BS EN 26:2015

BSI Standards Publication

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

bsi.

...making excellence a habit.™

National foreword

This British Standard is the UK implementation of EN 26:2015. It supersedes BS EN 26:1998 which is withdrawn.

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

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

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

Published by BSI Standards Limited 2015

ISBN 978 0 580 77034 0

ICS 91.140.10

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 May 2015.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 26

May 2015

ICS 91.140.10

Supersedes EN 26:1997

English Version

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

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

Gasbeheizte Durchlauf-Wasserheizer für den sanitären Gebrauch

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

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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 United Kingdom.

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

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

Ref. No. EN 26:2015 E

Contents

Page

Foreword

This document (EN 26:2015) 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 26:1997.

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.

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).

This document deals with:

— safety;

— rational use of energy;

— fitness for purpose.

It gives specific requirements or disposals relative to:

— requirements and test methods for type C water heaters with a fan incorporated in the combustion air supply circuit or in the combustion products evacuation circuit;

— combustion products evacuation ducts which are part of a water heater;

— condensing water heaters;

— water heaters installed indoors and/or partially protected place;

— requirements and test procedures for resistance to freezing;

— NOx measurement;

— 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.

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 concerning the construction, safety, rational use of energy and fitness for purpose, and also the classification and marking of gas-fired instantaneous water heaters for sanitary uses, hereafter called “water heaters”.

This European Standard applies to water heaters:

— of types A_{AS}, B_{11}, B_{11BS}, B_{12}, B_{12BS}, B_{13}, B_{13BS}, B_{14}, B_{22}, B_{23}, B_{32}, B_{33}, B_{44}, B_{52}, B_{53}, C_{11}, C_{12}, C_{13}, C_{21}, C_{22}, C_{23}, C_{32}, C_{33}, C_{42}, C_{43}, C_{52}, C_{53}, C_{62}, C_{63}, C_{72}, C_{73}, $C_{82}$and C_{83} according to CEN/TR 1749;

— fitted with atmospheric burners;

— equipped with atmospheric burners assisted by a fan for the supply of combustion air or evacuation of combustion products or fully premix burners;

— using one or more combustible gases corresponding to the three gas families and at the pressures stated in accordance to EN 437;

— of nominal heat input not exceeding 70 kW;

— with an ignition burner or with direct ignition of the main burner.

In this European Standard, the heat inputs are expressed in relation to the net calorific value (H_i).

This European Standard does not contain all the requirements necessary for:

— boiling water appliances;

— appliances intended to be connected to a mechanical means of evacuating the combustion products;

— appliances which fulfil a dual role of space heating and heating water for sanitary use;

— appliances making use of the heat of condensation of the water contained in the combustion products;

— water heaters of types B_{21}, B_{31}, B_{41}, B_{42}, B_{43} and B_{51}.

This European Standard only covers water heaters where the fan, if any, is an integral part of the appliance.

This European Standard:

— does not apply to appliances not intended to be connected to a flue when they are not fitted with an atmosphere sensing device;

— takes account of the information given in Technical Report CR 1472:1994 with respect to marking.

The main symbols used in this European Standard are summarized in Annex F.

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*

EN 1443, *Chimneys — General 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 1856-2, *Chimneys — Requirements for metal chimneys — Part 2: Metal flue liners and connecting flue pipes*

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

EN 10088-1:2014, *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 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+A1:2015, *Chimneys — System chimneys with plastic flue liners — Requirements and test methods*

EN 15036-1:2006, *Heating boilers — Test regulations for airborne noise emissions from heat generators — Part 1: Airborne noise emissions from heat generators*

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

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

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 (all parts), *Rubber, vulcanized or thermoplastic — Determination of indentation hardness*

3 Terms and definitions

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

3.1
instantaneous water heater
appliance where the heating of water is directly dependent on the draw off

3.1.1
instantaneous water heater with fixed output
appliance where the burner operates at a fixed heat input

3.1.2
instantaneous water heater with adjustable output
appliance where the heat input can be reduced by operation of the manual gas rate control incorporated in the appliance

3.1.3
instantaneous water heater with automatic output variation (AVO)
appliance where the gas rate varies automatically so as to keep the hot water temperature within a predetermined range when the water delivery rate varies

3.1.3.1
thermostatic appliance
appliance with automatic output variation where the gas rate is varied by a thermostatic device controlling the water temperature, the set point of this device being adjustable or non-adjustable

3.1.3.2
proportioning appliance
appliance with automatic output variation where the gas rate is varied proportionally to the water rate, the factor of proportionality may be adjustable

3.1.4
condensing instantaneous 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

3.1.5
range of automatic output variation
range of useful outputs of an appliance with automatic output variation inside which the subordination of the gas rate to the water rate maintains the hot water temperature within a predetermined range when the water rate varies

3.1.6
condensate
liquid formed from the combustion products during the condensation process

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 gas
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/m^3) 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/m^3) 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
all 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

Note 1 to entry: Unit: millibar (mbar); 1 mbar = 10^2 Pa.

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
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)

3.4
adjusting, control and safety devices
3.4.1
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

3.4.2
preset gas rate adjuster
component allowing the gas rate of the burner to be set to a predetermined value according to the supply conditions

3.4.3
locking a preset adjuster
immobilisation of the preset gas rate adjuster by some means (screw, etc.) in a position after adjustment

3.4.4
sealing a preset adjuster
arrangements made to make evident any change to the adjustment

EXAMPLE: breakage of the device or sealing material

3.4.5
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 removed.

3.4.6
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

3.4.7
gas volume governor
device that maintains a rate between fixed limits independent of variations, within a given range, of the upstream and downstream pressures

3.4.8
control knob
component intended to be moved by hand in order to act on an appliance control (tap, thermostat, etc.)

3.4.9
manual shut off valve
component that permits manual interruption of the gas rate to the burner and ignition burner (if any)

3.4.10
manual gas rate adjuster
device that allows the user to reduce the gas rate to the burner

Note 1 to entry: This device may be the shut off valve.

3.4.11
automatic shut off valve
valve designed to open when energized by an electrical current and which closes automatically in the absence of the current

3.4.12
automatic water-operated gas valve
automatic device that subordinates the admission of gas to the main burner to the flow of water through the appliance

3.4.13
electrical ignition device
electrical device that ignites a mixture of air and gas in the combustion zone of a burner

Note 1 to entry: A distinction is made between:

— a manually operated ignition device for the ignition burner;

— an automatically controlled ignition device for the ignition burner;

— an automatically controlled ignition device for the main burner.

3.4.14
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

3.4.15
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.

3.4.16
automatic burner control system
system that comprises at least a programming unit and all the elements that make up a flame supervision device

3.4.17
atmosphere sensing device
device intended to interrupt the gas supply to the burner and permanent ignition burner of a type A_{AS} water heater before vitiation of the atmosphere of the room in which it is installed, by combustion products from this appliance, reaches a predetermined threshold value

3.4.18
combustion products discharge safety devices
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})

3.5
stages of operational and safety sequences
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
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; the resulting state of the system is defined by deactivated terminals for the shut-off valves and the ignition device

Note 1 to entry: See EN 298:2012, 3.17.

3.5.5
locking out
complete interruption of the gas supply with lockout

3.5.6
non-volatile lockout
shutdown condition such that a restart can only be accomplished by a manual reset

3.5.7
volatile lockout
shutdown condition such that a restart can only be accomplished by restoration of the electrical supply after its loss

3.6
burners
3.6.1
injector
component that admits gas into an atmospheric burner

3.6.2
burner
component that provides the air-gas mixture and ensures the combustion of the gas

3.6.3
main burner
burner that is intended to assure the thermal function of the appliance and is generally called “the burner”

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.

3.6.4.6
pre-mixed burner
burner in which the gas and a quantity of air at least equal to that theoretically necessary for complete combustion are mixed before the flame ports

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
deflector
part of a type A_{AS} appliance that is intended to deflect the combustion products away from the walls against which it is installed

3.7.3
flue outlet
part of a type B appliance that is intended to be connected to the flue evacuating the combustion products

3.7.4
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

3.7.5
ducts support
accessory used to fix, or transfer the load of, air supply and combustion product evacuation ducts to structural elements (building, etc.)

3.7.6
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

3.7.7
condensing operation mode of flue system
operation mode where, under normal operation conditions, flue gas condensate is available

3.7.8
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);

— the combustion products evacuation duct for types B_4 and B_5 water heaters

Note 1 to entry: This device is intended to maintain the quality of combustion in the event of wind.

3.7.9
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

3.7.10
protected combustion chamber
combustion chamber which is constructed such that an ignition in the combustion chamber does not ignite an air/gas mixture outside the combustion chamber

3.7.11
air supply and combustion products evacuation circuits
3.7.11.1
air supply and combustion products evacuation ducts
means for transporting combustion air to the burner and combustion products to the terminal or duct adapter

Note 1 to entry: This European Standard differentiates between:

— completely surrounded ducts: the combustion products evacuation duct is surrounded by combustion air throughout its length;

— separate ducts: the combustion products evacuation duct and the combustion air supply duct are neither concentric nor the combustion products evacuation duct completely surrounded by the air supply duct.

3.7.11.2
terminal guard
device that protects the terminal from mechanical damage from outside influences

3.7.11.3
duct adapter
device which allows the fitting of:

— the air supply and combustion products evacuation ducts to a single shared duct for type C_2 water heaters;

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

— for type C_6 water heaters to a system for air supply and combustion products evacuation that is approved and marketed independently from the water heater;

— the combustion products evacuation duct to a chimney that is part of the building for type C_8 water heaters

Note 1 to entry: The duct adapter may be part of the water heater or of the air supply and/or combustion products evacuation system.

3.7.11.4
roof space
ventilated part of a building between the uppermost habitable space of the building and the roof

3.7.11.5
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

3.8
water circuit
3.8.1
preset water rate adjuster
component allowing adjustment of the water rate to a predetermined value according to the water supply conditions

3.8.2
water rate or water pressure governor
device that maintains a controlled water pressure or rate independently of fluctuations in the supply pressure

3.8.3
water temperature selector
device allowing the water rate to be adjusted so as to obtain the desired delivery temperature

3.8.4
summer-winter switch
manual or automatic device that allows the seasonal temperature variation of the cold water to be compensated for

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; 1 bar = 10^5 Pa.

3.8.6
specific rate
D
domestic hot water rate stated in the technical instructions 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).

[SOURCE: EN 13203-1:2006, modified]

3.9
soundness of the gas circuit
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

3.9.3
sealing force
force acting on the valve seat when the closure member is in the closed position, independent of the force provided by the fuel gas pressure

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).

3.10.1.3
nominal gas rate
V_n or M_n
gas rate stated by the manufacturer corresponding to nominal operating conditions expressed under reference conditions

3.10.2
minimum water rate
D_m
smallest water rate stated in the technical instructions that allows gas to be admitted to the burner

Note 1 to entry: Unit: litres per minute.

3.10.3
heat inputs
3.10.3.1
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).

3.10.3.2
nominal heat input
Q_n
value of the heat input declared by the manufacturer

3.10.3.3
minimum heat input
Q_m
heat input stated in the technical instructions corresponding to the useful minimum output of an appliance with manual adjustment of the gas rate or automatic output variation

3.10.3.4
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)

3.10.4
useful outputs
3.10.4.1
useful output
P
quantity of heat transmitted to the water in unit time

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

3.10.4.2
nominal useful output
P_n
useful output stated in the technical instructions to be obtained when the appliance operates at the nominal heat input and water temperature specified in 6.1.6.6.2 a)

3.10.4.3
minimum useful output
P_m
smallest useful output stated in the technical instructions, obtained by automatic or manual reduction of the gas rate

3.10.5
efficiency
η_u
ratio of the useful output to the heat input in percent (%)

3.10.6
gas combustion
3.10.6.1
combustion
3.10.6.1.1
complete combustion
combustion with no more than traces of combustible constituents (hydrogen, hydrocarbons, carbon monoxide, carbon, etc.)

3.10.6.1.2
incomplete combustion
combustion at which at least one combustible constituent is present in significant proportions in the combustion products

3.10.6.2
flame stability
characteristics of flames which remain on the burner ports or in the flame retention zone

3.10.6.3
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

3.10.6.4
light-back
phenomenon characterized by the entry of a flame into the body of a burner

3.10.6.5
lightback at the injector
ignition of the gas at the injector, either as a result of the flame entering the burner or by the propagation of the flame around the outside of the burner

3.10.6.6
yellow tipping
phenomenon characterized by the yellowing of the tip of the blue cone of an aerated flame

3.10.6.7
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

3.10.7
response times
3.10.7.1
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).

3.10.7.2
ignition safety time
T_{SA}
time that elapses between the order to open the gas supply to the burner and the gas supply being shut off in the event of the presence of flame not being detected

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

3.10.7.3
maximum ignition safety time
T_{SAmax}
ignition safety time measured under the most unfavourable conditions of temperature and supply voltage

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

3.10.7.4
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).

3.10.7.5
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).

3.10.8
ignition input
Q_{IGN}
ratio of the average heat input during the ignition safety time and the maximum nominal heat input, in percent

3.10.9
water temperature deviations
3.10.9.1
variation of the temperature according to the water rate
variation of the mean hot water temperature consequent upon variations in the demand for useful output

3.10.9.2
temperature fluctuation
difference between the minimum and maximum water temperatures that can occur during delivery of water at a constant rate

3.10.10
device monitoring the air supply or combustion products evacuation
device intended to cause safety shutdown in the event of abnormal conditions of air supply or of combustion products evacuation

3.10.11
gas/air ratio control
device that automatically adapts the combustion air rate to the gas rate or vice versa

3.10.12
frost protection system
system that actively protects the water in the appliance against freezing

Note 1 to entry: An anti-freeze solution is not considered as an active frost protection system.

3.10.13
appliances intended to be installed in a partially protected place
appliances intended to be installed in the open air, not exposed to the direct action and infiltration of rain, snow or hail

Note 1 to entry: If an appliance is sold with a casing intended to provide protection, this casing is an integral part of the appliance.

3.10.14
appliances intended to be installed indoors and/or in a partially protected place
appliances intended to be installed:

— either only indoors;

— either only in a partially protected place;

— either indoors or in a partially protected place

3.11
steady state
condition of the appliance when it has operated for sufficient time to reach thermal stabilization so that the water temperature at the outlet does not vary more than ± 0,5 K

Note 1 to entry: This condition can be reached with a gas which is different from the specified test gas, provided that the appliance is supplied with the specified test gas for at least 5 min before the requirements are verified.

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 water heaters

4.1 General

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;

— according to the maximum water service pressure.

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.

4.5 Water pressure

4.5.1 General

Appliances are differentiated according to the maximum water service pressure.

4.5.2 Low pressure appliances

The maximum service pressure is 2,5 bar.

4.5.3 Normal pressure appliances

The maximum service pressure is 10 bar.

4.5.4 High pressure appliances

The maximum service pressure is 13 bar.

5 Constructional requirements

5.1 Conversion to different gases

5.1.1 Introduction

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

5.1.2 General

5.1.2.1 Introduction

The operations allowed in order to convert from a gas of one family or group to a gas of another family or group and/or to adapt to the normal supply pressure to which the appliance will be installed, are given below:

— adjustment of the gas rate to the main burner and the ignition burner (except for 5.2.9);

— change of injectors or restrictors;

— change of ignition burner or its components;

— change of adjusting and/or control devices specific to appliances with automatic output variation;

possibly:

— change of the automatic water operated gas valve or its components;

— removal, putting out of operation or change of the gas pressure governor or its components.

These operations shall be possible without having to interfere with the connections of the appliance to its pipework (gas, water, air supply, flue system, if any).

The conditions given in 4.2, 5.2.3, 5.2.4 and 5.3 shall be observed.

5.1.2.2 Permissible operations for changing gases

For appliances of categories I_{2Esi}, II_{1c2E+}, II_{1c2Esi}, II_{Esi3+}, $III_{1c2E+3+}$, and $III_{1c2Esi3+}$, the following operations are permitted when changing gas family or group:

— preadjustment of the gas rate to the main burner and the ignition burner;

— change of injectors or restrictors and of the atmosphere sensing device;

— change of ignition burner or its components.

The operations below are only permitted when the gas family is changed:

— change of control devices and/or adjusting devices specific to appliances with automatic output variation;

— if necessary, change of the automatic water operated gas valve or its components.

For appliances of other categories, 5.1.2 applies.

5.1.3 Materials

5.1.3.1 General

When the appliances including its connecting ducts and terminals 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.

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

Zinc alloys in contact with gas may only be used 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.

Parts of the body which separate a gas containing chamber from the atmosphere shall be made from metallic materials.

The use of asbestos-based materials is forbidden.

Moreover, parts in contact with water shall be made of materials of quality such that the water cannot be polluted.

For separated air supply and combustion products evacuation ducts connected to a type C, B_2, B_3, B_5 water heater, the requirements given in 5.1.8.4, in accordance with EN 1443, shall additionally apply.

For appliances intended to be installed in a partially protected place, all materials employed in the construction, including seals, gaskets and sealing pastes, if any, shall function properly in the environmental conditions under which they are expected to operate.

The technical instructions shall precise the minimum and maximum ambient temperatures at which the appliance is designed to operate (see 9.1).

5.1.3.2 Metallic materials

5.1.3.2.1 Corrosion resistance

Provided that the water heater is used in accordance with the appliance 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.

5.1.3.2.2 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 I.2 and I.3 (see Annex I).

5.1.3.3 Non-metallic materials

5.1.3.3.1 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.

5.1.3.3.2 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 the microbiological properties of the plastic materials used and to the prevention of substances leaching out.

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

5.1.3.3.3 Other 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. Only those 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.

5.1.3.3.4 Durability against corrosion of combustion product evacuation duct

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

— the requirements in Table 1 or

— a corrosion test method from EN 1856-1:2009, Annex A.

