BS EN 89:2015

BSI Standards Publication

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 It supersedes BS EN 89:2000 which is withdrawn.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.

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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

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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of an identical text or by endorsement, at the latest by November 2015 and conflicting national standards shall be withdrawn at the latest by November 2015.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 B_1, B_2, B_3, B_5, C_1, C_2, C_3, C_4, C_5, C_6, C_7, C_8, C_9 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 exceding 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_s; 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 = 10^2 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 = 10^2 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 overheat 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 our 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 B_1 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 C_1 and C_3 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 C_5 water heaters (two devices);

— the air supply duct for type C_8 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 C_2 appliances;

— the air supply and combustion products evacuation ducts to two ducts of a shared duct system for type C_4 appliances;

— type C_6 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 C_8 appliances.

— the air supply duct to a chimney that is part of the building for type C_9 appliances;

— type B_2 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 B_3 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 C_7 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 valve[1)];

— a safety valve;

— a drain device;

— an air break to drain;

— a pressure tapping[1)]

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 = 10^5 Pa.

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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 °C, with an atmospheric pressure of 1 013,25 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 mg/(m^2.d);

— hot water test: 0,3 mg/(m^2.h).

Cadmium:

— cold water test: 0,03 mg/(m^2.d);

— hot water test: 0,03 mg/(m^2.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 ± 5) °C and the hot water test using water at a temperature of (90 ± 5) °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 B_1 appliances

Type B_1 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 C_1 and C_3 water heaters;

— may terminate in zones of different pressure for type C_5 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 C_2, C_4 and C_8, 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 B_{12} and B_{13} 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 h[2)], 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 mm^2 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 mm^2.

[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 x 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 kN/m^2 ± 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 m ± 0,01 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 $\left(9{,}0\,^{0}_{-0{,}5}\right)$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_{11BS} 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 B_{11} 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 shut-down.

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 faills, 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 $\left(20^{+7}_{-3}\right)$ °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

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

S is the cross-sectional area of this duct, in mm^2;

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 B_1 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 C_1, C_3, and C_5 water heaters are tested with their terminals fitted. Type C_1, water heaters are tested with a duct suitable for a wall with a thickness of 300 mm.

Type C_2, C_4 and C_8 water heaters are tested with their fitting pieces fitted but not connected to a test duct.

Type C_6 water heaters are fitted with restrictors enabling the minimum and maximum duct pressure losses specified by the technical instructions to be simulated.

Type C_7 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 ± 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 ± 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 thermometer[3)].

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 ± 0,05 mbar;
c)	gas pressure	± 2 %;
d)	water-side pressure loss	± 5 %;
e)	water rate	± 1 %;
f)	gas rate	± 1 %;
g)	time	± 0,2 s up to 1 h;
		± 0,1 % beyond 1 h;
h)	auxiliary electrical energy	± 2 %;
i)	temperatures:	
	— ambient	± 1 K;
	— water	± 2 K;
	— combustion products	± 5 K;
	— gas	± 0,5 K;
	— surface	± 5 K;
j)	CO, CO_2 and O_2	± 6 %;
k)	gas calorific value	± 1 %;
l)	gas density	± 0,5 %;
m)	mass	± 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 dm^3/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 ± 2 % by changing the setting of the present 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 ± 0,2 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 dm^3/h;

— test n° 2: 0,06 dm^3/h, per shut-off device;

— test n° 3: 0,14 dm^3/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.

Test n° 3

The total leakage is checked with all the valves open as if the appliance were in operation, and the gas outlet blocked off by the careful use of solid injectors or suitable parts specified in the technical instructions.

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.

6.2.2 Soundness of the combustion circuit and evacuation of the combustion products

6.2.2.1 General

The combustion circuit shall be constructed so as to prevent any leakage of combustion products.

Any means used to achieve soundness of the combustion circuit shall be such that it remains effective under normal conditions of use and servicing.

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 maintenance may be joined in such a way, that permanent soundness is ensured during continuous service under normal conditions of use.

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

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

6.2.2.2 General requirements

Requirements

Water heaters shall be sound in accordance with 6.2.2.3 or 6.2.2.4. Ducts shall be sound in accordance with 6.2.2.3.3, 6.2.2.3.4 and 6.2.2.3.5.

Soundness is verified before and after all the tests of this standard, except the tests specified in the mechanical tests.

Test methods

All the joints specified by the technical instructions shall be checked, for instance:

— the water heater and its ducts;

— interconnecting ducts;

— the ducts and any bends and;

— the ducts and any fitting piece or terminal.

In the case that leakage can also occur along the length of the ducts, the tests are also carried out with the maximum length of ducts.

In accordance with the technical instructions, the wall connections, the joint with the terminal or the joint with the fitting piece with another system of combustion products evacuation may be made sound.

6.2.2.3 Soundness of the air supply and combustion product circuit type C appliances

6.2.2.3.1 General Requirements

Requirements

Soundness with respect to the room where the water heater is installed is ensured if, under the specified test conditions the leakage rates do not exceed the values in Table 2.

Table 2 —Maximum admissible leakage rates

Test object	Surrounding of the combustion products circuit by the combustion air circuit	Maximum leakage rate till 40 kW m^3/h	Maximum leakage rate above 40 kW m^3/h
Water heater with its air supply and combustion products evacuation ducts and all their joints	Completely not completely	5 1	$5Q_n/40$ $Q_n/40$
Water heater and the joint to the air supply and combustion products evacuation duct	Completely not completely	3 0,6	$3\ Q_n/40$ $0,6\ Q_n/40$
combustion products evacuation ducts, not completely surrounded by combustion air, with all its joints excluding the joint tested above		0,4	$0,4\ Q_n/40$
Air supply duct with all its joints excluding the joint tested above		2	$2\ Q_n/40$

Test Methods

The test can be carried out either separately on the appliance body and on the ducts or on the appliance assembled with its ducts.

The combustion circuit of the test object in accordance with Table 1 is connected to a pressure source on one side and blocked on the other side.

The test pressure difference is 0,5 mbar unless otherwise stated.

For water heaters with a fan of which the combustion product circuit is not completely surrounded by the combustion air circuit, the test is also carried out on the part of the combustion circuit downstream of the fan, with a test pressure which is increased by the highest pressure between the combustion circuit, in the envelope of the water heater or the ducts, and the atmosphere, measured with the water heater in thermal equilibrium at nominal heat input and fitted with the longest ducts specified by the installation instructions.

6.2.2.3.2 Requirements for Combustion products evacuation duct for appliances with indirect air proving

Requirements

The soundness of the combustion products evacuation duct for installation both inside and outside the room where the water heater is installed, permitted for alternative control systems, is ensured if, under the test conditions the leakage rate per surface area of the duct does not exceed 0,006 $dm^3/s \cdot m^2$.

Test Methods

The combustion products evacuation duct is connected to a pressure source on one side and blocked on the other side. The test pressure is 2,0 mbar.

It is checked that the requirements are met.

6.2.2.3.3 Requirements for separate combustion products evacuation duct

Requirements

The soundness of a separate combustion products evacuation duct with respect to areas other than the room where the appliance is installed is ensured if under the test conditions the leakage rate per surface area of the duct does not exceed 0,006 $dm^3/s \cdot m^2$.

Test methods

When tested in accordance with 6.2.2.3.1, but with a test pressure of 2,0 mbar, it is checked that the requirements are met.

6.2.2.3.4 Requirements for separate and concentric air supply duct

Requirements

The soundness of the air supply duct with respect to all areas other than the room where the water heater is installed, is ensured if under the test conditions of the leakage rate per surface area of the duct does not exceed 0,5 $dm^3/s \cdot m^2$.

Test Methods

When tested in accordance with 6.2.2.3.1, it is checked that the requirements are met.

6.2.2.3.5 Requirements for leakage of combustion products for Type C7 appliances

Requirements

Under the test conditions combustion products shall only escape from the secondary flue outlet.

Test Methods

The sampling probe is removed. The test is carried out with one of the reference gases, or a gas actually distributed, for the category concerned at the nominal heat input.

Escape of combustion products is looked for with a dew point plate, whose temperature is maintained at a value above the dew point of the ambient air. The plate is brought near to all the places around the air inlet/draught diverter where an escape is suspected.

In doubtful cases, however, an escape is looked for with a sampling probe connected to a rapid response CO_2 analyser enabling concentrations of the order of 0,2 % to be detected.

It is checked that the requirement is satisfied.

6.2.2.4 Soundness of the combustion product circuit of Type B appliances

6.2.2.4.1 General Requirements

Water heaters shall comply with 6.2.2.4.2 or 6.2.2.4.3. Ducts of type B_5 water heaters shall comply with 6.2.2.4.4.

Soundness shall be verified before and after all the tests of this document.

6.2.2.4.2 Type B_2 and B_5 appliances

Requirements

The combustion products circuit of a water heater incorporating a fan shall be sound with respect to the room where the appliance is installed. This soundness is ensured if, under the following test conditions, combustion products only escape from the flue outlet. Additionally the ducts of type B_5 water heaters should also meet the requirements of 6.2.2.4.4.

Test method

The water heater is tested alone without its flue duct. The maximum pressure at which the water heater can operate is determined by progressively blocking the combustion products evacuation duct or air inlet, until the air proving device acts. The air proving device is then put out of operation, to allow the operation of the burner at the maximum cut-off pressure of the air proving device.

The water heater is connected to a short length of flue duct incorporating a restriction to reach the maximum operating pressure determined above.

Possible leaks are looked for with a dew point plate, whose temperature is maintained at a value slightly above the dew point of the ambient air. The plate is brought close to all the places where a leak is suspected.

In doubtful cases, however, leaks are looked for with a sampling probe connected to a rapid-response CO_2-analyser enabling concentrations of the order of 0,20 % to be detected. In this case, precautions shall be taken to ensure that sampling does not interfere with the normal evacuation of the combustion products.

It is checked that the above requirement is satisfied.

6.2.2.4.3 Type B_3 appliances

Requirements

Soundness is ensured if one of the following requirement is met

a) The leakage rate of the combustion products circuit does not exceed:

   — 3,0 m^3/h for water heaters with a nominal heat input until 40 kW or

   — 3 $Q_n/40$ m^3/h for water heaters above 40 kW;

or

b) The leakage rate of the combustion circuit (with all the duct and joints) does not exceed:

— 5,0 m^3/h for water heaters with a nominal heat input until 40 kW or

— 5 Q_n/40 m^3/h for water heaters above 40 kW.

Test conditions

The flue outlet is connected to a pressure source. The orifices in the surface of the concentric duct through which air is supplied, are blocked. The test pressure is to be 0,5 mbar.

It is checked that the above requirements are met.

6.2.2.4.4 Combustion products evacuation ducts of type B_5 appliances passing through walls

Requirements

The soundness of a combustion products evacuation duct stated in the design documentation, not completely surrounded by combustion air, with respect to areas other than where the appliance is installed, is ensured if under the following test conditions the leakage rate per square metre surface of the duct does not exceed 0,006 dm^3/s.

Test conditions

All the joints specified by the technical instructions shall be checked, for instance:

— the water heater and its ducts;

— interconnecting ducts;

— the ducts and any bends and

— the ducts and any fitting piece or terminal.

To guard against the possibility of leakage along the length of the ducts, the tests are also carried out with the maximum length of duct as specified in the technical instructions. In accordance with the technical instructions, the wall connections, the joint with the terminal or the joint with the fitting piece with another system of combustion products evacuation may be made sound.

The flue duct and its joint to the appliance shall be connected to a pressure source on one side and blocked on the other side with a pressure corresponding to the maximum pressure measured in 6.2.2.4.2.

It is checked that the above requirement is met.

6.2.3 Hydraulic test and soundness of the water circuit

6.2.3.1 Requirements

No water leakage shall appear during the test, nor any permanent visible deformation after the test.

6.2.3.2 Tests

The test pressure for the water circuit is 1,5 times the maximum service pressure specified in the technical instructions.

The water circuit is kept at the test pressure for at least 10 min, with the hydraulic safety group, if fitted, being put out of service.

6.3 Heat inputs

6.3.1 General

6.3.1.1 Heat input obtained

The heat input Q, expressed in kW, obtained during a test is given by one of the following expressions:

— if the volumetric rate is measured:

$$Q = 0,278 \times V_r \times H_i$$

or

— if the mass rate is measured:

$$Q = 0,278 \times M_r \times H_i$$

where

Q is the heat input obtained, in kilowatts (kW);

V_r is the measured volumetric rate expressed under reference conditions (15 °C, 1 013,25 mbar) in cubic metres per hour of dry gas (m^3/h);

M_r is the measured mass rate, in kilograms per hour of dry gas (kg/h);

H_i is the net calorific value of the gas used for the test, expressed as dry gas at 15 °C and 1 013,25 mbar, in MJ/m^3 on the volume basis, or in MJ/kg on the mass basis, as appropriate.

6.3.1.2 Corrected heat inputs for the verification of declared heat inputs

During the tests to verify a heat input, the corrected heat input Q_c, which would have been obtained if the test had been carried out under the reference test conditions (dry gas, 15 °C, 1013,25 mbar), is determined using the following formulae.

— If the volumetric gas rate V is measured:

$$Q_c = H_i \cdot \frac{10^3}{3600} \cdot V \sqrt{\frac{1013,25 + p_g}{1013,25} \cdot \frac{p_a + p_g}{1013,25} \cdot \frac{288,15}{273,15 + t_g} \cdot \frac{d}{d_r}}$$

whence

$$Q_c = \frac{H_i \, x \, V}{214,9} \sqrt{\frac{(1013,25 + p_g)(p_a + p_g)}{273,15 + t_g} x \frac{d}{d_r}}$$

— If the mass gas rate M is measured:

$$Q_c = H_i \, x \, \frac{10^3}{3600} \, x \, M \sqrt{\frac{1013,25 + p_g}{p_a + p_g} \, x \, \frac{273,15 + t_g}{288,15} \, x \, \frac{d_r}{d}}$$

whence

$$Q_c = \frac{H_i \, x \, M}{61,1} \sqrt{\frac{(1013,25 + p_g)\ (273,15 + t_g)}{p_a + p_g}} \, x \, \frac{d_r}{d}$$

In these formulae:

Q_c is the corrected heat input, in kilowatts (kW);

V is the measured volumetric gas rate expressed under the humidity, temperature and pressure conditions at the meter, in m^3/h;

M is the measured mass gas rate, in kg/h;

H_i is, as appropriate, the net calorific value of the dry reference gas:

— on the volume basis, in MJ/m^3;

— on the mass basis, in MJ/kg;

t_g is the gas temperature at the meter, in °C;

d is the density of the test gas[4)];

d_r is the density of the reference gas;

p_g is the gas pressure at the meter, in mbar;

p_a is the atmospheric pressure at the time of the test, in mbar.

To carry out the tests:

— the water rate is adjusted as stated in 6.1.6.8 to ensure continuous operation of the burner;

— the pressure at the meter shall be approximately the same as that at the appliance inlet.

6.3.2 Nominal heat input

6.3.2.1 Appliances without a preset adjuster

6.3.2.1.1 Requirements

For appliances without a preset gas rate adjuster, the corrected heat input shall not differ by more than 5 % from the declared nominal heat input.

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4) If a wet meter is used to measure the volumetric rate, it may be necessary to make a correction to the density of the gas in order take account of its humidity. The value of d is then replaced by d_h given by the following formula:

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

where p_s is the saturated water vapour pressure at t_g, in mbar.

$$p_S = EXP(21,094 - \frac{5262}{(273,15 + tg)}) .$$

6.3.2.1.2 Tests

The tests are carried out at the normal test pressure with each of the appropriate reference gases.

6.3.2.2 Appliances with preset adjusters

6.3.2.2.1 Requirements

For appliances with preset gas rate adjusters, it is checked that the nominal heat input may be obtained.

6.3.2.2.2 Tests

The tests are carried out at the normal test pressure. It is checked that the gas rate, determined as stated in 6.3.1.2, may be obtained after operating the preset adjuster.

6.3.2.2.3 Instructions for adjustment of the heat input

6.3.2.2.3.1 Requirement

When the technical instructions specify the value of the downstream pressure that enables the nominal heat input to be obtained, the corrected heat input obtained in accordance with these instructions shall not differ by more than 5 % from the declared nominal heat input.

6.3.2.2.3.2 Tests

The tests are carried out with each of the appropriate reference gases at normal test pressure.

The preset gas rate adjuster is set to the position giving the burner pressure stated in the technical instructions, measured at the downstream pressure test point.

6.4 Temperature of the control knobs

6.4.1 Requirements

The surface temperatures of the knobs measured only in the areas where they are touched shall not exceed the ambient temperature by more than:

a) 35 K for metals or equivalent materials;

b) 45 K for porcelains or equivalent materials;

c) 60 K for plastics or equivalent materials.

6.4.2 Test

The test is carried out with one of the reference gases or a distributed gas.

The temperatures are measured using temperature sensors. Verification is carried out when thermal equilibrium has been attained (see 6.1.6.9) at the maximum temperature given by the adjustment.

6.4.3 Supplementary requirements for type B_{14}, B_2 and B_3 water heaters

6.4.3.1 Requirement

Under the test conditions of 6.4.3.2, no extinction of the burner is permitted. The flames shall be stable. Nevertheless, during the tests, a slight tendency to lift is allowed. Shut down by the action of the device monitoring the air supply or combustion products evacuation is allowed.

6.4.3.2 Test

The tests are carried out with an appropriate reference gas for the water heater category at the nominal heat input and the minimum heat input given by the controls, if such operation is prescribed in the technical instructions.

The water heater is installed with the test flue. The flue outlet is progressively blocked. It is checked that the requirements of 6.4.3.1 are satisfied, at the moment that the pressure at the flue outlet of the water heater has reached the value of 50 Pa.

For water heaters intended to operate with a pressurized flue duct, designated by a “P”, this value is raised by the maximum nominal overpressure specified in the technical instructions, which shall not be greater than 200 Pa.

6.5 Temperature of the adjusting, control and safety devices

6.5.1 Requirement

The temperature rise of the device above the ambient temperature of the test room shall not exceed the maximum rise given by (T_{max} - 25) K, where T_{max} is the maximum temperature in °C of the device stated in the technical instructions.

6.5.2 Test

The test is carried out under the conditions of 6.4.2.

However, when the device is itself likely to cause temperature rises (e.g. electromagnetic valves) the temperature measurement of the device may be replaced by measurement of the ambient temperature.

In this case, temperature sensors are arranged so as to measure the air temperature in the neighbourhood of the device. The result is considered satisfactory if the rise, above room temperature, of the air temperature in the region of the device does not exceed (T_{max} - 25) K.

6.6 Limit temperature of the walls and the test panels

6.6.1 Side walls, front and top

6.6.1.1 Requirements

The temperature of the side walls, front and top of the appliance, apart from the walls of the draught diverter and that of the duct that may exist between the appliance case and the draught diverter, shall not exceed the ambient temperature by more than 80 K.

However, parts of the case located less than 5 cm from the edge of the ignition port or viewing window and at least 15 cm from the flue are not concerned by this requirement.

6.6.1.2 Tests

The test is carried out under the conditions of 6.4.2.

The temperatures of the hottest points of the side walls, front and top are measured by means of temperature sensors by applying the sensing element to the outside of these parts of the appliance.

6.6.2 Test panels

6.6.2.1 Requirements

The temperature of the floor on which the appliance is possibly placed and that of the panels alongside and behind the appliance shall not exceed the ambient temperature by more than 80 K at any point.

When this temperature rise is between 60 K and 80 K, the installation instructions shall indicate the nature of the protection to be provided between the appliance and the floor or the walls when they are made of inflammable materials.

If the appliance is fitted with a protection, according to the installation instructions, the measured temperature of the floor and panels will not exceed the ambient temperature by more than 60 K.

6.6.2.2 Tests

Depending on its design, the appliance is installed on a horizontal or vertical wooden test panel.

If the installation instructions indicate the possibility of installing appliances adjacent to one or several walls, the distances between the back and sides of the appliance and the wooden test panels are those indicated in the installation instructions or, in the case of appliances designed to be fixed to the wall, those given by the fixing device; however, this distance shall not exceed 200 mm in any case.

This distance is measured from the closest part of the appliance. The side panel is situated on the side of the appliance where the highest temperatures are.

If the installation instructions indicate the possibility of installing the appliance beneath a shelf, or a similar type of installation, a suitable panel is placed on top of the appliance at the minimum distance given in the technical instructions.

If the installation instructions specify nothing regarding the possibility of installing the appliance close to one or several walls or beneath a shelf, the test is carried out with a suitable panel placed in contact with the appliance.

The wooden panels shall be (25 ± 1) mm thick and finished in mat black paint. Their dimensions shall be such that they measure at least 5 cm more than the corresponding dimensions of the appliance.

The temperature sensors are incorporated in the panels in the centre of 10 cm squares and penetrate into the panels via the outer face so that the hot junctions are situated 3 mm from the surface facing the appliance.

The appliance is left in operation under the same conditions as 6.4.2 and the temperatures of the test panels measured when they have stabilized to within ± 2 K.

If the technical instructions state that it is necessary to use efficient protection, a further test is carried out with this protection in place.

The ambient temperature is measured at a height of 1,50 m above the floor and at a minimum distance from the appliance of 3 m by a temperature sensor protected against radiation from the test installation.

6.7 Ignition - Cross-lighting - Flame stability

6.7.1 Normal conditions

6.7.1.1 Requirements

In still air, it shall be capable of ensuring that ignition and cross-lighting are carried out correctly, quickly and quietly. The flames shall be stable. A slight tendency to lift at the moment of ignition is permitted but the flames shall be stable during operation.

There shall be a burner ignition for all values of the gas rate that can result from the adjustment and there shall be no prolonged lightback or lifting of the flame.

However, a brief lightback during ignition or extinction of the burner is tolerated if it does not affect its correct operation.

The permanent ignition burner, if fitted, shall not be extinguished during ignition or extinction of the burner; its flame shall not change either during operation of the appliance to the point of no longer being able to fulfil its role (burner ignition, operation of the flame supervision device).

When the ignition burner has been alight for a sufficient time to obtain normal and regular operation of the appliance, it shall always be ready to operate without failure even if the gas to the burner is interrupted and restored by operating the thermostatic control rapidly several times in succession.

For multi-rate or modulating appliances, these requirements are verified at nominal heat input and minimum heat input.

In addition in test n°4, for appliances with an indirect means of signalling the presence of the flame, the carbon monoxide content of the neutral combustion products shall not exceed by more than 0,01 % that obtained during the same conditions with the reference gas (see 6.12.2.1).

If spark restoration or recycling is planned, the above requirements shall also be met.

6.7.1.2 Tests

These tests are carried out twice with the appliance at ambient temperature and the appliance in the steady-state condition.

The burner and ignition burner, if fitted, equipped with suitable injectors are adjusted beforehand as follows: they are supplied successively with each of the reference gases corresponding to the category so as to obtain the nominal heat input (see 6.1.6.6).

Then, the following four tests are carried out:

Test n° 1

The test is carried out without changing the adjustment either of the burner or the ignition burner.

For ungoverned appliances, the appliance inlet pressure is reduced to a value equal to 70 % of the normal pressure (see 6.1.5) for second family gases and to the minimum pressure indicated in 6.1.5 for the third family gases.

For governed appliances, the pressure is also reduced to a value equal to 70 % of the normal pressure, but the pressure downstream of the governor is reduced to a value corresponding to 90 % of the nominal heat input for first family gases, 92,5 % of the nominal heat input for second family gases and 95 % of the nominal heat input for third family gases.

This test is repeated at the minimum heat input if ignition is possible under these conditions.

Test n° 2

For ungoverned appliances, without altering the initial adjustment of the burner and ignition burner, the reference gases are replaced by the corresponding light-back limit gas and the pressure at the appliance inlet is reduced to the minimum pressure given in 6.1.5.

For governed appliances, the pressure downstream of the governor is reduced, if necessary, to the value corresponding to 90 % of the nominal heat input for first family gases, 92,5 % of the nominal heat input for second family gases of 95 % of the nominal heat input for third family gases, then the lightback limit gases are substituted for the reference gas.

This test is repeated at the minimum heat input if ignition is possible under these conditions.

Test n° 3

For ungoverned appliances, without altering the initial adjustment of the burner and ignition burner, the appliance is supplied with the flame lift limit gas at the maximum pressure given in 6.1.5 and the absence of lift is checked.

For governed appliances, the test is carried out with the burner input increased to 107,5 % of the nominal heat input for first family gases or 105 % of the nominal heat input for second and third family gases for the reference gases; then the corresponding flame lift limit gas is substituted for the reference gas.

This test is repeated at minimum heat input if ignition is possible under these conditions.

Test n° 4

For appliances with an indirect means of signalling the presence of the flame without changing the initial setting either of the burner or of the ignition burner, the appliance is supplied with the flame lift limit gas. The CO content is measured.

6.7.2 Special conditions

6.7.2.1 Type B_1 appliances

6.7.2.1.1 Resistance to draught

6.7.2.1.1.1 Requirements

The flames shall be stable.

6.7.2.1.1.2 Tests

The appliance is supplied with the reference gas or a distributed gas at nominal heat input and is subjected at burner level to a wind stream of 2 m/s. The wind stream covers at least the width of the burner and is made up of essentially parallel components (speed uniform to within ± 20 %).

The axis of the wind stream is in a horizontal plane and is moved through one or more appropriate angles of incidence within a semi-circle in front of the appliance, the centre of the semi-circle being at the intersection of the plane of symmetry of the appliance and the plane of the test.

The test is carried out on the ignition burner only (if fitted), then on the main burner at nominal heat input (and at minimum heat input, if appropriate). If there is a lighting door for the ignition burner, the test is carried out with the door closed.

6.7.2.1.2 Flue conditions

6.7.2.1.2.1 Requirements

The burner shall not be extinguished even if this is a result of the flame supervision device.

6.7.2.1.2.2 Tests

The appliance is supplied with a reference gas or a distributed gas at the nominal heat input.

For type B_{11BS} appliances, the combustion products discharge safety device is put out of operation.

A first test is carried out applying a continuous down-draught of 3 m/s to the top and within the flue.

A second test is carried out with the flue blocked.

6.7.2.2 Type C appliances

6.7.2.2.1 Requirements

Ignition of the ignition burner, ignition of the main burner by the ignition burner or direct ignition of the main burner, flame propagation over the whole of the main burner and stability of the ignition burner when it alone is alight or of the ignition burner and the main burner operating simultaneously shall be ensured. Slight turbulence of the flames is accepted but extinction shall not occur.

6.7.2.2.2 Tests

6.7.2.2.2.1 General

These tests are carried out twice with the appliance at ambient temperature and with the appliance in thermal equilibrium.

