shall not exceed 0,2 mm.

All the devices specified in 5.3 or the multifunctional control in which they may be fitted shall be removable or exchangeable if this is necessary for cleaning or replacement of the device.

The control knobs shall be designed and located so that they can neither be fitted in an incorrect position nor be capable of moving of their own accord.

When there are several control knobs, they shall not be interchangeable if this could prejudice safety.

All appliances shall be provided with a manual shut-off valve which allows the user to shut off the gas supply to the main burner and the ignition burner, if it exists. This device shall be designed and fixed in such a way that its operation is easy.

5.3.2 User controls

Every appliance shall be provided with at least one device enabling the user to control the admission of gas to the burner and to the ignition burner.

Shut-off shall be effected without delay, for example it shall not be subject to the delay time of the thermoelectric flame supervision device.

No markings are required if incorrect operation is impossible, for example when a single button controls a flame supervision device for the burner and ignition burner. However, where it is necessary to use markings, the following symbols shall be used:

— off	: full disc	
— ignition	: stylized spark	
— full rate of the burner	: large stylized flame	

If the appliance has two distinct gas rate controls, one for the burner and one for the ignition burner, the operation of these devices shall be interlocked in such a way that it is impossible for the burner to be supplied before the ignition burner.

If the burner and ignition burner are served by a single gas rate control, the position for ignition of the latter shall have a stop or notch making this position clearly perceptible to the user. It shall be possible to carry out the unlatching operation (if any) with one hand.

If the only gas shut-off device operates by turning, it shall turn off in a clockwise direction as seen by an observer facing the knob.

5.3.3 Preset gas rate adjusters

Preset gas rate adjusters shall be designed so that they are protected against accidental incorrect adjustment by the user once the appliance has been put into service.

Any parts of the appliance that are not to be manipulated by the installer or user shall also be protected in an appropriate manner. Lacquer may be used for this purpose provided that it resists the heat to which it is subjected during normal operation of the appliance.

A preset gas rate adjuster is mandatory for appliances using more than one group of the first gas family, and optional for other appliances.

The preset adjusters shall be sealed or the installation instructions shall prescribe that the present adjuster shall be sealed after the installation:

The preset gas rate adjuster shall be locked and sealed when a gas of a family or group carrying a “+” suffix is used.

The adjustment may be continuous (adjusting screw) or discrete (change of restrictors).

The adjuster of an adjustable gas pressure regulator is regarded as a preset adjuster.

The action of adjusting these devices is called “adjusting the gas rate”.

These devices shall be designed so that they can be moved easily with commercially available tools, even after prolonged use.

5.3.4 Gas pressure regulator

Gas pressure regulator shall meet the applicable requirements of EN 88-1.

Appliances intended to operate with first family gases shall have a gas pressure regulator. A gas governor is optional for other appliances.

A governor intended for operation with a pressure couple shall be adjusted or shall be capable of being adjusted in such a way that it cannot operate between the two normal pressures. However, when operating with a pressure couple, a non-adjustable gas pressure regulator is permitted for the ignition burner.

The design and accessibility of the gas pressure regulator shall be such that it can be easily adjusted or put out of service or, possibly, the governor or its components can be changed on conversion to another gas, but precautions shall be taken to make unauthorized interference with the preset adjuster difficult.

5.3.5 Pressure test points

All appliances shall be provided a gas pressure test point which allows the pressure at the appliance inlet to be measured.

For appliances which require the burner pressure to be measured, in accordance with the installation or conversion instructions, a second pressure test point shall be provided downstream of any preset adjuster.

For type C appliances, the measurement shall be able to be carried out at these points without opening the combustion circuit.

The pressure test points shall have an external diameter of $(9,0_{-0,5}^0)$ mm and a length of at least 10 mm to enable a rubber tube to be fitted.

The diameter of the bore of the pressure test point shall not exceed 1 mm at the narrowest place.

5.3.6 Ignition devices

5.3.6.1 Ignition of the ignition burner

It shall be possible to light, in a simple manner, ignition burners that are directly ignited by hand.

Ignition devices for the ignition burner shall be designed and fitted in such a way that they are located correctly in relation to the components and the ignition burner. It shall be possible to fit or remove the ignition device for the ignition burner, or the ignition burner-ignition device assembly, using normal tools.

Special ignition devices shall be provided (e.g. electric igniters) for type C appliances. Ignition of these appliances shall always be possible with the combustion chamber closed.