Table 1 — Metallic flue duct material specifications

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]
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 3.1.4).

[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.

5.1.4 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 such that they cannot fall inside the pipes. In addition, their threads shall not deteriorate even after several successive manipulations.

Appliances shall be designed so as to avoid any spillage of condensate from the appliance. However, for type C_{11} appliances, a spillage of condensate from the flue is permitted at start up.

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

If an appliance has two draw off taps, the hot water tap (marked in red) shall be placed on the left and the cold water tap (marked in blue) on the right of the appliance, looking at the front face.

The gas and water connections shall be sufficiently distant from the wall and far enough apart from each other to permit the easy use of a commercially available tool, in accordance with the technical instructions.

5.1.5 Accessibility - Ease of maintenance - Fitting and removal

It shall be possible to clean the combustion circuit by following the maintenance's 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 chamber, as defined in 6.2.2, shall be maintained after refitting following cleaning or maintenance operations.

Appliances shall have a case that protects the heating body and the burner. Removable components, for example the burner or the heating body, shall be able to be removed with existing commercially available tools and with the appliance remaining in position.

5.1.6 Gas connections

The appliance gas inlet connection shall permit a rigid connection.

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

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

For category I_3 appliances, the connection may be made either by a compression union, or a conical joint or a flat joint.

If the inlet connection consists of a plain copper tube, this 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.

5.1.7 Means of achieving soundness

5.1.7.1 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 at these points.

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, whichever is applicable.

5.1.7.2 Soundness of the combustion circuit

5.1.7.2.1 Type B_{11} and B_{11BS} 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.

5.1.7.2.2 Type C appliances

The sealing of the combustion circuit up to the connection with the terminal (type C_{11}, C_{12}, C_{13}, C_{32}, C_{33}, C_{52}, C_{53}, (if necessary C_{62}, C_{63}), C_{82} and C_{83}), or to the common duct or to the duct adapter (type C_{21}, C_{22}, C_{23}, C_{42}, C_{43}, (if necessary C_{62}, C_{63}), C_{82} and C_{83}), except for parts permanently fixed to the common duct (type C_{21}, C_{22}, C_{23}, C_{42}, C_{43}, (if necessary C_{62}, C_{63}), C_{82} and C_{83}), shall be achieved only by mechanical means, excluding mastics and pastes.

However, assemblies not intended to be dismantled during routine maintenance may be jointed using mastics, pastes or appropriate tapes in such a way that permanent soundness is ensured in continuous service under normal conditions of use.

The appliance shall be constructed in such a way that the soundness requirements of 6.2.2.1 are observed.

5.1.8 Supply of combustion air and evacuation of the combustion products

5.1.8.1 All appliances

The cross-section of the airway to the combustion chamber and the cross- section of the flueway shall not be adjustable.

Every appliance shall be so constructed that the supply of combustion air is ensured under normal conditions of use and maintenance.

5.1.8.2 Type A_{AS} appliances

Type A_{AS} appliances shall be fitted with a deflector.

The openings provided for evacuation of the combustion products shall be designed and arranged so that they cannot be easily obstructed by a pan or similar object.

5.1.8.3 Type B appliances

5.1.8.3.1 General

The outlet connection shall be female. Except for types B_4 and B_5 water heaters, the installation instructions shall specify clearly the conditions for connecting the flue outlet pipes for which the appliance is intended.

NOTE Flue pipe diameters, available in the various countries, are listed in Table 4.

The connection shall not impair the evacuation of the combustion products.

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

The minimum and maximum flue diameters for which the water heater is designed shall be stated in the installation instructions.

For a separate combustion products evacuation duct which is part of a type B_4 or B_5 water heater, the requirements given in 5.1.8.4, in accordance with EN 1443 apply as well as the applicable requirements of EN 1856-1, EN 1856-2 and EN 1859.

The water heater shall not be fitted with manual or automatic devices for the adjustment of the supply of combustion air and/or the evacuation of the combustion products, except for water heaters without draught diverter and for water heaters with gas/air ratio controls.

5.1.8.3.2 Water heaters with a draught diverter (water heaters of types B_{11}, B_{11BS}, B_{12}, B_{12BS}, B_{13}, B_{13BS}, B_{14}, and B_{44})

The draught diverter shall be part of the water heater. Downstream of this draught diverter the water heater shall incorporate a female flue outlet that allows the connection to a flue duct.

The operation of the water heater shall be tested with the appropriate flue sizes specified by the installation instructions.

5.1.8.3.3 Water heaters without a draught diverter (water heaters of type B_{22}, B_{23}, B_{32}, B_{33}, B_{52}, and B_{53})

The combustion circuit of these water heaters may be fitted with an adjusting device to adjust the water heater to pressure losses of the installation. This adjustment can be effected either by means of restrictors or by adjustment, which requires the use of tools, to a predetermined position given in the installation instructions.

5.1.8.4 Separate combustion products evacuation duct

5.1.8.4.1 Stability under mechanical loading

The combustion products evacuation duct shall be capable of withstanding horizontal and vertical loads. The following requirements shall be considered:

— compressive strength;

— tensile strength;

— where applicable, resistance to lateral load which corresponds to a reference wind velocity pressure of 1,5 kN/m^2.

5.1.8.4.2 Stability under exposure to heat

The stability of the walls of the evacuation duct shall be ensured during and after exposure to heat occurring under all operating conditions of the water heater.

5.1.8.4.3 Corrosion resistance

The evacuation duct shall keep its essential characteristics in the presence of the corrosion load corresponding to all operating conditions of the water heater.

5.1.8.4.4 Resistance to condensates and moisture under normal operating conditions

The evacuation duct shall keep its essential characteristics in the presence of condensate and moisture under normal operating conditions.

5.1.8.5 Type C appliances

5.1.8.5.1 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 maybe fitted with a means of adjustment in the combustion circuit intended to adapt the water heater to the installation conditions. This adjustment is effected either by restrictors or by setting a means of adjustment to predetermined positions in accordance with the installation instructions.

5.1.8.5.2 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 the duct adapter 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.

Separate air supply and combustion products evacuation ducts, whose tightness characteristics are different, shall be marked so as to be clearly identifiable.

5.1.8.5.3 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.

5.1.8.5.4 Terminal guard

If the installation instructions, specifies 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.

5.1.8.5.5 Fitting pieces

For types C_2, C_4 and C_8 water heaters, the duct adapter 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 discharge ducts into the common duct, whatever the total thickness (flue and cladding) of the common duct.

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

5.1.8.6.1 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.

5.1.8.6.2 Air proving device

Before each fan start or at the end of a delivery, it shall be checked that there is no simulation of air flow in the absence of air flow. If there is an isolated demand then this proving shall occur either at the start, or not more than one minute after the end of that demand. If there is a series of demands each separated by less than one minute then the proving shall occur either at the start or not less than one minute after the end of that series of demands. This requirement does not apply to water heaters fitted with gas/air ratio controls.

The air proving device shall detect the presence of a sufficient air supply within 10 s.

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

a) supervision of the combustion air pressure or the combustion products pressure

   This supervision of pressure is only allowed for water heaters fitted with a constant speed fan during the operation of the main burner and where the combustion products duct is completely surrounded by combustion air throughout its length which shall not exceed 3 m. In addition the following requirements shall be fulfilled:

   — the ducts shall not have adjustable or removable restrictions; and

   — the pressure loss of the heat exchanger shall not exceed 0,05 mbar;

b) continuous supervision of the combustion air rate or the combustion products rate

   In this system, the supervision device 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 by separate supervision devices.

c) gas/air ratio control

   The following proving systems are only allowed for water heaters where the combustion products circuit is completely surrounded by the air supply circuit or for separate ducts when the leakage rate of the combustion products evacuation ducts meets the requirements of 6.2.2.3.4 both inside and outside the room where the water heater is installed;

d) indirect supervision (e.g. fan speed supervision) when there is an air proving device which proves the supply of combustion air at least once at each start;

e) supervision of the minimum and maximum air or combustion products rates with two rate supervision devices.

5.1.8.6.3 Gas/air ratio control

Gas/air ratio control shall comply with EN 88-1. Control tubes may be made of metal with suitable mechanical connections or of other materials with at least equivalent properties. In this case, they are considered immune to breakage, accidental disconnection and leakage after initial soundness checks. As such they are not subject to the tests in 6.7.12.4.2.2.

When such control tubes are made of materials with less than 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 water heater.

Control tubes for air or combustion products shall have a minimum internal 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.

5.1.9 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.

5.1.10 Drainage

It shall be possible, when necessary, to drain the appliance manually or with the aid of currently available tools.

5.1.11 Electrical safety

5.1.11.1 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 5.1.11.2.

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.

5.1.11.2 Controls

5.1.11.2.1 General

In 5.1.11.2.2 controls requirements are specified by reference to existing controls standards. For some clauses, additional requirements and/or deletions are given in 5.1.11.2.2.

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 5.1.11.2.2 for details on this.

5.1.11.2.2 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 8.10;

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 or 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's 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.

5.1.12 Operational safety in the event of failure of the auxiliary energy

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

5.2 Adjusting, control and safety devices

5.2.1 General

The operation of safety devices shall not be overruled by preset adjusters 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.

If the appliance is fitted with temperature sensing controls for safety purposes, these controls shall comply with the requirements of EN 60730-2-9.

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 swarf may be used. It shall be possible to replace them by metric machine screws complying with ISO 262.

Self-tapping screws that cut a thread and produce swarf 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) 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.

All the devices specified in 5.2 or the multifunctional control in which they might 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 placed 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 (taps, temperature selectors...), they shall not be interchangeable if this could prejudice safety.

For appliances intended to be installed in a partially protected place, the devices shall operate correctly at the temperatures to which they are subjected on the basis of:

— the “minimum declared installation temperature for appliances in partially protected places”;

— eventually the maximum ambient temperature stated by the installation instructions.

5.2.2 Manual shut off valves and/or gas rate adjusters

In addition, the gas circuit shall include a manual shut-off valve which may interrupt the gas rate directly, or by means of a closure valve or an automatic shut-off valve specified in 5.2.12 b). This device shall be designed and fixed in such a way that its operation is easy.

The various tap positions shall be marked indelibly and clearly as follows :

— Off : full disc; ●

— Ignition : stylised spark; ☆

— Full rate of the burner : large stylised flame;

— Minimum rate (if any) : small stylised flame.

However, where a single button operates a safety device with flame supervision on the burner and ignition burner, if any, no marking is required if incorrect operation is made impossible.

Control knobs that operate by turning shall turn off in a clockwise direction as seen by an observer facing the knob.

The reduced gas rate control, if any, shall have a stop or notch such that this position is clearly perceptible to the user.

5.2.3 Preset gas rate adjusters

Preset gas rate adjusters shall be designed so that they are protected against accidental maladjustment 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 adjuster shall be sealed or the installation instructions shall prescribe that the preset adjuster shall be sealed after installations.

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 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 after normal, even prolonged, use, they can be moved easily with commercially available tools.

5.2.4 Gas pressure regulator

Appliances intended to operate with first family gases shall have a pressure regulator. A pressure regulator 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 pressure regulator is permitted for the ignition burner.

The design and accessibility of the 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.

5.2.5 Pressure test points

All appliances shall incorporate a gas pressure test point orifice 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 adjuster or preset adjuster.

For type C_{11} and C_{21} appliances, the measurement shall be possible without opening the combustion circuit.

The pressure test points shall have an external diameter of (9,0 ± 0,5) 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.

5.2.6 Automatic water-operated gas valve

The automatic water operated gas valve shall subordinate the admission of gas to the main burner to the water flow through the appliance.

In the event of leakage at the joint sealing the water circuit, it shall not be possible for water to penetrate into the gas circuit. To this end, a space shall be provided between the gas-carrying and water-carrying parts of the automatic water-operated gas valve. This space shall be ventilated to atmosphere by a vent having an area of at least 19 mm^2. It may consist of one or more orifices of which the smallest transverse dimension shall not be less than 3,5 mm.

5.2.7 Ignition devices

5.2.7.1 Ignition burner

The ignition burner shall be arranged such that its combustion products are evacuated with those of the main burner.

It shall not be possible for the relative positions of the ignition burner and the main burner to change.

If the ignition burners or the injectors differ according to the nature of the gas used, they shall be marked and be easily substituted one for another. They shall be capable of being fitted in accordance with the technical instructions.

The ignition burner jet shall be made of a material that cannot deteriorate under normal conditions of use.

For ignition burners that form part of the atmosphere sensing device of type A_{AS} appliances, the admission of air may be varied automatically in order to permit easy ignition when cold.

The diameter or the smallest transverse dimension of the primary air orifice shall not be less than 4 mm for permanent ignition burners of type A_{AS} appliances.

Where the ignition burner rate is not governed, the provision of a preset gas rate adjuster on the ignition burner is forbidden for:

— any ignition burner which is part of an atmosphere sensing device;

— and/or for any ignition burner operating on third family gases.

5.2.7.2 Manual ignition of the ignition burner

It shall be possible to light, in a simple manner, ignition burners that are directly ignited by hand, either by a match or by an appropriate ignition device.

Ignition devices for the ignition burner shall be designed and fitted so that it is correctly located in relation to the components and to the ignition burner. The ignition device of the ignition burner or the ignition burner/ignition device assembly shall be able to be installed or removed using currently available tools.

For type C appliances, special ignition devices shall be provided (e.g. electrical igniter). It shall always be possible to light the permanent ignition burner of these appliances with the combustion chamber closed.

5.2.7.3 Automatic ignition device

All appliances without a permanent or alternating ignition burner shall be fitted with an automatic ignition device ensuring:

— either ignition of:

  — an intermittent safety ignition burner; or

  — an intermittent ignition burner; or

  — an interrupted ignition burner;

  — or direct ignition of the main burner.

The relative positions of the burner or ignition burner on one hand and the ignition electrode on the other hand shall not change.

The electrical output of the ignition device shall be adequate for the whole range of heat inputs.

5.2.8 Flame supervision device

5.2.8.1 General

Every appliance shall be fitted with a flame supervision device, namely:

— a thermoelectric device for the permanent ignition burner; or

— a flame supervision device with intermittent safety ignition burner; or

— the flame supervision device of an automatic burner control system.

Thermoelectric devices and flame supervision devices of automatic burner control systems with ignition of the main burner shall supervise all gas supplies.

The gas supply of intermittent safety ignition burners in which the heat input does not exceed 0,250 kW need not be supervised. This does not apply to type C appliances using third family gases.

Where the sensing element or the link between the sensing element and the operational control are destroyed, the supply to the main burner shall be prevented.

The use of deformable bimetallic thermal detectors is forbidden.

5.2.8.2 Thermoelectric device of a permanent ignition burner

With the appliance out of operation, during ignition of the ignition burner the gas way to the main burner shall be closed. Gas may only be admitted to the main burner if there is a signal that a flame is present at the permanent ignition burner.

5.2.8.3 Flame supervision device of an appliance with an intermittent safety ignition burner

The electrical spark igniter shall start to operate at the latest when gas is supplied to the intermittent safety ignition burner and shall continue at least until flame presence is detected.

Gas shall only be admitted to the main burner when there is a signal that a flame is present at the intermittent safety ignition burner.

Flame failure shall cause at least shutdown of the main burner.

However, if in the event of flame failure, there is an attempt at automatic re-ignition of the ignition burner, the ignition device shall be re-energised within 1 s and shall remain energised until re-ignition.

If, in the event of flame failure, there is no attempt at automatic spark restoration of the ignition burner, it shall not be possible for the ignition device to be re-energized during the extinction safety time nor before water delivery has ceased. The ignition procedure shall start again from the beginning.

5.2.8.4 Flame supervision devices for automatic burner control systems

Flame supervision devices for automatic burner control systems shall comply with the relevant operational requirements of EN 298, except for the degree of electrical protection, endurance, markings and instructions. In case of flame failure, the system shall result in, at least:

— re-ignition;

— 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.

5.2.9 Atmosphere sensing device for type A_{AS} appliances

Type A_{AS} appliances shall be factory-fitted with an atmosphere sensing device. This device, including the ignition burner which forms part of it, shall not be adjustable. Any adjusters that may be necessary in manufacture shall be sealed.

Interference with the device shall be made evident for example by breakage of a seal, distortion of a part, etc.

The device shall be designed and made so as to permit easy maintenance, particularly the removal of dust. Its correct operation shall in no case be compromised by this maintenance.

It shall be possible, when the technical instructions are followed, to replace parts essential for the correct operation of the atmosphere sensing device by identical parts. Effective measures shall be employed, e.g. in construction or by a means of identification clearly noted in the instructions, to guard against replacement by non-identical parts.

The device shall be designed and made in such a way that deterioration of the sensing element and the means of transmission of the closure signal results in a complete interruption of the gas supply.

It shall also be designed so that either fouling of the device is not possible or complete interruption of the gas supply is caused under the conditions of simulated fouling of the 2nd paragraph of 6.8.10.3.2.

After complete interruption of the gas supply by the action of the atmosphere sensing device, manual intervention shall be required to put the appliance back into service.

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

5.2.10 Combustion products discharge safety device for type B_{11BS}, B_{12BS} and B_{13BS} appliances

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.

For type B_{11}, B_{12} and B_{13} water heaters, this can be achieved with a combustion products discharge safety device complying with the essential requirement 3.4.3 of the Gas Appliance Directive 2009/142/EC. In this case type B_{11}, B_{12}, and B_{13} water heaters are designated respectively as type B_{11BS}, B_{12BS}, and B_{13BS} water heaters.

Only appliances which are intended to be installed in the open air and/or partially protected, or in a room separate from inhabited rooms and provided with appropriate ventilation are not required to have this safety device (in this case, they are designated as type B_{11}, B_{12} or B_{13}).