6.7.2.2.2.2 Type C_1 and C_3 appliances

The appliance is installed in accordance with the installation instructions, with its accessories, on the test apparatus in Annex B.

The tests are carried out with the shortest and longest air supply and combustion products evacuation ducts.

The appliance is supplied with one of the reference gases for the category at the normal pressure.

First test series

With the appliances in thermal equilibrium, the terminal is subjected successively to winds of speeds:

— 1 m/s;

— 12,5 m/s;

and in the directions given in the figures, depending on the situation.

For each of the three incident planes, the three combinations of wind speed and incident angle that produce the lowest CO_2 content and, for the test described in 6.12.2.4.2, the highest CO content in the combustion products are noted.

Second test series

The appliance is at ambient temperature.

For each of the nine combinations giving the lowest CO_2 content in the first test series, it is checked that it is possible to light the ignition burner, if any, and then the main burner by means of either the ignition burner or the device for direct ignition.

Third test series

The appliance is at ambient temperature.

The tests of the first and second series are repeated at the minimum heat input if such operation is prescribed in the technical instructions.

Fourth test series

If the technical instructions make provision for a terminal guard, this is fitted in accordance with the instructions, and the tests in the first series that gave the highest CO contents in the dry air-free combustion products are repeated.

The corresponding requirements of 6.7.2.2.1 are verified and the CO content of the dry, air-free combustion products is determined for use in evaluating compliance with the requirements of 6.12 (see 6.12.2.4.2).

6.7.2.2.2.3 Type C_{21} water heaters

The appliance is installed in accordance with the installation instructions on the test apparatus shown in Figure 3, the use of which is described in Annex C, using successively the minimum and maximum duct lengths specified by the installation instructions.

The appliance is supplied with the reference gas corresponding to the lift limit gas for its category at the nominal heat input.

The test apparatus is adjusted to give successively the following conditions:

— an upflow of average speed 2 m/s, a CO_2 concentration of 1,6 % and a temperature within the range 60 °C to 80 °C;

— an upflow of average speed 3 m/s, a CO_2 concentration of 0,75 % and a temperature within the range 40 °C to 60 °C.

All tests are repeated at minimum heat input if such operation is prescribed in the technical instructions.

The combustion products are also sampled under each of these test conditions, and the CO content of the dry, air-free combustion products is determined according to 6.12.2. These values of the CO content are used (see 6.12.2.4.3) in assessing compliance with the requirements of 6.12.

6.7.2.2.2.4 Type C_4 appliances

The appliance is installed with the shortest ducts specified by the installation instructions. A suction of 0,5 mbar is applied to the combustion products evacuation duct (see Figure 10).

6.7.2.2.2.5 Type C_5 water heaters

a) Type C_{51} water heaters

The water heater is installed with the shortest ducts specified by the installation instructions. A negative pressure of 2 mbar is applied.

The water heater is installed with the longest ducts specified by the installation instructions. An overpressure of 2 mbar is applied.

b) Type C_{52} and C_{53} water heaters

The water heater is installed with the shortest ducts specified by the installation instructions. A negative pressure of 2 mbar is applied.

6.7.2.2.2.6 Type C_6 appliances

The appliance is installed with its ducts. A pressure loss of 0,5 mbar is introduced to the opening of the combustion products evacuation flue (see Figure 10).

6.7.2.2.2.7 Type C_7 water heaters

Tests are carried out, by applying continuous down-draughts of up to 3 m/s to the top of the test flue (see Figure 11).

A further test is carried out with the flue blocked.

6.7.2.2.2.8 Type C_8 water heaters

a) Type C_{81} water heaters

The water heater is installed with the shortest ducts specified by the installation instructions. A negative pressure of 2 mbar in the combustion products evacuation duct is applied.

The water heater is installed with the longest ducts specified by the installation instructions. An overpressure of 2 mbar is applied at the outlet.

b) Type C_{82} and C_{83} water heaters

The water heater is installed with the shortest ducts specified by the installation instructions. A negative pressure of 2 mbar in the combustion products evacuation duct is applied.

6.7.3 Reduction of supply to ignition burner

6.7.3.1 Requirement

Ignition of the main burner shall be ensured without damaging the appliance.

6.7.3.2 Test

The appliance is supplied with each of the reference gases for its category. The gas supply to the ignition burner is reduced to the minimum necessary to keep the shut-off device of the flame supervision device open.

6.7.4 Additional requirements relating to operation of the permanent ignition burner when the fan is stopped

6.7.4.1 Requirements

The stability of the pilot flame of the ignition burner shall be correct.

6.7.4.2 Test

The ignition burner is adjusted with the reference gas at normal pressure as specified in the technical instructions.

The test is carried out with the fan stopped, in still air, at maximum pressure with incomplete combustion gas and coal gas. When the appliance is cold, the ignition burner is ignited and maintained in operation for 1 h.

6.8 Temperature of combustion products in condensing appliances

6.8.1 Requirements

If the appliance incorporates a device to limit the temperature of the combustion products, the temperature of the combustion products shall not exceed the maximum temperature for the materials of the combustion circuit and the flue materials specified by the technical instructions.

Actuation of this device shall result in non-volatile lockout of the appliance.

6.8.2 Tests

The appliance is supplied with one of the corresponding reference gases for the appliance category at the nominal heat input.

Type B appliances are connected to a 0,5 m test flue and type C appliances are fitted with the shortest ducts specified by the installation instructions.

The appliance thermostat is overridden.

Where fitted, the control to limit the temperature of combustion products remains in operation.

The temperature of the combustion products is progressively raised, either by increasing the gas rate or by another means which increases the temperature (e.g. removal of baffles), in accordance with the technical instructions.

6.9 Adjusting, control and safety devices

6.9.1 General

The devices shall operate correctly in the case of normal or abnormal variation of the voltage between 85 % and 110 % of the rated voltage or extreme values of the range of rated voltages, as indicated in the various tests below.

For voltages less than 85 % of the rated value, the devices shall continue to ensure safety, or cause a safety shutdown.

6.9.2 Ignition devices

6.9.2.1 Ignition burner ignition devices

6.9.2.1.1 Requirements

At least half the manual ignition attempts shall result in correct ignition of the ignition burner.

The efficiency of the ignition device shall be independent of the speed and sequence of operation. If manually-operated electric ignition devices are involved, their operation shall remain satisfactory when the voltage is varied between 85 % and 110 % or of the range of the rated voltage.

The signal to open the gas supply to the main burner shall only be given after detection of the ignition burner flame.

6.9.2.1.2 Tests

The tests are carried out at nominal heat input, with the appliance at ambient temperature, with each of the reference gases corresponding to the appliance category.

Ignition burners fitted with the suitable injectors, adjusted beforehand to the nominal heat input, are operated 40 times at intervals of at least 1,5 s after a first positive attempt.

6.9.2.2 Automatic ignition system of the ignition burner or main burner

6.9.2.2.1 Ignition

6.9.2.2.1.1 Requirements

The direct ignition devices shall ensure reliable ignition.

Ignition may be obtained after a maximum of 5 automatic attempts.

After each ignition attempt, the valve(s) shall open and close.

The ignition system shall be actuated at the latest at the same time as the command is given to open the valve(s).

If no ignition is produced, the spark shall persist until the end of the ignition safety time T_{SA} (a delay of - 0,5 s is permitted). Then, at least locking out with volatile lockout shall occur.

6.9.2.2.1.2 Tests

The burners and ignition burners fitted with suitable injectors are adjusted, if necessary, as indicated by the technical instructions. The tests are carried out with each of the reference gases corresponding to the appliance category at normal pressure and at a voltage equal to 0,85 times the rated voltage.

After a first positive ignition attempt, 20 ignition attempts with an interval of 30 s between two consecutive attempts are carried out when the appliance is at ambient temperature.

After first positive ignition attempt, 20 ignition attempts with interval of 30 s between two consecutive attempts are carried out immediately after deliberate extinction of the burner with the appliance at the thermal equilibrium.

Under these conditions, it is verified that each attempt results in ignition.

If several automatic ignition attempts are specified, the above test conditions are applied to the last automatic ignition attempt.

6.9.2.2.2 Endurance

6.9.2.2.2.1 Requirements

The spark generators shall withstand an endurance test of 100 000 cycles. After the tests, the operation of the device shall remain satisfactory and meet the requirements of 6.9.2.2.1.1.

6.9.2.2.2.2 Tests

The tests are carried out with the appliance at ambient temperature. The devices are supplied at a voltage of 1,10 times the rated voltage. The duration of the ignition sequence and waiting time between two attempts is given by the automatic control device.

6.9.3 Opening and safety times

6.9.3.1 Thermoelectric device

6.9.3.1.1 Ignition opening time (T_{IA})

6.9.3.1.1.1 Requirements

The ignition opening time of a permanent ignition burner with thermoelectric flame control shall not exceed 30 s.

This time may be increased to 60 s if, during this period, no manual intervention is required.

6.9.3.1.1.2 Tests

The appliance is supplied successively with each of the reference gases of the family concerned.

With the appliance at ambient temperature, the gas supply is opened and the ignition burner is lit. After a period equal to the limit fixed above, the manual assistance is withdrawn and it is verified that the ignition burner remains alight.

6.9.3.1.2 Extinction delay time (T_{IE})

6.9.3.1.2.1 Requirements

The extinction delay time of a thermoelectric flame control device shall not exceed:

a) 60 s if $Q_n \leq 35$ kW;

b) 45 s if 35 kW < $Q_n \leq 70$ kW;

c) 30 s if 70 kW < $Q_n \leq 150$ kW.

6.9.3.1.2.2 Tests

The appliance is supplied successively with each of the reference gases of the family concerned.

With the appliance at ambient temperature, the flame supervision device is actuated and the ignition burner lit.

The appliance is left to operate at its nominal heat input for 10 min.

The extinction delay time (T_{IE}) is measured between the moment the ignition burner and the burner are deliberately extinguished by interrupting the gas supply and the moment when, this supply having been re-established, it stops through the operation of the flame supervision device.

6.9.3.2 Automatic control and safety system

6.9.3.2.1 Ignition safety time (T_{SA})

6.9.3.2.1.1 Requirements

The T_{SAmax} is indicated by the technical documentation.

NOTE Where several automatic ignition attempts are carried out, the sum of the T_{SA}s and waiting times meet the above requirement for the T_{SAmax}.

If the nominal heat input of the ignition burner does not exceed 0,250 kW, there is no requirement for T_{SAmax}.

If the nominal input of the ignition burner is greater than 0,250 kW, or for direct ignition of the main burner, the T_{SAmax} shall avoid any dangerous situation for the user or damage to the appliance.

This requirement is considered to be met when, for appliances with an heat input not exceeding 70 kW, the T_{SAmax} meets the following requirement:

$$T_{SA\max} \leq 5 \cdot \frac{Q_n}{Q_{IGN}} \text{ seconds but without exceeding 10 s;}$$

where

Q_n is the nominal input in kW;

Q_{IGN} is the ignition heat input in kW (see 3.10.2.4).

For the following appliances:

— type B with a heat input exceeding 70 kW;

— type B with a heat input not exceeding 70 kW whose T_{SAmax} does not meet the above requirement;

— type C;

a limit ignition test is carried out as described in 6.9.3.2.5.

6.9.3.2.1.2 Tests

The appliance is supplied successively with each of the reference gases of the family concerned.

The ignition safety time (T_{SAmax}) is verified with the reference gas at the normal pressure, and the appliance adjusted to its nominal heat input is subjected to the limit supply voltages (85 % to 110 %) and temperatures (cold and at thermal equilibrium).

6.9.3.2.2 Extinction safety time (T_{SE})

6.9.3.2.2.1 Requirements

The extinction safety time of the ignition burner and of the main burner shall not exceed 5 s.

6.9.3.2.2.2 Tests

The appliance is supplied successively with each of the reference gases of the family concerned.

With the appliance operating at its nominal heat input, the extinction safety time is measured between the moment when the ignition burner and main burner are deliberately extinguished by interrupting the gas supply and the moment when, the supply having been re-established, it is stopped by the action of the safety device. The gas meter or any other suitable device may be used to detect closure of the flame supervision device.

With the burner alight, flame failure is simulated by disconnecting the flame detector and the time elapsing between this moment and the moment when the flame supervision device effectively shuts off the gas supply is measured.

6.9.3.2.3 Spark restoration

6.9.3.2.3.1 Requirements

If there is spark restoration, the ignition device shall be put back into service within a maximum period of 1 s after disappearance of the flame signal.

In this case, the T_{SA} is the same as for ignition and starts at the putting into service of the ignition device.

6.9.3.2.3.2 Tests

The appliance is supplied successively with each of the reference gases of the family concerned at the rated heat input.

6.9.3.2.4 Recycling

6.9.3.2.4.1 Requirements

If there is recycling, this shall be preceded by interruption of the gas supply. The ignition sequence shall start at its original point.

In this case, the T_{SA} is the same as for ignition and starts at the putting into service of the ignition device.

6.9.3.2.4.2 Tests

The appliance is supplied successively with each of the reference gases of the family concerned at the nominal heat input.

6.9.3.2.5 Limit ignition

6.9.3.2.5.1 Requirements

For type C appliances, type B appliances with a heat input exceeding 70 kW and type B appliances with a heat input not exceeding 70 kW with a T_{SAmax} not meeting the requirement of 6.9.3.2.1, it is checked that there is no deterioration of the appliance or ignition of the test fabric (type B appliances only).

6.9.3.2.5.2 Tests

The appliance is supplied successively with one of the reference gases of the family concerned at the nominal heat input.

A limit ignition test is carried out on the appliance under the following conditions:

— with the appliance at ambient temperature, an ignition spark is produced successively from 0 s to T_{SAmax} in steps;

— for type B appliances only, the test fabric (cheesecloth) is placed at the minimum distances indicated in the technical instructions for flammable materials; if no indication is given, 0 cm is used.

The strip of material used for the test shall meet the following requirements:

—	composition	cotton;
—	mass per unit area	135 g/m^2 to 152 g/m^2;
—	other materials	3 % maximum;
—	number of threads per mm	warp 2,32 to 2,44, weft 2,28 to 2,40;
—	weave	plain or twilled 2/2;
—	finish	bleached (no fluff).

It is checked that there is no ignition of the test material and that the appliance has not undergone any deterioration.

6.9.4 Endurance of thermostats and temperature limiters

6.9.4.1 General

6.9.4.1.1 Requirements

The interlocking and release temperatures shall not deviate by more than 6 K from those indicated by the technical instructions.

6.9.4.1.2 Tests

If the tests are carried out away from the appliance, the sensor and body of the thermostats and of the temperature limiters are placed in an enclosure where the temperature is controlled and regulated.

The sensor is subjected to the temperature indicated in the relevant subclause.

60 % of the cycles are carried out at 1,10 times the rated voltage and the remaining tests are carried out at 0,85 times the rated voltage.

For adjustable thermostats, this requirement is checked at the minimum and maximum temperatures of the control range.

6.9.4.2 Control thermostats

6.9.4.2.1 Requirements

At the end of the endurance tests, the thermostats shall remain satisfactory.

6.9.4.2.2 Tests

Bulb thermostats are placed in an enclosure in which the temperature varies by no more than 2 K/min. between the interlocking and release temperatures of the thermostat.

In the case of adjustable thermostats, these are adjusted to 0,7 times the maximum design temperature. Non-adjustable thermostats are tested at their maximum temperature stated in the technical instructions.

Contact thermostats are tested under the same conditions except that they are subjected to a contact temperature instead of being subjected to ambient temperature.

The thermostats are subjected to a 100 000 cycle endurance test.

6.9.4.3 Overheat and combustion products evacuation safety limiters

6.9.4.3.1 Requirements

At the end of the endurance tests, the operation of these limiters shall remain satisfactory.

Interruption of the connection between the detection element and actuator shall result at least in a safety shutdown.

6.9.4.3.2 Tests

The limiters, except for combined temperature and pressure discharge valves, shall withstand an endurance test of 4 500 thermal cycles without release and 500 interlocking and resetting cycles.

During the first test series, these limiters are subjected to the same test conditions as the non-adjustable thermostats except that the temperature of the enclosure or the surface temperature varies between 0,70 times and 0,95 times the maximum declared temperature.

The second test series is carried out alternately at the temperature that results in release and that which permits interlocking.

Finally, with the appliance in the steady-state condition, the connection between the detecting element and the actuator is broken.

6.9.5 Operation of water temperature safety devices

6.9.5.1 Control thermostat

6.9.5.1.1 Requirements

The minimum control temperature shall be between 40 °C and 50 °C (test n° 1).

In the case of an adjustable thermostat, the maximum control temperature measured shall be between 60 °C and 85 °C (test n° 2).

In the case of a non-adjustable thermostat, the water temperature measured under the same conditions, shall be between 55 °C and 70 °C (test n° 3).

6.9.5.1.2 Tests

Test n°1:

The appliance thermostat is adjusted to its minimum position and the appliance is started up at its nominal heat input with one of the reference gases corresponding to its category.

After the first shutdown of the burner by the thermostat, the burner gas supply is interrupted and a quantity of water equal to 10 % of the nominal capacity at a rate equal to 1 % of the nominal capacity, expressed in l/min (litre per minute) is drawn off via the hot water outlet.

At the end of this drawing off, the hot water temperature is measured as close as possible to the outlet.

Test n° 2:

The thermostat is then adjusted to its maximum position, the burner is reignited and the procedure of test no. 1 is repeated.

Test n° 3:

For non-adjustable thermostats, a single test is necessary.

6.9.5.2 Water overheat safety device

6.9.5.2.1 Requirements

The overheat safety device shall result in non-volatile lockout before the water temperature can exceed 100 °C.

The overheat safety device shall not be actuated by prolonged operation of the ignition burner or of the reduced rate of the modulating thermostat or the high/low thermostat.

6.9.5.2.2 Tests

The appliance is started up at its nominal heat input with one of the reference gases corresponding to its category.

The control thermostat is put out of operation.

The water temperature in the tank is measured by drawing off immediately at the moment of shutdown by the overheat safety device.

In addition, for appliances with a permanent or alternating ignition burner, and/or with a modulating or multi-rate ignition burner the following test is carried out:

— the control thermostat is adjusted to its maximum position;

— the ignition burner preset device, if fitted, is adjusted to its maximum position.

The main burner rate is reduced or stopped by the control thermostat and the ignition burner supplied at the maximum gas pressure given in 6.1.4.

After 16 h, it is verified that, solely under the action of the ignition burner or reduced rate, the water temperature in the tank has not risen to the above value.

6.9.6 Combustion products evacuation safety device for type B_{11BS} appliances

6.9.6.1 General

The general test conditions are specified in 6.1 except for the following specific points:

— the appliance is connected to a test flue;

— the tests are carried out with a reference gas corresponding to the appliance category;

— the shutdown times at nominal heat input are verified at the beginning of the heating-up time.

6.9.6.2 Nuisance shutdown

6.9.6.2.1 Requirements

When the combustion products are being evacuated normally the safety device shall not cause shutdown and the temperature rise that ensues with repeated drawing-off (see 6.10) shall not cause shutdown.

6.9.6.2.2 Tests

The appliance is installed as indicated in 6.9.6.1.

The appliance is kept operating at its maximum temperature for 30 min. It is verified that the device does not cause a shutdown. The main burner is then shut down.

The temperature rise after the burner shutdown shall not cause the device to order a shutdown.

6.9.6.3 Shutdown time

6.9.6.3.1 Requirements

The control device results at least in a safety shutdown within the maximum time limit fixed in Table 3:

Table 3 —Shutdown time as a function of the blockage

Degree of blockage	Diameter of the opening in the blocking plate	Maximum shutdown time (minutes)	
		At nominal heat input	Minimum heat input
	d	Q_n	Q_m
Total	0	2	$2\ \frac{Q_n}{Q_m}$
Partial	0,6 × *D* ou 0,6 × *D′*	8	—
D: internal diameter of the test flue at its top. *D′*: diameter of plate allowing limit of spillage to be obtained.			

When there is a safety shutdown, automatic return to service will only be possible after a minimum waiting time of 10 min. The technical instructions shall indicate for use the actual waiting time of the appliance.

6.9.6.3.2 Tests

6.9.6.3.2.1 Tests with complete blockage

The appliance is operated at nominal heat input. The gas evacuation duct is completely blocked (see Figure 8). The reaction time between blocking the duct and shutdown is measured. For appliances without lockout, the time between shutdown and ignition of the main burner is then measured with the blockage being maintained.

A second test is carried out at reduced heat input (if applicable).

6.9.6.3.2.2 Tests with partial blockage

The appliance is operated at nominal heat input.

The length of the telescopic duct is progressively reduced to the limit of spillage before the blocking plate is put into position.

If the device operates before this length has been reached, the requirement of 6.9.6.3.1 is regarded as satisfied.

If not, the telescopic test flue is covered with a blocking plate having a concentric circular orifice with a diameter d of 0,6 times the diameter D of the test flue at its upper extremity (see Figure 8).

If spillage is not achieved with the telescopic test flue, it is covered with a plate incorporating a circular hole of diameter D' which allows the limit of spillage to be obtained.

This plate is then replaced by another blocking plate incorporating a circular hole of diameter d which is equal to 0,6 times D'.

The time between the blocking plate being put into position and shutdown is measured.

However, if the technical instructions state a minimum flue height for this test, mandatorily not exceeding 0,50 m the test is carried out with a test flue of that height.

6.9.6.4 Endurance

6.9.6.4.1 Requirements

After the endurance test, the device shall operate as indicated in 6.9.6.3.

6.9.6.4.2 Tests

The device is made non-operational without any change to the component parts.

Under the test conditions of 6.9.6.1, the flue is totally blocked and the appliance is operated without interruption for 4 h. For this test, it is possible to use a distributed gas instead of the reference gas.

6.9.7 Pressure regulator

6.9.7.1 Requirements

The gas rate of appliances fitted with a pressure governor shall not differ from the gas rate obtained at normal pressure by more than:

a) - 10 %, + 7,5 % for first family gases, between p_n and p_{max};

b) - 7,5 %, + 5 % for second family gases (without a pressure couple), between p_{min} and p_{max};

c) ± 5 % for third family gases (without a pressure couple), between p_{min} and p_{max};

d) ± 5 % for second and third family gases (with a pressure couple) between p_n and p_{max} corresponding to the higher pressure of the couple.

6.9.7.2 Tests

If the appliance is fitted with a pressure governor, the gas rate is measured with the reference gas at the normal pressure. Keeping the initial adjustment, the supply pressure is varied between:

— p_n and p_{max} for first family gases for requirement a);

— p_{min} and p_{max} for first and second family gases without a pressure couple for requirements b) and c);

— p_n and p_{max} for the higher pressure of the couple for second and third family gases with a pressure couple for requirement d).

6.9.8 Flue dampers

6.9.8.1 Resistance to high temperatures

6.9.8.1.1 Requirement

At the end of the resistance to high temperatures test, the operation of the flue damper shall remain unchanged.

6.9.8.1.2 Test

The appliance is supplied with the incomplete combustion gas at maximum pressure. After the main burner has been ignited the appliance is kept operating continuously for 4 h. The water flow rate is so adjusted that the supply water temperature is about 60 °C.

6.9.8.2 Long-term performance

6.9.8.2.1 Requirement

At the end of the long-term performance test, the operation the flue damper shall remain unchanged.

6.9.8.2.2 Tests

This test is carried out at nominal input with one of the reference gases at normal supply pressure.

At operating temperature, 5 000 switching operations of the flue damper, from closed to open and back to the closed position, are carried out by on/off regulation of the main burner.

At ambient temperature, i.e. with the appliance turned off, 40 000 switching actions of the flue damper, from closed to open and back to the closed position, are carried out. This test is carried out at the nominal input with one of the reference gases at nominal supply pressure.

At operating temperature another 5 000 switching actions are carried out. After each switching action it is shall be checked whether that the opening and closing times do not deviate by more than 50 % from of the times measured at the beginning of this long term performance test.

6.10 Repeated draw-off

6.10.1 Requirements

During the repeated draw-off test, the water temperature shall never exceed 95 °C with the thermostat adjusted to its maximum position. The gas supply shall not be interrupted by the overheat safety device before a whole number of draw-offs corresponding to at least 50 % of the nominal capacity.

6.10.2 Tests

The appliance is installed as indicated in 6.1.6.

The thermostat, if adjustable, is adjusted to its maximum position.

The test commences 1 h after the end of the heating-up period.

The test is carried out at nominal rate with one of the reference gases corresponding to the appliance category.

Water is drawn off several times at a rate, expressed in l/min, of:

— 5 % of the nominal capacity, but not less than 1 l/min nor greater than 15 l/min for appliances with a heat input less than 12 kW;

— 10 % of the nominal capacity, but not less than 2 l/min or greater than 30 l/min for appliances with a heat input not less than 12 kW.

In each draw-off period, the water is drawn off until the burner operates at a rate of at least 95 % of its nominal heat input and then the drawing-off is immediately ended.

The following drawing off period commences immediately after extinction of the burner or when the gas rate drops to a value of less than 1,5 times the minimum rate in the case of a modulating or high/low thermostat.

The temperature of the water being drawn off is measured as close as possible to the outlet port at the beginning of each drawing-off period.

The test is continued:

— until a constant value is obtained for this temperature; or

— for 5 h; or

— for 10 draw-offs.

6.11 Nominal capacity

6.11.1 Requirements

The volume of water measured shall not deviate by more than ± 5 % from the nominal capacity indicated by the technical instructions.

6.11.2 Tests

The appliance is filled with cold water, with the hot water outlet open to the atmosphere. It is then emptied as completely as possible either by gravity or siphoning. The water collected during drainage and weighed gives the capacity of the appliance.

6.12 Combustion

6.12.1 Requirements

The CO content of the dry, air-free combustion products shall not exceed:

a) 0,10 % under the normal conditions of 6.12.2.2 when the appliance is supplied with the reference gas(es) and under the special conditions of 6.12.2.4.1;

b) 0,20 % under the limit conditions of 6.12.2.2 when the appliance is supplied with the incomplete combustion limit gas and under the conditions of 6.12.2.4.2, 6.12.2.4.3, 6.12.2.4.4, 6.12.2.4.5, 6.12.2.4.6, 6.12.2.4.7, 6.12.2.4.8 and 6.12.2.4.9.

6.12.2 Tests

6.12.2.1 General

The appliance is supplied with gas and, if necessary, adjusted according to the instructions given in 6.12.2.2 and 6.12.2.3.

When the appliance is in the steady-state condition, in accordance with 6.1.6.8, the combustion products are sampled using, for type B_{11} and type B_{11BS} appliances.