5.3.6.2 Ignition device for the main burner

5.3.6.2.1 General

The main burner shall be fitted with an ignition burner or a device for direct ignition. Direct ignition shall not cause deterioration of the burner.

5.3.6.2.2 Ignition burners

The cross-section of the flame ports and the terminal area of the injectors shall not be adjustable.

Ignition burners shall be designed and fitted in such a way that they are located correctly in relation to the components and to the burners which they ignite. If the ignition burners differ according to the type of gas used, they shall be marked, easy to substitute for one another and easy to fit. The same applies to injectors where only they shall be changed.

If the ignition burner rate is not governed, a rate adjuster is mandatory for appliances operating on first family gases and optional for second and third family gases. It is however forbidden for second and third family gases if a pressure couple is used. The adjuster may be omitted if ignition burners and/or injectors suiting the characteristics of the gas can be changed easily.

Primary air inlet control devices are not permitted.

5.3.6.2.3 Direct ignition

Devices for direct ignition shall ensure safe ignition even if the voltage is varied from 85 % to 110 % of the nominal voltage. The order to energize devices for direct ignition shall be given no later than the order to open the automatic valve that releases the gas to be ignited. The ignition device shall be de-energized separately from flame detection and no later than the end of the ignition safety time.

5.3.7 Flame supervision device

5.3.7.1 General

The presence of a flame shall be detected:

- either by a thermoelectric flame supervision device;
- or by the flame detection device of an automatic burner control system.

At least one flame detector is required.

If the main burner is ignited by an ignition burner, the presence of a flame at the ignition burner shall be detected before the gas to the main burner is released.

5.3.7.2 Thermoelectric flame supervision device

Separately marketed thermoelectric flame supervision devices shall meet the applicable requirements of EN 125 or EN 126 in the case of devices integrated in multifunctional valves.

The device shall cause a non-volatile lockout of the appliance in the case of flame failure and if the sensing element or the connection between this element and the actuator is destroyed.

If a safety device acts on the thermoelectric flame supervision device, closure shall be immediate.

In addition, for type C appliances, this device shall comprise either an ignition lockout, or a restart lockout.

5.3.7.3 Automatic burner control systems

Automatic burner control systems shall meet the applicable requirements of EN 298.

In case of flame failure, the system shall result in, at least:

- spark restoration;
- or recycling;
- or volatile lockout.

In the case of spark restoration or recycling, an absence of flame at the end of the ignition safety time (T_{SA}) shall result in, at least locking out with volatile lockout.

5.3.8 Combustion products discharge safety device

Appliances shall be so constructed that in abnormal draught conditions there is no release of combustion products in a dangerous quantity into the room concerned.

This can be achieved with a combustion products discharge safety device complying with essential requirement 3.4.3 of the Gas Appliances Directive 2009/142/EC. In this case, the appliance is designated as a type B_{1BS} appliance.

However, appliances intended to be installed:

- either in the open air;
- or in a room separated from living rooms and provided with appropriate ventilation directly to the outside;

may not be fitted with such a device but in this case, appropriate warnings on the packaging and in the instructions shall clearly indicate the limit on the use of this type of appliance; in this case, the appliance is designated as a type B₁₁ appliance.

Any adjustable component forming part of the safety device shall be sealed.

The safety device shall be designed so that it cannot be dismantled without a tool.

Incorrect refitting, after servicing, shall be made difficult.

The safety device shall be designed so that the electrical insulation withstands the thermal stresses resulting from spillage of the combustion products.

Interruption of the link between the sensor and the device responding to its signal or destruction of the sensor shall cause at least safety shutdown, if necessary after a waiting time.

5.3.9 Protection against accidental overheating

Closed appliances shall be fitted with overheating protection which cuts off the gas supply before the water temperature reaches 100 °C.

If the appliance is fitted with an electric overheating safety limiter, it shall meet the requirements of EN 60730-2-9 for type 2 K.

The action of the overheating safety device shall result in a non-volatile lock-out.

The sensor of the overheating safety device shall be independent of that of the control thermostat.

The valve which interrupts the gas supply shall be separate from the valve controlled by the control thermostat. The overheating safety device shall not be adjustable. The operation of the overheating safety device shall not be disrupted by the cold water supply or by deposits.