The safety device shall not have any adjustment. Adjustable components shall be sealed.

The safety device shall be so designed 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 shall at least cause safety shutdown, if necessary after a waiting time.

If the control and its link are arranged such that they shall be removable or they can be damaged during maintenance, the instructions shall specify the test which shall be carried out to check the operation of the control after servicing.

5.2.11 Protection against accidental overheating of thermostatic appliances

Thermostatic appliances shall be designed so that thermostat failure does not cause the water to overheat under the conditions of 6.8.9. When the requirement is met by means of an overheat protection device, this shall, on thermostat failure, close the gas supply to at least the burner by actuating a shut-off component independent of that of the control device. Re-establishment of the gas supply shall be achieved only by manual intervention.

5.2.12 Composition of the gas circuit

The main burner gas circuit shall include at least two valves in series:

a) an automatic water-operated gas valve which subordinates the main burner gas supply to the water flow, and

b) a closure valve as part of the flame supervision device or an automatic shut-off valve of at least class C or C' operated by the flame supervision device.

These closure valves may also be operated by an overheat device and/or by an atmosphere sensing device and/or by a combustion products discharge safety device.

or

For water heaters with a fan:

c) the main burner gas circuit shall include at least two valves in series:

   — an automatic water-operated gas valve which subordinates the main burner gas supply to the water flow; and

   — a closure valve as part of the flame supervision device or an automatic shut-off valve of at least class C or C’ operated by the flame supervision device.

These closure valves may also be operated by an overheat device and/ or by an atmosphere sensing device and/or by a combustion products discharge safety device.

For water heaters with a fan, this solution is only applicable with a permanent ignition burner.

or

d) the main burner gas circuit shall include at least two valves of at least class C or C’. The operation of one of the valves depends on a water flow detected by any suitable device and is controlled by the flame supervision device. The opening of the valves can be made simultaneously or not but the closure shall be simultaneous. If the delay between the signals to close the two valves is not greater than 5 s, the signals are considered to be simultaneous.

In addition, at least one of these valves shall be controlled by an overheat device

5.2.13 Protection against frost for appliances intended to be installed in a partially protected place

If the minimum ambient temperature stated in the technical instructions is less than 0 °C, an appliance intended to operate in a partially protected place, shall be protected from freezing by a frost protection system.

Under the test conditions of 6.11 the frost protection system, if any, shall act.

The temperature of the water shall remain above 0,5 °C at any point in the appliance during the test of 6.11.

Appliances with minimum installation temperatures greater than 0 °C do not need a frost protection system.

5.2.14 Protection against the ingress of rain

The appliance, including its protective casing, if any, shall meet the requirements for the enclosure protection designated as IPX4D in accordance with EN 60529.

Immediately after the test for the protection against water in EN 60529:1991, 14.2.4, which is part of the test programme for the enclosure protection IPX4D, the appliance shall start. However, if the appliance does not come in to operation after this test, the appliance fitted with the minimum protection declared in the installation instructions shall start immediately after the tests of 6.12.

5.3 Main burner

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

When conversion from one gas to another is effected by changing the injectors, these shall carry an indelible means of identification preventing any confusion.

The location of the burners shall be well defined and their fixing such that it is impossible to put them in an incorrect position. In particular, the burners shall be correctly positioned in relation to the heating body and it shall only be possible to fix them in that position, following the technical instructions.

Appliances shall be designed so that the cross-section of the primary air orifice is not adjustable.

5.4 Supplementary requirements for condensing water heaters

5.4.1 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.

5.4.2 Discharge of condensate

5.4.2.1 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.

5.4.2.2 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.

5.4.3 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 stated in the technical instructions.

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

5.4.4 Chemical composition of the condensate

If the technical instructions specify the chemical composition of the condensate, the composition shall be verified at the end of the test of 7.3.2.

6 Operational requirements

6.1 General

6.1.1 Introduction

The requirements below are verified under the test conditions that follow.

6.1.2 Characteristics of the test gases

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

6.1.3 Requirements for preparation of the test gases

The rules for the preparation of test gases are described in 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.

6.1.5 Test pressures

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.

6.1.6 General test conditions

6.1.6.1 General

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

6.1.6.2 Test room

The appliance is installed in a well-ventilated, draught-free room (air speed less than 0,5 m/s), which has an ambient temperature of (20 ± 5) °C, unless otherwise specified.

The appliance is protected from direct solar radiation.

6.1.6.3 Conditions of installation

The appliance is installed in accordance with the installation instructions.

A type A_{AS} appliance is fitted with the deflector specified in 5.1.8.2.

A type B appliance (except for types B_4 and B_5) is subjected to the draught created by the test flue of height 0,5 m and wall thickness less than 1 mm. Except where otherwise stated, the appliance is fitted with a test flue of the minimum diameter stated in the installation instructions making use of the appropriate adapter where necessary.

Type B_4 and B_5 water heaters are tested with their ducts and terminals. The terminal guard is not fitted.

Except where otherwise stated, water heaters of types B_4 and B_5 are connected to the shortest ducts with the smallest pressure loss stated in the installation instructions. If necessary, an external telescopic duct may be sealed in accordance with the technical instructions.

Except where otherwise stated, a type C_{11} appliance is tested in still air with the air supply and combustion products ducts and the terminal assembled in accordance with the technical instructions for a wall thickness of 350 mm. When the technical instructions that a terminal guard shall be fitted in certain cases, the tests are in general carried out without this guard except where specially stated in the relevant tests.

A type C_{21} appliance is tested in still air with the connecting ducts assembled in accordance with the technical instructions but not connected to a common test duct.

For all the tests, except where otherwise stated in the particular clauses, the water heaters, ducts, duct adapters and terminals, as appropriate, are installed, used and put into operation under the conditions specified in the technical instructions.

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 plywood panel shall be (25 ± 1) mm thick and painted matt black; the panel dimensions are at least 50 mm greater than the corresponding dimensions of the water heater.

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

Type C_1, C_3 and C_5 water heaters are tested with their ducts and their terminals fitted. Type C_1 water heaters are tested with a duct suitable for a wall with a thickness of 30 cm.

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

Type C_6 water heaters are fitted with restrictors to simulate the minimum and maximum duct pressure losses stated by the technical instructions. The ducts used for the tests shall be supplied with the appliance.

Type C_7 water heaters are tested with 1 m of vertical secondary flue.

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 2 and Figure 3):

— for circular ducts: $L = D_i$

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

where

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

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

C circumference of this duct, in mm.

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

6.1.6.4 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. Except where otherwise stated, the outlet temperatures are measured immediately downstream of the outlet connection or, in the case of a water heater with spout delivery, by means of an immersed temperature measuring device, e.g. a U-tube fitted at the outlet of a tube of the same length as the minimum length of the spout supplied with the appliance.

The hot water temperature is measured with a low inertia thermometer.

“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.

6.1.6.5 Measurement uncertainties

Except where otherwise stated in particular paragraphs, measurements shall be made having uncertainties which do not exceed those 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.

1) atmospheric pressure	± 5 mbar;
2) combustion chamber and test flue pressure	± 5 % or ± 0,05 mbar;
3) gas pressure	± 2 %;
4) water-side pressure loss	± 5 %;
5) water rate	± 1 %;
6) gas rate	± 1 %;
7) time	± 0,2 s up to 1 h;
	± 0,1 % beyond 1 h;
8) auxiliary electrical energy	± 2 %;
9) temperatures :	
- ambient	± 1 °C;
- Water	± 2 °C;
- combustion products	± 5 °C;
- gas	± 0,5 °C;
- surface	± 5 °C;
10) CO, CO_2 and O_2	± 6 %;
11) gas calorific value	± 1 %;
12) gas density	± 0,5 %;
13) mass	± 0,05 %;
14) couple	± 10 %;
15) 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 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.

The carbon monoxide CO is measured by an instrument capable of determining CO contents between 5×10^{-5} and 100×10^{-5} parts by volume. In this range of use, the method shall be selective to $\pm 5\times10^{-5}$ parts of CO by volume and accurate to $\pm 2\times10^{-5}$ parts of CO by volume.

The carbon dioxide CO_2 is measured by a method enabling the measurement to be made with an uncertainty of less than 5 % of the measured value.

6.1.6.6 Adjustment of the appliance

6.1.6.6.1 Preadjustment of the gas rate

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

The 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 full rate.

Before the required tests with a reference gas at the nominal heat input are carried out, an adjustment is carried out, where necessary, to ensure that the nominal heat input is obtained to within ± 2 % by using formula mentioned in 6.3.1.1, by changing the setting of the preset gas rate adjuster or:

— if the appliance is provided with a gas pressure regulator kept in service for the gas to be used but has no preset gas rate adjuster, by putting the governor out of service and adjusting the appliance supply pressure; or

— if the appliance has neither a preset gas rate adjuster nor a governor, or if these devices are put out of service for the gas to be used, by adjusting the appliance supply pressure.

The tests with the limit gases will 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 will be maintained to within ± 0,2 mbar.

For all the tests at the minimum and maximum pressures, the pressures in EN 437 will be used without the above correction.

6.1.6.6.2 Water rate and water temperature

Unless otherwise specified, the appliance shall be adjusted under the following conditions, as appropriate.

Appliances are supplied with a water pressure of 2 bar.

At the nominal heat input :

a) Normal water temperature:

— the water rate is adjusted, where possible, so that, with the water inlet temperature below 25 °C, the temperature rise of this water is (40 ± 1) K at the nominal heat input.

b) Maximum water temperature:

— where possible, the water rate and, where appropriate, any water temperature adjusting device are adjusted to give the maximum water temperature at the nominal heat input.

At the minimum heat input :

a') Normal water temperature and b') Maximum water temperature:

— the appliance is initially adjusted in accordance with a) for a') or b) for b') then:

— for appliances with adjustable output, the manual gas rate adjuster is set to the minimum opening position;

— for appliances with automatic output variation, the water rate is reduced until the minimum heat input is obtained.

6.1.6.7 Testing conditions

Except where otherwise stated, the tests are carried out in the steady-state condition.

6.1.6.8 Electrical supply

Except where otherwise stated, the appliance is supplied at the rated voltage.

6.2 Soundness

6.2.1 Soundness of the gas circuit

6.2.1.1 General

The gas circuit shall consist of metallic parts.

Holes for screws, studs, etc., intended for the assembly of parts shall not open into gas-ways. The wall thickness between drillings and gas-ways shall be at least 1 mm. This does not apply to orifices for measurement purposes. It shall not be possible for water to penetrate into the gas circuit.

The soundness of parts and assemblies making up the gas circuit and likely to be dismantled for routine maintenance *in situ* shall be achieved by means of mechanical joints, e.g. metal to metal joints, gaskets or toroidal seals, i.e. excluding the use of all sealing materials such as tape, paste or liquid.

However, the sealing materials mentioned above may be used for permanent assemblies. These sealing materials shall remain effective under normal conditions of water heater use.

Where parts of the gas circuit are assembled without threads, soundness of the assembly shall not be achieved by means of soft solder or by means of adhesives.

6.2.1.2 Requirement

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 and test n° 4: 0,14 dm^3/h.

6.2.1.3 Test

The appliance gas inlet is connected to an air supply delivering an appropriate and constant pressure (see Annex E).

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

As appropriate, two or three tests are carried out, firstly on delivery of the appliances, before any other test, and then on completion of the tests in this European 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 five times.

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

For other controls, the upstream pressure of the appliance is equal to:

— 50 mbar for first and second gas families;

— 150 mbar for the third gas family.

The soundness test of each appropriate closure member is carried out successively, with the other closure members held open.

If, due to the design of the automatic water-operated gas valve, the water pressure can have an influence on the soundness, this last test is carried out without water in the appliance and at the maximum water pressure.

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 means supplied with the appliance which block off the gas flow.

The pressure upstream of the appliance is 50 mbar for appliances that do not use third family gases, and 150 mbar for appliances that use third family gases.

Test n°4

The pressure upstream of the water heater is 50 mbar for water heaters that do not use third family gases, and 150 mbar for water heaters that do use third family gases.

The flame supervision device is held open by an appropriate means. If necessary, the gas supply circuit of the pilot is blocked off.

The water heater is connected to a water supply at the maximum pressure as described by the technical instructions.

All the closure devices of the gas circuit are held open except for the device(s) directly controlled by the water rate.

The ambient temperature of air around the water flow sensing device is lowered at approximately 1 °C/min down to a temperature of −10 °C during a time sufficient to obtain the freezing of the device.

In the case where after thaw the water heater has not suffered any visible damage, tests n°1, n°2 and n°3 of 6.2.1.3, and test n°1 of 6.7.1.2 are carried out.

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 2 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 steady state 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 C_7 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 test conditions is fulfilled:

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, 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 by 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 Soundness of the water circuit

6.2.3.1 Requirements

No water leakage shall appear during and after the test.

Also, no permanent distortion shall appear after the test.

6.2.3.2 Tests

The test pressures for the water circuit are as follows:

— low pressure appliances: 4 bar;

— normal pressure appliances: 15 bar;

— high pressure appliances: 20 bar.

The water circuit is kept under pressure for 15 min.

6.3 Heat inputs

6.3.1 General

6.3.1.1 Heat input obtained

The heat input obtained during a test is given by one of the following expressions:

— if the volumetric rate is measured:

Q = 0,278 x V_r x H_i

or:

— if the mass rate is measured:

Q = 0,278 x M x 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 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 input

During the tests to verify the nominal 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, 1 013,25 mbar), is determined using the following formulae.

— If the volumetric gas rate V is measured:

$$Q_c = H_i \times \frac{10^3}{3\,600} \times V \sqrt{\frac{1013{,}25 + p_g}{1013{,}25} \times \frac{p_a + p_g}{1013{,}25} \times \frac{288{,}15}{273{,}15 + t_g} \times \frac{d}{d_r}}$$

or

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

— if the mass gas rate M is measured:

$$Q_c = H_i \times \frac{10^3}{3\,600} \times M \sqrt{\frac{1013{,}25 + p_g}{p_a + p_g} \times \frac{273{,}15 + t_g}{288{,}15} \times \frac{d_r}{d}}$$

or

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

In these formula:

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 kilograms per hour (kg/h);

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

on the volume basis, in megajoules per cubic metre (MJ/m^3);

on the mass basis, in megajoules per kilogram (MJ/kg);

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

d is the relative density of the test gas [1)];

d_r is the relative 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 6.1.6.6.2 b) or b'). In addition, the water temperature variation shall not exceed ± 0,5 °C throughout the test;

— 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 Requirement

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

6.3.2.1.2 Test

The tests being 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 Requirement

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

---

1) 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 to take account of its humidity. The value of d is then replaced by d_h given by the following formula.

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

Where

p_s is the saturated wapour pressure of water at t_g, in millibar (mbar).

6.3.2.2.2 Test

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 nominal heat input.

6.3.2.2.3.2 Test

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, in accordance with the provisions of 6.3.1.2.

6.3.3 Minimum heat input

6.3.3.1 Requirement

For appliances with a manual or automatic gas rate control, the minimum heat input shall be no greater than the minimum heat input specified in the technical instructions.

6.3.3.2 Test

The test is carried out with each of the reference gases for the category.

6.4 Temperature of the control knobs

6.4.1 Requirements

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

— 35 K for metals or equivalent materials;

— 45 K for porcelains or equivalent materials;

— 60 K for plastics or equivalent materials.

6.4.2 Test

The appliance is supplied with one of the reference gases or an actually distributed gas at the nominal heat input and adjusted in accordance with 6.1.6.6.2 b).

The temperatures of the knobs are measured, using temperature sensors. Verification is carried out after the appliance has operated for 20 min.

6.5 Temperature of the adjustering, 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 permitted temperature in °C of the device.

6.5.2 Test

The test is carried out under the conditions of 6.4.2. The temperatures are measured using temperature sensors.

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 Temperature of the appliance casing, the surface on which it is installed and adjacent surfaces and external temperature of the ducts

6.6.1 Requirements

Under the conditions of test n° 1, the temperature of the sides, front face and the top of the appliance shall not exceed the ambient temperature by more than 80 K. However in the area bounded by two parallel planes located respectively 10 cm above and 10 cm below the plane of the burner ports this temperature difference may reach 100 K.

However, the following are not covered by these requirements:

— the draught diverter;

— the flue outlet and the 5 cm zone around the flue outlet;

— the viewing window, provided that the surface area does not exceed 18 cm^2;

— the surface of the case which is no more than 5 cm from the edge of the ignition port or the viewing window.

Under the conditions of test no 2, the temperature of the panels shall not exceed the ambient temperature by more than 60 K.

The installation instructions shall specify the minimum distances to be observed between the sides of the appliance and any wall, furniture, etc., and also the minimum heights to be observed between the top of type A_{AS} appliances and any ceiling, furniture, etc. of inflammable material.

Where appropriate the technical instructions shall specify the necessary means of insulation.

The temperature of the ducts in contact with or passing through the walls of the dwelling shall not exceed the ambient temperature by more than 60 K.

However, when this temperature rise exceeds 60 K, the installation instructions shall specify the nature of the efficient protection which has to be applied between the ducts and the walls where they are constructed from inflammable materials. This protection shall be supplied to the test laboratory which shall check that, with the water heater fitted with this protection, the measured temperature at the external surface in contact with the wall does not exceed the ambient temperature by more than 60 K.

6.6.2 Tests

The burner is supplied with one of the reference gases or an actually distributed gas at the nominal heat input and adjusted in accordance with 6.1.6.6.2 b).

The appliance is installed in accordance with the technical instructions on a vertical test panel made of wood (25 ± 1) mm thick and finished in matt black paint. The dimensions of the panel are such that it extends at least 5 cm outside the appliance.

Temperature sensors are incorporated into the panels at the centre of 10 cm squares and penetrate the panels from the external face such that the hot junctions are situated 3 mm from the surface facing the appliance.