For the other combustion tests, the combustion products are sampled by means of a probe of the type illustrated in Figure 4 or Figure 5 which is placed in the test flue, 150 mm from the top of the flue.

For type C appliances, the combustion products are sampled by means of a probe of the type illustrated, by way of example, in Figure 6 installed as shown in Figure 7.

The CO content of the dry, air-free combustion products (neutral combustion) is given by the formula:

$$CO = (CO)_M \times \frac{(CO_2)_N}{(CO_2)_M}$$

where

CO is the carbon monoxide content of the dry air-free combustion products, in percent;

$(CO_2)_N$ is the maximum carbon dioxide content of the dry, air-free combustion products of the relevant gas, in percent;

$(CO)_M$ et $(CO_2)_M$ are the measured concentrations in the samples taken during the combustion test, both expressed in percent.

The contents, in percent, of $(CO_2)_N$ for the test gases are given in Table 4:

Table 4 — Percentage of CO_2

Designation of the gas	G110	G 20 G 27	G 21	G 23	G 25 G231	G 26	G 30	G 31 G 130	G 120	G 150	G 271
$(CO_2)_N$	7,6	11,7	12,2	11,6	11,5	11,9	14,0	13,7	8,35	11,8	11,2

The CO content, in percent, of the dry, air-free combustion products may also be calculated by the formula:

$$CO = \frac{21}{21-(O_2)_M} \times (CO)_M$$

where

$(O_2)_M$ and $(CO)_M$ are measured concentrations of oxygen and carbon monoxide in the samples taken during the combustion test, both expressed in percent.

The use of this formula is recommended when the CO_2 content is less than 2 %.

6.12.2.2 Tests in still air

Type B_1 appliances are placed in the test room of 6.1.6.2, with the back as near as possible to a wall while following the technical instructions.

The appliances are installed under the conditions of 6.1.6.3.

Test n° 1

The test is carried out with each of the reference gases. The water rate and water temperature are adjusted in accordance with 6.1.6.8.

— For appliances with neither a gas pressure regulator in the main burner circuit, nor a preset gas rate adjuster, the test is carried out by supplying the appliance at the maximum pressure stated in 6.1.5;

— for appliances fitted with preset gas rate adjusters and without a gas pressure regulator in the main burner circuit, the test is carried out by adjusting the burner so as to obtain a heat input of 1,10 times the nominal heat input;

— for appliances fitted with a gas pressure regulator in the main burner circuit, the test is carried out by altering the burner heat input to 1,07 times the nominal heat input if it is supplied with gas G 110 or to 1,05 times the nominal heat input if it is supplied with gas G 20 or G 25.

For appliances having a preset gas rate adjuster or a gas pressure regulator in the main burner circuits but which is put out of service for one or more gas families, the tests are carried out successively according to the various supply situations specified.

Test n° 2

The appliance is tested with the incomplete combustion limit gas for its category.

The appliance is first supplied with the reference gas and the heat input is adjusted to 1,075 times the nominal heat input, if the appliance has no governor, or 1,05 times the nominal heat input if the appliance has a governor.

If the appliance is intended to be installed exclusively on an installation with a meter governor, the factor of 1,05 may be applied. Then, without changing the adjustment of the appliance or the supply pressure, the reference gas is replaced by the corresponding incomplete combustion gas.

In addition, a test is carried out with each of the reference gases at the minimum heat input if it exists.

6.12.2.3 Water heaters using gas/air ratio controls

Water heaters using gas/air ratio control systems are subjected to the following tests. The CO and CO_2 concentrations are measured:

a) The gas/air ratio control is adjusted in accordance with the installation instructions (or left as factory set if the control is not adjustable). The appliance is operated at both maximum and minimum heat input allowed by the control system;

b) Simulate reasonable maladjustment of any adjustable “throttle” setting by adjusting the CO_2 at maximum rate to be 0,5 % higher than the maximum value to which the gas/air ratio control should be set. For gas/air ratio controls that are adjustable then the maximum value shall include the maximum extent of the setting tolerance. For non-adjustable gas/air ratio controls the maximum value shall include the maximum extent of the factory setting tolerance. Following this adjustment, the appliance is operated at both maximum and minimum heat input allowed by the control system;

c) Simulate reasonable maladjustment of any adjustable “offset” setting by measuring the gas/air ratio control differential pressure (with the water heater operating at minimum rate) and adjusting the offset screw sufficiently to increase the differential pressure by 5 Pa. Following this adjustment, the appliance is again operated at both maximum and minimum heat input allowed by the control system. The tests are repeated by adjusting the offset screw sufficiently to decrease the differential pressure by 5 Pa.

For each test condition it is checked that the requirement of 6.12.1 a) is met.

6.12.2.4 Supplementary tests

6.12.2.4.1 Type B_1 appliances

The tests are carried out at the nominal heat input with the reference gas with the highest Wobbe number for the category.

The probe shall be placed between the heat exchanger area and the draught diverter.

The appliance is fitted with a flue of the maximum diameter stated by the installation instructions.

— a first test is carried out with the flue blocked;

— a second test is carried out by applying successively from the top of the flue a continuous down-draught of speeds 1 m/s and 3 m/s (see Figure 2, Figure 4 and Figure 5).

For type B_{11BS} appliances, the combustion products discharge safety device is put out of action.

6.12.2.4.2 Types C_1 and C_3 water heaters

The test is carried out as stated in the first and third test series in 6.7.2.2.2.2, if appropriate.

For each of the test series, the value of the arithmetic mean of the CO concentrations determined at the nine combinations of wind speed and angle of incidence that produce the highest CO concentration in the combustion products is calculated.

6.12.2.4.3 Type C_{21} water heaters

Under the test conditions of 6.7.2.2.2.3, it is checked that the requirements of 6.12.1 are met.

6.12.2.4.4 Type C_4 water heaters

Under the test conditions of 6.7.2.2.2.4, it is checked that the requirements of 6.12.1 are met.

6.12.2.4.5 Type C_5 water heaters

Under the test conditions of 6.7.2.2.2.5, it is checked that the requirements of 6.12.1 are met.

6.12.2.4.6 Type C_6 water heaters

These water heaters are intended to be connected to a separately approved and marketed system for the supply of combustion air and discharge of the combustion products to which reference is made in Annex I.

Type C_6 water heaters are fitted with a restriction to simulate the minimum pressure loss stated by the technical instructions.

The air supply is fitted with a mixing device which permits adjustment of the re-circulation of the products of combustion. The mixing device is adjusted such that 10 % of the combustion products are re-circulated to the air supply.

It is checked that the requirements of 6.12.1 are met.

A supplementary test is carried out by adjusting the restriction such that the air monitoring device just fails to operate.

If the water heater is fitted with an air monitoring device that does not interrupt the gas rate before the CO concentration exceeds 0,20 %, the test is done with a blockage that generates a CO concentration of 0,10 % at equilibrium.

For water heaters with gas/air ratio controls the supplementary test is done at the minimum adjustable heat input.

Under these test conditions, it is checked that the requirements of 6.12.1 are met.

6.12.2.4.7 Type C_7 water heaters

Under the test conditions of 6.7.2.2.2.7, it is checked that the requirements of 6.12.1 are met.

6.12.2.4.8 Type C_8 water heaters

Under the test conditions of 6.7.2.2.2.8, it is checked that the requirements of 6.12.1 are met.

6.12.2.4.9 Supplementary test for fan-assisted assisted water heaters

Fan-assisted water heaters are supplied with the reference gases for the category to which they belong at normal pressure. It is checked that the requirements of 6.12.1 are met when the supply voltage is varied between 85 % and 110 % of the nominal voltage stated by the technical instructions.

6.13 Non-condensation in the flue (type B appliances)

6.13.1 Requirements

Under the normal operating conditions, the appliance shall not give rise to condensation in a traditional flue. This requirement is met if:

a) the combustion products temperature (t_{pdc}) exceeds the dew point temperature (t_{ms}) by at least 20 °C ($t_{pdc} > t_{ros}$ + 20 °C);

b) or the flue losses are at least 8 %;

c) or the useful efficiency does not exceed 90 %;

d) or the combustion products temperature is not less than 80 °C.

These requirements do not apply to condensing appliances.

6.13.2 Tests

6.13.2.1 Exceeding the dew point temperature

The appliance is installed as indicated in 6.1.6. However, it is connected to the 5 m test flue as shown in Figure 9.

The test is carried out at nominal heat input and minimum heat input if appropriate, in accordance with 6.1.6.8.

The combustion products temperature and their CO_2 content are measured.

6.13.2.2 Determination of flue losses

The combustion products temperature and their CO_2 content are measured at the nominal heat input.

The flue losses are determined, for example, using the following formula:

$$qc = \left(a + \frac{b}{CO_2} \right) x \frac{(tc - ta)}{100}$$

where

q_c are the flue losses of the heat input in percent;

CO_2 is the carbon dioxide content in the dry products of combustion, in per cent;

t_c is the temperature of the products of combustion in °C;

t_a is the ambient temperature, in °C.

a et b are the coefficients given in Table 5 below:

Table 5 — Coefficients for determination of flue losses

Coefficient	Reference gas			
	G 110	G 20	G 25	G 30
a	1,05	0,86	0,85	0,65
b	23,2	36,6	36	42,5

6.13.2.3 Maximum useful efficiency

The useful efficiency is determined at nominal heat input.

6.13.2.4 Minimum combustion products temperature

The combustion products temperature is measured in the 1 m test flue 150 mm from the top of the flue.

The test is carried out at the minimum heat input (or nominal heat input if there is only one rate).

6.14 Supplementary tests for condensing water heaters

6.14.1 Formation of condensate

6.14.1.1 Requirements

The formation of condensate shall not impair the correct operation of the appliance.

The appliance shall meet one of the following requirements:

— when the condensate discharge is blocked, the gas supply of the appliance shall be shut off before the CO concentration exceeds 0,20 %, or

— when the condensate discharge is blocked, causing a restriction in the flow of combustion products or air for combustion, resulting in a CO concentration equal to or greater than 0,10 % at equilibrium, restart shall not be possible from cold.

In either case, there shall be no spillage of condensate from the appliance.

6.14.1.2 Test conditions

The appliance is supplied with one of the reference gases or a distributed gas for the category to which it belongs.

The means of condensate discharge is blocked.

The appliance is operated at the nominal heat input as given in 6.3.2.

NOTE Artificially filling the condensate discharge system with water may shorten the test.

6.14.2 Temperature of combustion products

6.14.2.1 Requirement

The temperature of the combustion products shall not exceed the maximum allowable overheat combustion products temperature for the materials of the combustion circuit and/or the flue materials, specified by the technical instructions.

If the appliance incorporates a device to limit the maximum temperature of combustion products the operation of the device shall cause non-volatile lock-out of the appliance.

6.14.2.2 Test conditions

The appliance is installed as specified in the general test conditions as applicable, and supplied with one of the corresponding reference gases for the appliance category at the nominal heat input. The use of an actually distributed gas, appropriate to the appliance category, is permitted.

Type B appliances are connected to a 1 m test flue and type C appliances are fitted with the shortest ducts specified by the technical instructions.

The control thermostat or control temperature set point in electronic temperature control system is put out of operation.

Where fitted the control to limit the temperature of combustion products remains in operation.

The temperature of the combustion products is progressively raised, either by increasing the gas rate or by another means which increases the temperature (e.g. removal of baffles) as specified by the technical instructions.

The temperature rise shall be within the range 1,0 K/min and 3,0 K/min.

It is verified that the requirement is fulfilled.

6.15 Prepurging

6.15.1 Requirements

For fan-assisted appliances, prepurging is compulsory before each ignition of the main burner (one attempt or several sequential automatic ignition attempts), except if one of the following conditions is satisfied:

a) the appliance is equipped with a permanent or non-permanent ignition burner;

b) if the heat flow rate is greater than 0,250 kW, the gas circuit features two closure members which close simultaneously;

1) of class C (or B, or A); or

2) one of class B (or A) and the other of class J (or C, or B, or A).

Under test conditions, the volume or duration of prepurging shall be at least the following:

— for appliances in which the prepurging air is drafted over the whole of the intake cross-section of the combustion chamber: at least the volume of the combustion chamber or at least 5 s at air flow rate corresponding to the nominal heat flow rate;

— for other appliances, at least three times the volume of the combustion chamber or at least 15 s.

6.15.2 Test

One of the following tests shall be conducted. The volume or time for prepurging are determined as follows:

a) prepurging volume

— the air flow rate is measured at the combustion products flue output at ambient temperature;

— the appliance is stopped at ambient temperature. The fan is powered at the electrical voltage specified for prepurging;

— the flow rate measured precisely in a range of ± 5 % is returned to reference conditions (15 °C, 1,013.25 mbar);

— the volume of the combustion circuit is indicated by the technical instructions;

b) prepurging time

the duration between the fan start-up command and power up of the ignition device is determined.

6.16 Air monitoring device

6.16.1 Type B_{12} and B_{13}

6.16.1.1 General

Depending on the principle of air proving, the applicable requirements are described in the clauses below.

The water heater is installed as stated in 6.1.6.3. The water heater is supplied with one of the reference gases for the category to which it belongs.

The CO concentration is determined as stated in 6.12.1.

6.16.1.2 Supervision of the combustion air rate or combustion products rate

Requirements

At a reduced flow rate the CO concentration (dry, air-free) may not exceed a specific value.

The following methods of flow reduction are to be examined:

a) progressive blockage of the air inlet;

b) progressive blockage of the combustion products evacuation ducts; *take care to not influence the draught of the test flue*;

c) progressive reduction of the fan speed, for example by reduction of the fan voltage.

There are two alternative supervision strategies for the air proving; a start-up supervision or a continuous supervision. Based on the supervision strategy the water heater shall at a reduced flow rate meet one of the following two requirements:

d) continuous supervision: Shutdown before the CO concentration exceeds 0,2 %, or

e) start up supervision: Not start if the CO concentration exceeds 0,1 %.

Test conditions

The test is carried out when the water heater is in thermal equilibrium, at the nominal heat input, or for modulating boilers at the maximum and the minimum heat input and at the heat input corresponding to the arithmetic mean of these two inputs. When several rates are provided, supplementary tests are needed at each of these rates.

The CO and CO_2 concentrations are measured continuously.

The means of carrying out the blockage shall not give rise to recirculation of the products of combustion.

It is checked that for each of the 3 methods of flow reduction at least one of the alternative requirements is met.

6.16.2 Type C and other type B

6.16.2.1 General

Depending on the principle of air proving, the applicable requirements are described in the clauses below.

The water heater is installed as stated in 6.1.6.3. The water heater is supplied with one of the reference gases for the category to which it belongs.

The water heater is fitted with the longest combustion air supply and combustion products evacuation ducts stated in the installation instructions. The tests may be carried out without the terminal or fitting piece.

The CO concentration is determined as stated in 6.12.1.

6.16.2.2 Supervision of the combustion air rate or the combustion products rate

Requirements

At a reduced flow rate the CO concentration (dry, air-free) may not exceed a specific value.

The following methods of flow reduction are to be examined:

a) progressive blockage of the air inlet;

b) progressive blockage of the combustion products evacuation ducts;

c) progressive reduction of the fan speed, for example by reduction of the fan voltage.

There are two alternative supervision strategies for the air proving; a start-up supervision or a continuous supervision. Based on the supervision strategy the boiler shall at a reduced flow rate meet one of the following two requirements:

d) continuous supervision: Shutdown before the CO concentration exceeds 0,2 %, or

e) start up supervision: Not start if the CO concentration exceeds 0,1 %.

Test conditions

The test is carried out when the water heater is in thermal equilibrium, at the nominal heat input, or for modulating water heaters, at the maximum and the minimum heat input and at the heat input corresponding to the arithmetic mean of these two inputs. When several rates are provided, supplementary tests are needed at each of these rates.

The CO and CO_2 concentrations are measured continuously.

The means of carrying out the blockage shall not give rise to recirculation of the products of combustion.

It is checked that for each of the 3 methods of flow reduction at least the requirement of one alternative supervision strategies is met.

6.16.3 Gas/air ratio controls

6.16.3.1 Leakage of control tubes

Requirements

When control tubes are not made of metal or of other materials with at least equivalent properties, their disconnection, breakage or leakage shall not lead to an unsafe situation. This implies either locking out or safe operation with no leakage of gas outside the boiler.

Test conditions

The boiler is installed as stated in 6.1.6. It is supplied with the reference gas at its nominal heat input. The above requirements are checked under the various situations that could occur, in particular:

a) simulated leak from the air pressure tube;

b) simulated leak from the combustion chamber pressure tube;

c) simulated leak from the gas pressure tube.

6.16.3.2 Supervision of the combustion air rate or the combustion products rate

Requirements

At a reduced flow rate the CO concentration may not exceed a specific value. The following methods of flow reduction are to be examined:

a) progressive blockage of the air inlet;

b) progressive blockage of the combustion products evacuation ducts;

c) if internal recirculation can occur then an additional test shall be carried out by progressive reduction of the fan speed, for example by reduction of the fan voltage.

There are two alternative supervision strategies for the air proving; a start-up supervision or a continuous supervision. Based on the supervision strategy the water heater shall at a reduced flow rate meet one of the following two requirements:

d) continuous supervision

Shutdown before the CO concentration (dry, air free) exceeds:

1) 0,20 % over the range of modulation specified in the installation instructions), or

2) CO_{mes} x (Q /Q_{KB}) ≤ 0,20 % below the minimum rate of the modulation range.

where

Q is the instantaneous heat input, in kW;

Q_{KB} is the heat input at the minimum rate, in kW;

CO_{mes} is the measured CO concentration (dry, air free).

e) start-up supervision

Not start if the CO concentration (dry, air free) exceeds 0,1 %.

Test conditions

The test is carried out when the water heater is in thermal equilibrium, at the nominal heat input, or for modulating water heaters at the maximum and the minimum heat input.

When several rates are provided, supplementary tests are needed at each of these rates.

The CO and CO_2 concentrations are measured continuously.

The means of carrying out the blockage to achieve a reduced flow rate shall not give rise to recirculation of the products of combustion.

It is checked that for each of the 3 methods of flow reduction at least the requirement of one alternative supervision strategies is met.

f) If internal recirculation can occur then an additional test shall be carried out by progressive reduction of the fan speed, for example by reduction of the fan voltage.

6.17 Functioning of the fan of a type C_4 water heater

6.17.1 Requirements

For type C_{42} and C_{43} water heaters, when controlled shutdown or safety shutdown occurs, the fan shall stop after any post-purge.

If the water heater is fitted with a permanent or alternating ignition burner, it is permissible for the fan to function at the lowest speed corresponding to the flow which is necessary for the ignition burner.

6.17.2 Tests

The water heater is brought to controlled shutdown. It is checked that the requirement of 6.17.1 is met.

After restart the water heater is brought to safety shutdown. It is checked that the requirement of 6.17.1 is satisfied.

6.18 Nitrogen oxides

6.18.1 General

The water heater is installed as indicated in 6.1.6.3.

For water heaters intended to use second family gases, the tests are carried out with reference gas G20.

For water heaters intended to use only G25, the tests are carried out with reference gas G25.

For water heaters intended to use only third family gases, the tests are carried out with reference gas G30 and the limit *NOx* value is multiplied by a factor of 1,30.

For water heaters intended to use propane only, the tests are carried out with reference gas G31 and the limit *NOx* value is multiplied by a factor of 1,20.

Except where otherwise stated, the *NOx* measurements are carried out when the water heater is at thermal equilibrium, conforming to the details given in CR 1404. Also, the tests are effected under normal combustion products evacuation in accordance with 6.1.6.3, with the exception of type B appliances which are fitted with a test flue of the largest diameter stated in the installation instructions, into which is placed a probe of the type illustrated in Figure 4 or Figure 5, 100 mm from the top of the test flue.

During the test the inlet water temperature shall be (10 ± 2) °C.

For measurements at partial heat inputs lower than the nominal heat input Q_n, the tests are carried out as specified above.

No wet meters are used during the *NOx* measurements.

The appliance is installed in a well-ventilated, draught-free room (air speed less than 0,5 m/s), which has the following conditions for the combustion air:

— ambient temperature: 20 °C;

— relative humidity: 10 g H_2O/kg air.

If the test conditions are different to these reference conditions, it will be necessary to correct the *NOx* values as specified below:

$$NO_{x,0} = NO_{x,m} + \frac{0,02NO_{x,m} - 0,34}{1 - 0,02(h_m - 10)}.(h_m - 10) + 0,85.(20 - T_m)$$

Where

$NO_{x,m}$ is the *NOx* measured at hm and Tm in milligram per kilowatt-hour (mg/kWh) in the range 50 mg/kWh to 300 mg/kWh;

h_m is humidity during the measurement of *NOx* in g/kg in the range 5 g/kg to 15 g/kg;

T_m is the temperature during the measurement of *NOx* in °C in the range 15 °C to 25 °C;

$NO_{x,0}$ is the value of *NOx* corrected to the reference conditions expressed in milligram per kilowatt-hour (mg/kWh).

Where appropriate, the measured *NOx* values are weighted in accordance with 6.9.3.2.

For the calculation of conversions of *NOx* see Annex H.

6.18.2 Weighting

6.18.2.1 General

The weighting of the *NOx* measured values shall be as described in 6.9.3.2.2 and 6.9.3.2.3, on the basis of the values in Table 6.

Table 6 —Weighting factors

Partial heat input Q_{pi} as a % of Q_n	Q_{min}	50	70
Weighting factor Fpi	0,45	0,45	0,10

The following symbols are used:

Q_{min} the minimum modulating heat input, expressed in kilowatts (kW);

Q_n the nominal heat input, expressed in kilowatts (kW);

Q_{pi} the partial heat input for weighting, expressed in percent of Qn;

F_{pi} the weighting factor corresponding to the partial heat input Qpi;

$NO_{x,pond}$ the weighted value of NOx concentration, in milligrams per kilowatt-hour (mg/kWh);

$NO_{x,mes}$ the measured (and possibly corrected) value:

at the partial heat input: $NO_{x,mes}$ (Qn), $NO_{x,mes}$ (70), $NO_{x,mes}$ (50), $NO_{x,mes}$ (Q_{min});

at the minimum heat input (modulating water heaters): $NO_{x,mes,}Q_{min}$;

at the heat input corresponding to a single rate: $NO_{x,mes\ (rate)}$.

6.18.2.2 Storage water heaters with fixed output

The NOx concentration is measured at the appliance nominal output.

$$NO_{x,pond} = NO_{x,mes(Qn)}$$

6.18.2.3 Storage water heaters with adjustable output or automatic output variation

The *NOx* concentration is measured at the partial heat inputs specified in Table 6:

$$NO_{x,pond} = 0,45NO_{x,mes(Q\min)} + 0,45NO_{x,mes(0,5Qn)} + 0,10NO_{x,mes(0,7Qn)}$$

If Q_{min} is greater than 0,5 Q_n the following formula should be applied:

$$NO_{x,pond} = 0,90NO_{x,mes(Q\min)} + 0,10NO_{x,mes(Qn)}$$

6.19 Electrical power measurements

6.19.1 Nominal conditions

The electrical power consumption shall be measured at the same conditions as for the measurement of heat input according to 6.3.2.

6.19.2 Standby

The electrical power consumption, expressed in W, is measured when the appliance is in standby mode.

7 Rational use of energy

7.1 Efficiency

7.1.1 Requirements

The efficiency based on the net calorific value shall not be less than:

a) 84 % for all appliances, except condensing appliances;

b) 98 % for condensing appliances.

7.1.2 Tests

7.1.2.1 General

The appliance is supplied with the reference gas corresponding to its category and adjusted to supply the nominal heat input.

The measuring uncertainties are selected so as to ensure an overall uncertainty in the measurement of the efficiency of ± 2 %.

The test is carried out under the following normal combustion products evacuation conditions:

— type B_1 appliances connected in accordance with 6.1.6 to the test flue of the largest diameter specified by the technical instructions;

— type C appliances installed as described in 6.7.2.2.2.2 in still air and 6.7.2.2.2.3 in a non-polluted atmosphere (all dampers open and test bench fan stopped as in Figure 3.

7.1.2.2 Determination of efficiency

The efficiency η_u (in %) is calculated using one of the formulae:

$$\eta_u = 100 \frac{m \cdot C_p \cdot \Delta T}{V_\eta \cdot H_i}$$

or

$$\eta_u = 100 \frac{m \cdot C_p \cdot \Delta T}{m_\eta \cdot H_i}$$

where

m is the mass of water collected during the test, in kg;

C_p is the specific heat of water, 4,186 × 10^{-3} in megajoules per kilogramme and per kelvin (MJ kg^{-1} K^{-1});

ΔT is the temperature rise of this water, in K, obtained by subtracting the mean temperature of the cold water in degrees Celsius from the mean of 10 measurements of the temperature of the hot water in degrees Celsius;

V_η is the volume of dry gas (first, second and third family gases) used by the appliance during the test, corrected to reference conditions in m^3;

M_η is the mass of gas (third family gases) used by the appliance during the test and expressed in kg;

H_i is the net calorific value of the dry gas used expressed, as appropriate:

— on the volume basis, in MJ/m^3;

— on the mass basis, in MJ/kg.

The temperatures are measured immediately before the inlet connection and immediately after the water outlet connection of the appliance, every precaution being taken that the measuring device does not give rise to any thermal losses.

With the thermostat set at its maximum value, the cold water inlet is closed. The gas supply is interrupted and the hot water is drawn through the drainage port. The drainage rate is adjusted if possible to a value of approximately 1/10 of the capacity per minute.

In addition, during the test the inlet water temperature shall be (10 ± 2) °C.

At the end of drainage, the appliance is refilled with cold water and its temperature t_f is measured. The burner is relit and the temperature rises again until the gas is shut off by the action of the thermostat. During this new temperature rise, the cold water supply is shut off, the quantity of gas consumed is measured and the water evacuated by expansion is collected (at the valve and hot water outlet).

The gas supply is shut off and the appliance is drained as previously.

During the second drainage period, the temperature of the water leaving the appliance is measured 10 times: the first when the quantity of water equal to approximately one twentieth of the normal capacity has drained, then each time that a quantity of water equal to approximately one tenth of the capacity has drained.

The total mass of water drained is measured by weighing.

Where the technical instructions state chemical composition of the condensate the conditions of the second drainage period shall be repeated as necessary to allow collection of sufficient condensate for analysis.