Any fault in the sensor or the connections between this element and the actuator or any interruption of the external power supply likely to impair the correct operation of the device shall result at least in a safety shutdown.

5.3.10 Control thermostat

All appliances shall be fitted with a thermostat which makes it possible to keep the water temperature in the storage vessel within specific temperature limits.

The water temperature thermostat shall meet the requirements of EN 60730-2-9 for type 1.

This thermostat may be:

- a) adjustable by the user. In this case, the position shall be clearly marked. It shall be easy to adjust, for example by means of a knob;
- b) adjustable by the installer. In this case, there shall be a device which allows the installer to adjust the thermostat and then seal it;
- c) non-adjustable.

5.3.11 Automatic shut-off valves

Automatic shut-off valves shall meet the relevant requirements of EN 161.

The gas circuit of the main burner and the gas circuit of the ignition burner, if heat input exceeds 0,250 kW, shall comprise at least two valves in series:

- a class C valve or a thermoelectric flame supervision device;

- a second class J valve without an imposed closing time for appliances with a heat input not exceeding 70 kW, and with a closing time not exceeding 5 s for appliances with a heat input greater than 70 kW.

If the heat input of the ignition burner is less than or equal to 0,250 kW, the gas circuit of the ignition burner shall have at least one class C valve or a thermoelectric flame supervision device.

The safety devices which shall result in locking out with a non-volatile lockout shall give the order for the two valves to close simultaneously. However, in the case of a thermoelectric supervision device, the safety devices may act just on this device.

If the main burner is ignited directly and the order for control closure is not given simultaneously to the two valves, they may be class C valves.

If the period between the orders for control closure of the valves is less than or equal to 5 s, the orders are regarded as being simultaneous.

A class C valve may be replaced by a class B or class A valve; a class J valve may be replaced by a class C, class B, or class A valve.

Diagrams of the composition of the gas circuit are given in Annex D.

5.3.12 Combustion products temperature limiter

If the appliance is intended to be connected to a flue likely to be adversely affected by the heat of the combustion product (for example a plastics flue or a plastics-lined flue), the appliance shall have a device that prevents the combustion products temperature from exceeding the maximum permissible temperature for these materials specified in the technical instructions.

This device to limit the temperature of the combustion products shall not be adjustable and shall not be accessible without a tool. The action of this device shall result in a non-volatile lockout of the appliance.

5.3.13 Combined temperature and pressure relief valve

If the installation instructions specify the use of a combined temperature and pressure relief valve, the appliance shall be fitted with a combined temperature and pressure relief valve, complying with EN 1490, or supply one with the appliance.

If a combined temperature and pressure relief valve is specified, the appliance shall be fitted with a connector at a specified location and of such a size that the combined temperature and pressure relief valve is fully open before the water temperature has reached 100 °C.

5.3.14 Flue damper

5.3.14.1 General

If the appliance and flue damper are to be marketed separately they shall be so designed that they cannot be assembled incorrectly. The installation instructions shall refer to this means of assembly.

If the auxiliary energy is interrupted or if some part that is important for the operation of the flue damper fails, it shall not be possible for the main burner to remain alight with the flue damper closed.

The gas supply to the main burner of the appliance shall not be released before the closure member has gone through 90 % of its total passage to the open position.

The connections between the damper and the shaft of the electric motor shall be rigid.

The connection of the closure member to the switch actuating the gas supply to the main burner shall be such that it cannot work loose. The switch controlling the gas supply to the main burner shall be actuated directly by the valve position. Otherwise it shall be safeguarded in some other, at least equivalent way.

Limit switches shall be so constructed and connected that a false "open position" signal cannot occur.

The position of the flue damper switch shall be proved prior to the operation of the burner.

5.3.14.2 Visual indication

An indication of the position of the flue damper shall be readily visible (to the user).

5.3.14.3 Safety shut-off valve

The flue damper shall actuate an automatic shut-off valve of class A, B or C.

5.3.14.4 Minimum passage

For appliances with permanent or semi-permanent ignition burner, the minimum passage of the flue damper in a closed position shall be such that satisfactory pilot performance is ensured and there is no condensation from the combustion products.

5.4 Main burner

The cross-section of the flame ports and the terminal area of the injectors of the burners and ignition burners shall not be adjustable.

All removable injectors and/or restrictors shall have an indelible identification mark to prevent any confusion. In the case of non-removable injectors and/or restrictors, the marking may be on the tank.