Two tests are carried out under these conditions :

Test n° 1

The temperature of the case, the ducts and the protection (if any) are measured using temperature sensors, the sensing element of which is applied against the external surface of the appliance case.

The verification shall be carried out after 20 min operation.

Test n° 2

— For all appliances, 2 vertical side panels are added at the minimum distance from the sides of the appliance specified in the technical instructions, if this distance is no more than 2 cm. If the technical instructions specify the use of insulation, this is applied in accordance with the technical instructions.

— For type A_{AS} appliances, an upper horizontal panel is added at the minimum distance from the appliance specified in the technical instructions, unless the instructions forbid installation of the appliance under a ceiling of inflammable material.

These added test panels are made of wood (25 ± 1) mm thick and finished in matt black paint. The dimensions of all the panels are such as to ensure that they meet.

The side panels shall extend at least 5 cm beyond the front face of the appliance, and the upper panel shall extend beyond the front face of the appliance by at least the specified minimum distance between the appliance and the upper panel.

Each of these test panels is fitted with temperature sensors arranged like those of the rear support panel.

The verification in respect of the side panels, the upper panel and the rear support panel shall be carried out after 20 min operation.

6.7 Ignition - Cross-lighting - Flame stability

6.7.1 Operation in still air for all appliances

6.7.1.1 Requirements

The appliance shall satisfy the following specifications :

Tests n° 1, n° 2, n° 5, n° 6, n° 7 and n° 8

Ignition of the ignition burner shall be satisfactory.

Ignition of the main burner shall occur quietly.

Cross-lighting shall be certain.

The flames shall be stable, although a slight tendency to lift at the moment of ignition is allowed.

The flame supervision device shall not cause lockout during repeated ignitions and extinctions of the burner by operation of the water tap, and no hazardous situation shall occur.

Tests n° 3 and n° 4

Ignition of the main burner by the ignition burner shall occur without damage to the appliance and without hazard to the user.

Tests n° 7 and n° 8

For appliances which have an indirect means of indicating the presence of the flame, the carbon monoxide content of the dry, air-free combustion products shall not be more than 0,01 % greater than that obtained under the same conditions with the reference gas.

Test n° 9

Cross-lighting between the ignition burner and main burner and also flame propagation to the various parts of the main burner shall occur with complete safety.

6.7.1.2 Test

The adjustment is carried out, as appropriate, in accordance with 6.1.6.6.2 b) and b').

Test n° 1

The appliance is supplied with the reference gas with the lowest Wobbe number for its category under the conditions of 6.1.6.6.2 b), then the supply pressure is reduced to 0,7 p_n.

Verification is carried out when cold and in the steady-state condition.

Test n° 2

Test n° 1 is repeated under the conditions of 6.1.6.6.2 b').

Test n° 3

The appliance is supplied with each of the reference gases for its category under the conditions of 6.1.6.6.2 b). The gas supply to the ignition burner is reduced to the minimum required to keep open the valve of the flame supervision device.

The verification is carried out when cold.

Test n° 4

Test n° 3 is repeated under the conditions of 6.1.6.6.2 b').

Test n° 5

Without altering the initial adjustment in 6.1.6.6.2 b), the appliance is supplied with the light-back gas for its category at the corresponding minimum test pressure.

The verification is carried out in the steady-state condition.

Test n° 6

Test n° 5 is repeated under the conditions of 6.1.6.6.2 b').

Test n° 7

Without altering the initial adjustment in 6.1.6.6.2 b), the appliance is supplied with the flame lift gas for its category at the corresponding maximum test pressure.

The verification is carried out when cold.

In addition, for appliances having an indirect means of seeing the flame, it is verified that the corresponding requirement of 6.7.1.1 is satisfied.

Test n° 8

Test n° 7 is repeated under the conditions of 6.1.6.6.2 b').

Test n° 9

The appliance is supplied with gas and adjusted under the conditions of 6.1.6.6.2 b). The delivery tap is shut off then opened, the water rate being increased over a period of (3,0 ± 0,5) s to the rate corresponding to the minimum heat input for appliances with automatic output variation or to the nominal heat input for appliances with fixed or adjustable output.

The verification is carried out when cold and in the steady-state condition.

6.7.2 Supplementary tests for appliances of types A_{AS} and B_1 except for B_{14}

6.7.2.1 Requirements

The flames shall be stable. However, slight flame lift is allowed during the tests. Extinction of the burner is not allowed.

In particular, during test n° 3 and n° 4, the flame supervision device shall not cause shutdown. However if the appliance is fitted with a combustion products discharge safety device, shutdown during test n° 3 and n° 4 is allowed but the above specifications apply in so far as the burner can operate.

6.7.2.2 Tests

Type B appliances are fitted with the test flue of the maximum diameter stated in the installation instructions.

The appliance is supplied with one of the reference gases.

Test n° 1

The appliance is adjusted in accordance with 6.1.6.6.2 b). When the appliance is in the steady-state condition, it is subjected at burner level to a wind stream, 200 mm in diameter, having a speed of 2 m/s and an axis which moves in a horizontal plane in all directions centred on the burner. The air speed is measured approximately 0,5 m from the appliance, and the air outlet of the fan is at least 1 m from the appliance.

After operation of the burner and ignition burner with the specifications of 6.7.2.1 has been verified, the burner is extinguished and operation of the ignition burner alight on its own is verified.

Test n° 2

Test n° 1 is repeated under the conditions of 6.1.6.6.2 b').

Test n° 3

For appliances of type B, the test is carried out in the steady-state condition under the gas supply conditions of test n° 1 but with a continuous down-draught of 3 m/s within the flue (see Figure 2) and without the draught at burner level.

Test n° 4

Test n° 3 is repeated under the conditions of 6.1.6.6.2 b').

6.7.3 Supplementary tests for type C_{11} appliances and outdoors and/or partially protected appliances

6.7.3.1 Requirements

For the 1st, 2nd and 3rd test series: 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 also the stability of the ignition burner when it alone is alight or of the ignition burner and main burner when both are operating simultaneously shall be ensured. Turbulence is accepted if extinction of the flame does not occur.

For the 2nd, 3rd and 4th test series: ignition of the ignition burner by the ignition device specified in the last paragraph of 5.2.7.2 shall be possible.

6.7.3.2 Tests

The appliance is installed in accordance with the technical instructions on the test wall described in Annex B. The tests are carried out with the shortest air supply and combustion products evacuation ducts, unless otherwise stated.

The soundness of the assembly of these ducts on the vertical wall (see Annex B) is completed if necessary using, for example, adhesive tape.

The water heater is supplied with one of the reference gases of its category and adjusted in accordance with 6.1.6.6.2 b). With the appliance in the steady-state condition, four test series are carried out :

1st test series

With the appliance in the steady-state condition, the terminal is subjected successively to winds of different speeds and with directions in three planes:

— horizontal wind;

— ascending wind at 30° to the horizontal;

— descending wind at 30° to the horizontal.

In each of these three planes, the incident angle is varied by 15° between 0° and 90°. If the terminal is not symmetrical about a vertical plane, the wind incident angles are varied from 0° to 180°, still by 15°.

The tests are carried out at three wind speeds: 1 m/s, 2,5 m/s and 12,5 m/s.

For each of the three planes of incidence:

— the three combinations of wind speed, angle and incident plane are found giving the lowest CO_2 content (for evaluating 6.7.3.1); and

— the three combinations for which the highest CO content are measured, in the dry, air-free combustion products. These are used in evaluating compliance with the specifications of 6.9.1 in accordance with the directions of 6.9.2.4.2.

2nd test series

For each of the nine combinations, defined in the first test series, which give the lowest CO_2 content, it is verified that the corresponding requirement of 6.7.3.1 is satisfied.

3rd test series

For appliances with adjustable output, the first and second test series are repeated under the same supply conditions, but with the manual gas rate adjuster in the minimum open position.

For appliances with automatic output variation, the first and second test series are repeated under the same gas supply conditions but the water rate is adjusted to the minimum water rate.

It is verified that the corresponding requirements of 6.7.3.1 are satisfied.

4th test series

If the appliance has a 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 6.7.3.1 are verified and the CO content of the dry, air-free combustion products is determined for use in evaluating compliance with the requirements of 6.9 (see 6.9.2.4.2).

6.7.3.3 Resistance to draught for water heaters intended to be installed in a partially protected place

For appliances intended to be installed outside and/or in partially protected appliances, the speeds and wind directions are the following, the appliance is subjected at the burner level to wind streams of:

— 12,5 m/s for horizontal and ascending winds (a = 0° respectively - 30°) and

— 10 m/s for descending winds (a = + 30°).

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

It is checked that the requirement of 6.7.3.1 is met.

6.7.4 Supplementary tests for type C_2 appliances

6.7.4.1 Requirements

The appliance shall comply with the following specifications:

— ignition of the ignition burner by means of the special ignition device (see 5.2.7.2) shall be satisfactory;

— the ignition burner flame shall be stable whether the main burner is alight or not, and the flame supervision device shall not shut off the gas supply;

— ignition of the ignition burner, ignition of the main burner by the ignition burner or direct ignition of the main burner shall occur quietly and the flames shall ensure cross-lighting to all the burner ports. The flames shall be stable. Slight flame disturbance is allowed but extinction shall not occur.

6.7.4.2 Tests

The appliance is installed in accordance with the installation instructions on the test apparatus shown in Figure 4 and described in Annex C.

The appliance is supplied with the reference gas corresponding to the flame lift limit gas for its category and adjusted under the conditions of 6.1.6.6.2 b) and then under the conditions of 6.1.6.6.2 b'). The test is carried out at steady state.

The test apparatus is adjusted to give the following conditions in the duct to which the appliance is connected :

1) 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;

2) an upflow of average speed 4,5 m/s, a CO_2 concentration of 0,75 % and a temperature within the range 40 °C to 60 °C.

Compliance with the specifications of 6.7.4.1 is then checked.

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 6.9.2. These values of the CO content are used (see 6.9.2.4.3) in assessing compliance with the specifications of 6.9.

6.7.5 Supplementary tests for appliances of types C_{12}, C_{13}, C_{32}, C_{33}, B_4 and B_5

6.7.5.1 Requirements

The requirements in 6.7.3.1 are applicable.

6.7.5.2 Tests

The tests of 6.7.3.2 are applicable, the terminal being submitted to wind speeds of 1 m/s, 2,5 m/s and 12,5 m/s. The wind directions are given in Figures B.1 to B.4 depending on the water heater type and the situation.

Wind tests in a wind tunnel shall be carried out in conjunction with the appropriate wall/roof configurations as specified in Figures B.1 to B.4.

Alternative tests are possible, provided results are equivalent.

6.7.6 Supplementary tests for type C_{42} and type C_{43} appliances

6.7.6.1 Requirements

The requirements in 6.7.4.1 are applicable.

6.7.6.2 Tests

The water heater 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.

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

6.7.7 Supplementary tests for type C_{52} and type C_{53} appliances

6.7.7.1 Requirements

The requirements in 6.7.4.1 are applicable.

6.7.7.2 Tests

The water heater is installed with the shortest ducts specified by the installation instructions. A suction of 2,0 mbar is applied to the combustion products evacuation duct.

Where the installation instructions permit the installation of the terminal on opposite or adjacent walls, a second test shall be carried out with an overpressure of 2,0 mbar applied to the combustion products evacuation duct.

This (these**)** test(s) is(are) repeated at the minimum heat input permitted by the controls, if ignition is possible under these conditions.

6.7.8 Supplementary tests for type C_6 appliances

6.7.8.1 Requirements

The requirements in 6.7.4.1 are applicable.

6.7.8.2 Tests

The water heater is installed with its ducts. A suction of 0,5 mbar is applied to the combustion products evacuation duct outlet.

6.7.9 Supplementary tests for type C_{72} and type C_{73} appliances

6.7.9.1 Requirements

The requirements in 6.7.4.1 are applicable.

6.7.9.2 Tests

The test are carried out with the shortest air supply and combustion products evacuation ducts. They are carried out by applying continuous down-draughts of up to 3 m/s to the top of the test flue (see Figure 12).

A further test is carried out with the flue blocked.

6.7.10 Supplementary tests for type C_{82} and type C_{83} appliances

6.7.10.1 Requirements

The requirements in 6.7.4.1 are applicable.

6.7.10.2 Tests

The water heater is installed with the shortest ducts specified by the installation instructions.

The combustion air intake terminal is subjected to wind with a speed of 12,5 m/s in the directions given in Figure B.1, Figure B.2, Figure B.3 and Figure B.4 depending on the situation.

6.7.11 Functioning of a permanent ignition burner when the fan stops during the standby time

6.7.11.1 Requirements

The ignition burner flame shall be stable.

6.7.11.2 Tests

The ignition burner is adjusted using the reference gases at the normal pressure in accordance with the installation instructions.

The test is carried out with the fan stopped, in still air, at the maximum pressure using the incomplete combustion and sooting limit gas. With the water heater cold, the ignition burner is ignited and kept in operation for 1 h.

6.7.12 Air proving device for fan assisted water heaters

6.7.12.1 Supervision of the pressure or of the rate of the combustion air or of the combustion products

6.7.12.1.1 Requirements

Where the air proving device detects that there is insufficient air, there shall be no attempt to open the automatic shut-off valve, or the water heater shall lock out.

6.7.12.1.2 Tests

The water heater is supplied with one of the reference gases for the category to which it belongs. The requirement is checked by making several deliveries with blocked air supply.

6.7.12.2 Supervision of the combustion air or combustion products pressure

6.7.12.2.1 Requirements

The water heater shall meet one of the following requirements:

— when the fan supply voltage is progressively reduced, the gas supply shall be shut off by at least one safety shutdown before the CO content exceeds 0,20 %;

— for a voltage corresponding to a CO content greater than 0,10 % in steady-state, restart shall not be possible from cold.

6.7.12.2.2 Tests

The water heater is adjusted to the nominal heat input. Measurements are taken at steady state. The CO and CO_2 Contents are measured continuously. One of the following tests shall be conducted:

— either the voltage at the fan terminals is progressively reduced. It is checked that the gas supply is shut off by at least one safety shutdown before the CO content of the combustion products exceeds 0,20 %;

— or with the water heater cold, the fan voltage is progressively increased from zero. The voltage at which the burner ignites is determined. At this voltage, it is checked that, the water heater in steady-state, the CO content of the products of combustion does not exceed 0,10 %.

6.7.12.3 Supervision of the combustion air or combustion products rate

6.7.12.3.1 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) $CO_{mes} \times Q / Q_{KB} \leq 0{,}20$ % 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 %.

6.7.12.3.2 Tests

The test is carried out when the boiler is in steady state, at the nominal heat input, or for modulating water heater 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 the alternative supervision strategies is met.

6.7.12.4 Gas/air ratio control

6.7.12.4.1 Endurance

6.7.12.4.1.1 Requirements

Ratio controls are subjected to an endurance test of 250 000 cycles with full diaphragm travel in each cycle.

NOTE This number of cycles is appropriated to the expected use of the appliances covered by this standard.

After the endurance test it is checked that the gas/air ratio control continues to operate correctly.

6.7.12.4.1.2 Tests

The ratio control is supplied with air, at ambient temperature, in the direction of gas flow. The air flow rate shall not exceed 10 % of the gas flow rate corresponding to the nominal heat input.

The pressure at the inlet of the ratio control is the highest normal pressure for the water heater category stated by the technical instructions.

If the test is carried out away from the water heater, the ratio control is fitted on a test rig having a fast-closing valve upstream and downstream of the ratio control and may include a device creating a downstream suction.

The test rig is programmed such that the first valve opens when the second closes and a complete cycle is effected every 10 s.

When the ratio control is fitted on the water heater, the device is subjected to a similar endurance test.

6.7.12.4.2 Leakage from non-metallic control tubes

6.7.12.4.2.1 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 water heater.

6.7.12.4.2.2 Tests

The water heater is supplied with the reference gas at its nominal heat input.

The requirements are verified for the various situations that could occur, for example:

— a leak from the air pressure tube;

— a leak from the combustion chamber pressure tube;

— a leak from the gas pressure tube.

6.7.12.4.3 Safety of operation

6.7.12.4.3.1 Requirements

The water heater shall meet one of the following requirements:

— when, the air duct or the combustion products evacuation duct is progressively blocked, the gas supply shall be shut off before the CO content exceeds:

— 0,20 % over the range of modulation provided by the technical instructions; or

— $\frac{Q}{Q_{KB}} \cdot CO_{mes} \leq 0,20$ %, below the minimum rate of the modulation rate

where

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

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

CO_{mes} is the measured CO content, in percent (%).

— for a blockage of the air supply duct or the combustion products evacuation duct, corresponding to a CO content greater than 0,10 %, restart shall not be possible from cold;

— when the fan supply voltage is progressively reduced, the gas supply shall be shut off before the CO content exceeds 0,20 %;

— for a fan supply voltage corresponding to a CO content greater than 0,10 % at equilibrium, restart shall not be possible from cold.

6.7.12.4.3.2 Tests

The water heater is supplied at the nominal heat input and one of the following tests shall be conducted:

— the air supply duct or combustion products evacuation duct is progressively blocked;

— with the water heater cold, the air supply duct or combustion products evacuation duct is reopened gradually. The degree of blockage at which the burner ignites is determined. At this degree of blockage, it is checked that, in steady-state, the CO content of the products of combustion does not exceed 0,10 %;

— when the fan supply voltage is progressively reduced, it is checked that the gas supply shall be shut off before the CO content of the products of combustion exceeds 0,20 %;

— with the water heater cold, the fan supply voltage is progressively increased from zero. The voltage at which the burner ignites is determined. At this voltage, it is checked that, with the water heater in steady-state, the CO content of the products of combustion does not exceed 0,10 %.