7.2 Maintenance consumption

7.2.1 Requirements

The maintenance consumption shall not exceed the value given by the following formulae:

— for appliances of any nominal capacity with a heating-up time (see 8.1) not less than 45 min, and for appliances with a nominal capacity up to 200 l with a heating-up time less than 45 min:

q = $11C^{2/3}$ + 0,015 Q_n (or 250 W if the value given by the formula is lower);

— for appliances with a nominal capacity exceeding 200 l with a heating-up time less than 45 min:

q = 9C$^{2/3}$ + 0,017 Q_n (or 250 W if the value given by the formula is lower);

where

q is the maintenance consumption in W;

C is the nominal capacity in litres;

Q_n is the nominal heat input in W.

7.2.2 Tests

The appliance connected to the 1 m flue if it is of type B_1 or to the special evacuation device of minimum length if it is of type C is supplied with one of the reference gases; the thermostat is adjusted to a position corresponding to a hot water temperature of approximately 45 K above the ambient temperature t_a in the case of a variable temperature appliance and the value specified in the case of a fixed temperature appliance.

The appliance is started up to attain this temperature rise and with the gas having been shut off twice by the thermostat in the case of the on/off type thermostats or operating at the minimum rate given by the high/low or modulating thermostats, the mean water temperature t_{ch1} is determined (using a circulator for example).

The appliance is then kept at the maintenance consumption for a number of complete cycles and for a period T_e of at least 24 h. Then the water is drawn off and temperature t_{ch2} is measured.

The quantity of gas consumed is measured.

The volumetric consumption of gas G obtained is corrected as follows:

$$G' = G\ x\ \frac{t_{ch} - 20}{t_{ch} - t_a}\ x\ \frac{45}{t_{ch} - t_a}\ x\ \frac{24}{T_e}$$

with

$$t_{ch} = \frac{t_{ch}1 + t_{ch}2}{2}$$

where

G is the maintenance consumption obtained during the test, in m^3/h;

t_{ch1} is the mean water temperature at the beginning of the test;

t_{ch2} is the mean water temperature at the end of the test;

t_a is the mean ambient temperature;

T_e is the test duration, in h.

The maintenance consumption q (in W) is obtained by the following formula

$$q = \frac{1000}{3,6} \cdot \frac{(G' \cdot H_i)}{24}$$

8 Fitness for purpose

8.1 Heating-up time

8.1.1 Requirements

For all types of appliances, the time necessary to raise the water temperature by 45 K shall not exceed the value given by the technical instructions.

8.1.2 Tests

Starting with the appliance cold, it is heated up once then drained then immediately filled with cold water. The thermostat is adjusted to obtain a temperature rise of the water of approximately 45 K or the value specified in the case of a fixed temperature appliance.

The burner is relit and the time T_C is measured between ignition of the burner and:

— either shutdown of the burner by the action of the thermostat if this is of the on/off type;

— or when the gas rate falls to the minimum rate if the thermostat is of the high/low or modulating type.

1/10th of the nominal capacity is drawn off and the water temperature t_{ch} is measured.

The nominal heating-up time T is derived from the formula:

$$T = T_C \frac{45}{t_{ch} - t_f}$$

where

t_{ch} is the hot water temperature after drawing off 1/10th of the nominal capacity;

t_f is the cold water temperature.

8.2 Mixing factor of the water temperature in the appliance

8.2.1 Requirements

The water temperature measured at the outlet at the end of drawing off shall exceed:

$t_f + 0{,}9\ (t_c - t_f)$ after drawing off 70 % of the nominal capacity;

and

$t_f + 0{,}6\ (t_c - t_f)$ after drawing off 85 % of the nominal capacity.

where

t_c is the hot water temperature in degrees Celsius (°C);

t_f is the cold water temperature in degrees Celsius (°C).

During this test, it shall only be possible for the burner to be brought back into service by the action of the control thermostat.

8.2.2 Tests

The appliance is installed in accordance with 6.1.6, then brought into the thermal equilibrium conditions of 6.1.6.9.

The test is carried out at the nominal input with one of the reference gases corresponding to the appliance category.

The thermostat is adjusted to obtain a cold water temperature rise of approximately 45 K.

The test begins after the first shut-off by the thermostat.

The cold water temperature t_f is measured.

Water is drawn off via the hot water outlet port at a rate, expressed in l/min, of (10 ± 0,5 %) of the nominal capacity but not less than 2 l/min. nor greater than 30 l/min.

The temperature of the hot water drawn off t_c is measured as close as possible to the hot water outlet port of the appliance.

The temperature t_c is measured at the moment when a quantity of water approximately 5 % of the nominal capacity has been drawn off.

During the test, the main burner shall only be capable of being restored by the action of the control thermostat.

8.3 Draw-off limits causing operation of the burner

8.3.1 Requirements

The appliance shall be relit for a draw-off value between the following limits:

— lower limit 0,05 C;

— upper limit $(0{,}17 + \frac{10}{T})\ C$;

where

T is the heating-up time expressed in minutes (min);

C is the capacity expressed in litres (l).

8.3.2 Tests

With the appliance installed in accordance with 6.1.6 and brought to thermal equilibrium as specified in 6.1.6.9. Water is drawn from the hot water outlet port at a rate, expressed in litres per minute of (5 ± 0,5 %) of the nominal capacity without however being less than 1 l/min.

During the test, the main burner shall only be capable of being brought back into operation by the action of the control thermostat.

8.4 Continuous draw-off

8.4.1 Requirements

If the technical instructions declare a continuous draw-off for a temperature rise of 30 K, it is checked that the continuous draw-off rate is at least equal to that declared by the technical instructions.

8.4.2 Tests

The draw-off rate is adjusted to that indicated by the technical instructions. Measurement begins after having drawn off a quantity of water equal to 1,5 times the appliance capacity.

Under these conditions, the burner shall never be extinguished and the temperature of the water drawn off shall not vary by more than ± 2 °C relative to the variation of the cold water temperature.

8.5 Requirements for the specific rate

If the technical instructions declare a specific rate D, the value measured afterwards shall not be more than 5 % below the value indicated on the data plate. This specific rate is measured according to EN 13203-1.

8.6 Designation and measurement of reference temperatures of flue systems

8.6.1 Nominal working combustion products temperature

Requirements

For the purpose of flue design, the nominal working combustion products temperature of the combustion products shall be recorded at the outlet of the water heater. The test shall be carried out as prescribed below

Test methods

During the test according to 6.9.5.1.2 with the control device set at the maximum setting temperature, the temperature of the combustion products is recorded continuously until the thermostat operates. The nominal working combustion products temperature is determined.

8.6.2 Overheat combustion products temperature

Requirements

For the purpose of flue design, the overheat temperature of the combustion products shall be recorded at the outlet of the appliance. The test shall be carried out as prescribed below.

Test methods

During the temperature of combustion products tests, according to 6.13.2.2 the temperature of the combustion products is recorded continuously until the temperature ceases to increase after the safety devise or if available the safety temperature limiter or the overheat cut-off device causes non-volatile lockout of the appliance. The overheat combustion products temperature is determined.

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

8.6.3.1 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.

8.6.3.2 Compressive strength

8.6.3.2.1 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 installation 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 installation instructions.

It is visually checked that the requirement is satisfied.

8.6.3.2.2 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 installation 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 installation instructions.

It is visually checked that the requirement is satisfied.

8.6.3.2.3 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 x 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.

8.6.3.3 Lateral strength

8.6.3.3.1 Flexural tensile strength

Requirement

When the technical instructions declare 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 declared by the installation instructions.

It is checked that the requirement is satisfied.

8.6.3.3.2 Components subject to wind load

Requirements

When the technical instructions declare 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 declared by the installation 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 kN/m^2 ± 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 m ± 0,01 m intervals. The individual loads do not vary by more than 1 %.

It is checked that the requirement is satisfied.

8.7 Requirements for plastic in the combustion product evacuation ducts, terminals and fitting pieces for appliances

8.7.1 Thermal resistance

Requirements

If the thermal resistance is not declared to be zero, the thermal resistance value of the chimney section declared by the technical instructions of the appliance shall be verified by testing with overheat combustion temperature in accordance with EN 13216-1.

8.7.2 Materials

8.7.2.1 Characterization

Requirements

The material shall be identified by the thermal, mechanical and physicochemical behaviour.

The characterization shall include the density and at least 5 more properties. At least one property shall be taken of each of the three groups of methods in EN 14471:2013, Annex A.

The characterization methods shall be chosen in such a way that the characterization includes the relevant properties of the material. Examples are given in EN 14471:2013, Annex B.

Test conditions

The density shall be determined in accordance with EN ISO 1183.

Prior to the characterisations the test pieces shall be conditioned at least for 24 h in air with a relative humidity of 50 % and a temperature of 23 °C.

8.7.2.2 Long-term resistance to thermal load

Requirements

The material shall be capable of withstanding exposure to the nominal working temperature as described under test conditions in this clause.

The tensile modulus and the yield stress shall be measured in all cases.

In case of thermosetting plastics the flexural modulus and flexural strength shall also be determined.

In case of flexible tubes the ring stiffness shall also be determined.

Other relevant properties like the density or the impact strength shall be measured additional before and after the period of exposure, if they are relevant to evaluate the deterioration of the material.

The properties shall be determined in accordance with the methods of Annex K.

Alterations to the properties shall not exceed those set out in Table 7.

If these values are not met, it is allowed to take new reference values obtained after 24 h exposure in air at nominal working temperature (conditioning) to release processing pressures/effects.

These effects are covered by the requirements for the mechanical stability of chimneys in accordance with 8.6.3

Table 7— Criteria for testing long-term resistance to thermal load

Property	Maximum permitted variation
Impact strength	≤ 50 %
Tensile modulus	≤ 50 %
Yield stress	≤ 50 %
Density	≤ 2 %
Flexural modulus	≤ 50 %
Flexural strength	≤ 50 %
Ring stiffness	≤ 50 %

Test conditions

To determine the long-term resistance to thermal load the test pieces are exposed to hot air in a forced air circulation oven, which meets the following conditions:

— the exhaust rate is at least one oven chamber volume in 10 min,

— the temperature varies no more than 1,5 °C within the oven volume and 1 °C over time.

Metal parts that come into contact with test pieces are lined with fluorocarbon film or other materials that have no effect on the oxidative stability of the material to be tested. The exposure time of the test pieces is dependent upon the test temperature as given in Table 8.

Table 8—Exposure time in weeks at raised temperatures

	Nominal working combustion products temperature					
	80 °C	**100 °C**	**120 °C**	**140 °C**	**160 °C**	**200 °C**
Test Temperature						
80°C	21,9					
85°C	13,0					
88°C	10,0					
100°C		17,2				
105°C		10,8				
106°C		10,0				
120°C			14,4			
124°C			10,0			
140°C				12,6		
143°C				10,0		
160°C					11,4	
162°C					10,0	
200°C						10,0

8.7.2.3 Criteria for testing long term resistance to thermal load

Requirements

The combustion products evacuation duct with the terminal and fitting pieces shall be designed so that no condensate remains.

The material shall be capable of withstanding exposure to condensate as described under test conditions.

The tensile modulus and the yield stress shall be measured in all cases.

In case of thermosetting plastics the flexural modulus and flexural strength shall also be determined.

In case of flexible tubes the ring stiffness shall also be determined.

Other properties like the density or the impact strength shall be measured before and after the period of exposure if they are relevant, by evaluation of the deterioration of the material.

The properties shall be determined in accordance with the methods of Annex K.

Alterations to the properties shall not exceed those set out in Table 9.

Table 9 —Criteria for testing long-term resistance to condensate exposure

Property	Value
Impact strength	≤ 50 %
Tensile modulus	≤ 50 %
Yield stress	≤ 50 %
Density	≤ 2 %
Flexural modulus	≤ 50 %
Flexural strength	≤ 50 %
Ring stiffness	≤ 50 %

NOTE If these values are not met, it is allowed to take new reference values obtained after 24 h exposure in air at nominal working temperature (conditioning) to release processing pressures/effects.

These effects are covered by the requirements for the mechanical stability of chimneys in accordance with 5.2.12.

If the air supply and combustion products evacuation duct has been tested before on an appliance with a higher nominal temperature and/or thermal load this system will be deemed to meet these requirements.

Test conditions

To determine the long-term resistance to condensate exposure the test pieces are fully immersed in test condensate.

The composition of test condensate is in accordance with following Table 10.

Table 10—Composition of test condensate for corrosion

Component	Concentration mg/l
Chloride	30
Nitrate	200
Sulphate	50

The test condensate shall be prepared using hydrochloric acid (HCl), nitric acid (HNO_3) and sulphuric acid (H_2SO_4). The condensate temperature shall be 90 °C.

If the nominal working combustion products temperature is below 90 °C the test shall be carried out at the nominal working combustion products temperature.

The duration of the exposure to condensate is 10 weeks.

At the conclusion of the test, the requirement is checked.

8.7.2.4 Resistance to condensing/non-condensing cycling

Requirements

After exposure in accordance with the test conditions the flue duct is disassembled and visually examined. It shall not show damages like cracks and pinholes.

The dimensions of the sections and fittings shall not change more than 2 %.

The tensile modulus and the yield stress shall be measured in all cases.

In case of thermosetting plastics the flexural modulus and flexural strength shall also be determined.

In case of flexible tubes the ring stiffness shall also be determined.

Other properties like the density or the impact strength shall also be measured before and after the period of exposure, if they are relevant to the evaluation of the deterioration of the material.

The properties shall be determined in accordance with the methods as given in Annex K.

Alterations to the properties shall not exceed those set out in Table 11.

If the values are not met, it is allowed to take new reference values obtained after 24 h exposure in air at nominal working temperature (conditioning) to release processing pressures/effects.

Table 11 —Criteria for testing resistance to condensing/ non- condensing cycling

Property	Value
Impact strength	≤ 30 %
Tensile modulus	≤ 30 %
Yield stress	≤ 30 %
Density	≤ 2 %
Flexural modulus	≤ 30 %
Flexural strength	≤ 30 %
Ring stiffness	≤ 30 %

Test conditions

The flue ducts to be tested shall consist of sections and fittings. Flue ducts for installation with enclosure shall be built with an enclosure. If the ducts are intended to be insulated they are to be installed in that way, according to the technical instructions.

The height of the flue duct shall be 4,5 m at least.

All fittings for normal installation shall be used.

The top of the flue duct shall be subjected to a vertical load representative of the weight of the maximum flue height as declared by the technical instructions.

The quality of the natural gas shall be fixed to a specific content of sulphur of 60 mg/m^3 and 0,025 % Cl.

Operate the appliance during 10 min under full load conditions P_n, 10 min under 30 % part load conditions $P_{30\,\%}$ and during 10 min in standby mode. The cycling time is to be equal or more than 84 days.

Alternatively the test may be carried out in accordance with EN 14471:2013, 7.7.5.

8.7.2.5 Resistance to ultraviolet radiation (UV)

Requirements

Those parts of the air supply and combustion products evacuation duct that are exposed to UV shall be tested in accordance with the test conditions.

After the exposure test the following requirements shall be met:

— the impact strength, as given in Annex K, shall not change more than 50 %;

— in case of thermosetting plastics the flexural modulus and flexural strength, as given in Annex K, shall not change more than 50 %.

The above tests shall be carried out in such a way that the maximum stress will occur at the radiated side of the test pieces.

Testing is not necessary in cases where the free end of the plastic flue duct (terminal) is not more than 2D but maximum 0,4 m in length exposed to UV of the sun.

Test conditions

The artificial weathering test is carried out in accordance with EN 513.

The apparatus is adjusted as follows:

— intensity of light: 30 W/m^2;

— exposure time: 1330 h;

— relative humidity: (65 ± 5) %;

— black standard temperature: (50 ± 3) °C;

— spray cycle: 18/102 (time of spraying = 18 min, dry interval between spraying = 102 min);

— no rotation of test pieces.

Overall radiation shall amount to 0,144 GJ/m^2.

The requirements are verified.

8.7.2.6 Geometrical stability

Requirements

After exposure in accordance with the test conditions the change in internal diameter/length of the pipe shall not exceed 2 %.

For each size group of diameters one size shall be tested.

Test conditions

To determine the geometrical stability 3 flue sections / segments with a length of 20 cm are coupled together with each other by the system specific joints or three samples without coupling are tested in accordance with 8.7.2.3 on long term resistance to thermal load.

The test pieces are placed in a horizontal position. The three sections are conditioned for a period of 48 h at the nominal operating temperature *T*.

8.7.2.7 Reaction to fire

Requirements

The reaction to fire shall be declared in the technical instructions according to EN 13501-1, but shall be equal or better than E.

Test conditions

The declaration is checked.

8.8 Requirements for elastomeric seals and elastomeric sealants in the combustion product evacuation ducts, terminals and fitting pieces

8.8.1 Characterization

Requirements

The material shall be characterized by determining the following properties in accordance with the methods as described in EN 14241-1:2013, 6.2.

— hardness;

— density;

— compression set;

— tensile strength;

— stress at 100 % of elongation.

Test conditions

To characterize the material the following properties are determined:

— hardness in accordance with ISO 7619 on a minimum of 6 test pieces;

— density in accordance with ISO 2781 on a minimum of 6 test pieces;

— compression set in accordance with ISO 815-1 on a minimum of 3 test pieces;

— tensile strength in accordance with ISO 37 on a minimum of 6 test pieces;

— stress at 100 % of elongation in accordance with ISO 37 on a minimum of 6 test pieces.

8.8.2 Long-term resistance to thermal load

Requirements

The material shall be capable of withstanding exposure to the nominal working combustion products temperature.

After exposure the following requirements shall be met:

After 56 days of exposure the properties given in Table 12 should not deviate from the original value by more than the values as listed in Table 12 in column A.

If the change of a property is greater, then the deviation from the original value shall not be greater than the values as listed in column B. Furthermore the change in properties between 28 and 56 days of exposure shall be less than the change between the original value and 28 days of exposure (stabilization of the material).

Table 12 —Criteria for testing long-term resistance to thermal load

Property	A	B
Hardness (shore A)	7 units	10 units
Tensile strength	30 %	50 %
Stress at 100 % of elongation	35 %	45 %

Test conditions

The test pieces are exposed for 56 days in air at the nominal working combustion products temperature.

The test is carried out in accordance with ISO 188.

After exposure it is checked that the requirements are met:

— hardness is determined in accordance with ISO 7619 on a minimum of 6 test pieces;

— tensile strength is determined in accordance with ISO 37 on a minimum of 6 test pieces;

— stress at 100 % of elongation is determined in accordance with ISO 37 on a minimum of 6 test pieces.

8.8.3 Long-term resistance to condensate exposure

Requirements

The material shall be capable of withstanding exposure to test condensate as described in Table 13.

The test condensate and its test temperature is depending on the construction class as mentioned below:

— construction class K1, no direct exposure to the flue gas and/or condensate;

— construction class K2, direct exposure to the flue gas and/or condensate.

After exposure the following requirements shall be met:

After 56 days of exposure the properties given in Table 13 should not deviate from the original value by more than the values as listed in Table 13, column A. If the change of a property is higher, then the deviation from the original value shall not be more than the values as listed in Table 13, column B. Besides the change in properties between 28 and 56 days of exposure shall be less than the change between the original value and 28 days of exposure (stabilization of the material).

Table 13 —Criteria for testing-long term resistance to condensate exposure

Property	A	B
Hardness (shore A)	≤ 7 units	≤ 10 units
Tensile strength	≤ 30 %	≤ 50 %
Volume	−5 / +25 %	−5 / +25 %
Stress at 100 % of elongation	35 %	45 %

Test conditions

The test pieces are exposed for 56 days in test condensate at 90 °C for K2 and at 60 °C for K1.

The composition of the test condensate is given in Table 14.

Table 14 —Condensate composition, related to construction classes

Chemical component	Concentration for K2 mg/l	Concentration for K1 mg/l
Chloride	30	30
Nitrate	200	50
Sulphate	50	50

The test is carried out in accordance with ISO 1817.

After exposure it is checked that the requirements are met:

— hardness is determined in accordance with ISO 7619 on a minimum of 6 test pieces;

— tensile strength is determined in accordance with ISO 37 on a minimum of 6 test pieces;

— volume is determined in accordance with ISO 1817 on a minimum of 6 test pieces;

— stress at 100 % of elongation is determined in accordance with ISO 37 on a minimum of 6 test pieces.

8.8.4 Cyclic condensate resistance test

Requirements

After exposure in accordance with the test conditions the test pieces or seals are inspected. The seals shall not show damage e.g. cracks. The inspection shall be performed visually at approximately 100 % elongation. If the performance of the visual inspection is not applicable (depending on the properties of the test pieces e.g. diameter, hardness) or in case of any suspected change of the material, alternatively it shall be checked that the tensile strength and the stress at 100 % of elongation will not have changed by more than 30 % when tested in accordance with ISO 37 on a minimum of 6 test pieces.

Test conditions

This test comprises the following 24 h cycle:

At least 6 test pieces are mounted on a base plate in such a way that they have an elongation of 25 % and that one side of the test pieces is in contact with the base plate. Throughout the full test sequence the base

plate is kept horizontal with the test pieces on top. The base plate shall consist of a material that is sufficiently resistant to the influence of condensate and shall have a maximum surface roughness of 5 µm.

Alternatively at least 3 flue pipe assemblies including one seal each may be used.

The test pieces mounted on the base plate are immersed in condensate for 6 h at 60 °C. Alternatively the flue pipe assemblies, filled with condensate in such a way that the level of the condensate is higher than all parts of the seal, are exposed for 6 h at 60 °C.

The composition of the test condensate shall be in accordance with Table 10.

After the exposure to condensate the test pieces mounted on the base plate are removed from the condensate.

The flue pipe assemblies are emptied of condensate. It is important not to dry the test pieces or the flue pipe assemblies before immediately transferring them to a ventilated oven.

The oven is operated for 0,5 h at a temperature of 60 °C and for 17,5 h at the nominal working temperature with a maximum of 110 °C.

The above cycle is repeated 12 times.

After exposure it is checked that the requirements are met.

8.8.5 Relaxation behaviour

Requirements

When tested in accordance with the test conditions the stress relaxation shall be lower than 50 %.

Test conditions

The test is carried out in accordance with ISO 6914.

The test pieces are exposed for 3 weeks in air, at nominal working combustion products temperature at 50 % elongation.

It is checked that the requirement is met.

8.8.6 Compression set

Requirements

When tested in accordance with the test conditions below the compression set shall not exceed 25 %.

Test conditions

The test is carried out in accordance with ISO 815-1.

The test pieces are exposed for 24 h in air at nominal working combustion products temperature.

It is checked that the requirement is met.

8.8.7 Low temperature resistance

Requirements

When tested in accordance with the test conditions the compression set shall not exceed 50 %.

Test conditions

The test is carried out in accordance with ISO 815-1 on a minimum of 6 test pieces.

The test pieces are exposed for 72 h in air at a temperature of – 20 °C.

It is checked that the requirement is met.

8.8.8 Joints in elastomeric seals

8.8.8.1 Durability

Requirements

If an elastomeric seal has a joint, the requirements specified in “long term resistance to thermal load” and “long term resistance to condensate exposure” shall also be met for test pieces that include the joint.

8.8.8.2 Strength

Requirements

When tested in accordance with the test conditions, visual inspection of the test pieces that are still being elongated shall not reveal any cracks or fractures.

A joint in an elastomeric seal is always a risk, so seals should not have more than one joint.

Test conditions

Three test pieces including the joint are 100 % elongated and exposed for 1 h in air at 23 °C and 50 % humidity.

After exposure it is checked that the requirements are met.

9 Marking and instructions

9.1 Appliance marking

9.1.1 Data plate

Each appliance shall carry an indelible data plate which is visible on installation, possibly after removal of part of the case, which is solidly fixed and durable, carrying at least the following information:

— the name of the manufacturer and/or his identifying symbol;

— the serial number or year of manufacture;

— the trade name of the appliance;

— the identification number of the appliance;

— the last two digits of the year of which CE marking is affixed on the appliance;

— the direct and indirect country(ies) of destination in accordance with EN ISO 3166-1;

— the category(ies) of appliance in relation to the direct countries of destination. Any category shall be specified in accordance with 4.3;

— the gas supply pressures in millibars, if several normal pressures can be used for the same gas group. They are indicated by their numerical value and the unit “mbar”;

— the appliance type(s). The appliance type shall be specified in accordance with 4.4;

— the nominal useful output and, for appliances with automatic output variation, the minimum useful output in kilowatts, given by the symbol P, followed by the equals sign, the numerical value(s) and the units “kW”;

— the nominal heat input and, for appliances with automatic output variation and appliances with adjustable output, the minimum heat input, in kilowatts given by the symbol *Q*, followed by the equals sign, the numerical value(s) and the units “kW”;

— the maximum water pressure and, for low water pressure appliances the minimum water pressure, at which the appliance can be used, in bars given by the symbol p_w, followed by the equals sign, the numerical value(s) and the units “bar”;

— if necessary, the protection factor in accordance with EN 60529;

— the type and voltage of the electrical supply, in volts (*V*), where applicable. Information relating to the electrical values shall be in accordance with EN 60335-1.

The indelibility of markings shall be checked by a test carried out in accordance with EN 60335-1:2012, 7.14.

9.1.2 Supplementary markings

The appliance shall carry visible and indelible information on a supplementary rating plate with regard to its state of adjustment:

— the country/countries of direct destination in accordance with symbols in EN ISO 3166-1;

— the gas group or range, the gas type symbol and the gas supply pressure and/or pressure couple according to EN 437;

— the gas supply pressure and/or the pressure couple (where applicable) for which the appliance has been adjusted.

The indelibility of the markings shall be verified by a test carried out as described in EN 60335-1:2012, 7.14.

9.1.3 Packaging

The packaging shall carry the category/categories, the type of appliance and the information given on the supplementary data plate (see 9.1.2) and the warnings as specified in 9.1.4.

9.1.4 Warnings on the appliance and packaging

9.1.4.1 General

One or more labels shall give at least the following visible and legible warnings.

The warnings on the appliance shall be visible to the user.

9.1.4.2 For all appliances

— “Read the technical instructions before installing the appliance”;

— “read the user's instructions before lighting the appliance”.

9.1.4.3 For type B_{11} appliances

— “This appliance shall only be installed outside or in a room separated from living rooms and provided with appropriate ventilation directly to the outside”.

9.1.4.4 For type B_{11BS} appliances

— “This appliance shall only be installed in a room if the room meets the appropriate ventilation requirements”.

9.1.5 Other information

No other information shall be carried on the appliance or packaging if it is likely to create confusion in relation to the actual state of adjustment of the appliance, the corresponding category or categories and the direct country or countries of destination.

9.1.6 Additional marking for appliances with flue dampers

On the appliance data plate or on an alternative permanently fixed, readily visible plate, it shall be stated that the appliance:

— is fitted, or

— is fitted at the installation

with a flue damper.