Any change of injectors or restrictors shall be capable of being carried out without a need to disconnect the appliance. If the injectors or restrictors are removable, their position shall be well defined and their fixing shall be such that it is difficult to put them in an incorrect position.

Burners shall be accessible without the need for any major disassembly of the appliance. If the burners or part of the burners are removable, their position shall be well defined and their fixing shall be such that it is difficult to place them in an incorrect position.

Primary air inlet control devices are not permitted.

NOTE Primary air adjusters are authorized for adjustments made and sealed at the factory. In this case, they are regarded as being non-existent.

5.5 Supplementary requirements for condensing water heaters

5.5.1 Materials in contact with condensate

All parts of the heat exchanger(s) and other parts of the appliance likely to come into contact with condensate shall be constructed of sufficiently corrosion resistant materials or materials protected by a suitable coating in order to ensure a reasonable life for a appliance that is installed, used and maintained in accordance with the technical instructions.

5.5.2 Discharge of condensate

5.5.2.1 Requirements

Condensing appliances shall be fitted with a condensate discharge system of corrosion-resistant material or covered by a durable protection against corrosion.

Where disposal of condensate from the appliance is by gravity the internal diameter of the condensate discharge connection shall be at least 13 mm. If the appliance incorporates some form of pump assisted condensate disposal the size of the discharge from the appliance and connection to any point of gravity discharge shall be specified in the technical instructions. The disposal system, forming part of the appliance or supplied with the appliance, shall be such that:

- it can be easily inspected and cleaned in accordance with the technical instructions;
- it cannot transmit combustion products or let enter air into the room where the appliance is installed; this requirement is satisfied if the disposal system incorporates a water trap.

Surfaces in contact with condensates (except purpose provided drains, water traps and siphons) shall be designed to prevent condensate retention.

It shall be possible to service and clean the system easily. There may be a common condensate drain for flue gas exhaust and the condensing appliance.

5.5.2.2 Test conditions

By measurements, visual inspection or manual tests it is checked whether the requirements for the condensate discharge are fulfilled. It is considered that the requirements are fulfilled if the safety device responds when the flue gas discharge is covered in steps while repeatedly switching on and off the heat demand signal.

5.5.3 Control of the combustion products temperature

If the combustion products circuit contains materials that are likely to be affected by heat or is intended to be connected to a flue (including seals) that is likely to be affected by heat from the combustion products, the appliance shall incorporate a device to prevent the combustion products temperature exceeding the maximum allowable working temperature for the material as specified by the technical instructions.

The device for limiting the combustion products temperature shall be non-adjustable and shall not be accessible without tools.

5.5.4 Chemical composition of the condensate

If the technical instructions state the chemical composition of the condensate, the composition shall be verified at the end of the test of 7.1.2.

6 Operational requirements

6.1 Carrying out the tests

6.1.1 General

Except where otherwise stated, the requirements below are verified under the test conditions that follow.

6.1.2 Characteristics of the test gases

Storage water heaters are intended to use gases of various qualities. One of the aims of these specifications is to verify that the operation of the appliances is satisfactory for each of the gas families or gas groups for the pressures for which they are designed, after making use of the preset adjusters where appropriate.

The compositions and principal characteristics of the different test gases corresponding to the families or gas groups are given in EN 437.

6.1.3 Requirements for preparation of the test gases

The test gases are prepared in accordance with EN 437.

6.1.4 Choice of test gases

When an appliance can use gases of several groups or families, the tests are carried out using the reference gases and limit gases that correspond to the appliance categories as stated in EN 437.

For the efficiency tests (see 7.1.2.2), if several reference gases are specified, one of the 2nd family gases is used, preferably G 20.

6.1.5 Test pressures

Depending on the appliance categories, the test pressures shall be selected from EN 437, as appropriate, depending on the test gases and in compliance with the requirements of this standard.

The test pressures, i.e. the static pressures to be applied at the gas inlet connection with the appliance in operation, are given in EN 437.

These pressures and corresponding injectors shall be used in accordance with the requirements specified in Annex A depending on the country in which the appliance is to be installed.

6.1.6 General test conditions

6.1.6.1 General

The appliances are tested under the following conditions except where otherwise stated.

6.1.6.2 Test room

The appliance is installed in a well-ventilated, draught-free room (air speed less than 0,5 m/s), which has an ambient temperature of (20^{+7}_{-3}) °C, unless otherwise specified. The appliance is protected from direct solar radiation.