6.7.12.4.4 Adjustment of the air/gas or gas/air ratio

6.7.12.4.4.1 Requirements

When the air/gas or gas/air ratio is adjustable, the device shall operate at the extreme limits and the range of adjustable pressures shall match the field of adjustment completely.

6.7.12.4.4.2 Tests

For adjustable automatic air/gas or gas/air ratio control, supplementary tests are carried out at the maximum and minimum ratios.

6.7.12.5 Supplementary test for type B water heaters with draught diverter

6.7.12.5.1 Requirement

Under the specific test conditions of 6.7.12.2, 6.7.12.3.2 or 6.7.12.4.3.2, combustion products shall escape only from the flue outlet.

6.7.12.5.2 Test

For type B water heaters with fan and draught diverter, the following tests are carried out:

— With the water heater at ambient temperature, the flue outlet is fully blocked. The water heater is set to ignite and the blockage is progressively removed. At the point where ignition occurs, the absence of spillage is checked.

— The flue outlet is unblocked and the water heater is operated at steady state. The flue outlet is then progressively blocked. It is verified that at least safety shutdown occurs before spillage is detected.

— Spillage is 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 places around the draught diverter where a leak is suspected. It is checked that no spillage is taking place.

— In doubtful cases, however, leaks are looked for with a sampling probe connected to a rapid-response CO_2 analyser, enabling contents of the order of 0,2 % to be detected. It is checked that no spillage is taking place.

Where the water heater operates at different fan speeds, the tests are repeated at the lowest fan speed and the appropriate gas rate. The water flow and return temperatures may be adjusted to achieve this condition.

6.7.13 Functioning of the fan of types C_{42} and C_{43} water heaters

6.7.13.1 Requirements

When the delivery stops or when a 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.

6.7.13.2 Test

The delivery is interrupted, the requirement is checked.

After restart, the water heater is brought to safety shutdown. It is checked that the requirement is met.

6.7.14 Protection against the accumulation of gas in the combustion circuit

6.7.14.1 General

For water heaters with a fan, one of the following conditions shall be respected:

— the water heater shall be equipped with a permanent or alternating ignition burner;

— if the heat input is above 0,250 kW, the gas circuit shall carry an automatic valve and at least one other valve, or two valves that close simultaneously. These valves shall be at least of class C';

— the water heater shall satisfy 6.7.14.2 (verification of the protected nature of a combustion chamber);

— the water heater shall satisfy 6.7.14.3 (verification of normal ignition in a combustible mixture of air/gas for types C_{12} and C_{13} water heaters).

6.7.14.2 Verification of the protected nature of a combustion chamber

6.7.14.2.1 Requirements

It is checked by visual examination that an ignition within the combustion chamber does not ignite a combustible mixture of air and gas outside the combustion chamber.

6.7.14.2.2 Tests

The water heater is supplied with one of the reference gases at the normal test pressure; it is installed as stated in 6.1.6 and connected to the longest ducts specified by technical instructions.

With the water heater cold, a combustible air/gas mixture that is within the flammability limits of the gas used is introduced upstream of the burner surface or head. The water heater burner could be used for this purpose if it supplies a fully mixed air/gas mixture.

The electrical igniter is put into service after the time required to fill the combustion chamber and combustion products evacuation circuit with a combustible air/gas mixture.

6.7.14.3 Verification of normal ignition in a combustible air/gas mixture for types C_{12} and C_{13} water heaters

6.7.14.3.1 Requirements

Ignition shall occur correctly without damage to the water heater when the combustion chamber is first filled with a combustible air/gas mixture.

6.7.14.3.2 Tests

The water heater is supplied with one of the reference gases at the normal test pressure; it is installed as stated in 6.1.6 and connected to the longest ducts specified by the technical instructions.

With the water heater cold, a combustible air/gas mixture that is within the flammability limits of the gas used is introduced upstream of the burner surface or head. The water heater burner could be used for this purpose if it supplies a fully mixed air/gas mixture.

The test is carried out by putting the water heater into service in accordance with its normal ignition procedure.

6.7.15 Leakage of combustion products from type C_7 water heaters

6.7.15.1 Requirements

Combustion products shall only escape from the secondary flue outlet.

6.7.15.2 Test

The water heater is installed in accordance with 6.1.6. The sampling probe is removed. The test is carried out with one of the reference gases, or with a gas actually distributed, for the category concerned at the nominal heat input.

A dew point plate is used to look for escape of combustion products. Its temperature is maintained at a value above the dew point of ambient air. The plate is brought close to all the places around the air inlet/draught diverter where an escape is suspected.

In doubtful cases, however, an escape may be looked for with a sampling probe connected to a rapid response CO_2 analyser enabling contents of the order of 0,20 % to be detected.

6.7.16 Supplementary tests for type B_{14}, B_2 and B_3 water heaters

6.7.16.1 Requirement

Under the test conditions of 6.7.16.2, 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.

6.7.16.2 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 existing.

The water heater is installed with the test flue. The flue outlet is progressively blocked. It is checked that the requirements of 6.7.16.1 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 supplied by the installation instructions, which shall not be greater than 200 Pa.

6.8 Adjusting, control and safety devices

6.8.1 General

The devices shall operate correctly in the range of temperatures to which they are subjected in the appliance in normal operation.

This requirement is checked by all the tests comprised in this European Standard.

6.8.2 Control devices

6.8.2.1 Rotary knob

6.8.2.1.1 Requirement

The operating torque of a control knob shall not exceed 0,6 Nm or 0,017 Nm/mm of knob diameter.

6.8.2.1.2 Test

Using an appropriate torque meter, the possibility of operation is verified over the whole range between open and closed positions. The opening and closing operations are carried out at a constant speed of about 5 revs/min.

6.8.2.2 Push-button

6.8.2.2.1 Requirement

The force required to open and/or to keep open or close the closure member shall not exceed 45 N or 0,5 N/mm^2 of the area of the button.

6.8.2.2.2 Test

The test is verified using an appropriate dynamometer.

6.8.3 Closing mechanisms and the automatic water operated gas valve

6.8.3.1 Sealing force

6.8.3.1.1 Requirement

The air leakage shall not exceed 0,04 dm^3/h when the closing mechanism:

— of a class C' automatic shut-off valve or a thermoelectric flame supervision device is subjected to a pressure of 10 mbar;

— of the automatic water operated gas valve is subjected to a pressure of 150 mbar.

6.8.3.1.2 Test

The closing mechanisms are first operated twice. In the de-energized position they are supplied with air in such a way that the air pressure opposes the closing direction of the closure member. The air pressure is increased at a rate not exceeding 1 mbar/s.

As soon as a pressure of 10 mbar or 150 mbar, as appropriate, is obtained, the leakage rate is measured. The sensitivity of the measuring equipment shall be 0,001 dm^3/h and 0,1 mbar.

6.8.3.2 Opening and closing function

6.8.3.2.1 Requirement

The automatic shut-off valves shall open automatically for any voltage in the range 85 % to 110 % of the nominal voltage and close automatically as a result of a reduction in their electrical supply voltage to 15 % of the minimum rated voltage.

6.8.3.2.2 Test

The automatic shut-off valves are subjected to 85 % of the minimum voltage stated by the technical instructions, then the voltage is reduced progressively down to 15 % of the minimum rated voltage.

6.8.3.3 Closing time

6.8.3.3.1 Requirement

It is checked that the closing time of the class C' automatic shut-off valves does not exceed 1 s.

6.8.3.3.2 Test

The automatic shut-off valve is supplied at a voltage corresponding to 110 % of the maximum rated voltage and with air under the following conditions:

— the maximum gas pressure given by the technical instructions;

— a working pressure of 6 mbar.

The time interval between the de-energization of the valve and the achievement of the closed position is measured.

6.8.3.4 Endurance

6.8.3.4.1 Requirement

Automatic shut-off valves that remain permanently open and that are closed only by the overheat protection device or the atmosphere sensing device are subjected to an endurance test of 5 000 cycles.

The automatic water operated gas valve and other automatic shut-off valves that are operated each time water is drawn are subjected to an endurance test of 50 000 cycles.

At the end of the test, the operation of the automatic shut-off valve or the automatic water operated gas valve shall remain satisfactory and shall comply with the conditions stated in 6.2.1 (or equivalent conditions if the valve is tested away from the appliance), 6.8.3.1 and 6.8.3.2.

In addition, for automatic shut-off valves, the requirements specified in 6.8.3.2 shall be met.

6.8.3.4.2 Test

— for automatic shut-off valves:

  — the gas circuit is supplied with air, at ambient temperature, in the direction of gas flow at a rate not exceeding 10 % of the value stated by the technical instructions. The pressure at the inlet is the highest normal pressure for the category. The cycles are the followings;

  — 60 % of the cycles are carried out at the maximum temperature to which the device is subjected in the appliance (see 6.5) and 110 % of the rated voltage;

  — 40 % of the cycles are done at ambient temperature and 85 % of the rated voltage.

The endurance tests at the maximum temperature to which the device is subjected in the appliance shall be carried out without interruption and over a period of at least 24 h. During the whole period of the endurance test the correct operation of the automatic shut-off valves shall be verified at each cycle, e.g. by recording the downstream pressure or the rate, or by some other suitable device.

— for the automatic water operated gas valve;

— the gas circuit is supplied with air at ambient temperature.

The water circuit is supplied with water at ambient temperature in the direction of flow at a pressure and rate such that the automatic water operated gas valve is fully operated.

6.8.4 Ignition devices

6.8.4.1 Automatic ignition devices

6.8.4.1.1 Requirement

a) at each draw of, the ignition device shall be activated at the latest at the same time as the signal to open the automatic shut-off valve(s).

   If ignition does not occur, the spark shall continue until the end of the T_{SA} (a tolerance of - 0,5 s is permitted).

b) mains operated ignition devices shall operate correctly over a range of 85 % to 110 % of the rated voltage.

   Battery operated ignition devices shall still operate correctly at a voltage of 75 % of the rated voltage.

6.8.4.1.2 Test

a) an ignition sequence is carried out at rated voltage in the absence of gas;

b) test n°1 of 6.7.1.2 is repeated under the supply voltages of 6.8.4.1.1 b).

6.8.4.2 Heat input of ignition burners

6.8.4.2.1 Requirement

The heat input of intermittent ignition burners shall be measured.

6.8.4.2.2 Test

The appliance is supplied successively with each of the reference gases for its category at the normal pressure.

Verification is carried out with only the ignition burner alight and at steady state.

6.8.5 Safety times

6.8.5.1 Appliances with a thermoelectric device

6.8.5.1.1 Requirement

The extinction delay time (T_{IE}) shall not exceed 60 s.

6.8.5.1.2 Test

The tests are carried out with each of the reference gases. The appliance is adjusted in accordance with 6.1.6.6.2 b).

With the appliance cold, the flame supervision device is actuated, the ignition burner is lit.

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

The extinction delay time (T_{IE}) is measured between the moment when 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.

6.8.5.2 Appliances with an intermittent safety ignition burner

6.8.5.2.1 Requirement

The extinction safety time (T_{SE}) shall not exceed 60 s and any attempt at spark restoration shall satisfy 5.2.8.3.

6.8.5.2.2 Test

The tests are carried out with each of the reference gases. The appliance is adjusted in accordance with 6.1.6.6.2 b).

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

The extinction safety time (T_{SE}) is measured between the moment of deliberate extinction by interrupting the gas supply to the main burner and ignition burner, and the moment when, this supply having been re-

established with any ignition device put out of action, the supply to the main burner stops through the operation of the flame supervision device.

The spark restoration time is measured between the disappearance of the flame from the ignition burner and the main burner and the operation of the ignition device.

6.8.5.3 Appliances with automatic burner control systems

6.8.5.3.1 Ignition safety time (T_{SA})

6.8.5.3.1.1 Requirement

The T_{SAmax} is stated in the technical documentation.

If the nominal heat input of an ignition burner does not exceed 0,250 kW, there is no requirement for the T_{SAmax}, except for type C_{11} et C_{21} appliances using third family gases.

If the nominal heat input of the ignition burner stated 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 and/or damage to the appliance.

For type A_{AS} water heaters, type B water heaters and type C water heaters with fan, this requirement is considered to be met when the T_{SAmax}, determined during the test, complies with the following requirement:

$$T_{SA} \leq 5 \cdot \frac{Q_n}{Q_{IGN}}$$ **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 3.10.8).

For type A_{AS} and type B appliances in which the T_{SAmax}, does not satisfy the above requirement and for type C_{11} and type C_{21} water heaters, a delayed ignition test is carried out (see 6.8.5.4.2).

Where several automatic ignition tests are made, the sum of the partial T_{SA} and the waiting times shall satisfy the above requirement for the T_{SAmax}.

The absence of a flame signal at the end of these periods shall result in at least volatile lockout of the gas supply.

6.8.5.3.1.2 Test

The maximum ignition safety time (T_{SAmax},) is verified with each of the reference gases. The appliance adjusted in accordance with 6.1.6.6.2 b) voltages between 85 % and 110 % of the rated voltage.

The test is carried out cold and under steady-state conditions.

With the burner shut down, the flame detector is disconnected. The order is given to admit gas to the main burner, and the time is measured that elapses between this moment and that when the safety device effectively shuts off the gas supply.

6.8.5.3.2 Extinction safety time (T_{SA}) - Spark restoration

6.8.5.3.2.1 Requirement

If there is no spark restoration, the T_{SA} of the main burner and ignition burner, where the heat input is greater than 0,250 kW, shall be no greater than 5 s.

If there is spark restoration, re-energization of the ignition device shall occur within a maximum time of 1 s, after the disappearance of the flame signal. In this case, the spark restoration safety time is the same as the T_{SA} and starts with the operation of the ignition device.

6.8.5.3.2.2 Test

The test is carried out with each of the reference gases for the appliance category, at its rated voltage.

If there is no spark restoration, with the burner alight, flame failure is simulated by disconnecting the flame detector, and the time is measured that elapses between this moment and that when the flame supervision device effectively shuts off the gas supply.

If there is spark restoration, the gas supply is interrupted and the time until the ignition device is re-activated is measured.

6.8.5.4 Delayed ignition

6.8.5.4.1 Requirement

There shall not be:

— deterioration of the appliance;

— ignition of the test fabric for type A_{AS} and B appliances.

6.8.5.4.2 Test

A delayed ignition test is carried out on the appliance in accordance with the following conditions:

— with the appliance cold and with each of the reference gases at the normal test pressure, the ignition attempts are carried out successively with a delay from 0 s to T_{SAmax} in steps of 1 s;

— the test fabric (cheese-cloth) is placed at the minimum distances stated in the technical instructions in the technical instructions for inflammable materials. In the absence of any information, 0 cm is used.

The strip of material used for the test shall comply with 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).

6.8.6 Pressure regulator

6.8.6.1 Requirement

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

— appliances operating without a pressure couple:

  — − 10 % + 7,5 % between p_n and p_{max} for first family gases;
  — − 7,5 % + 5 % between p_{min} and p_{max} for second family gases;
  — ± 5 % between p_{min} and p_{max} for third family gases;

— appliances operating with a pressure couple:

  ± 5 % between the higher p_n and the higher p_{max};

— the pressure governor shall not operate between the lower p_n and the higher p_n.

In addition, if the pressure regulator does not comply with the requirements of EN 88-1:2011, it is subjected to an endurance test of 50 000 cycles.

6.8.6.2 Test

If the appliance is fitted with a governor, the gas rate is measured using reference gas at the normal pressure given in 6.1.5 corresponding to this gas. Keeping the initial adjustment, the supply pressure is varied between:

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

— p_{min} and p_{max} for second and third family gases without a pressure couple;

— the higher p_n and the higher p_{max} for second and third family gases with a pressure couple;

— the lower p_n and the higher p_n for second and third family gases with a pressure couple.

This test is carried out for all the reference gases for which the governor is not put out of action.

If it is necessary to carry out an endurance test, the governor is placed in a temperature controlled chamber with an air supply at ambient temperature and at the maximum inlet pressure stated in the technical instructions. With a quick acting shut-off valve both upstream and downstream, connect the valves to a suitable time switch so that as one opens the other closes, with a complete cycle every 10 s.

The test consists of 50 000 cycles, in each of which the diaphragm is fully flexed and the valve is held on its seat for at least 5 s.

Of the 50 000 cycles :

— 25 000 cycles are with the governor environment at the maximum ambient temperature stated in the technical instructions but at least 60 °C, and

— 25 000 cycles are with the governor environment at the minimum ambient temperature stated in the technical instructions but at most 0 °C.

After the endurance test, the governor is subjected to the previous tests without changing the setting point of the governor.

6.8.7 Adjustment of the water rate - Maximum water temperature (all appliances)

6.8.7.1 Requirement

For all adjustments of the water rates, the water temperature rise shall not exceed 75 K

6.8.7.2 Test

The appliance is supplied with one of the reference gases and adjusted in accordance with 6.1.6.6.2 b) and with water inlet temperature of (20 ± 2) °C.

The water rate is progressively reduced and the maximum water temperature rise is found.

6.8.8 Overheating of the water

6.8.8.1 Requirement

The overheating of the hot water shall never exceed 20 K above the steady-state temperature.

The overheat protection device, if any, shall not operate during the test.

6.8.8.2 Test

The appliance is supplied with one of the reference gases and adjusted in accordance with 6.1.6.6.2 b) and with water inlet temperature of (20 ± 2) °C.

With the appliance in the steady-state condition, the hot water delivery tap is closed quickly. After a time of 10 s the tap is opened quickly and the maximum temperature at the centre of the flow is measured, as close as possible to the appliance outlet, by means of a rapid-response thermometer.

The appliance is put back into operation until it has again reached its steady-state condition.

The same measurement is carried out at intervals, increased each time by 10 s, until the maximum flow temperature is obtained.