9.2 Instructions

9.2.1 Installation instructions

9.2.1.1 Introduction

Each appliance shall be accompanied by installation instructions intended for the installer giving instructions for installation, adjustment and maintenance of the appliance.

These instructions shall comprise at least the following information:

9.2.1.2 General

— The information on the data plate, except for the appliance number and the year of manufacture;

— the meaning of the symbols used on the appliance and its packaging in accordance with 9.1.1 and 9.1.2;

— if appropriate the minimum distances to be maintained between easily flammable materials;

— if necessary, indication that walls sensitive to heat, e.g. wood, shall be protected by suitable insulation, and the distance to be observed between the wall on which the appliance is fixed and the hot external parts of the appliance;

— a general description of the appliance with an illustration of the main parts (subassemblies) to be removed to correct operating faults;

— for electrical installation:

  a) the need to earth appliances comprising mains-supplied electrical equipment;

  b) a circuit with connection terminals (including those for external adjustment);

— the method recommended for cleaning the appliance;

— indication of the necessary maintenance.

9.2.1.3 For installation and adjustment of the gas circuit

— Information that the data in 9.1.2 on the state of adjustment mentioned on the data plate or supplementary plate shall be compatible with the local supply conditions;

— adjustment instructions for appliances that can be adjusted, comprising an adjustment table giving the volumetric rates or mass rates in cubic metres per hour (m^3/h) or kilogrammes per hour (kg/h) or the pressure at the burner as a function of the possible adjustment data according to the category or categories. The reference conditions for the volumetric rates are 15 °C, 1013,25 mbar, dry;

— if necessary, that the appliance is intended to be installed only on a gas supply with a governed meter;

— for appliances capable of operating on several gases, indication of the operations required to convert from one gas to another and indication that the adjustments and modifications shall only be carried out by a qualified professional or competent person. When an adjustment is carried out by the installer, the adjuster shall be sealed after adjustment;

— for water heaters fitted with gas/air ratio controls, a clear statement on whether or not the gas/air ratio control settings are intended to be adjustable by the installer and/or a service operative. If the gas/air ratio control is to be adjustable then the adjustment method shall be described. Information shall include any relevant value indicative for the actual gas/air ratio to be measured on the appliance, for example CO_2 level or O_2 level or a pressure difference. This value should be accompanied by the acceptable tolerances on the CO_2 and/or O_2 value. A maximum permitted value for CO should also be given.

9.2.1.4 For installation of the domestic hot water

— Installation of a check valve at the cold water inlet;

— incorporation of a hydraulic safety group and/or a combined temperature and pressure relief valve;

— the maximum water pressure for which the appliance is designed indicating that even when subjected to the effect of water expansion, the water pressure in the appliance shall not exceed this value.

9.2.1.5 For installation of the combustion products evacuation circuit

— For type B1 appliances:

- the flue pipe diameter(s) as given in Table A.2 which may be used, if necessary with a duct adapter;
- the minimum length of the flue (1 m, or 0,5 m for certain wall-mounted appliances specified by the installation instructions);
- for calculation of the flues, the combustion products mass rate in g/s and their mean temperature measured under the conditions of 7.2.2;

— for type B11 appliances:

- indicate clearly that type B11 appliances shall be installed outside or in a room separated from inhabited rooms with suitable ventilation directly to the outside;

— for type B11BS appliances:

- give a technical description of the combustion products discharge safety device;
- specify that the combustion products discharge safety device shall not be put out of operation;
- draw attention to the seriousness of untimely interference with the combustion products discharge safety device;
- give instructions on the mounting of the combustion products discharge safety device and the replacement of defective parts. Specify that only the manufacturer's original parts shall be used, and describe the test for the correct operation of the device which shall be carried out after servicing;
- draw attention to the fact that in the case of repeated shutdown of the appliance, it will be necessary to take appropriate action to remedy the discharge fault;
- indicate the waiting time for appliances with an automatic reset;

— for type C appliances:

- indicate the type of air supply and combustion products evacuation system to which the appliances may be connected;
- give the special characteristics of the terminal protection device and indications of its fitting and position relative to the terminal;
- indicate the maximum number of bends to be used and the maximum length of the air supply and combustion products evacuation ducts;
- for type C21 appliances, the minimum dimension of the common duct on which this can be installed;

— for type C_1 water heaters:

- the information if and how the terminal shall be placed on the wall and/or on the roof space;
- the instruction that the terminal outlets from separate ducts shall fit inside a square of 50 cm;

— for type C_2 water heaters:

- the characteristics of the shared duct systems to which the water heater may be connected;

— for type C_3 water heaters:

- the instruction that the terminal outlets from separate ducts shall fit inside a square of 50 cm;

— for type C_4 water heaters:

  — the minimum and maximum pressure loss permitted in the air supply and combustion products evacuation ducts, or the minimum and maximum length of these ducts;

  — the combustion products temperature and mass rate at the maximum and minimum heat input with the maximum length of ducts, if necessary;

  — the characteristics of the shared duct systems to which the water heater may be connected;

— for type C_5 water heaters:

  — the instruction that the terminals for the supply of combustion air and for the evacuation of combustion products shall not be installed on opposite walls of the building;

— for type C_6 water heaters:

  — the minimum and maximum pressure loss permitted in the air supply and combustion products evacuation ducts, or the minimum and maximum length of these ducts;

  — the combustion products temperature and mass rate at the maximum and minimum heat input;

  — the instruction that the water heater shall only be installed with a terminal that complies with the requirements of EN 1856-1 (see Annex K);

  — the method of calculating the pressure loss in the air supply and combustion products evacuation ducts, starting from the values of the temperature and mass rate of the combustion products in relation to the CO_2 concentration;

— for type C_7 water heaters:

  — the instruction that the draught diverter and the air intake shall be installed in the roof space of the building;

— for type C_8 water heaters:

— the characteristics of the chimney to which the water heater may be connected.

9.2.1.6 Supplementary instructions for condensing appliances

The installation instructions shall include the following information:

— detailed specifications for the means of discharging the combustion products and the condensate. Attention shall be drawn to the necessity of avoiding horizontal runs in the flue gas duct and the condensate draining duct, furthermore the minimum slope for these ducts shall be indicated;

— for type C appliances, the measures to be taken to avoid continuous discharge of condensate from the terminal;

— when the water heater complies with the requirements of 6.13.2.1 for combustion products temperature, it shall be specified or supplied the flue ducts and their accessories to be used, otherwise it shall be specified that the water heater is not intended to be connected to flues that are likely to be affected by heat (e.g. plastic ducts or ducts with internal plastic coatings);

— provisions for the discharge of condensate, in particular instructions for the installation of the condensing water heater where a condensate neutralization system is necessary.

9.2.1.7 Appliances with flue dampers

The installation instructions shall include all data needed for checking the appliance and the built-in flue damper for proper performance and for their maintenance.

The appliance may be delivered:

a) without a flue damper;

b) with a flue damper;

c) with the possibility of installing a flue damper.

If there is a possibility of installing a flue damper after the installation of the appliance the installation instructions shall state that:

1) the only damper permitted is that tested/certificated with the appliance;

2) the damper is to be installed in accordance with the installation instructions.

9.2.2 Instructions for use

9.2.2.1 Introduction

Each appliance shall be accompanied by instructions for use intended for the user. They shall comprise the necessary data on the use and maintenance of the appliance and shall include the following information at least:

9.2.2.2 General

— point out that a qualified installer should be called on to install and adjust the appliance and that, in order to convert it to use other gases, a qualified installer, gas distributor, or other competent person should be called on according to the practice in the country where the appliance is installed;

— specify the operations for starting up and putting the appliance out of service;

— specify that the warnings should be observed;

— explain the procedures for normal operation, cleaning and day-to-day maintenance of the appliance;

— warn against incorrect use;

— explain any necessary precautions to be taken against frost;

— forbid any interference with a sealed component;

— point out that appliances should be checked and maintained periodically by a competent person on according to the practice in the country where the appliance is installed;

— indicate the normal capacity.

9.2.2.3 For type B_{11BS} appliances

— State that the device interrupts the admission of gas to the burner if the evacuation of the combustion products is disturbed;

— describe the restart procedure;

— recommended that a competent person is called if there are repeated interruptions, on according to the practice in the country where the appliance is installed.

9.2.2.4 For type C appliances

— For type C appliances with manual ignition, mention the precautions to be taken before carrying out new ignition attempts;

— for type C_7 water heaters the roof space shall not be used as living area.

9.2.2.5 Supplementary use and maintenance instructions for condensing appliances

The instructions shall state that the condensate outlet(s) shall not be modified or blocked and shall include instructions relating to the cleaning and servicing of any condensate neutralization system.

9.2.2.6 Appliances with flue dampers

In the instructions for the user, it shall be stated that during maintenance of the appliance the functioning of the flue damper shall be checked for proper performance by a competent person.

9.2.3 Conversion instructions

Parts intended for conversion to another gas family, another group or gas range and/or another supply pressure shall be accompanied by conversion instructions intended for the competent person.

The instructions shall:

— specify the parts necessary to carry out the conversion and the method of identifying them;

— specify clearly the operations required to change the parts, and where necessary, the correct adjustment;

— specify that any broken seal shall be reconstituted and/or the preset adjusters shall be sealed;

— indicate that for appliances operating with a pressure couple, any gas pressure regulator shall either be rendered inoperative over the normal range of pressures or be put out of operation and sealed in this position.

A self-adhesive label intended to be placed on the appliance shall be supplied with the parts and conversion instructions. The supplementary markings in 9.1.2 for which the appliance has been converted shall be indicated on this label.

9.3 Presentation

All information of 9.1 and 9.2 shall be given in the language(s) and in accordance with the rules of installation in the countries in which the water heater will be installed.

10 Ecodesign Data

10.1 Water heating energy efficiency (η_{wh})

The water heating energy efficiency shall be measured and calculated according to EN 13203-2.

The water heating energy efficiency is determined for the tapping cycle.

The water heating energy efficiency of water heaters shall not fall below the values given in the existing regulation.

10.2 Nitrogen oxides emissions

The nitrogen oxides emissions shall be measured and corrected according to 6.18.

The calculated value shall be expressed in GCV as follows:

$$NO_{x,pond,Hs} = \frac{H_i}{H_s} \times NO_{x,pond}$$

$NO_{x,pond,Hs}$ the weighted value of the NO_x concentration, in milligrams per kilowatt-hour (mg/kWh) on a GCV basis;

$\frac{H_i}{H_s}$ = the ratio of the Net to Gross Calorific Value for the appropriate gas family.

The emissions of nitrogen oxides, expressed in nitrogen dioxide, of water heaters shall comply with the existing regulation.

10.3 Additional product information

Additional product information shall include the data listed in the existing regulation.

10.4 Storage volume

The storage volume of storage water heaters shall comply with the existing regulation.

10.5 Mixed water at 40 °C (*V40*)

The amount of mixed water at 40 °C of storage water heaters shall comply with the existing regulation.

The mixed water at 40 °C is determined according to EN 13203-1.

11 Energy Labelling Data

11.1 General

From the date the Delegated Regulation (EU) N°812/2013 has entered into force suppliers placing water heaters on the market and/or putting them into service, shall ensure that the following provisions are satisfied.

The technical parameters to put on the label according to the existing regulation are determined by EN 13203-2.

11.2 Printed label

11.2.1 General

It shall be in compliance with the existing regulation.

The water heating energy efficiency class of a water heater shall be determined on the basis of its water heating energy efficiency as set out in the existing regulation.

11.2.2 Annual Electricity Consumption (AEC)

AEC as defined in the existing regulation shall be determined according to EN 13203-2.

11.2.3 Annual Fuel Consumption (AFC)

AFC as defined in the existing regulation shall be determined according to EN 13203-2.

11.2.4 Sound power level (L_{WA})

The sound power level as defined in the existing regulation shall be determined according to the following.

The appliance is installed and adjusted according the technical instructions.

The test is carried out under steady-state conditions according to 6.1.6.8.

The test is carried out with one of the reference gases or distributed gases for the category concerned at the nominal heat input.

When the appliance is in the steady-state condition (see 6.1.6.7) the A-weighted sound power level shall be recorded according the test methods of EN 15036-1:2006, 4.2.

The used test method shall be in correspond with the uncertainty of category 1 (precision class) or 2 (engineering class).

11.3 Product fiche

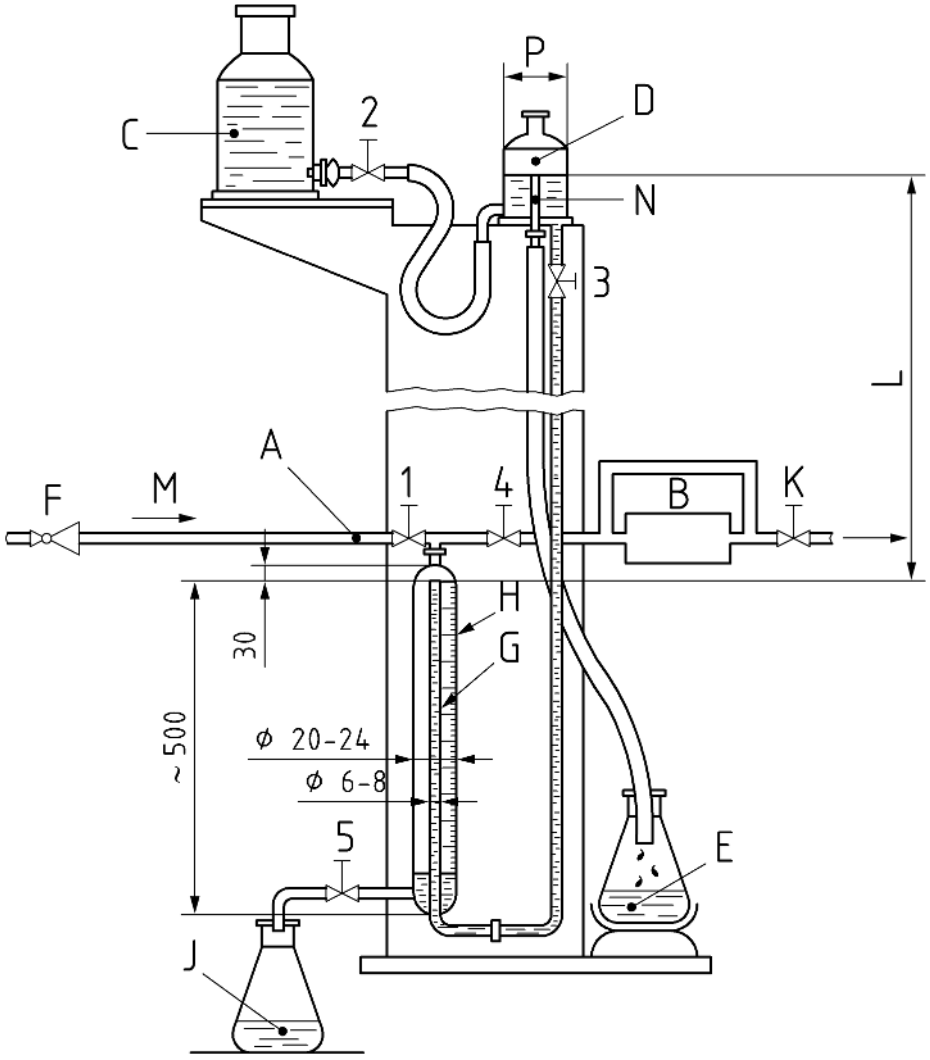
It shall be in compliance with the existing regulation.

11.4 Technical documentation

It shall be in compliance with the existing regulation.

12 Figures referenced in this standard

Dimensions in millimetres

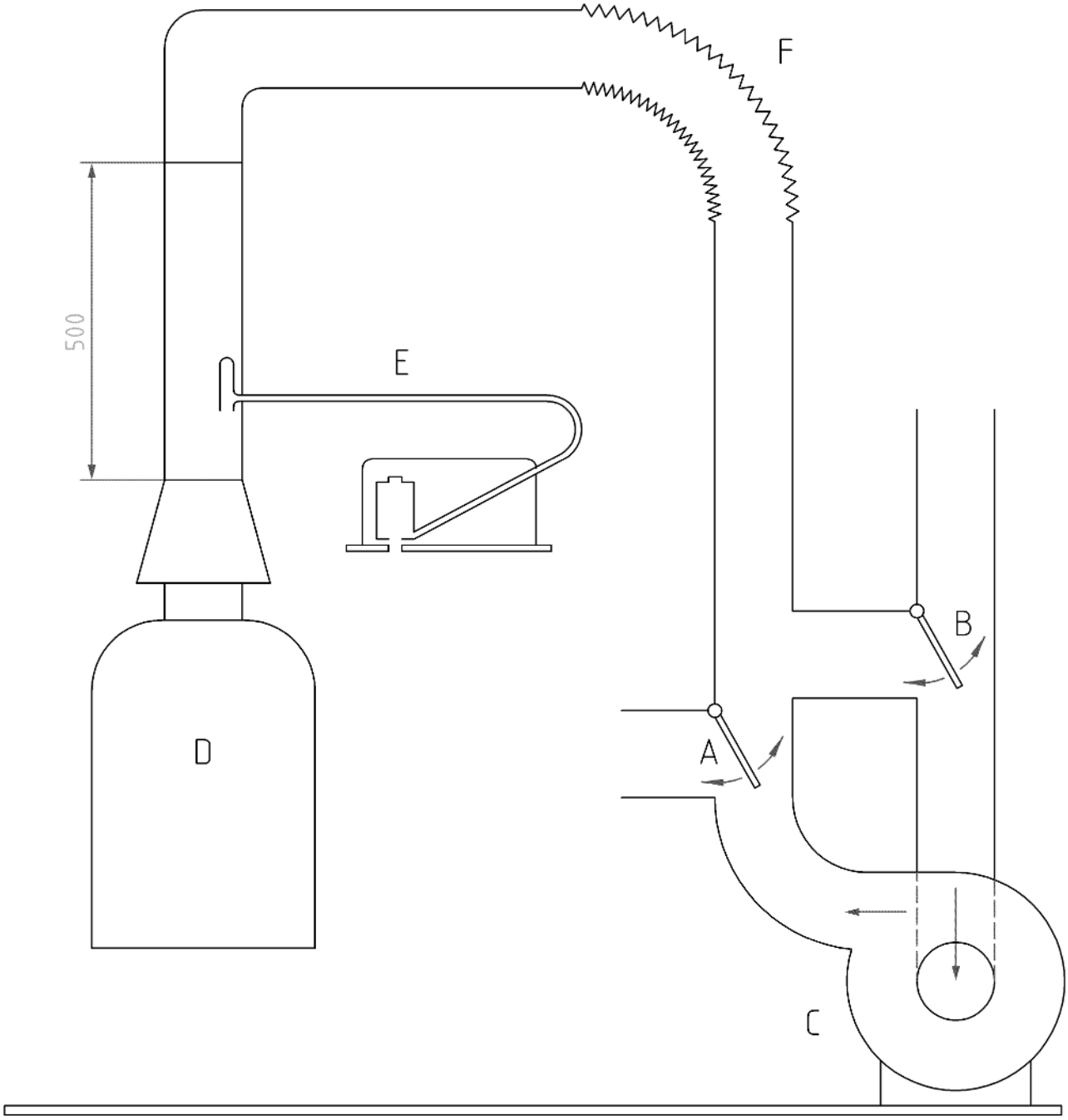


Key

A	inlet	J	receptacle for overflow from burette
B	sample to be tested	K	downstream tap
C	water reservoir	L	height of water corresponding to the test pressure
D	constant level vessel	M	compressed air
E	overflow from constant level vessel	N	tube 10 to 12
F	pressure regulator	P	ø 90 int
G	tube	1 to 5	manually operated taps
H	burette		

Figure 1 — Apparatus for verifying soundness of the gas circuit (see 6.1.6.5, 6.2.1.2 and Annex E)

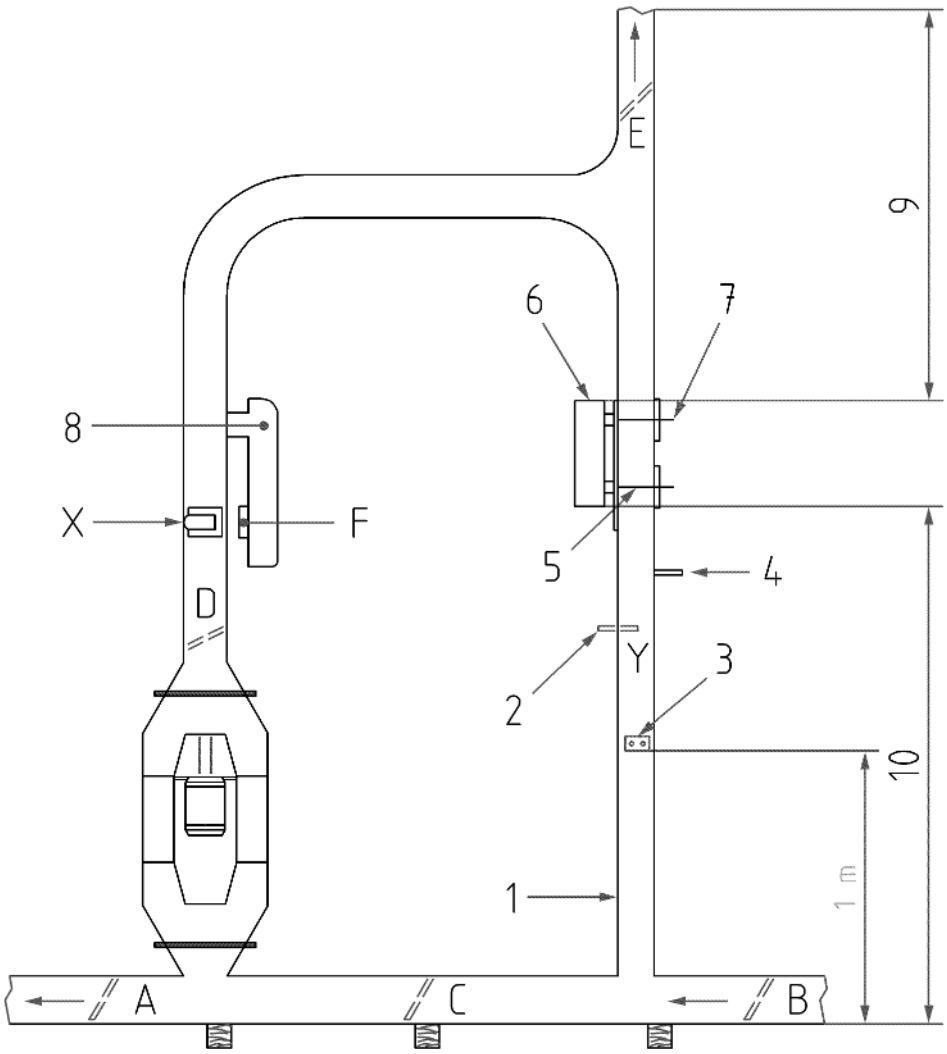
Dimensions in millimetres



Key

A and B	by-pass valves to obtain either a downdraught or suction
C	fan
D	hot water generator
E	measurement of speed by means of pilot tube
F	hose

Figure 2 — Test of an appliance of types B_1 under abnormal draught conditions (see 6.12.2.4.1)

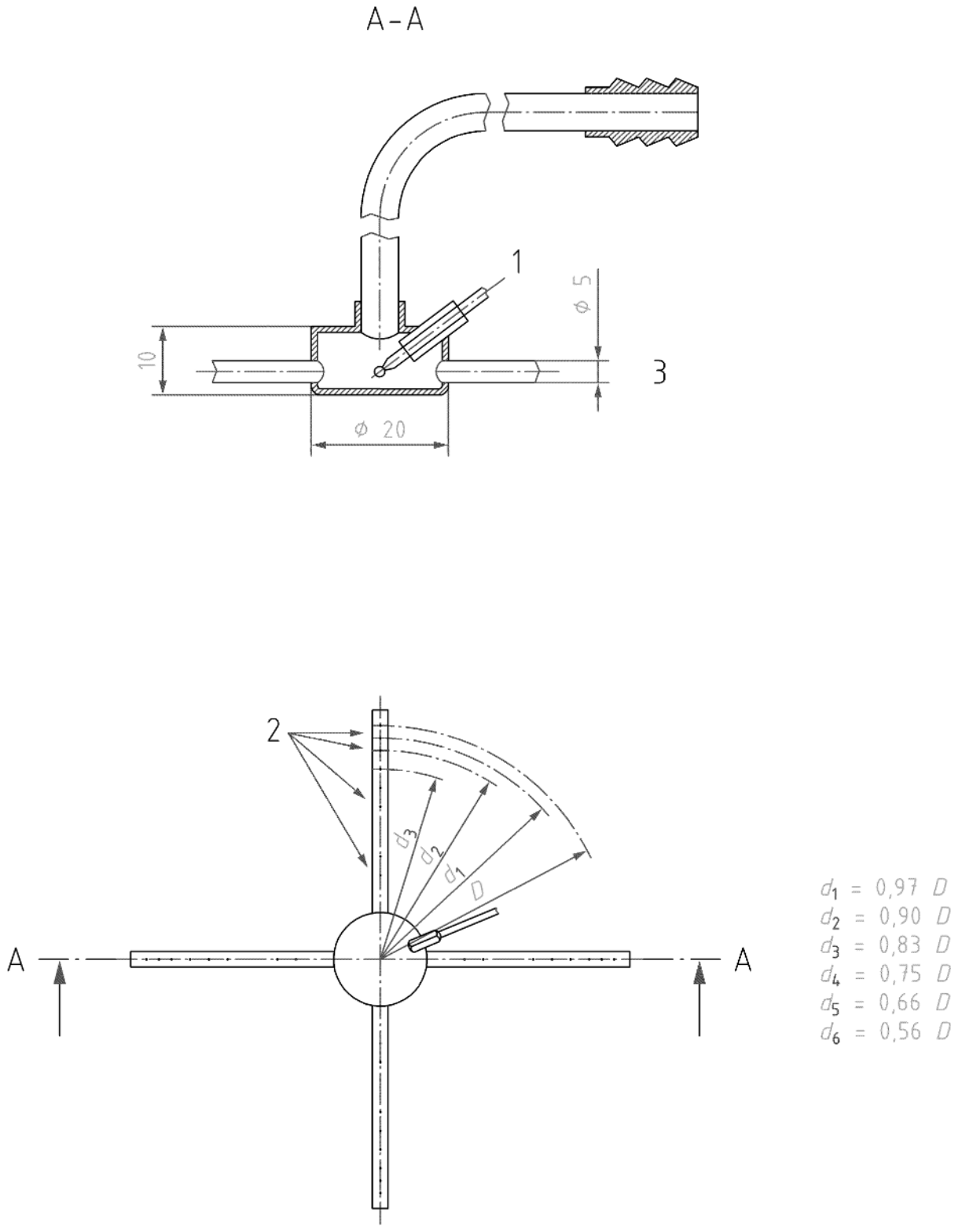


Key

1	rectangular section duct 225 mm × 400 mm
2	temperature reading point
3	2 recordings anemometers (interchangeable)
4	pressure tapping point
5	connection to CO and CO_2 analysers for pollution test in the updraught
6	appliance under test
7	thermocouple and sampling tube to be connected to CO and CO_2 analysers
8	hot water generator
9	1 m at least
10	2 m at least
X	heat exchanger
A, C, E, F, Y	see Annex C