6.1.6.3 Installation requirements

6.1.6.3.1 General

For all tests, except where otherwise stated in the particular clauses, the water heater is installed, used and put into operation under the conditions specified in the technical instructions.

In particular, wall-mounted water heaters are installed on a vertical test panel of plywood, or of a material with the same thermal characteristics, in accordance with the information in the technical instructions.

The sample of the combustion products is taken in the plane perpendicular to the direction of flow of the combustion products, and at a distance L from the extreme end of the combustion products duct (see examples in Figure 4, Figure 5 and Figure 6):

— for circular ducts: $L = Di$

— for rectangular ducts: $L = \frac{4S}{C}$

where

Di is the internal diameter of the combustion products evacuation duct, in mm;

S is the cross-sectional area of this duct, in mm²;

C is the circumference of this duct, in mm.

The sampling probe is positioned so as to obtain a representative sample of the combustion products.

6.1.6.3.2 for type B water heaters

Except where otherwise stated, a type B₁ water heater is subjected to the draught created by a test flue of height 1 m, with an internal diameter equal to the smallest diameter stated by the technical instructions and compatible with those given in Table A.2.

The thickness of the flue pipe is less than 1 mm.

If the diameter of the water heater flue socket does not correspond to the external diameter given in Table A.2, a linking piece of thickness 1 mm is used to adapt the flue socket diameter.

The height of the flue is measured:

- for water heaters having a flue socket with a horizontal axis, from this axis;
- for water heaters having a flue socket with a vertical axis, from the plane of the flue socket outlet.

6.1.6.3.3 for type C water heaters

Except where otherwise stated, the water heater is connected to the shortest ducts with the smallest pressure loss stated by the installation instructions. If necessary, an external telescopic duct may be sealed in accordance with the technical instructions. The terminal guard is not fitted.

Type C₁, C₃, and C₅ water heaters are tested with their terminals fitted. Type C₁ water heaters are tested with a duct suitable for a wall with a thickness of 300 mm.

Type C₂, C₄ and C₈ water heaters are tested with their fitting pieces fitted but not connected to a test duct.

Type C₆ water heaters are fitted with restrictors enabling the minimum and maximum duct pressure losses specified by the technical instructions to be simulated.

Type C₇ water heaters are tested with 1 m of vertical secondary flue.

6.1.6.4 Water supply

The appliance is connected to a water supply capable of being controlled to give the required supply pressures to within $\pm 4\%$. The stated water pressures are the pressure differences between the inlet and outlet of the appliance, including the valves supplied with the appliance.

The water inlet temperature shall in no case exceed 25 °C and, when the water outlet temperature is required to be measured, the water inlet temperature shall not vary by more than $\pm 0,5$ °C during the test.

The inlet temperatures are measured immediately upstream of the water inlet connection. Unless otherwise specified, the outlet temperatures immediately downstream of the outlet connection.

The hot water temperature is measured with a low inertia thermometer³⁾.

6.1.6.5 Measurement uncertainties

Unless otherwise specified in particular clauses, measurements shall be made with the maximum uncertainties stated below:

These uncertainties correspond to two standard deviations. The laboratory evaluates these standard deviations taking account of the various sources of uncertainty: contribution from the instrument, repeatability, calibration, ambient conditions, etc.

- | | |
|--|---|
| a) Atmospheric pressure | ± 5 mbar; |
| b) combustion chamber and test flue pressure | ± 5 % or $\pm 0,05$ mbar; |
| c) gas pressure | ± 2 %; |
| d) water-side pressure loss | ± 5 %; |
| e) water rate | ± 1 %; |
| f) gas rate | ± 1 %; |
| g) time | $\pm 0,2$ s up to 1 h;
$\pm 0,1$ % beyond 1 h; |
| h) auxiliary electrical energy | ± 2 %; |
| i) temperatures: | |
| — ambient | ± 1 K; |
| — water | ± 2 K; |
| — combustion products | ± 5 K; |
| — gas | $\pm 0,5$ K; |
| — surface | ± 5 K; |
| j) CO, CO ₂ and O ₂ | ± 6 %; |
| k) gas calorific value | ± 1 %; |
| l) gas density | $\pm 0,5$ %; |
| m) mass | $\pm 0,05$ %; |
| n) couple | ± 10 %; |
| o) force | ± 10 %. |

For the determination of the leakage rate during the soundness tests, a volumetric method is used which gives a direct reading of the leakage rate and which is of such accuracy that the error in its determination does not

³⁾ "Low inertia thermometer" means a measuring instrument with a response time such that 90 % of the final temperature rise, in the range 15 °C to 100 °C, is obtained within 5 s when the sensor is plunged into still water.

exceed $0,01 \text{ dm}^3/\text{h}$. The apparatus shown schematically in Figure 1 or another device giving equivalent results is used.