6.8.9 Effectiveness of the protection against accidental overheating of thermostatic appliances

6.8.9.1 Requirements

1) if conformity with 5.2.11 is achieved by an overheat protection device, under the conditions of test no 1, the operation of the appliance shall be interrupted before the temperature of the delivered water reaches 95 °C and before any deterioration occurs of the appliance or its components (fuses excepted);

2) if conformity with 5.2.11 results from the design of the appliance, under the conditions of test no 2 below, the operation of the appliance shall be interrupted before the water temperature rise exceeds 75 K.

6.8.9.2 Tests

The tests are carried out with one of the reference gases at the normal test pressure, and the water inlet temperature is (20 ± 2) °C. The adjustment of the water is made in accordance with 6.1.6.6.2 b).

Test n° 1

The thermostat is put out of operation in accordance with the technical instructions to simulate a failure and the water rate is reduced progressively until the overheat device operates. If under these conditions the water outlet temperature is not high enough for the overheat protection device to operate, the appliance is supplied

with pre-heated water at a temperature not exceeding 25 °C (e.g. by means of a suitable water heater) and the test is repeated.

Test n° 2

The thermostat is put out of service following the technical instructions to simulate a failure and the water rate is reduced until the gas rate to the main burner is shut off by the automatic water-operated gas valve.

6.8.10 Atmosphere sensing device for type A_{AS} appliances

6.8.10.1 Sensitivity of the device to lack of ventilation in the room

6.8.10.1.1 Requirement

The admission of gas to the burner and ignition burner shall be interrupted and locked out so that the carbon monoxide content of the room where the appliance is installed does not exceed 0,1 % .

Furthermore, the maximum carbon dioxide (CO_2) content of the room after shut-off shall not exceed 2,5 % when the tests are carried out with each of the reference gases.

6.8.10.1.2 Test

6.8.10.1.2.1 Installation of the appliance in the sealed room

The appliance is installed in the sealed room described in Annex D, over the sink and centred on one of the sides of the room. It is fixed in accordance with the technical instructions on a support plate 80 cm wide and 100 cm high, placed 10 cm away from the test room wall, and such that the burner is located about 1,5 m from the floor.

The sampling point for the test of the safety device is that one of the points defined in Annex D which is located on the axis of the room (point n° 7 of Figure 5) and at a height of 1,5 m from the floor.

The room is carefully ventilated after each test. Before each test, verify the concentrations of CO and CO_2 in the room to ensure that they do not exceed the normal ambient values.

6.8.10.1.2.2 Sensitivity of the device to loss of aeration in the room

The tests are carried out with each of the reference gases. However, for E+ categories, the test is also carried out with G 25.

The appliance is adjusted in accordance with 6.1.6.6.2 a).

After ignition of the appliance, the values of CO and CO_2 contents of the test room are continuously monitored until, after operation of the device, these contents no longer increase.

The maximum values so determined shall comply with the requirements of 6.8.10.1.1.

6.8.10.2 Sensitivity of the device to fouling of the heating body

6.8.10.2.1 In a ventilated sealed room

6.8.10.2.1.1 Requirement

The CO content of the dry, air free combustion products emitted by the appliance shall not exceed 0,20 %.

6.8.10.2.1.2 Test

The test room is said to be ventilated if the CO_2 content of the atmosphere of this room does not exceed 0,10 % during the period of the test.

The appliance is adjusted in accordance with 6.1.6.6.2 a).

After the deflector has been removed, the combustion products outlet is obstructed by a perforated plate completely covering the heat exchanger and placed on the fins. The deflector is then either replaced or not, according to the technical instructions.

This plate, supplied for each of the reference gases, shall have the following characteristics:

— unperforated rim 10 mm high;

— the perforated plate, which shall remain plane throughout the test, shall be of 1 mm thick stainless steel;

— the perforation shall consist of identical well-deburred orifices, 5 mm to 10 mm in diameter, arranged in staggered rows and uniformly distributed over the whole area corresponding to the area of the combustion products outlet;

— the total area of the orifices is the greatest area that causes the gas to be shut off in a time not exceeding 5 min, the appliance being cold at the start of the test. The appliance is considered to be cold when the temperature of its metallic mass approximates to the ambient temperature. It is determined by successive tests, in which the diameter of all the orifices is changed, from one plate to the next, in steps of 0,1 mm.

In addition the appliance, fitted with the plate(s)is supplied with each of the reference gases at the maximum pressure. The CO content of the combustion products is sampled using the device described in Figure 6.

6.8.10.2.2 In a sealed room

6.8.10.2.2.1 Requirement

The device shall interrupt the admission of gas to the burner and ignition burner in such a way that the carbon monoxide (CO) content of the test room where the appliance is installed does not exceed 0,1 %.

6.8.10.2.2.2 Test

The appliance is adjusted in accordance with 6.1.6.6.2 a). It is fitted with perforated plate(s)which are identical to the plaque(s) of 6.8.10.2.1.2 but where the hole diameters have been increased by 0,1 mm, and is installed in the sealed room. After igniting the appliance, supplied with one of the reference gases, the CO content of the atmosphere of the room is measured continuously until, after shut-off by the safety device, this content no longer increases. The maximum value measured shall comply with the provisions above.

6.8.10.3 Operating defect of the device

6.8.10.3.1 Requirement

The device shall interrupt the admission of gas to the burner and ignition burner in such a way that the carbon monoxide (CO) content of the test room where the appliance is installed does not exceed 0,2 %.

6.8.10.3.2 Test

Deterioration of the sensors of the device and, where appropriate, of the component transmitting the shut-off command, shall result in complete interruption of the gas supply (see 5.2.9).

A test for shut-off by the atmosphere sensing device, by simulating it being fouled, is carried out under the following simultaneous conditions:

— the appliance is installed in the sealed room and fitted with one of the perforated plate of 6.8.10.2.2.2;

— any tube supplying air or combustion products to the atmosphere control device is partially blocked by means of a sleeve 1 mm thick and 10 mm long which is introduced without significant free play into the inlet of the tube;

— the tests are carried out with the corresponding reference gas;

— the appliance is adjusted in accordance with 6.1.6.6.2 a).

6.8.11 Combustion products discharge safety device of type B_{11BS} appliances

6.8.11.1 General

When it is actuated, the device shall interrupt the admission of gas, with or without lockout.

The safety device shall shut off the gas supply at least to the main burner.

6.8.11.2 Test conditions

The ambient temperature shall be less than 25 °C.

Unless otherwise specified, the test is carried out at the nominal heat input with one of the reference gases.

The appliance will be fitted with a telescopic test flue (H ≤ 0,50 m), of the smallest diameter (D) stated in the installation instructions.

In the case of an appliance fitted with a manual temperature adjuster, the water temperature is adjusted to (50 ± 2) °C or to the maximum temperature as close as possible to 50 °C.

In the case of an appliance without a manual temperature adjuster, the test is carried out at a temperature close to 50 °C, the water rate being adjusted accordingly, if necessary.

Spillage is determined with a dew point plate. In doubtful cases, however, the limit of spillage is looked for using a sampling probe connected to a rapid-response CO_2 analyser enabling contents of the order of 0,1 % to be detected.

6.8.11.3 Nuisance shutdown

6.8.11.3.1 Requirement

When the combustion products are being evacuated normally the safety device shall not cause shutdown, and the temperature rise that ensues when water delivery stops shall not cause its shutdown.

6.8.11.3.2 Test

The appliance operates for 30 min at its nominal heat input under the conditions of 6.8.11.2, with H = 0,50 m, then the draw off tap is closed.

6.8.11.4 Shutdown times

6.8.11.4.1 Requirement

Table 3 gives the maximum times, in relation to the blockage, for shutdown due to the combustion products safety device in the following tests.

Table 3 — Shutdown times in relation to blockage

Level of blockage	Diameter of the opening in the blocking plate *d*	Maximum shutdown time (min)		
		All appliances : nominal heat input Q_n	Automatic Variation of Output (AVO) appliances : 0,52 Q_n [a]	Appliances with reduced manual heat input Q_m
Total blockage	$d = 0$	2	4	$2 \frac{Q_n}{Q_m}$
Partial blockage	$d = 0{,}6 \times D$ or $d = 0{,}6 \times D'$	8	-	-
D: Internal diameter of the telescopic test flue at its top. *D'*: Diameter of the plate which provides the limit of spillage.				
[a] For appliances with a minimal heat input Q_m which is above 0,52 Q_n test is carried out with Q_m.				

When shutdown occurs without lockout, automatic return to service shall be possible only after a minimum waiting time of 10 min, with the flue remaining blocked. The technical instructions shall state in the technical instructions the actual waiting time of the appliance.

6.8.11.4.2 Test

6.8.11.4.2.1 Test with complete blockage

The appliance is tested in accordance with 6.8.11.2 with H = 0,50 m.

When the appliance is in the steady-state condition, the test flue is completely blocked (see Figure 11). The time that elapses between blockage of the duct and shutdown is measured.

For appliances without lockout, the time between closure and restoration of the gas supply to the main burner is measured, with the blockage remaining complete and the water delivery rate being maintained.

For appliances fitted with a gas rate control, a second test is carried out:

— for appliances fitted with adjustable output, the burner is adjusted to the lowest heat input but not below 52 % of the nominal heat input, and the appliance is adjusted to obtain the nearest water temperature to 50 °C.

— for appliances with automatic output variation, the test is carried out at (52 ± 2) % of the nominal heat input (for appliances with a minimal heat input Q_m which is above 0,52 Q_n test is carried out with Q_m).

6.8.11.4.2.2 Test with partial blockage

The appliance is put into the steady-state condition in accordance with 6.8.11.2.

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 6.8.11.4.1 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 11).

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 states a minimum flue height for this test, mandatorily not exceeding the height stated in 6.8.11.4.2.1, the test is carried out with a test flue of that height.

6.9 Combustion

6.9.1 Requirements

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

a) 0,10 % under the normal conditions of 6.9.2.2 when the appliance is supplied with the reference gas(es) and under the special conditions of 6.9.2.4.1;

b) 0,20 % under the conditions of 6.9.2.2 and under the conditions of 6.9.2.4.2, 6.9.2.4.3, 6.9.2.4.4, 6.9.2.4.5, 6.9.2.4.6, 6.9.2.4.7, 6.9.2.4.8, 6.9.2.4.9, 6.9.2.4.10, 6.9.2.4.11, 6.9.2.4.12, 6.9.2.4.13 and 6.9.2.4.14.

6.9.2 Test

6.9.2.1 General

The appliance is supplied with gas and, if necessary, adjusted according to the instructions given in 6.9.2.2 and 6.9.2.3. When the appliance is in the steady-state condition (see 6.1.6.7), the combustion products are sampled using, for type A_{AS} appliances, a device such as that shown in Figure 6 or, for type B appliances, a probe of the type shown by way of example in Figure 3, placed as near as possible to the outlet of the heat exchanger is used for the blocked flue and downdraught tests.

For the other combustion tests, the combustion products are sampled by means of a probe of the type illustrated in Figure 7 or Figure 8 which is placed in the test flue, 100 mm from the top of the flue.

For type C_{11} appliances, the combustion products are sampled by means of a probe of the type illustrated, by way of example, in Figure 9 or Figure 10.

The CO content of the dry, air-free combustion products 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 (%);
$(CO)_M$ and $(CO_2)_M$	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

Gas designation	G 110	G 20 G 27	G 21	G 23	G 25 G 231	G 26	G 30	G 31 G 130	G 120	G 140	G 141	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	7,8	7,9	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

$(O2)_M$ and $(CO)_M$	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 %.

For type C water heaters, tests are carried out with the longest air supply and combustion products evacuation ducts specified by the technical instructions.

6.9.2.2 Test in still air

Type A_{AS} and type B_{11} and B_{11BS} appliances are placed in the test room of 6.9.2.1, with the rear surface put as near as possible to a wall while following the technical instructions.

A type B_4 or B_5 water heater is fitted with the longest flue duct stated in the technical instructions.

For water heaters intended to operate with a pressurized flue duct, designated by a “P”, the flue outlet of the water heater is exposed to the maximum nominal overpressure stated in the technical instructions, which shall not be greater than 200 Pa. This pressure may be achieved by partial blockage of the flue.

The appliances are installed under the conditions of 6.9.2.1.

The water rate and water temperature adjustment is carried out in accordance with 6.1.6.6.2 a). However, for thermostatic appliances, either the water rate is adjusted to 1,15 times this water rate or the thermostat is put out of operation.

Test n° 1

The test is carried out with each of the reference gases.

— for water heaters not equipped with a pressure governor in the main burner circuit or a device to pre-set the gas flow, or for water heaters with gas/air ratio control, the test is carried out by supplying the water heater at the maximum pressure indicated in 6.1.5;

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

— for appliances fitted with a pressure regulator in the line to the main burner, the test is done by altering the burner heat input to 1,07 times the nominal heat input for first family gases or to 1,05 times the nominal heat input for second family gases;

— for appliances having a preset gas rate adjuster or a gas pressure regulator in the line to the main burner 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 water heater is supplied with the reference gas and the heat input is pre-set to a value equal to 1,075 times the nominal heat input, if the water heater does not have a governor or if the water heater has gas/air ratio control, or 1,05 times the nominal heat input if the water heater has a governor. If the water heater is intended to be installed exclusively in an installation with a pressure reducing valve at the meter, the factor of 1,05 can be applied. Then, without altering the water heater setting, or the pressure of the supply, the reference gas is replaced by the corresponding incomplete combustion gas.

In addition, for appliances with adjustable output or automatic output variation, a test is carried out with each of the reference gases at the minimum heat input under the conditions of 6.1.6.6.2 a').

Compliance with the specifications of 6.9.1 is verified during each test.

6.9.2.3 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 6.9.1 a) is met.

6.9.2.4 Supplementary tests

6.9.2.4.1 General

The appliance is adjusted in accordance with 6.1.6.6.2 a).

6.9.2.4.2 Type B_1 appliances except for B_{14}

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

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

A first test is carried out with the flue blocked.

A second test is carried out by applying a continuous down-draught of speeds 1 m/s and 3 m/s within the flue (Figure 2).

For type B_{11BS}, B_{12BS}, B_{13BS} appliances, the combustion products discharge safety device is put out of action.

The CO contents obtained shall satisfy the requirements of 6.9.1.

6.9.2.4.3 Type C_{11} appliances

The tests are carried out with the reference gas having the highest Wobbe number for the category with the nine combinations of the first test series of 6.7.3.2 which give the highest CO contents. The arithmetic mean of the nine CO contents so measured is calculated.

In addition, when the appliance has a provision for a terminal guard, tests are carried out under the conditions of the fourth test series of 6.7.3.2, with the terminal guard fitted in accordance with the technical instructions, and the arithmetic mean of the nine CO contents thus determined is calculated.

The mean CO contents thus obtained shall satisfy the requirements of 6.9.1.

6.9.2.4.4 Type C_2 appliances

The appliance is installed and tested as stated in 6.7.4.2 with the reference gas with the highest Wobbe number for the category.

The CO contents of the dry, air-free combustion products shall satisfy the requirements of 6.9.1.

6.9.2.4.5 Combustion test with flame lift limit gas

The adjustment is modified as follows:

— water heaters without governors or with gas/air ratio control are adjusted to the minimum heat input; the pressure at the water heater inlet is reduced to the minimum pressure given in 6.1.5;

— for water heaters with governors the water heater is adjusted to a heat input equal to 0,95 times the minimum heat input.

The reference gas is then replaced by the flame lift limit gas.

It is checked that the requirement of 6.9.1 b) is met.

6.9.2.4.6 Types C_{12}, C_{13}, C_{32} and C_{33} water heaters

The test is carried out as stated in the first and fourth test series in 6.7.3.2, and in accordance with 6.7.5.2.

For each of the test series, the arithmetic mean of the CO contents, determined at the nine combinations of windspeed and incident angle that produce the highest CO content in the combustion products, is calculated.

It is checked that the requirement of 6.9.1 b) is met.

The tests can be carried out

— on the water heater complete with ducts and terminal and subjected to winds in accordance with 6.7.5.2, or

— on the water heater complete with ducts but without terminal, in which case the pressure losses and the corresponding recirculation rate of the terminal measured in wind tunnel are applied at the end of the ducts.

6.9.2.4.7 Type C_2 water heaters

The tests are carried out under the conditions of 6.7.4.2. It is checked that the requirement of 6.9.1 b) is met.

6.9.2.4.8 Type C_4 water heaters

The tests are carried out under the conditions of 6.7.6.2. It is checked that the requirement of 6.9.1 b) is met.

6.9.2.4.9 Type C_5 water heaters

The tests are carried out under the conditions of 6.7.7.2 (except for the test with an overpressure which is not required). It is checked that the requirement of 6.9.1 b) is met.

6.9.2.4.10 Type C_6 water heaters

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

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

It is checked that the requirement of 6.9.1 b) is met.

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

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

Under these test conditions, it is checked that the requirement of 6.9.1 b) is met.

6.9.2.4.11 Type C_7 water heaters

The tests are carried out under the conditions of 6.7.9.2. It is checked that the requirement of 6.9.1 b) is met.

6.9.2.4.12 Type C_8 water heaters

The tests are carried out under the conditions of 6.7.10.2. It is checked that the requirement of 6.9.1 b) is met.

6.9.2.4.13 Supplementary test for fan 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 requirement of 6.9.1 b) is met when the supply voltage is varied between 85 % and 110 % of the nominal voltage stated by the technical instructions.

6.9.2.4.14 Type B_{14}, B_2 and B_3, water heaters

In the test conditions of 6.7.16.2, it is checked that the requirements of 6.9.1 b) are met.

6.9.2.4.15 Type B4 and B5 water heaters

In the test conditions of 6.7.5 it is checked that the requirements of 6.9.1 b) are met.