Figure 3 — Test of a type C_{21} appliance mounted on the common duct (see 6.7.2.2.2.3 and Annex C)

Dimensions in millimetres

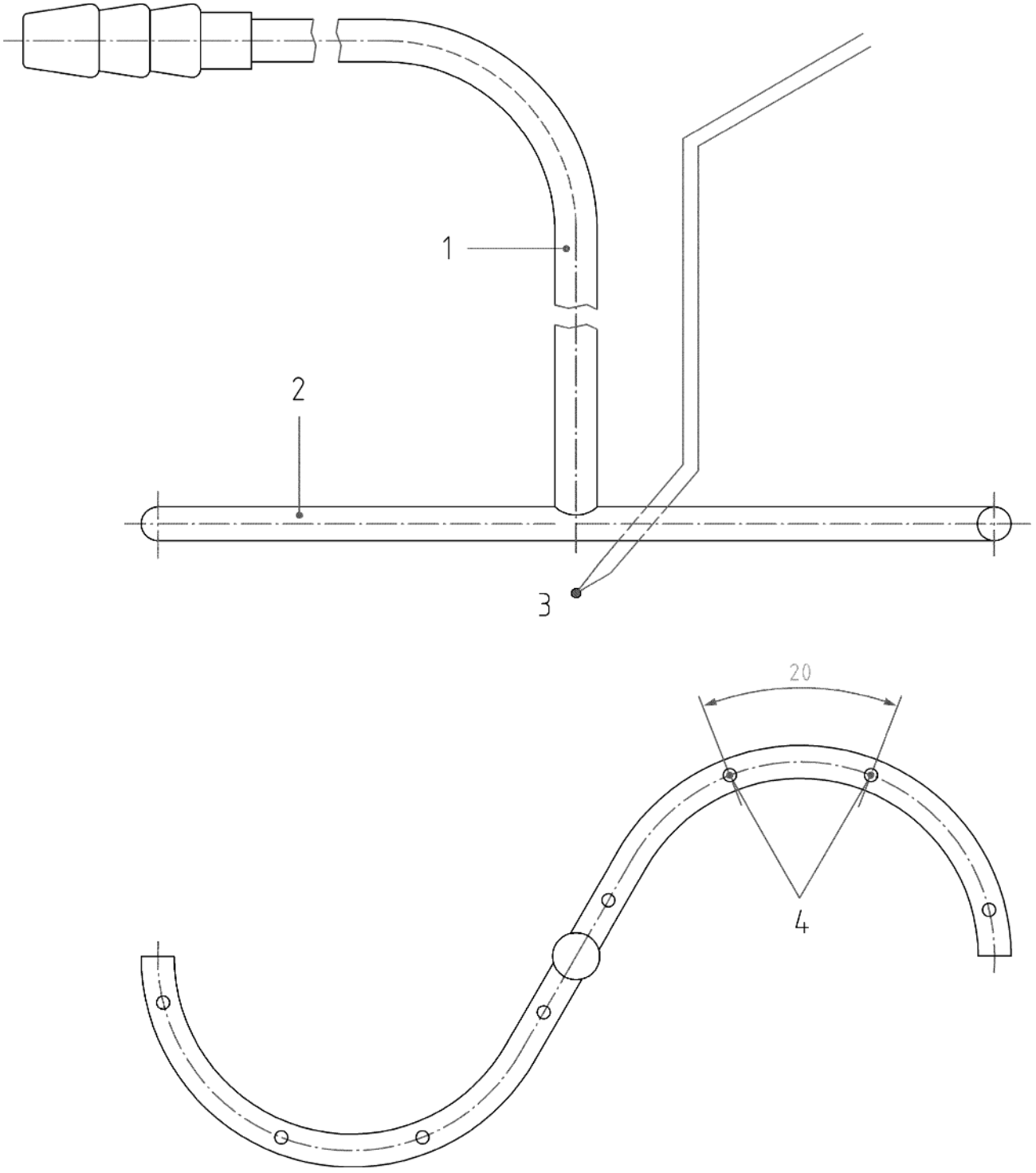


Key

1 thermocouple
2 openings in each branch: 8 × ø 1
3 sampling probe

Figure 4 — Sampling probe for test flues of diameter greater than 100 mm (see 6.12.2.1 and 6.12.2.4.1)

Dimensions in millimetres



Key

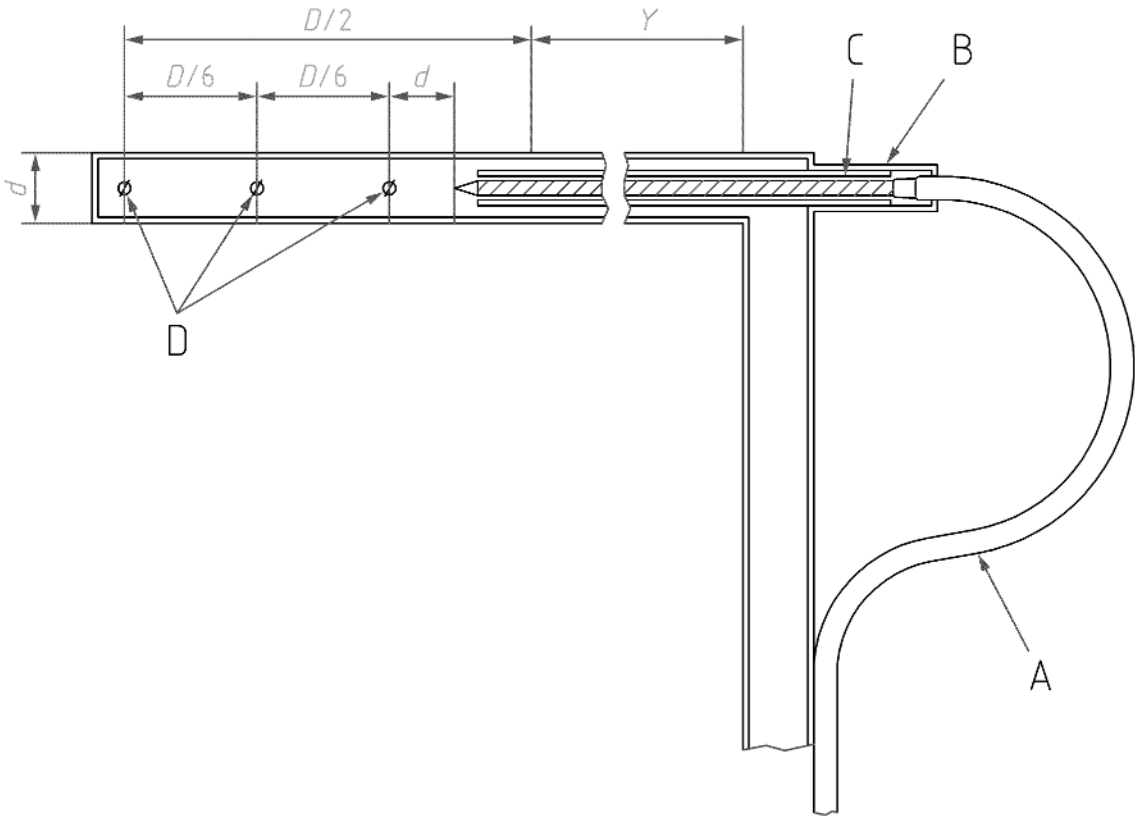
1 tube ø 6

2 tube ø 4/3

3 thermocouple

4 openings: 8 × ø 1

Figure 5 — Sampling probe for test flue diameters less than 100 mm (see 6.12.2.1 and 6.12.2.4.1)



NOTE 1 The dimensions of a 6 mm diameter probe (suitable for a flue of diameter D greater than 75 mm) are as follows:

external diameter of the probe (d)	6 mm;
wall thickness	0,6 mm;
diameter of the three sample holes (x)	1,0 mm;
two channel ceramic tube	3 mm diameter with channels of 0,5 mm diameter;
thermocouple wires	0,2 mm diameter.

The dimensions (d) and (x) of a probe suitable for a flue of diameter less than 75 mm shall be such that:

the cross-section of the probe shall be less than 5 % of the cross-section of the flue,

the total surface area of the three sampling holes is less than three quarters of the cross-section of the probe.

NOTE 2 The dimension Y is chosen depending on the diameter of the air inlet duct and its insulation.

Material: stainless steel.

Key

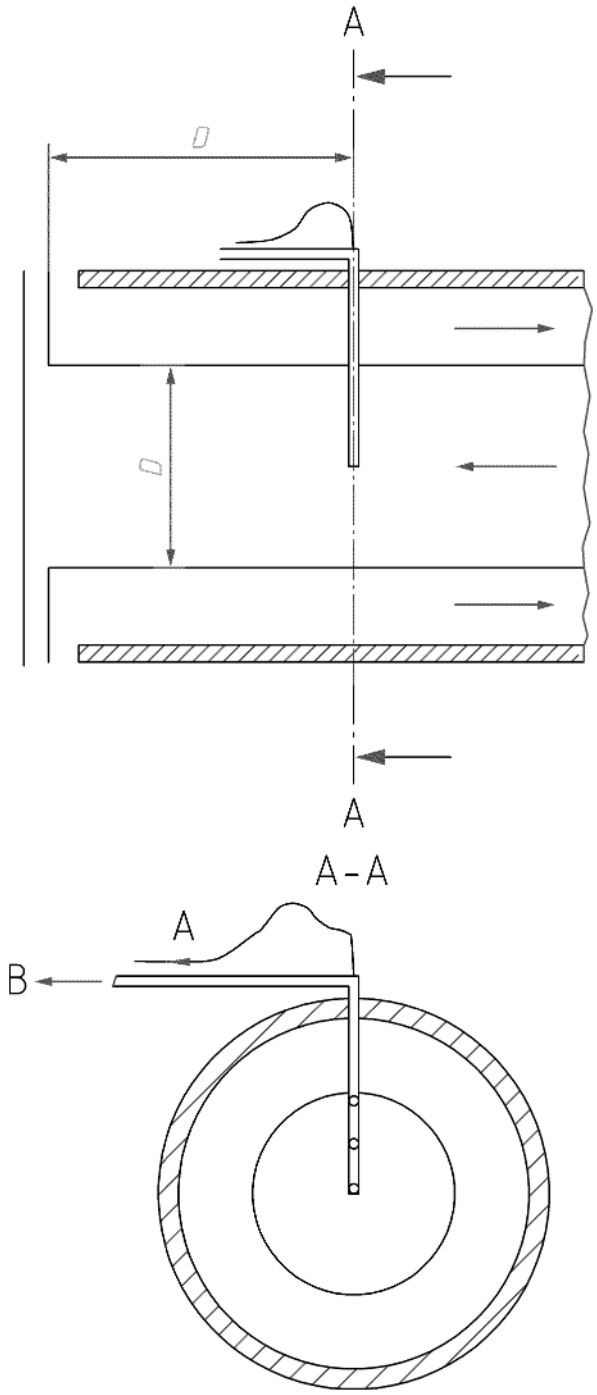
(A) thermocouples wires

(B) insulating cement

(C) two chanel ceramic tube

(D) 3 sampling probes Ø x mm

Figure 6 — Probe for sampling and measuring the temperature of the combustion products (see 6.12.2.1)



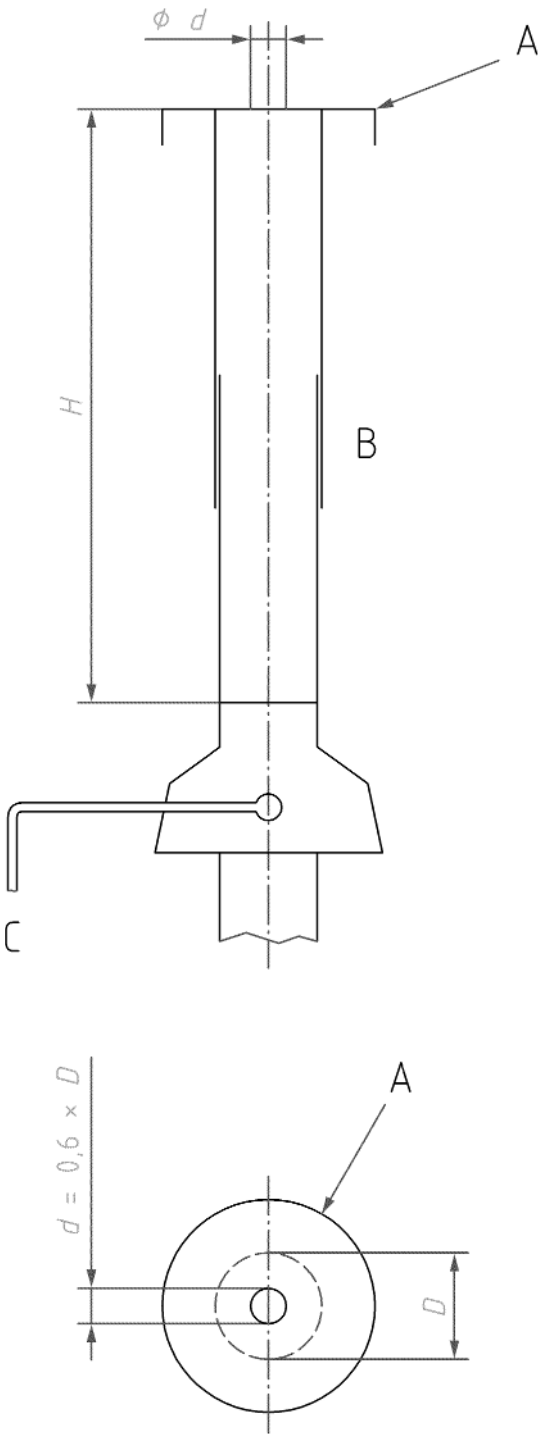
Key

(A) to temperature reader

(B) to sampling pump

(C) Section A - A

Figure 7 — Location of the probe for type C appliances (see 6.12.2.1)



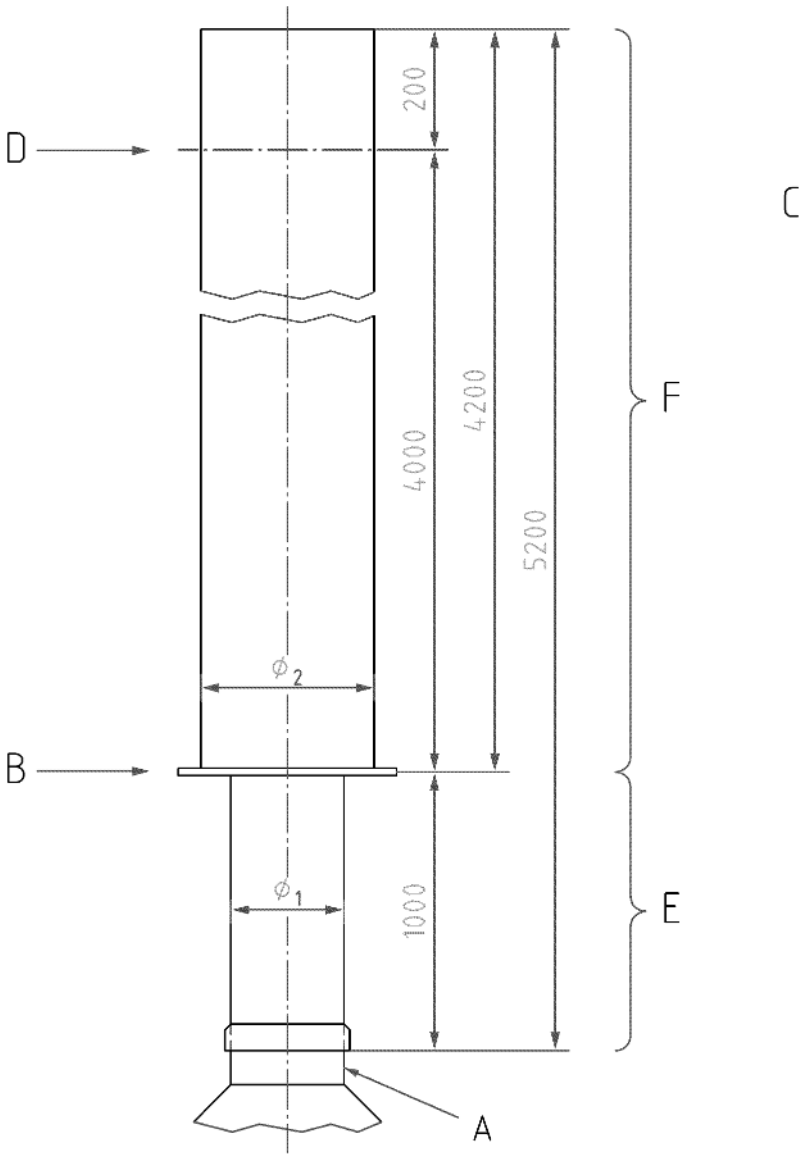
Key

A plate

B telescopic test flue

C detector

Figure 8 — Combustion products discharge safety device for Type B_{11BS} appliances (see 6.9.6.3.2.1 and 6.9.6.3.2.2)



Key

$Ø_1$	diameter of flue outlet
$Ø_2$	190 for appliances with heat input ≤ 35 k W
225	for appliances with heat input > 35 kW
A	appliance flue outlet
B	diaphragm permitting adjustment of $Ø_2$ of the 5 m flue to $Ø_1$ of the 1 m flue
C	material: non-insulated plate. Coefficient of linear thermal loss: 8,4 kJ/m.K.h
D	sampling probe from Figure 4
E	1 m flue
F	5 m flue

Figure 9 — 5 m test flue (see 6.13.2.1)

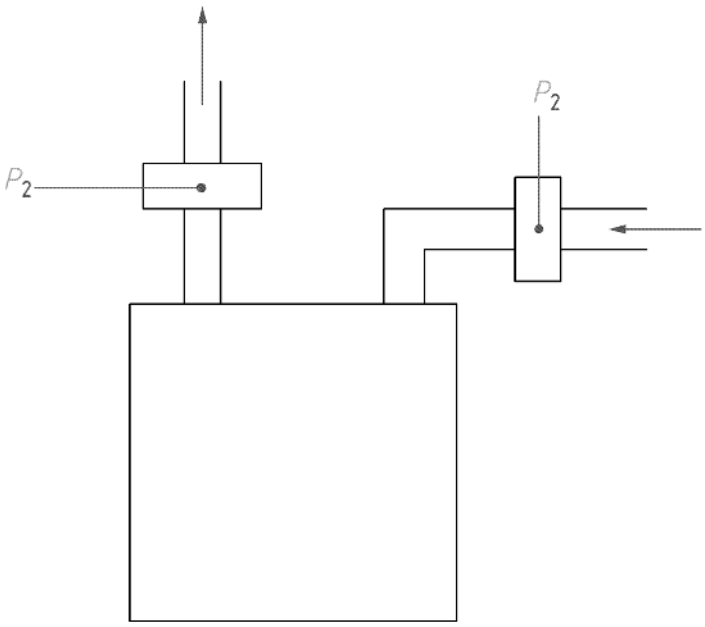
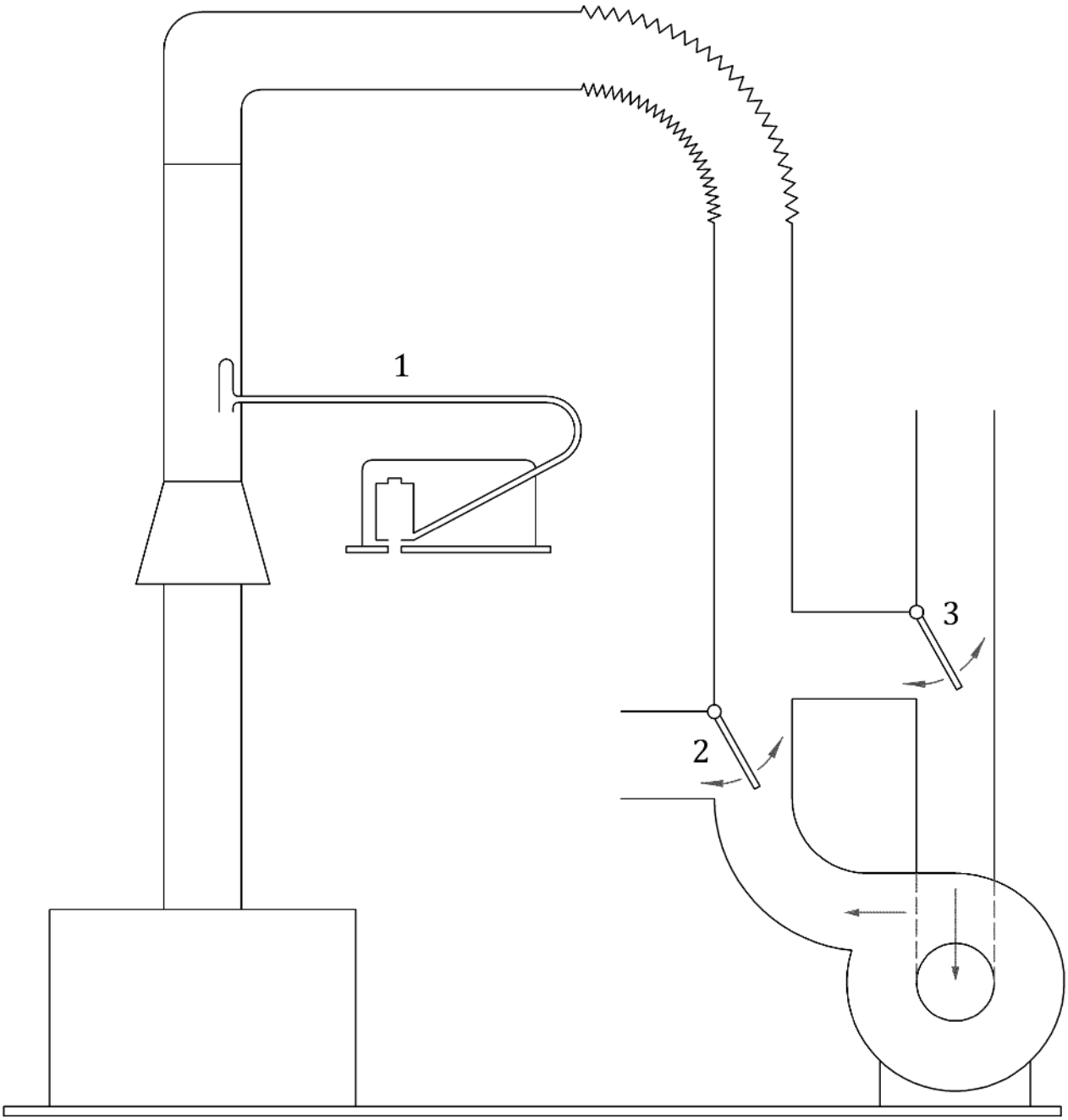


Figure 10 — Test device under pressure loss



Key

1	Pitot tube for velocity measurement
2 and 3	diverter valve to obtain down-draught

Figure 11 — Down-draught test for type C_7 water heaters

Annex A
(informative)

National situations

A.1 General

In each country that this standard concerns, gas-fired appliances may only be marketed if they comply with the particular national supply conditions.

Gas connections in common use in the various countries are given in A.2.

Table A.2 shows the national situations concerning European Standard flue pipe diameters.

A.2 Gas and water connections in common use in the various countries

Table A.1 shows the national situations concerning the various types of gas and water connections specified in 5.2.5.2 and 5.2.5.3.

Table A.1 — Gas and water connections

Country code	Category I3						Other categories				
	Threaded connections		Plain connections	Compression joints	Other connections in 5.2.5.2	Flanges	Threaded connections		Plain connections	Compression joints	Flanges
	EN 10226–1[a]	EN ISO 228-1	EN 1057			EN 1092	EN 10226–1[a]	EN ISO 228-1	EN 1057		EN 1092
AT	Yes			Yes	Yes		Yes				
BE	Yes			Yes	Yes		Yes				
CH					Yes		Yes				
CZ											
DE					Yes		Yes				
DK					Yes		Yes				
ES		Yes	Yes		Yes			Yes	Yes		
FI	Yes										
FR	Yes	Yes					Yes	Yes			
GB	Yes		Yes	Yes			Yes		Yes	Yes	
GR											
IE											
IS											
IT	Yes	Yes			Yes		Yes	Yes			
LU											
NL	Yes					Yes	Yes				
NO											
PL	Yes	Yes	Yes				Yes	Yes			
PT	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	

SE											
SI	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SK											
[a] Tapered male threads and parallel female threads.											

A.3 Flue pipe diameters in force in the various countries (see 5.2.7)

Table A.2 shows the national situations concerning standard flue pipe diameters.

Table A.2 — Diameters of marketed flues

Diameters in mm

Country	Diameter	Diameter of flues
AT	nominal	60 - 70 - 80 – 90 - 100 - 110 - 120 - 130 - 140 - 150 - 180 - 200
BE		no standardization
CH		60 - 70 - 80 – 90 - 100 - 110 - 120 - 130 - 140 - 150 - 160 - 170 −180 - 200
DE	internal	60 - 70 - 80 – 90 - 110 - 120 - 130 - 150 - 200
DK	nominal	50 - 60 - 70 – 80 - 90 - 104 - 118 - 120 - 130 - 150 - 180 - 200 - 250
ES		80 – 100 - 110 - 120 - 150 - 175 - 200
FI		90 – 100 - 110 - 130 - 150 - 180 - 200
FR	external	66 - 83 - 97 - 111 - 125 - 139 - 153 - 167 - 180
GB	internal	75 - 101 - 126 - 152 metal pipes 92 – 117 - 146 - 171 fibre-cement pipes
GR (?)		
IE	internal	75 - 101 - 126 - 152 metal pipes 84 – 109 - 136 - 162 fibre-cement pipes
IS (?)		
IT	internal	60 - 80 - 100 - 110 - 120 - 130 - 140 - 150
LU		
NL	internal	50 - 60 - 70 – 80 - 90 - 100 - 110 - 130 - 150 - 180 - 200
NO		no standardization
PT	external	60 - 85 - 90 - 95 - 105 - 110 - 115 - 120 - 125 - 130 - 135 - 145 - 155 - 205 - 255 - 305 - 355
SE (?)		
SI	internal	60 - 70 - 80 - 90 - 100 - 110 - 120 - 130 - 140 - 150 - 160 −170 - 180 - 200
SK (?)		
The (?) sign next to the country code mans that the countries concerned have not indicated their choice.		