The stated measurement uncertainties relate to individual measurements.

For measurements that combine a number of individual measurements (for example: efficiency measurements), smaller uncertainties may be necessary on the individual measurements to ensure the required total uncertainty.

6.1.6.6 Adjustment of the appliance

The appliance shall be fitted successively with the appropriate components for each of the reference gases used, for the corresponding normal test pressure.

The gas pressure regulator and the preset gas rate adjusters are put out of service if they are not permitted for the gas concerned.

The appliance is adjusted, if necessary, in accordance with the technical instructions.

Except for tests having different conditions, the appliance is supplied with the reference gas(es) at normal pressure, in accordance with 6.1.5, and operated at its nominal heat input.

Before the required tests with a reference gas at the nominal heat input are carried out, an adjustment is made, where necessary, to ensure that the nominal heat input is obtained to within $\pm 2 \%$ by changing the setting of the preset gas rate adjuster or:

- if the appliance is provided with a gas pressure regulator kept in service for the gas to be used but has no preset gas rate adjuster, by putting the governor out of service and adjusting the appliance supply pressure; or
- if the appliance has neither a preset gas rate adjuster nor a governor, or if these devices are put out of service for the gas to be used, by adjusting the appliance supply pressure.

The tests with the limit gases shall be carried out with the injector and adjustment corresponding to the reference gas of the group to which the limit gas belongs.

The test pressures shall be maintained constant to within $\pm 0,2 \text{ mbar}$.

For all the tests at the minimum and maximum pressures, the pressures in 6.1.5 shall be used without the above correction.

6.1.6.7 Electrical supply

The appliance is supplied with nominal electric voltage or a voltage within the nominal voltage range, unless otherwise indicated in the specific clauses.

6.1.6.8 Steady-state

Unless otherwise specified in the relevant subclauses, the tests are carried out in the steady-state condition.

With the thermostat set at a mean value, the steady-state is obtained by drawing off a quantity of water just sufficient to allow the burner to operate continuously at full rate or at reduced rate throughout the test, which, however, shall not commence until 10 min after the burner has achieved its maximum rate.

6.1.6.9 Thermal equilibrium

The thermostat is set at the value indicated for the corresponding test. Temperature equilibrium mentioned in the specific clauses is obtained when, starting with the appliance cold, it has been heated up once and drained and then heated up a second time until the burner is extinguished.

6.2 Soundness

6.2.1 Soundness of the gas circuit

6.2.1.1 Requirements

The gas circuit shall be sound.

Soundness is ensured if the leakage of air does not exceed:

- test n° 1: 0,06 dm³/h;
- test n° 2: 0,06 dm³/h, per shut-off device;
- test n° 3: 0,14 dm³/h.

6.2.1.2 Tests

The appliance gas inlet is connected to an air supply delivering an appropriate and constant pressure.

The appliance is at room temperature which shall remain constant throughout the tests.

The tests are carried out, firstly on delivery of the appliances, before any other test, and then on completion of the tests in this standard and after parts of the gas circuit comprising gas-tight joints which are specified as being removable in the technical instructions are removed and refitted 5 times.

An example of a device using the volumetric method is given in Annex E and Figure 1.

Test n° 1

The soundness of the first closure member is checked, with all other downstream closure members in the open position.

The pressure upstream of the appliance is 150 mbar.

Test n° 2

If the closure members have not been verified in accordance with the requirements of EN 161, the test is carried out with the appliance returned to its original state.

The test is carried out in the direction of the gas flow with the second closure member closed and the first one open. The ignition burner gas circuit is blocked.

The pressure upstream of the appliance is 50 mbar for appliances not using third family gases and 150 mbar for appliances using third family gases.

Any closure members in the ignition burner gas circuit are subjected to the same test.

This test is carried out at a test pressure of 6 mbar.