6.9.3 Nitrogen oxides emissions

6.9.3.1 General

The water heater is installed as indicated in 6.9.2.1.

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 steady state, conforming to the details given in CR 1404. Also, the tests are effected under normal combustion products evacuation in accordance with 6.1.6, 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 7 or Figure 8, 100 mm from the top of the test flue.

During the test:

— the inlet water temperature shall be (10 ± 2) °C. In addition, the outlet water temperature during the tests shall not vary more than ± 0,5 °C;

— the temperature rise shall be (30 ± 2) K.

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;

— 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 K .

6.9.3.2 Weighting

6.9.3.2.1 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 5.

Table 5 — 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: $NO_{x,mes}$ (100), $NO_{x,mes}$ (80), $NO_{x,mes}$ (60), $NO_{x,mes}$ (35)
at the minimum heat input (modulating water heaters): $NO_{x,mes,}Q_{min}$
at the heat input corresponding to a single rate: $NO_{x,mes\ (rate)}$;

6.9.3.2.2 Instantaneous water heaters with fixed output

The *NOx* concentration is measured at the appliance nominal output.

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

6.9.3.2.3 Instantaneous water heaters with adjustable output

The *NOx* concentration is measured at the partial heat inputs specified in Table 5:

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

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

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

6.9.3.2.4 Instantaneous water heaters with automatic variation output (AVO)

The *NOx* concentration is measured at the partial heat inputs specified in Table 5:

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

6.10 Soot deposition

6.10.1 Requirement

No deposition of soot likely to impair the quality of combustion shall be produced. The appearance of yellow tipping is permitted if this requirement is met.

6.10.2 Test

Test n°1 of 6.9.2.2 is carried out with the reference gas with the highest Wobbe number for the category at the normal of the test pressure.

If yellow tipping does not occur, the requirement is considered to be met.

In the event of the occurrence of yellow tipping or soft flames on ignition, the reference gas is replaced by the sooting limit gas for its category at the corresponding normal pressure, the appliance is put into operation six times, each of 20 min duration, and the absence of carbon deposits is checked by visual examination.

6.11 Frost protection system for appliances intended to be installed in a partially protected place

The appliance is placed in a climate chamber at ambient temperature. The appliance – in stand-by condition - is connected to a system containing not more than 100 l of water. The temperature of the climate chamber is reduced from ambient temperature to the minimum temperature stated in the technical instructions in not less than 1 h.

The test will last until a steady condition or a steady repetition of cycles has been reached.

It is checked that the requirements of 5.2.13 are met.

6.12 Protection against ingress of rain

The appliance fitted with its minimum protection declared in the installation instructions is placed in a test room, which consists of a rain-making installation and a wind generator.

The rain-making installation is made up of parallel pipes in a horizontal plane. The tubes have small spray holes (placed vertically downwards). These spray holes are evenly distributed across an area of (4 900 × 1 800) mm. The water from the spray holes shall be distributed through a web of fine 1,3 mm wide wire mesh, after which the water will fall in the form of raindrops. The rain intensity is (1,6 ± 0,1) mm per minute and shall be measured with a pluviometer.

The wind generator supplies a horizontal air flow at a velocity of (4 ± 0,5) m/s and (12 ± 0,5) m/s. The dimensions of the wind generator outlet are (1 200 × 1 200) mm.

The appliance is placed in the middle of the test room with its front towards the wind generator in such a way that the centre of the appliance front is in line with the centre of the wind generator outlet opening.

The appliance is then exposed each time for 20 minutes to the rain under the following conditions:

— no wind;

— a horizontal air flow of 4 m/s;

— a horizontal air flow of 12 m/s.

After each of these three conditions it is checked that the last requirement of 5.2.4 is fulfilled.

6.13 Supplementary tests for condensing water heaters

6.13.1 Formation of condensate

6.13.1.1 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.

6.13.1.2 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 with water temperature conditions as given in 6.1.6.6.2.a).

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

6.13.2 Temperature of combustion products

6.13.2.1 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, stated in 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.

6.13.2.2 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 stated in 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 stated in 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.

6.14 Electrical power measurements

6.14.1 General

These measurements apply only for appliances connected to mains electrical supply.

6.14.2 Nominal and minimal conditions

The electrical power consumption, expressed in W, is measured at the same conditions as for the measurement of heat input according to 6.3.2 and according to 6.3.3 for modulating appliances.

6.14.3 Standby

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

6.15 Measurement of standby heat losses

The standby heat losses are considered as negligible and equal to zero.

7 Rational use of energy

7.1 General

The general conditions of 6.1 apply.

7.2 Heat input of ignition burners

7.2.1 Requirement

The heat input of permanent and alternating ignition burners shall not exceed 0,17 kW.

7.2.2 Test

The appliance is supplied successively with each of the reference gases for its category at the corresponding normal test pressure.

Verification is carried out with only the ignition burner alight and at steady state.

7.3 Efficiency

7.3.1 Requirement

The efficiency at the nominal heat input shall not be less than:

— 84 % for appliances with a nominal heat input exceeding 10 kW;

— 82 % for appliances with a nominal heat input not exceeding 10 kW.

If, under the normal test conditions described in 7.2.2, the efficiency of type B appliances exceeds 89 %, the technical instructions shall state the special installation provisions in force in the country, or countries, of destination so as to limit the risk of water vapour condensing in the flue.

7.3.2 Test

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

$$\eta_u = 100 \frac{m \times c_p \times \Delta T}{V_\eta \times H_i}$$

or

$$\eta_u = 100 \frac{m \times c_p \times \Delta T}{M_\eta \times H_i}$$

where

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

c_p is the specific heat of water which is taken to be 4,186 x 10-^{3} MJ kg^{-1} K^{-1};

ΔT is the temperature rise of this water, in kelvins (K);

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, (see 3.2.1) in cubic metres (m^3);

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

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

- on the volume basis, in megajoules per cubic metre (MJ/m^3);
- on the mass basis, in megajoules per kilogram (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.

The efficiency is determined under the following conditions:

The appliance is supplied with one of the reference gases and adjusted in accordance with 6.1.6.6.2 a).

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

The test is effected under normal conditions of 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 7 or Figure 8, 100 mm from the top of the test flue.

For the purposes of 8.5.2.2, the test is repeated in accordance with 6.1.6.6.2 a').

Where the technical instructions state the chemical composition of the condensate the test with the appliance adjusted in accordance to 6.1.6.6.2 is continued as necessary to allow collection of sufficient condensate for analysis.

8 Fitness for purpose

8.1 General

The general conditions of 6.1 apply and the appliance is adjusted in accordance with 6.1.6.6.2 b) or b') unless otherwise specified.

8.2 Constructional characteristics

8.2.1 Water connections

When the connection to the water supply is made by threaded fittings, these shall comply with EN ISO 228-1 and the end of appliance connection shall be sufficiently flat to allow the use of a sealing washer.

If the connections consist of a plain copper tube this shall have a straight section of at least 5 cm in length and it shall comply with EN 1057.

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

8.2.2 Preset water rate adjuster

Appliances shall be fitted with a device to preset or to obtain a pre-determined water rate such as, for example, a preset water rate adjuster, a water rate governor or a water pressure governor.

Verification is carried out by inspection.

8.2.3 Temperature selector and summer-winter switch

Proportioning appliances shall be fitted with a temperature selector or a summer-winter switch.

In the latter case, compensation shall be able to be made automatically or manually by means of the summer-winter switch for differences in cold water temperature.

Verification is carried out by inspection.

8.2.4 Designation and measurement of reference temperatures of flue systems

8.2.4.1 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 6.8.7.2, 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."

8.2.4.2 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 test according to 6.13.2.2, the temperature of combustion products is recorded continuously until the temperature ceases to increase after the appropriate safety device causes non-volatile lockout of the appliance. The overheat combustion products temperature corresponds to this value.

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

8.2.5.1 General

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

8.2.5.2 Compressive strength

8.2.5.2.1 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 stated in 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 stated in the technical instructions.

It is visually checked that the requirement is satisfied.

8.2.5.2.2 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 stated in 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 stated in the technical instructions.

It is visually checked that the requirement is satisfied.

8.2.5.2.3 Vertical terminals

Requirements

When tested the terminal shall show no permanent deformation.

Test conditions

The terminal is installed in accordance with the technical 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.

8.2.5.3 Lateral strength

8.2.5.3.1 Flexural tensile strength

Requirement

When the technical instructions state 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 stated in the technical instructions.

It is checked that the requirement is satisfied.

8.2.5.3.2 Components subject to wind load

Requirements

When the technical instructions state 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 stated 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 %.

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 ± 0,01) m intervals. The individual loads do not vary by more than 1 %.

It is checked that the requirement is satisfied.

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

8.3.1 Thermal resistance

Requirements

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

8.3.2 Materials

8.3.2.1 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+A2:2015, 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+A2:2015, Annex B.

Test conditions

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

Prior to the characterizations 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.

8.3.2.2 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 J.

Alterations to the properties shall not exceed those set out in Table 6.

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 8.2.5.

Table 6 — 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 K within the oven volume and 1 K 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 7.

Table 7 — Exposure time in weeks at raised temperatures

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

8.3.2.3 Long-term resistance to condensate exposure

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 J.

Alterations to the properties shall not exceed those set out in Table 8.

Table 8 — 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 8.2.5.

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 9.

Table 9 — 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.

8.3.2.4 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 J.

Alterations to the properties shall not exceed those set out in Table 10.

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 10 — 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 stated in 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+A2:2015, 7.7.5.

8.3.2.5 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 J, 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: 1 330 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.

8.3.2.6 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 8.3.2.2 for 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*.

8.3.2.7 Reaction to fire

Requirements

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

Test conditions

The statement of the technical instructions is checked.

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

8.4.1 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.

8.4.2 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 10 should not deviate from the original value by more than the values as listed in Table 11 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 days 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 11 — 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, where:

— 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.

8.4.3 Long-term resistance to condensate exposure

Requirements

The material shall be capable of withstanding exposure to test condensate as described in Table 11.

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 11 should not deviate from the original value by more than the values as listed in Table 12, 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 12, 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 12 — 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 13.

Table 13 — 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, where:

— 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.

8.4.4 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 8.

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.

8.4.5 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.

8.4.6 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.

8.4.7 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.

8.4.8 Joints in elastomeric seals

8.4.8.1 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.

8.4.8.2 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.

8.5 Operational characteristics

8.5.1 Minimum heat input

8.5.1.1 Requirement

For appliances with automatic output variation, the declared minimum heat input shall not exceed 52 % of the nominal heat input.

8.5.1.2 Test

Verification is carried out in accordance with the corresponding test of 6.3.3.2.

8.5.2 Nominal and minimum useful outputs

8.5.2.1 Requirements

The nominal useful output shall not differ by more than 5 % from the useful output determined in accordance with the following test.

The minimum useful output shall not differ from the useful output determined in the following test and by more than 5 % from the nominal useful output.

8.5.2.2 Tests

The nominal and minimum useful outputs are determined by multiplying the corresponding efficiencies, measured under normal conditions of combustion products evacuation in accordance with the test described in 7.3.2, by the nominal and minimum heat inputs.

8.5.3 Ignition of permanent ignition burners by a spark generator

8.5.3.1 Requirement

At least half of 10 ignition attempts shall give rise to correct ignition of the ignition burner.

8.5.3.2 Test

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

There shall be a delay of at least 1,5 s between each successive attempt.

The test begins after having purged the gas supply circuit of the ignition burner.

8.5.4 Ignition opening time (T_{IA})

8.5.4.1 Requirement

The ignition opening time (T_{IA}) of appliances with a thermoelectric flame supervision device shall not exceed 20 s. However, this time limit may be increased to 60 s if, during this period, no manual intervention is required.

8.5.4.2 Test

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

With the appliance cold, the flame supervision device is actuated, the ignition burner is lit and it is verified that the ignition burner remains alight at the end of the ignition opening time (T_{IA}) specified in 8.5.4.1.

8.5.5 Automatic water-operated gas valve

8.5.5.1 Normal and high water pressure appliances

8.5.5.1.1 Requirements

At a minimum water pressure at the appliance inlet of 0,5 bar for fixed output or adjustable output appliances and 1 bar for appliances with automatic output variation. The corrected heat input (see 6.3.1.2) shall be at least 95 % of the heat input obtained in 6.3.2.1 when there is no preset gas rate adjuster or the nominal heat input when there is a preset gas rate adjuster.

For appliances with automatic output variation, at a water pressure of 0,5 bar, the corrected heat input (see 6.3.1.2) shall not be less than the minimum heat input.

8.5.5.1.2 Test

The test is carried out with one of the reference gases at the corresponding normal test pressure and the appliance is adjusted in accordance with 6.1.6.6.2 b).

The preset water rate adjuster is set to the position giving the highest temperature.

Then the water pressure is reduced to the following values:

— 0,5 bar for fixed output or adjustable output appliances;

— 1 bar then 0,5 bar for appliances with automatic output variation.

8.5.5.2 Low water pressure appliances

8.5.5.2.1 Requirements

At the minimum water pressure specified in the technical instructions, with the preset water rate adjuster set to give the highest temperature, the corrected heat input (see 6.3.1.2) shall be at least 95 % of the heat input obtained in 6.3.2.1 when there is no preset gas rate adjuster and the nominal heat input when there is a preset gas rate adjuster. The operation of the valve shall remain correct up to the pressure of 2,5 bar.

8.5.5.2.2 Test

The test is carried out with one of the reference gases at normal test pressure and at the minimum water pressure specified in the technical instructions.

The test is repeated at a water pressure of 2,5 bar.

8.5.6 Adjustment of the water rate - Water temperature

8.5.6.1 Fixed output or adjustable output appliances

8.5.6.1.1 Normal and high water pressure appliances fitted exclusively with a preset water rate adjuster

8.5.6.1.1.1 Requirement

Under the test conditions of 8.5.6.1.1.2, it shall be possible to adjust the appliances to a water rate corresponding to a temperature rise of not less than 50 K.

8.5.6.1.1.2 Test

The test is carried out with a water supply pressure of 6 bar, with one of the reference gases at the nominal heat input. Any water rate adjuster is adjusted to obtain the maximum water temperature at the nominal heat input.

8.5.6.1.2 Normal and high water pressure appliances with water rate governor and temperature selector

8.5.6.1.2.1 Requirement

With the temperature selector or summer-winter switch, if any, adjusted so as to give the maximum temperature and at a water pressure at 0,5 bar, a corrected heat input (see 6.3.1.2) of not less than 95 % of the heat input obtained in 6.3.2.1 when there is no preset gas rate adjuster, or the nominal heat input when there is a preset gas rate adjuster, shall be obtained.

Within the pressure range 0,6 bar to 6 bar, the water rate shall remain below that corresponding to a temperature rise of 50 K.

With the water temperature selector adjusted so as to give the minimum temperature, the water rate shall remain equal to or above that corresponding to the temperature rise stated in the technical instructions when the pressure is varied from 2 bar to 6 bar.

In addition, the maximum permitted deviation of the water rate in relation to the mean rate is given in Table 14.

Table 14 —Maximum permitted deviation for the water rate in relation to the mean rate

Test	Adjustment of the temperature selector so as to obtain	Variation of the water pressure (bar)	Values obtained for the water rate	Maximum permitted deviation for the water rate [a]
n° 1	Maximum water temperature	from 0,6 to 6	minimum maximum mean	±10 %
n° 2	Maximum water temperature	from 6 to 10	minimum maximum mean	±20 %
n° 3	Water rate corresponding to a temperature rise of 30 K at a pressure of 2 bar	from 2 to 6	minimum maximum mean	±10 %
n° 4	Water rate corresponding to a temperature rise of 30 K at a pressure of 2 bar	from 6 to 10	minimum maximum mean	±20 %
[a] The maximum deviations for each test are obtained by taking the difference between the minimum and maximum values observed during the test and the mean value calculated by taking the arithmetic mean of the minimum and maximum values. These deviations are expressed as a percentage of the mean value.				

8.5.6.1.2.2 Test

The test is carried out with one of the reference gases at the corresponding normal pressure. The water temperature is adjusted and the water pressure varied in accordance with Table 14.

8.5.6.1.3 Low water pressure appliances

8.5.6.1.3.1 Requirement

For low water pressure appliances, the conditions of 8.5.6.1.1 or 8.5.6.1.2 are verified at the minimum and maximum water pressures specified in the technical instructions.

8.5.6.1.3.2 Test

The test is carried out with one of the reference gases at the corresponding normal test pressure.

8.5.6.2 Appliances with automatic output variation

8.5.6.2.1 Normal and high water pressure appliances

8.5.6.2.1.1 Proportioning appliances

Requirements

Proportioning appliances with a temperature selector or manual summer-winter switch shall permit:

— a water temperature rise of not less than 50 K at one point at least in the output range between (52 ± 2) % and (100 ± 5) % of the nominal heat input;

— and 45 K minimum over the remainder of this same range.

For appliances with an automatic summer-winter switch:

— there shall be at least one point in the output range between (52 ± 2) % and (100 ± 5) % of the nominal heat input at which water is delivered at a temperature of not less than 55 °C;

— over the remainder of this same range, the delivered water shall have a temperature of not less than 50 °C.

Tests

The appliance shall first be supplied with one of the reference gases and operated for about 20 min with a water rate sufficient for the gas valve to be fully open.

The water temperature selector or the summer-winter switch, if manual, is set to the position giving the maximum temperature. The water inlet pressure is kept at 1,2 bar.

Only the following tests are carried out:

The water rate is reduced so that the appliance operates successively at the conditions in the range of automatic output variation corresponding to (100 ± 5) % and then (52 ± 2) % of the nominal heat input.

It is verified that, at these two operating points, the water temperature rise is not less than 45 K.