Annex B
(normative)

Test apparatus for type C_{11} appliances (see 6.7.2.2.1)

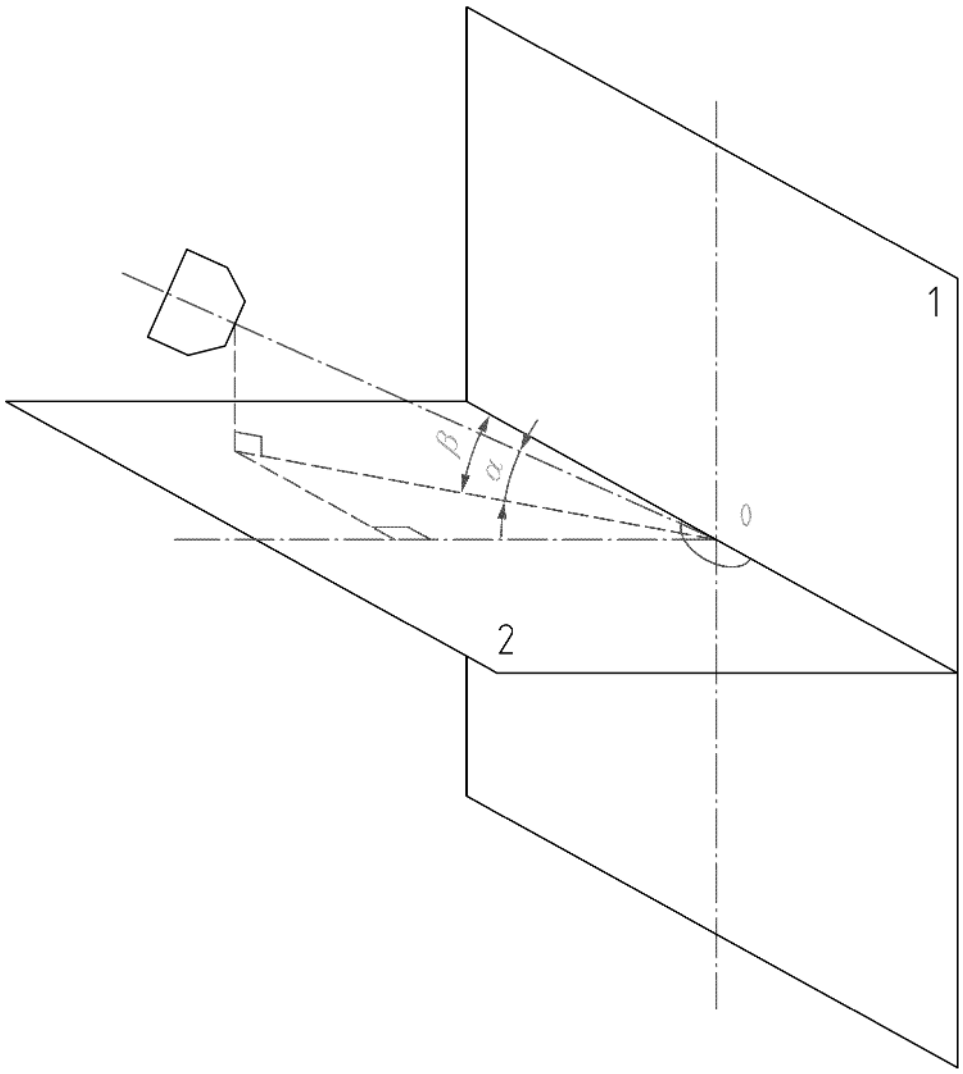
The characteristics of the wind generator and the distance from the test wall at which it is placed shall be chosen such that the following criteria are met at the level of the test wall, after the central panel has been removed:

— the wind front shall be either approximately 90 cm square or circular with a diameter of 60 cm;

— wind speeds of 1 m/s, 2,5 m/s and 12,5 m/s with an accuracy of 10 % shall be obtained;

— the wind stream shall be essentially parallel and has no residual rotational movement.

If the central removable panel is not large enough to allow checking of these criteria, they shall be checked without the wall and measured at a distance corresponding to the distance existing in practice between the test wall and the wind generator discharge nozzle.



Key

1 vertical plan

2 horizontal plan

α = 0° (horizontal winds) + 30° and - 30°

β = 0° (glancing winds), 15°, 30°, 45°, 60°, 75°, 90°, (perpendicular to the test wall)

For appliances fitted with a non-symmetrical terminal, the examination is continued for the following values: 105°, 120°, 135°, 150°, 165°, 180°.

Angle β may be varied either by modification of the position of the wind generator (fixed wall) or by rotation of the test wall about a central vertical axis.

The test wall consists of a strong vertical wall at least 1,8 × 1,8 m, with a removable panel at its centre. The device for supplying combustion air and discharging combustion products is mounted so that its geometric centre is at the centre 0 of the test wall, and its projection from the wall is as given by technical instructions.

Figure B.1 — Test apparatus for type C_1 appliances

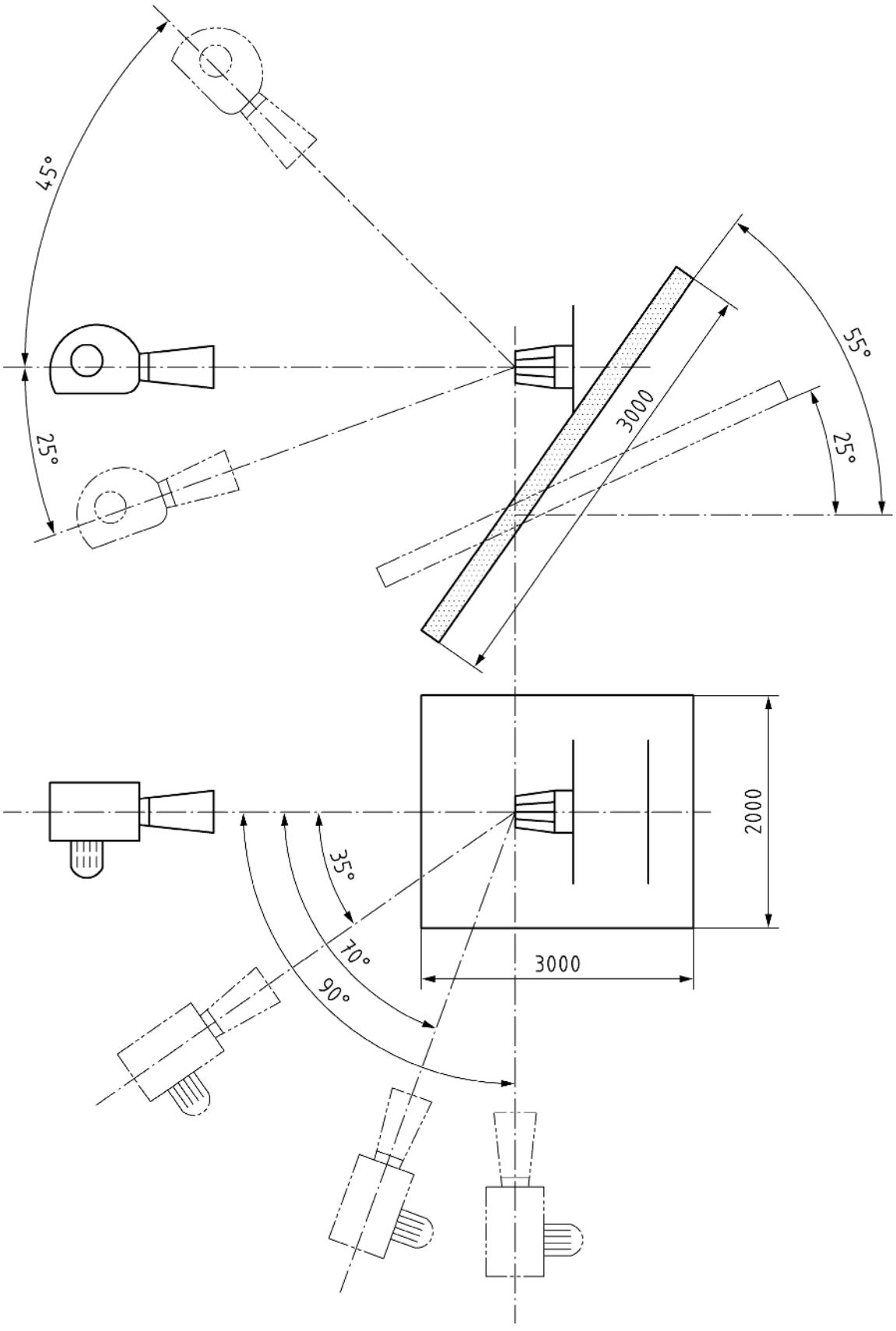


Figure B.2 — Test apparatus for type C_1, B_4 and B_5 water heaters fitted with a horizontal terminal installed on an inclined wall

Dimensions in millimetres

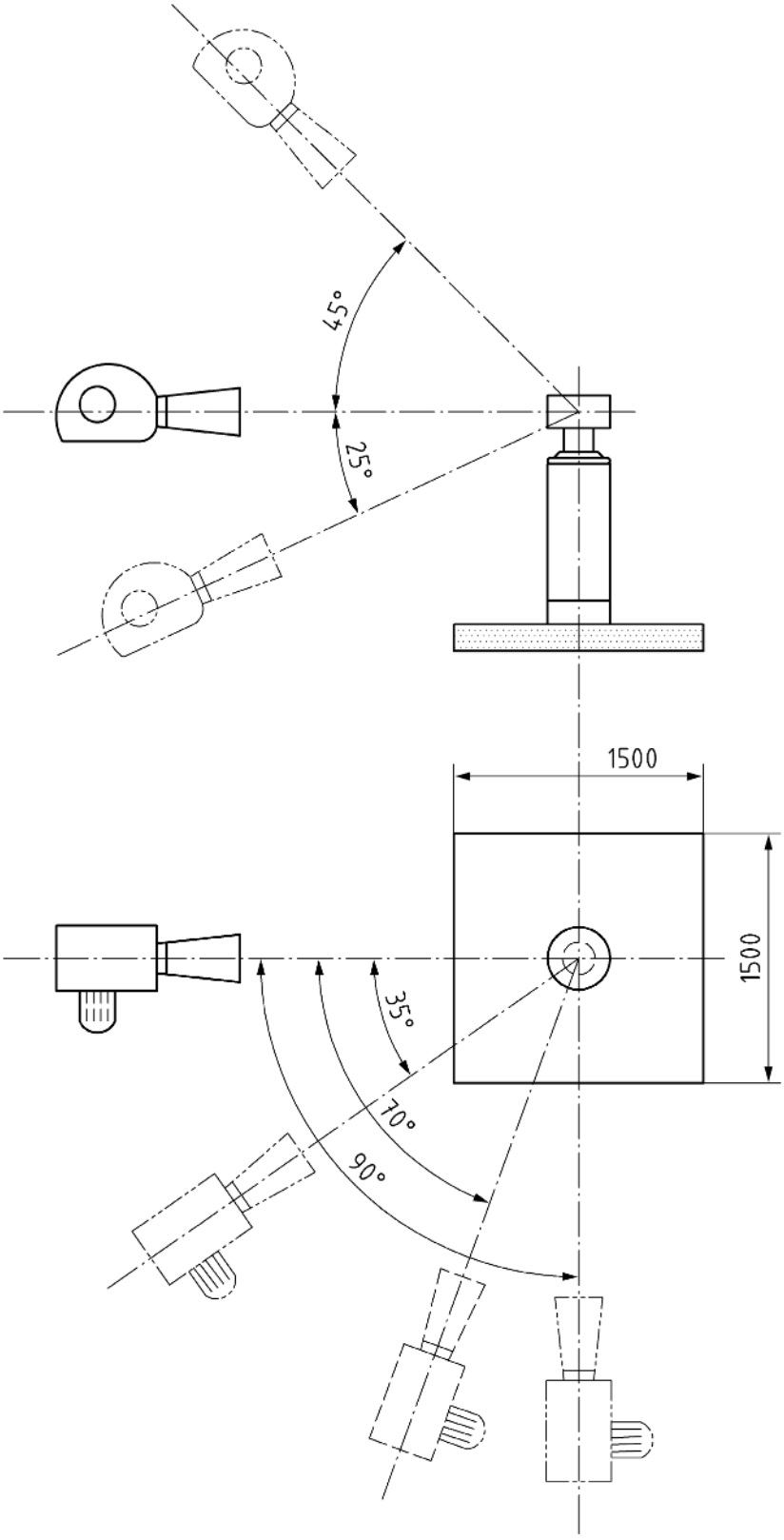


Figure B.3 — Test apparatus for type C_3, B_4 and B_5 water heaters fitted with a vertical terminal installed on a horizontal wall

Dimensions in millimetres

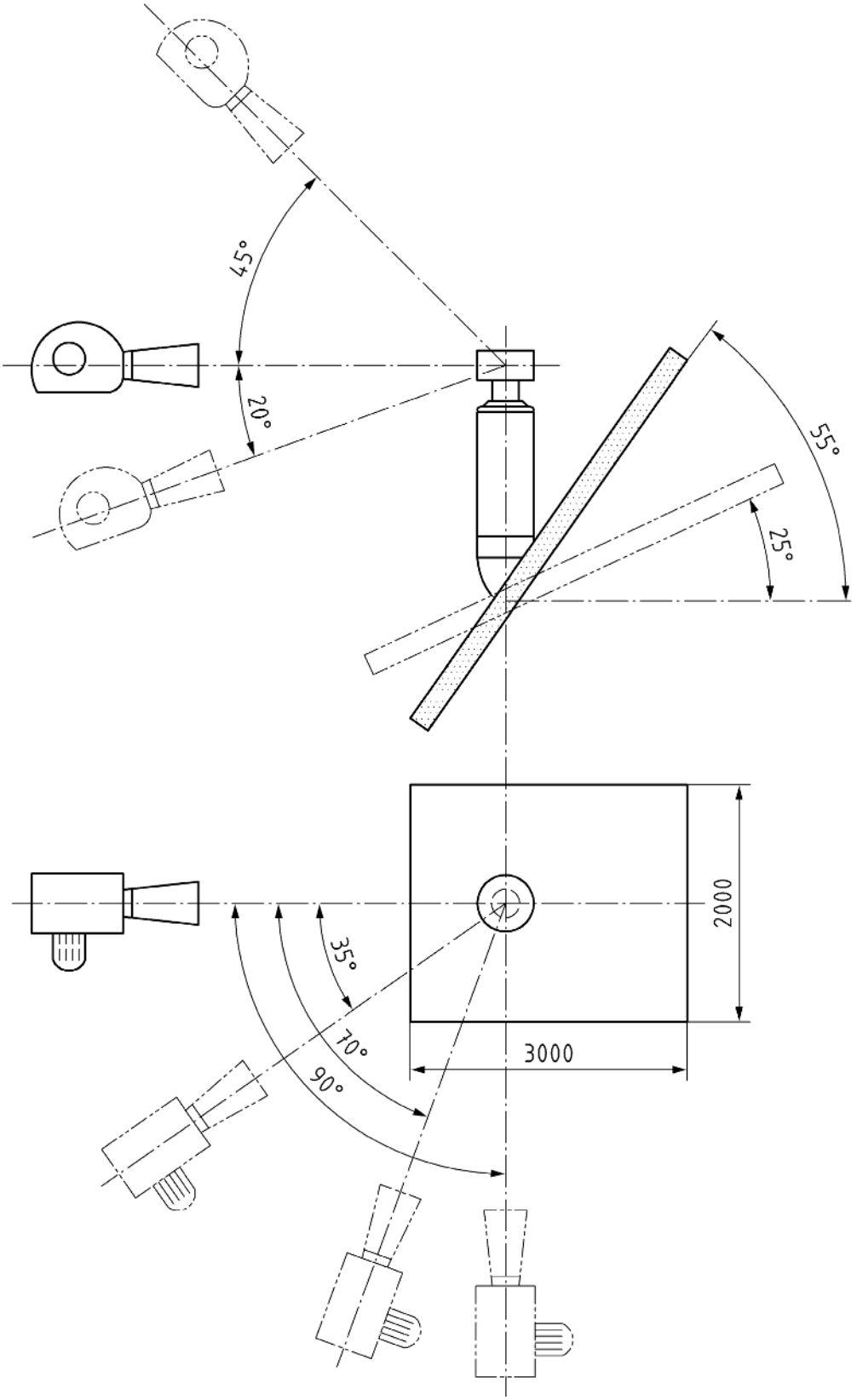


Figure B.4 — Test apparatus for type C_3, B_4 and B_5 water heaters fitted with a vertical terminal installed on an inclined wall

Annex C
(normative)

Test apparatus for type C_{21} appliances (see 6.7.2.2.2.3)

A suitable test rig is shown diagrammatically in Figure 3. It consists of a completely enclosed loop of 225 mm x 400 mm rectangular ducting through which air is circulated by a bifurcated axial-flow fan. Velocity and pressure conditions are controlled by a series of single leaf dampers.

An auxiliary instantaneous water heater is supplied to provide an additional source of vitiation, its inlet being open to air and fitted with an air control damper F.

The appliance tested is mounted on the longest side of the duct. It is positioned at least 2 m above the lower horizontal base limb of the rig, with at least 1 m of vertical duct above it.

Access panels are provided on the back of the mounting panels to facilitate the fitting of the sampling probes and temperature sensors. The flow velocity in the duct may be measured by an anemometer placed 1 m above the lower horizontal base limb. A calibration factor is used to convert the anemometer reading to the mean flow. To cover the range of rate 0,3 m/s to 5 m/s, two interchangeable anemometers may be used.

The test rig is designed to be used either open or closed circuit, or in any intermediate condition between these extremes. In practice, either the open circuit or an intermediate condition is required for the specified tests.

The conditions required for the tests of 6.7.2.2.2.3 are obtained as follows:

— with dampers E and F closed, the fan is started. The degree of vitiation and the velocity in the duct are controlled by means of dampers A, B, C and D. If the degree of vitiation has to be augmented, damper F is opened and the auxiliary water heater is lit;

— the proportion of fresh air to recirculated air is controlled by combinations of adjustments to dampers A, B and C;

— damper D provides an overriding control of the flow rate.

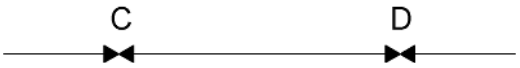
When necessary, water may be passed through the finned heat exchanger X in order to reduce the temperature of the circulated combustion products, measured at Y, to within the limits specified in 6.7.2.2.2.3. In practice, if the duct is made of metal it is probable that this heat exchanger will not be required.

Annex D
(informative)

Examples of composition of the gas circuit

D.1 Direct ignition of the main burner (MB)

Simultaneous closure

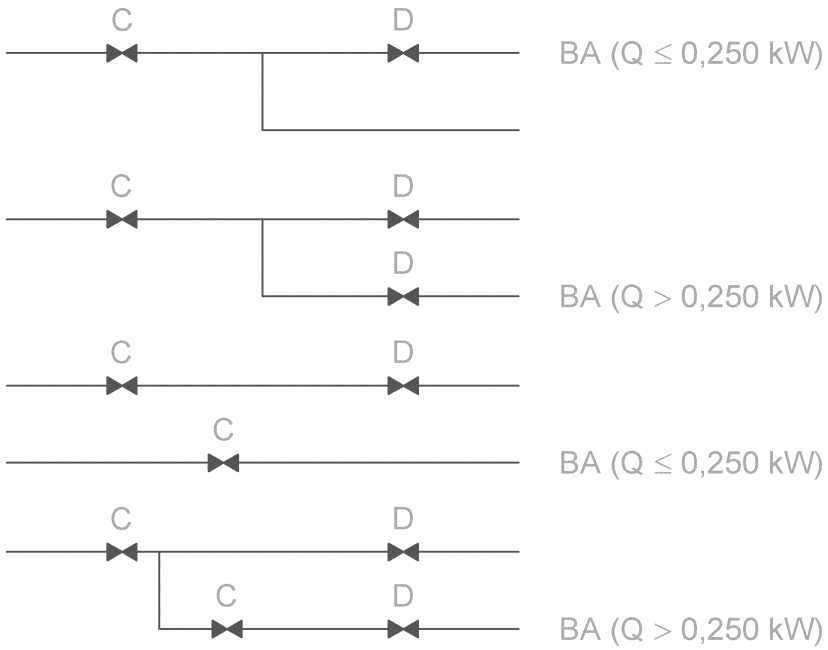


No simultaneous closure

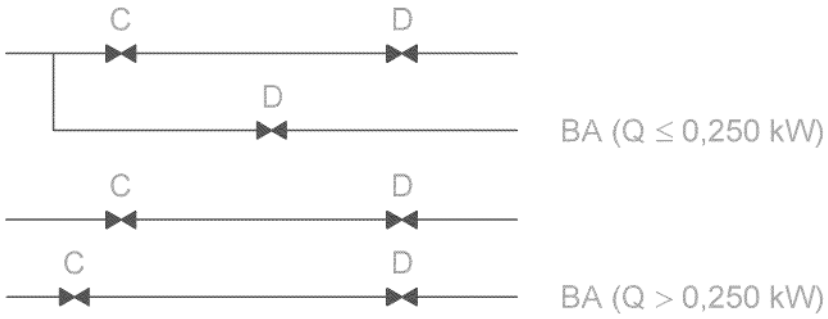
D.2 Ignition of the main burner by an ignition burner (IB)

D.2.1 Permanent IB

D.2.2 Intermittent IB



D.2.3 Alternating IB



Annex E
(normative)

Soundness test - Volumetric method

E.1 Equipment

A piece of apparatus is used that is constructed in accordance with the diagram of Figure 1, with the stated dimensions in millimetres.

The equipment is made of glass. Taps 1 to 5 are also of glass and fitted with a spring. The liquid used is water.

The distance L between the water level in the constant level vessel and the extremity of tube G is adjusted so that the height of the water corresponds to the test pressure.

The test rig is installed in an air-conditioned room.

E.2 Test method

The pressure of the compressed air, upstream of tap 1, is adjusted to the test pressure by means of a pressure regulator F.

All taps 1 to 5 are closed. The sample B to be tested is connected to the tube. The downstream tap K is closed.

Tap 2 is opened. When the water in the constant level vessel D spills over to the overflow E, tap 2 is closed.

Taps 1 and 4 are opened. By means of inlet A, the pressure is established in the burette H and in the device. Tap 1 is then closed.

Tap 3 is opened. 15 min is allowed to elapse in order for the air in the test equipment (and sample) to reach thermal equilibrium.

Any leak is shown by an overflow of water from tube G into the burette H.

Annex F
(informative)

Guidelines for extension to other categories

When an appliance complies with the requirements for one or several categories, to establish its conformity with one or several other categories, it is necessary to check that the appliance satisfies all the requirements of this or these new categories.

To this end, the tests required for the new category(ies) shall be compared to those carried out for the previous category(ies), to establish which supplementary tests are necessary.

These supplementary tests will be limited to the minimum necessary to ensure that the appliance will comply with the requirements applicable to the new category(ies).

Annex G
(informative)

A–deviations

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

“This European Standard falls under Directive 2009/142/EEC on the approximation of the laws of the member states relating to appliances burning gaseous fuels.

NOTE (CEN/CENELEC IR Part 2, 3.1.9) Where standards fall under EC Directives, it is the view of the Commission of the European Communities (OJ. No. G 59, 9.3.1982) that the effect of the decision of the court of Justice in case 815/79 Cremonini/Vrankovich (European Court Reports 1980, p. 3583) is that compliance with A-deviations is no longer mandatory and that the free movement of products complying with such a standard should not be restricted except under the safeguard procedure provided for in the relevant Directive.

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

A-deviation for Switzerland:

For gas-fired storage water heaters for the production of domestic hot water, the limit values for the flue losses and for the emission of CO and NO_x of the Swiss law (Luftreinhalte - Verordnung, LRV) of 1985-12-16 (state from 1996-01-01) are applicable. In addition, the combustion products must be evacuated at roof level.

Annex H
(informative)

NO_x conversion calculation

Table H.1 — Conversion of the emission value of NO_x for first family gases

1 ppm = 2,054 mg/m³		**G 110**	
(1 ppm = 1 cm³/m³)		**mg/kWh**	**mg/MJ**
O_2 = 0 %	1 ppm = 1 mg/m³ =	1,714 0,834	0,476 0,232
O_2 = 3 %	1 ppm = 1 mg/m³ =	2,000 0,974	0,556 0,270

Table H.2 — Conversion of the NO_x emission value for second family gases

1 ppm = 2,054 mg/m³		G 20		G 25	
(1 ppm = 1 cm³/m³)		(mg/kWh)	(mg/MJ)	(mg/kWh)	(mg/MJ)
O_2 = 0 %	1 ppm =	1,764	0,490	1,797	0,499
	1 mg/m³ =	0,859	0,239	0,875	0,243
O_2 = 3 %	1 ppm =	2,059	0,572	2,098	0,583
	1 mg/m³ =	1,002	0,278	1,021	0,284

Table H.3 — Conversion of the NO_x emission value for third family gases

1 ppm = 2,054 mg/m³		G 30		G 31	
(1 ppm = 1 cm³/m³)		(mg/kWh)	(mg/MJ)	(mg/kWh)	(mg/MJ)
O_2 = 0 %	1 ppm =	1,792	0,498	1,778	0,494
	1 mg/m³ =	0,872	0,242	0,866	0,240
O_2 = 3 %	1 ppm =	2,091	0,581	2,075	0,576
	1 mg/m³ =	1,018	0,283	1,010	0,281

Annex I
(informative)

Requirements and test methods for separate air supply and combustion products evacuation ducts of type C_6 water heaters

I.1 Requirements

I.1.1 Pressure losses

The pressure loss in the combustion products evacuation duct of a combined air supply and combustion products evacuation system corresponding to an air speed of 2 m/s shall be less than 0,2 mbar.

I.1.2 Pressure loss under the influence of wind

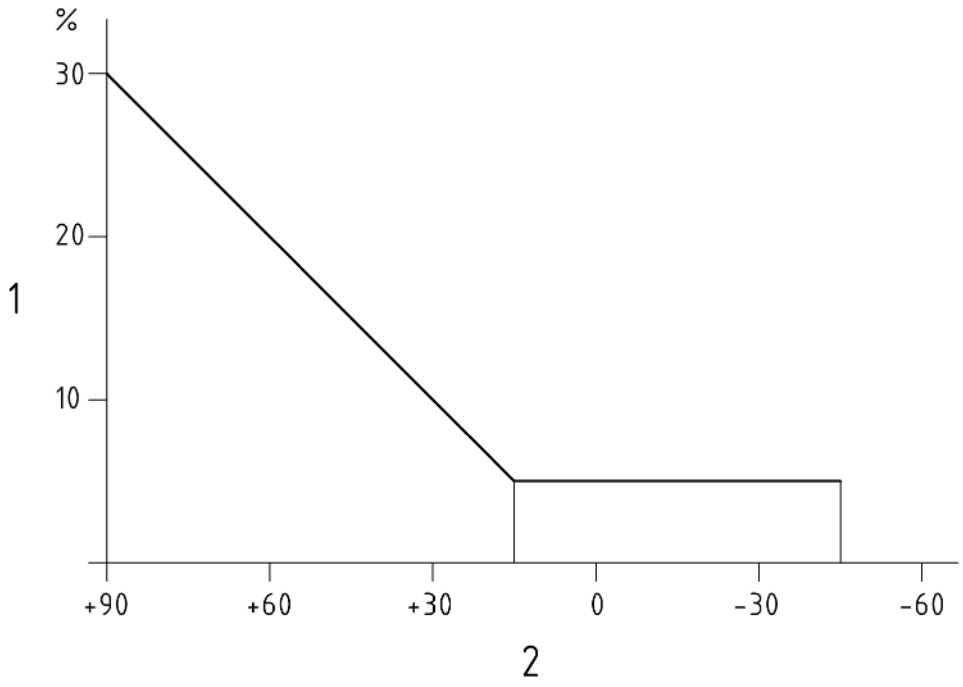
Under the test conditions corresponding to a wind speed of 2 m/s in the combustion products evacuation duct, the pressure loss of a combined air supply and combustion products evacuation system shall be less than 0,4 mbar.

I.1.3 Suction under the influence of wind

Under the wind test conditions corresponding to a wind speed of 2 m/s in the combustion products evacuation duct, the pressure difference between the inlet of the air supply duct and the outlet of the combustion products evacuation system shall be less than 0,5 mbar.

I.1.4 Re-circulation of the combustion products

Under the wind test conditions corresponding to a wind speed of 2 m/s in the combustion products evacuation duct, the re-circulation of the combustion products between the outlet and the inlet shall be less than the value given in Figure I.1.



Key

1 rate of recirculation in %

2 angle of incidence in °

Figure I.1 — Maximum permitted re-circulation of the combustion products

I.2 Test methods

I.2.1 Pressure loss in still air

The combined air supply and combustion products evacuation system is connected to the recycling device as shown in Figure I.2.

The air speed is maintained at a constant value of 2 m/s in the combustion products evacuation duct. It is checked that the pressure loss between the inlet and the outlet of the system is less than 0,2 mbar.

I.2.2 Pressure loss under the influence of wind

With the combined system installed and adjusted as stated in I.2.1, it is subjected to a wind speed as stated in I.2.5.

Under all test conditions, it is checked that the pressure loss between the inlet and outlet of the combined system is less than 0,4 mbar.

I.2.3 Suction under the influence of wind

Under the test conditions of I.2.2, it is checked that the suction between inlet and outlet of the combined system is less than 0,5 mbar.

I.2.4 Re-circulation of the combustion products

With the combined system installed and adjusted as stated in I.2.1, it is subjected to a wind speed as stated in I.2.5.

The re-circulation of air from the evacuation duct to the air supply duct is determined by means of a gas tracer (e.g. CO_2).

At the various wind angles, it is checked that the re-circulation is less than the value given in Figure I.1.

I.2.5 Wind test conditions

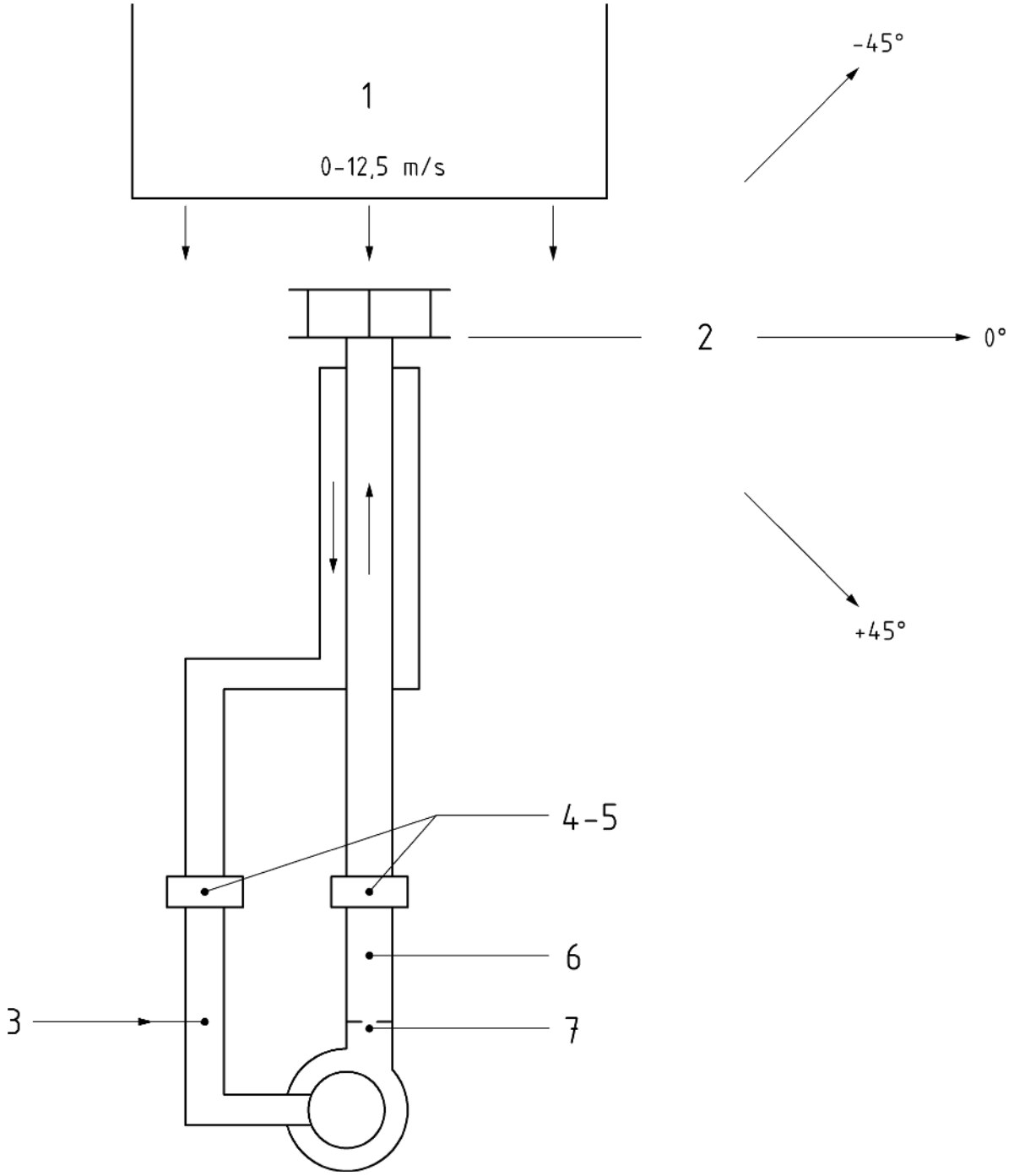
Angles of incidence:

The water heater terminal is subjected to various wind speeds at angles of incidence varying in 15° steps from - 45° to 90° in relation to a horizontal plane (see Figure I.3).

Wind speeds:

The tests described in I.2.2 and I.2.3 concerning the pressure loss and suction under the influence of wind, are carried out at a wind speed of 12,5 m/s.

During the re-circulation tests of I.2.4, the wind speed is maintained constant at 2,5 m/s.



Key

1	air tunnel (wind speed = 0 to 12,5 m/s)	4 and 5	air pressure measurement
2	rotation point	6	CO_2 measurement
3	CO_2 injection	7	orifice plate for wind speed from 2 m/s

$$\%\ \text{recirculation} = \frac{(\%\ \text{measured} - \%\ \text{source rec.})}{\%\ \text{measured}} \times 100$$

Figure I.2 — Test rig

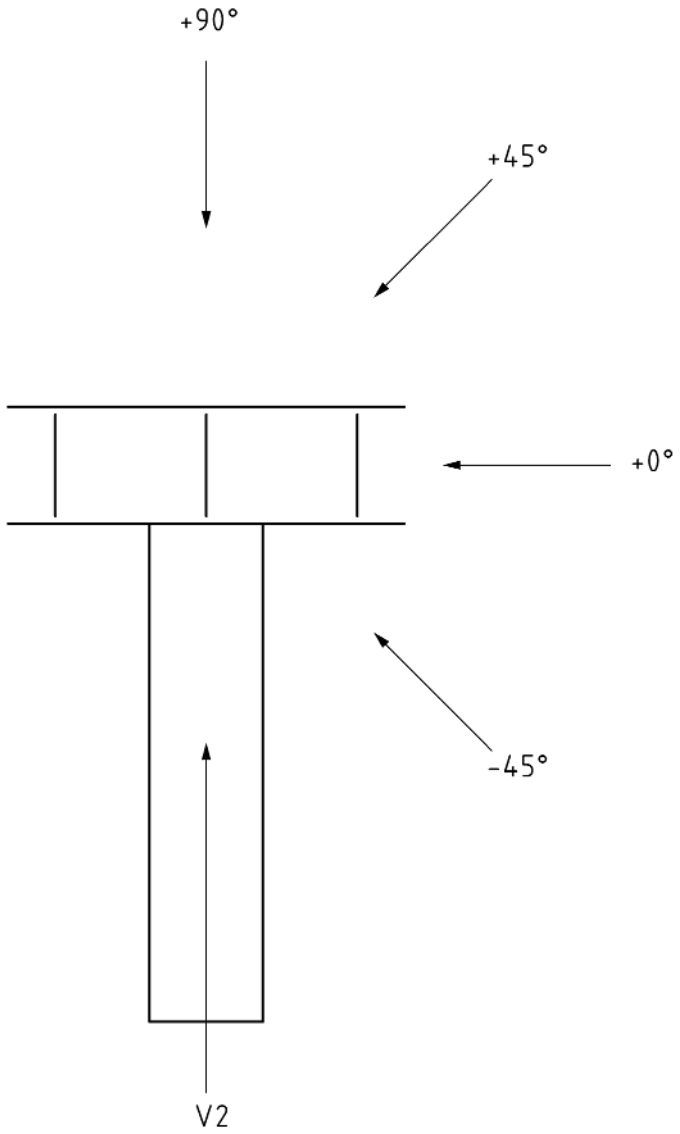


Figure I.3 — Wind test conditions

Annex J
(normative)

Lists of materials currently used

J.1 General

Materials in compliance with the requirements of proven test methods (e.g. ACS, ATA, KTW, WRC, …) are deemed to satisfy the requirements of the present standard.

NOTE The lists of materials provided by this annex are not an exhaustive list of materials to be used in the context of this European Standard.

J.2 Special types of steel

Table J.1 — Special types of steel

Material reference	Abbreviation
1.4571	X6CrNiMoTi 17 12 2
1.4435	X2CrNiMo 18 14 3
1.4539	X2NiCrMoCu 25 20 5
1.4462	X2CrNiMoN 22 5

J.3 Copper and copper alloys

Table J.2 — Copper and copper alloys

Material	Material reference	Abbreviation
Copper	2.0090	SF-Cu
Copper-Nickel alloy	2.0872	CuNi10Fe1Mn
Copper-Zinc alloys	2.0402 2.0340.02 2.0340.05 2.0290.01	CuZn40Pb2 GK-CuZn37Pb GD-CuZn37Pb G-CuZn33Pb
Copper-Tin-Zinc alloys	2.1096.01	G-CuSn5ZnPb
Copper-Tin alloys	2.1020	CuSn6

J.4 Plastic materials

Table J.3 — Examples of plastic materials

Material	Abbreviation	Area of application
Unplasticized polyvinylchloride	PVC-U	Cold water systems
High and medium-density polyethylene	PE-HD, PE-MD	
Cross-linked polyethylene	PE-X	Cold and hot water systems
Polybutylene	PB	
Propylene copolymer (Polypropylene)	PP-H, PP-R	
Chlorinated polyvinylchloride	PVC-C	
Composite pipes (plastic-metal-plastic)	Various	Cold and hot water systems
Polyamides	PA, PPA	Cold and hot water systems

Annex K
(normative)

Test methods to determine the effects of to long-term thermal load, long-term condensate exposure, condensing/ non- condensing cycling and resistance to UV radiation

Methods to determine the change in properties before and after exposure:

— impact strength in accordance with EN ISO 179-1 (unnotched test bars, Charpy impact strength);

— if execution meets with problems, the impact strength may be determined in accordance with EN ISO 8256 (unnotched test bars, tensile-impact strength);

— tensile modulus in accordance with EN ISO 527-1 and EN ISO 527-2;

— yield stress in accordance with EN ISO 527-1 and EN ISO 527-2;

— density in accordance with EN ISO 1183;

— in the case of thermosetting plastics:

  — flexural modulus and flexural strength in accordance with EN ISO 178;

— in the case of flexible pipes:

  — impact strength, tensile modulus and yield stress shall be carried out on rigid test pieces, manufactured as close as possible to the original manufacturing process;

  — ring stiffness in accordance with EN ISO 9969.

NOTE Deterioration of mechanical properties of plastics is often caused by surface attack. Miniature cracks at the surface may result in brittling of the material. This notching effect shows best under a rapid flexural load.

Any changes in tensile modulus and yield stress are relatively easy to determine and give an indication of all kinds of attack.

Any changes in volume (e.g. shrinking) shall be minor. In the case of a flexible tube ribs, if any, are essential to its flexibility and ring stiffness. At too high temperatures any residual strains may cause ribs to disappear (shrinking).

Annex L
(normative)

Parts in copper or copper alloys

Table L.1 — Properties of parts in copper or copper alloys

	Tensile strength R_m N/mm^2	Temperature range °C
SF - Cu	≥ 200	up to 250
Cu Ni 30 Fe	≥ 310	up to 350

Annex M
(informative)

Compilation of the test conditions for the various gas families

Table M.1 — first family

Test		Test gas	Pressure/Heat input[a]
Initial adjustment with reference gas		G 110	Q
Ignition, cross-lighting with reference gas		G 110	0,7 p_n
Light-back with limit gas		G 112	p_{min}
Flame lift with limit gas		G 110	p_{min}/p_{max}
Combustion	Nominal voltage	G 110	1,07 Q
	Nominal voltage	G 110	0,95 Q
	85 % of the nominal voltage	G 110	Q
	110 % of the nominal voltage	G 110	Q
	Wind conditions	G 110	Q

[a] Q is either the nominal heat input (Q_n) or the minimum heat input (Q_{min}) achieved by adjustment or by normal operation of the control, as appropriate.

Table M.2 — second family

Test		Test gas groups			Pressure/Heat input [a]	
		E	H	L	Without regulator[b]	With regulator
Initial adjustment with reference gas		G 20	G 20	G 25	Q	Q
Ignition, cross-lighting with reference gas		G 20	G 20	G 25	0,7 p_n	0,7 p_n
Light-back with limit gas		G 222	G 222	G 25	p_{min}	p_{min}
Flame lift with limit gas		G 231	G 23	G 27	p_{min}/p_{max}	p_{min}/p_{max}
Combustion	Nominal voltage	G 20	G 20	G 25	p_{max}	1,05 Q
	Nominal voltage	G 21	G 21	G 26	1,075 Q[c]	1,05 Q
	Nominal voltage	G 231	G 23	G 27	p_{min}	0,95 Q
	85 % of the nominal voltage	G 20	G 20	G 25	p_n	Q
	110 % of the nominal voltage	G 20	G 20	G 25	p_n	Q
	Wind conditions	G 20	G 20	G 25	p_n	Q

[a] Q is either the nominal heat input (Q_n) or the minimum heat input (Q_{min}) achieved by adjustment or by normal operation of the control, as appropriate.

[b] Or with a gas/air ratio control.

[c] 1,05 Q, if the boiler is intended to be installed exclusively on an installation with a meter with regulator or p_{max} for gas/air ratio controls.

Table M.3 — third family

Test		Test gas groups		Pressure/Heat input[a]	
		Butane/ Propane	Propane	Without regulator [b]	With regulator
Initial adjustment with reference gas		G 30	G 31	Q	Q
Ignition, cross-lighting with reference gas		G 30	G 31	p_{min}	p_{min}
Light-back with limit gas		G 32	G 32	p_{min}	p_{min}
Flame lift with limit gas		G 31	G 31	p_{min}/p_{max}	p_{min}/p_{max}
Combustion	Nominal voltage	G 30	G 31	p_{max}	1,05 Q
	Nominal voltage	G 31	G 31	p_{min} [c]	0,95 Q
	85 % of the nominal voltage	G 30	G 31	p_n	Q
	110 % of the nominal voltage	G 30	G 31	p_n	Q
	Wind conditions	G 30	G 31	p_n	Q

[a] Q is either the nominal heat input (Q_n) or the minimum heat input (Q_{min}) achieved by adjustment or by normal operation of the control, as appropriate.

[b] Or with a gas/air ratio controls.

[c] p_{max} for gas/air ratio controls.

Annex N
(informative)

Alternative Method for the determination of the nominal heat input or the maximum and minimum heat input (according to 6.3.1) for appliances using a pneumatic gas/air ratio control system

The calculation of the corrected heat input *Q*c according to the formulas given in paragraph 6.3.1 is valid for appliances where the gas flow is governed by a constant gas pressure, i.e. by an adjuster or a pressure regulator, and a gas nozzle, and the gas is flowing out into an injector or any volume at about atmospheric pressure.

If the gas flow is governed by a pneumatic gas/air ratio control, having e.g. a zero pressure regulator and restrictors for gas and air or a mixing venturi, followed by a fan sucking the mixture into a burner, the following alternative formulas apply:

— If the volumetric gas rate *V* is measured in m^3/h:

$$Q_c = H_i \cdot \frac{10^3}{3600} \cdot V \cdot \frac{1013{,}25 + p_g}{1013{,}25} \cdot \sqrt{\frac{288{,}15}{273{,}15 + t_g} \cdot \frac{273{,}15 + t_a}{293{,}15} \cdot \frac{d}{d_r}}$$

— If the mass gas rate *M* is measured in kg/h:

$$Q_c = H_i \cdot \frac{10^3}{3\,600} \cdot M \cdot \frac{1\,013{,}25}{p_a} \cdot \sqrt{\frac{273{,}15 + t_g}{288{,}15} \cdot \frac{273{,}15 + t_a}{293{,}15} \cdot \frac{d_r}{d}}$$

where all variables are the same as in 8.4.1 except one:

t_a is the temperature of the combustion air used from the surrounding, in degrees Celsius (°C).

For an electronic gas/air ratio control system the correction formulas should be checked according to the system in use.

Annex ZA
(informative)

Clauses of this European Standard addressing essential requirements or other provisions of UE Directives

This European Standard has been prepared under mandate M89/6 given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of EU Directive 2009/142/EC, relating to appliances burning gaseous fuels (GAD).

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 Identification form on the compliance of EN 89 with the essential requirements of the 2009/142/EC — Directive relating to appliances burning gaseous fuels

Essential requirement	Object	Subclauses or clauses of the standard complying wholly or in part to the essential requirement
Annex 1 - General conditions		
1	**General conditions**	
1.1	Safety of operation	Clause 1 (1st para.)
1.2	Marking of the appliance with: - technical instructions for the installer - instructions for the use and maintenance for the user - warnings on the appliance and on the packaging in the official language(s)	9.2.1 to 9.2.3 9.2.2 9.1 9.3
1.2.1	Contents of the technical instructions with, amongst other things: - type of gas - supply pressure - new air rate - combustion products discharge - burner/heating element assembly	9.2.1 to 9.2.3 9.2.1.1 to 9.2.1.3 9.2.1.1 to 9.2.1.3 9.2.1.5 9.2.1.5 not applicable
1.2.2	Contents of the instructions on use and maintenance	9.2.2
1.2.3	Warnings on the appliance and packaging - gas type - supply pressure - installation in ventilated rooms	9.1 9.1.1 (6th indent) to 9.1.2 9.1.1 (7th indent) to 9.1.2 9.1.4.3 to 9.1.4.4
1.3	Equipment (auxiliary equipment)	5.3

Essential requirement	Object	Subclauses or clauses of the standard complying wholly or in part to the essential requirement
2	**Materials**	
2.1	Material characteristics	5.2.2
2.2	Guarantee of material properties important for safety	not applicable
3	**Design and construction**	
3.1 3.1.1	General Resistance to constraints	5.2.3 to 6.2.3
3.1.2	Condensation	5.2.3, 8.7, 8.8, 8.8.4 to 6.13 to 6.14
3.1.3	Risk of explosion in the event of fire of external origin	5.2.2
3.1.4	Water and bleed air penetration into the gas circuit	5.2.5 to 5.2.6.1 to 5.5 to 6.2.1
3.1.5	Safe operation in the event of normal fluctuation of auxiliary energy	5.2.10, 5.2.11
3.1.6	No danger in the event of abnormal fluctuation of auxiliary energy	5.2.11
3.1.7	Hazards of electrical origin	5.2.10
3.1.8	Soundness of pressurized parts	6.2.3
3.1.9	No danger in the event of failure of safety and control devices: - flame supervision device - combustion products discharge safety device (type B_{11BS}) - automatic burner control systems - overheat protection	5.3 5.3.7.2 (2nd para.) 5.3.8 (last para.) 5.3.7.3 5.3.9 (last para.)
3.1.10	No problem with the safety devices in the event of failure of the adjustment devices	5.3.9 (4th para)
3.1.11	Protection of parts set by the manufacturer	5.3.3 to 5.4
3.1.12	Marking of taps and control or adjustment devices	5.3.1 to 5.3.2
3.2 3.2.1	Burnt gas release Risk of gas leakage	5.2.5.2 to 5.2.6.1 to 6.2.1
3.2.2	Risk of gas accumulation in the appliance	5.2.5.2 to 5.2.6.1 to 6.2.1
3.2.3	Risk of gas accumulation in rooms	5.2.5.2 to 5.2.6.1 to 6.2.1
3.3	Ignition During normal use of the appliance: - quiet ignition and spark restoration - reliable cross-lighting	6.7

Essential requirement	Object	Subclauses or clauses of the standard complying wholly or in part to the essential requirement
3.4 3.4.1	Combustion During normal use of the appliance: - reliable flame stability - no impermissible concentration of substances harmful to health	 6.7 6.12
3.4.2	During normal use of the appliance, no unspecified release of combustion products	5.2.6.2 to 5.2.7 to 6.2.2
3.4.3	In the event of abnormal draught conditions for appliances connected to a flue (type B_{11BS}) no release of a dangerous quantity of combustion products into the room	5.3.8 to 6.9.6 to 6.12.2.4.1
3.4.4	Unconnected appliances	not applicable
3.5	Rational use of energy: - efficiency - maintenance consumption	Clause 7 7.1 7.2
3.6 3.6.1	Temperatures Floor and adjacent walls	6.6.2
3.6.2	Knobs	6.4
3.6.3	Temperature of external surfaces of an appliance intended for domestic use	6.6.1
3.7	Foodstuffs and water used for domestic hot water purposes	Foreword to 5.2.2
Annex II - Attestation of conformity procedures		Clause 1 (4th and 5th paras.)
Annex III - Marking and inscription		
1	**CE marking**	
2	Inscription on appliance or its data plate: CE marking and: - manufacturer's name or identification symbol - trade name - type of electrical supply - appliance category and installation information	not applicable 9.1.1

WARNING — Other requirements and other EU Directives may be applicable to the products falling within the scope of this European Standard. (For examples see Annex ZA).

Annex ZB
(informative)

Relationship between this European Standard and the requirements of Commission Regulation (EU) No 814/2013

This European Standard has been prepared under mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to requirements of Commission Regulation (EU) No 814/2013 of 2 August 2013 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to eco design requirements for water heaters and hot water storage water tanks.

Once this standard is cited in the Official Journal of the European Union under that Commission Regulation, compliance with the clauses of this standard given in Table ZB.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding requirements of that and associated EFTA regulations.

Table ZB.1 — Correspondence between this European Standard and Commission Regulation (EU) No 814/2013

Clauses and subclauses of this EN	Requirements of Commission Regulation (EU) No 814/2013	Qualifying remarks/Notes
10.1	Annex II, 1.1 a), b), c) Requirements for water heating energy efficiency	
10.2	Annex II, 1.5 Requirements for emissions of nitrogen oxides	
10.3	Annex II, 1.6 Requirements for product information related to water heaters	As applicable
10.4	Annex II, 1.2 Storage volume	
10.5	Annex II, 1.3 Mixed water at 40°C (*V40*)	

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Annex ZC
(informative)

Relationship between this European Standard and the requirements of Commission Delegated Regulation (EU) No 812/2013

This European Standard has been prepared under mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to requirements of Commission Regulation (EU) No 812/2013 of 18 February 2013 implementing Directive 2010/30/UE of the European Parliament and of the Council with regard to energy labelling requirements for water heaters, hot water storage tanks and packages of water heater and solar device.

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Table ZC.1 — Correspondence between this European Standard and Commission Delegated Regulation (EU) No 812/2013

Clauses and subclauses of this EN	Requirements of Commission Delegated Regulation (EU) No 812/2013	Qualifying remarks/Notes
11.2	Annex III, point 1.1.1 or 1.1.2 Printed label	
11.2.2	Annex III, point 1.1.1 or 1.1.2, and Annex VIII, 2	
11.2.3	Annex III, point 1.1.1 or 1.1.2, and Annex VIII, 2	
11.2.4	Annex III, (a), VI Annex IV, 1.1, (w) Annex VI, 1.1, (j) Sound power level	
11.3	Annex IV - point 1 Product fiche	
11.4	Annex V – point 1 Technical documentation	

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

[1] EN 1487, *Building valves — Hydraulic safety groups — Tests and requirements*

[2] EN 1859:2009+A1:2013, *Chimneys — Metal chimneys — Test methods*

[3] EN ISO 8256, *Plastics — Determination of tensile-impact strength (ISO 8256)*

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