Then, if at one or other of these points the water temperature rise does not reach 50 K, a supplementary test is carried out at a point stated in the technical instructions in the above range (100 ± 5) % to (52 ± 2) %, where it is verified that a temperature rise of not less than 50 K is effectively obtained.

When the summer-winter switch is automatic, the appliance is supplied with water maintained at a temperature of (5 ± 2) °C and the preceding tests are then carried out, verifying that temperatures of 50 °C and 55 °C are obtained, instead of the specified respective temperature rises of 45 K and 50 K. The corresponding temperature rises obtained are noted.

These tests are repeated with a water inlet pressure kept at 6 bar.

8.5.6.2.1.2 Thermostatic appliances

Requirements

a) there shall be at least one point in the output range between (52 ± 2) % and (100 ± 5) % of the nominal heat input at which water is delivered at a temperature of not less than 55 °C:

   — over the remainder of this same range, the delivered water shall have a temperature of not less than 50 °C.

b) the difference between the outlet water temperatures T_1 and T_2 measured for inlet water temperatures of (5 ± 2) °C and (15 ± 2) °C respectively shall not exceed 5 °C.

Tests

The appliance shall first be supplied with one of the reference gases for its category and operated for about 20 min with a water rate sufficient for the gas valve to be fully open.

The thermostat, if adjustable, is set to the position giving the maximum temperature. The supply pressure is kept at 1,2 bar. The temperature of the cold water is (15 ± 2) °C.

a) Only the following tests are carried out:

— the water rate is reduced so that the appliance operates successively at the conditions in the range of automatic output variation corresponding to (100 ± 5) % and then (52 ± 2) % of the nominal heat input.

It is verified that, at these two operating points, the water outlet temperature is not less than 50 °C.

Then, if at one or other of these points, the water temperature does not reach 55 °C, a supplementary test is carried out at a point in the range of automatic output variation specified in the technical instructions, where it is verified that an outlet temperature of not less than 55 °C is effectively obtained. If necessary, a test at another point in the range may be carried out.

Then all of these tests are repeated with a water inlet pressure kept at 6 bar.

b) With an inlet water temperature of (5 ± 2) °C, the water rate is adjusted to obtain a heat input equal to (95 ± 5) % of the nominal heat input.

The outlet water temperature T_1 is measured in the steady-state. Without changing the adjustment of the appliance, the inlet water temperature is raised to (15 ± 2) °C. The outlet water temperature T_2 is measured in the steady-state.

8.5.6.2.1.3 All appliances

Requirement

When there is a summer-winter switch or a water temperature selector, it shall be possible, over the whole output range between (52 ± 2) % and (100 ± 5) % of the nominal heat input, to obtain a reduction of the temperature rise stated in theuser instructions.

Test

The appliance shall first be supplied with one of the reference gases for its category and operated for about 20 min with a water rate sufficient for the gas valve to be fully open.

After the tests 8.5.6.2.1.1 and 8.5.6.2.1.2, the temperature selector or the summer-winter switch, if manual, is set to the position giving the minimum temperature.

Verification is carried out by correlation with the temperature rises or temperatures measured during the two corresponding tests above.

When the appliance has an automatic summer-winter switch, it is supplied keeping the water inlet temperature at (20 ± 2) °C and verification is carried out by correlation with the temperature rises or temperatures measured during the corresponding tests of 8.5.6.2.1.1 and 8.5.6.2.1.2.

8.5.6.2.2 Low water pressure appliances

8.5.6.2.2.1 Requirement

Low pressure appliances shall satisfy the specifications of 8.5.6.2.1.

8.5.6.2.2.2 Test

For low pressure appliances, the specifications of 8.5.6.2.1 are verified under the test conditions of 8.5.6.2.1, replacing 1,2 bar by the minimum water pressure specified in the technical instructions, and 6 bar by the maximum water pressure specified in the technical instructions.

8.5.6.2.3 Temperature variation according to the water rate (high, normal and low pressure appliances)

8.5.6.2.3.1 Requirement

The variation of the mean temperature at the water outlet (absolute value of $T_1 - T_2$) resulting from variations in output demand shall not exceed 10 K.

8.5.6.2.3.2 Test

The appliance is supplied with each of the reference gases.

The water pressure, measured at the appliance inlet connection, is between 2 bar and 6 bar for normal and high pressure appliances and between the minimum and maximum pressures specified in the technical instructions for low pressure appliances.

The appliance water rate is adjusted to give a heat input of (52 ± 2) % of the nominal heat input and temperature T_1 is measured. The water rate is then adjusted to give 95 % of the nominal heat input and temperature T_2 is measured.

8.5.6.2.4 Temperature fluctuation (high, normal and low pressure appliances)

8.5.6.2.4.1 Requirement

The temperature fluctuations at the water outlet, 60 s after the delivery tap has been turned on, shall not exceed 5 K.

8.5.6.2.4.2 Test

The appliance is supplied with each of the reference gases.

The water pressure, measured at the appliance inlet connection, is between 2 bar and 6 bar for normal and high pressure appliances and between the minimum and maximum pressures specified in the technical instructions for low pressure appliances.

The test consists of three stages:

1st stage: the test is started cold at the minimum water rate that allows the nominal heat input to be obtained, wait 60 s then record the hot water temperature for 10 min.

2nd stage: reduce the water rate to 3/4 of the value found in the 1st test, wait 60 s then record the hot water temperature for 10 min.

3rd stage: reduce the water rate to 55 % of the value found in the 1st test, wait 60 s then record the hot water temperature for 10 min.

In each of these three stages, it is verified that the above requirements are observed.

8.5.7 Heating-up time

8.5.7.1 Requirement

The heating-up time shall be less than:

— 25 s for appliances with a nominal useful output not exceeding 17 kW;

— 35 s for appliances with a nominal useful output exceeding 17 kW.

8.5.7.2 Test

The appliance is supplied with one of the reference gases and adjusted to the nominal heat input.

The water outlet temperature shall be measured by means of a rapid-response thermometer.

The ambient temperature shall be higher than the water inlet temperature.

The water inlet temperature shall be (15 ± 2) °C.

The water rate and the means of temperature adjustment are adjusted, where possible, to give, at the nominal heat input and in the steady-state condition, the water temperature conditions stated in Table 15 below, according to the control mode of the appliance.

Table 15 — Water temperature conditions depending on the control mode of the appliance

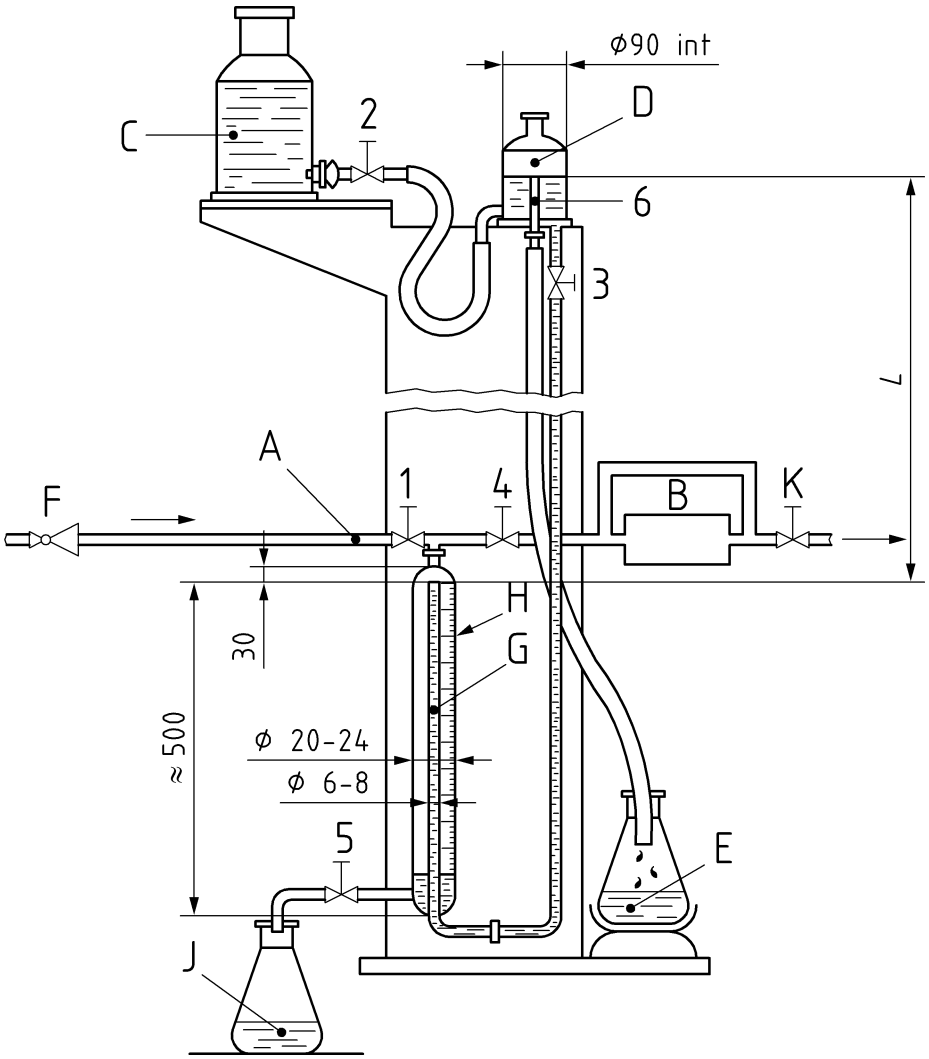
Control mode of the appliance	Temperature rise (ΔT_r) or outlet temperature (T_r) in the steady-state	Temperature conditions defining the heating-up time
Fixed or adjustable output	ΔT_r = 50 K	ΔT = 0,9 ΔT_r (K)
Proportioning	ΔT_r = 45 K	ΔT = 0,9 ΔT_r (K)
Thermostatic	T_r > 50 °C	T = (T_r - 5) °C

The steady-state condition having been established, the gas supply to the burner is shut off without changing the water rate. As soon as the water outlet temperature is within 1 K of the inlet temperature, the gas is ignited at the burner.

The time is measured that elapses between the moment when gas is restored and the moment when the temperature rise or temperature of the water outlet reaches the value defining the heating-up time given in Table 15.

8.5.8 Specific rate

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

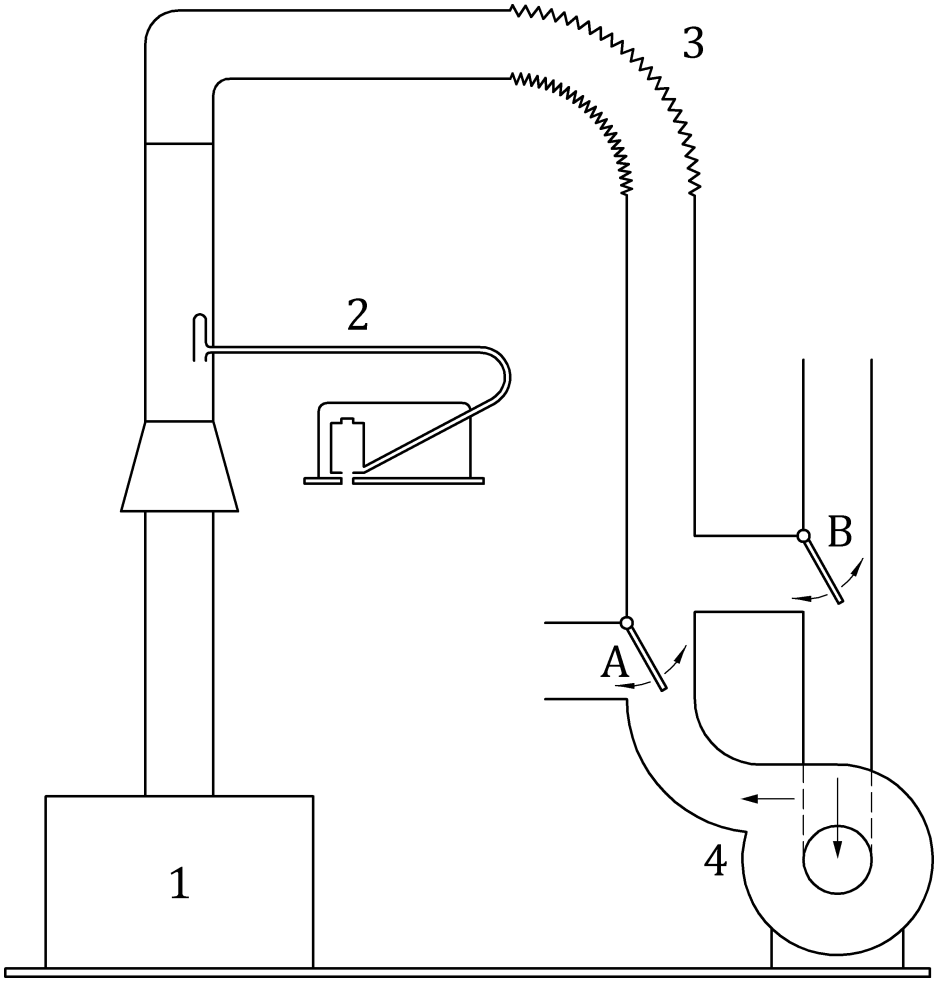


Key

A	inlet
B	sample to be tested
C	water reservoir
D	constant level vessel
E	overflow from constant level vessel
F	pressure regulator
G	tube
H	burette
J	receptacle for overflow from burette
K	downstream tap
1 to 5	manually operated taps
6	tube Ø 10 to 12

Figure 1 — Apparatus for verifying soundness of the gas circuit (see 6.1.6.5, 6.2.1.3 and Annex E)

Dimensions in millimetres

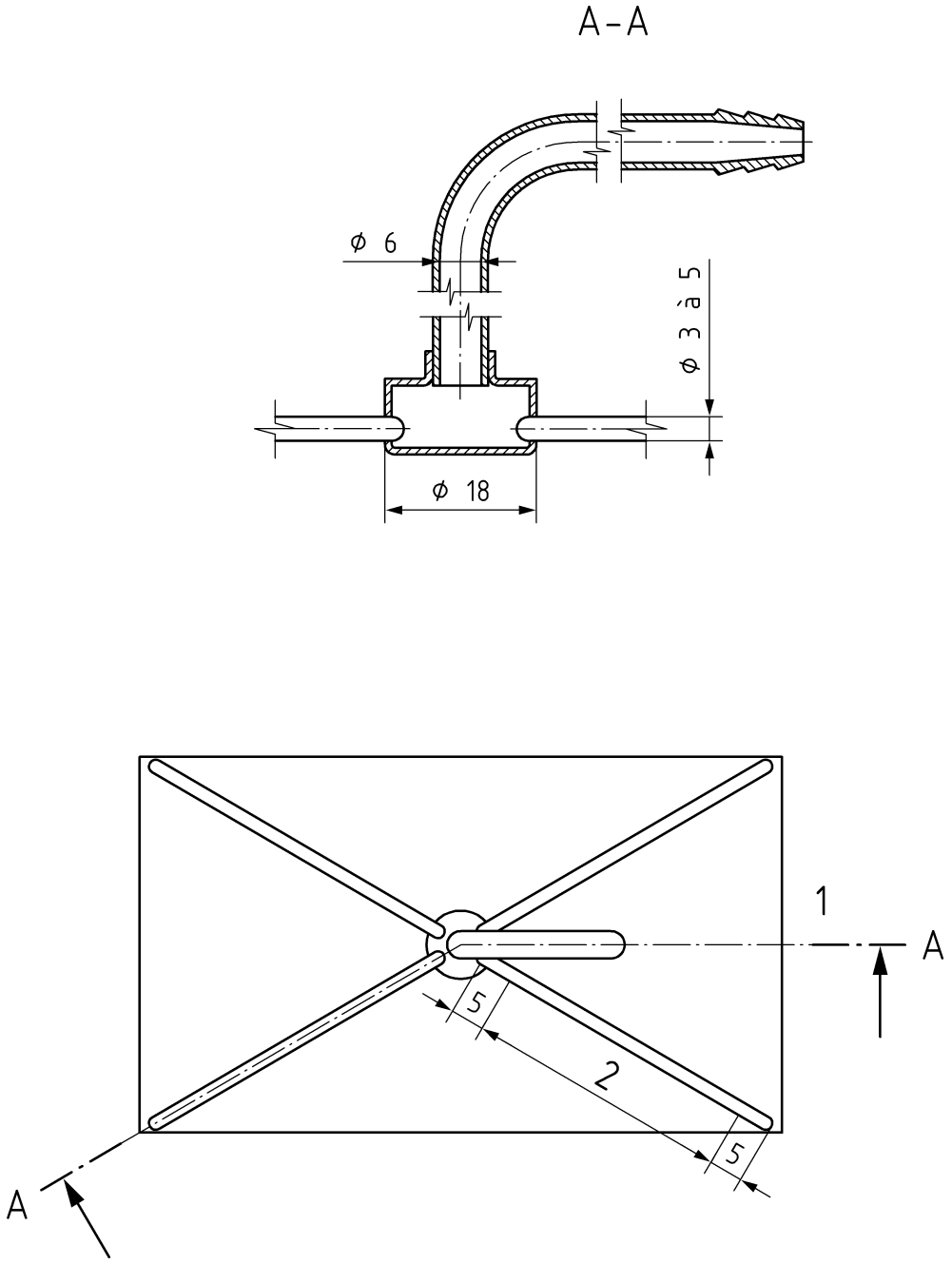


Key

A and B:	by-pass valves to obtain either a downdraught or a suction
1	water-heater
2	speed measured by means of a Pitot tube
3	hose
4	fan

Figure 2 — Test of an appliance of types B_{11} and B_{11BS} under abnormal draught conditions (see 6.7.2.2, test n° 3)

Dimensions in millimetres



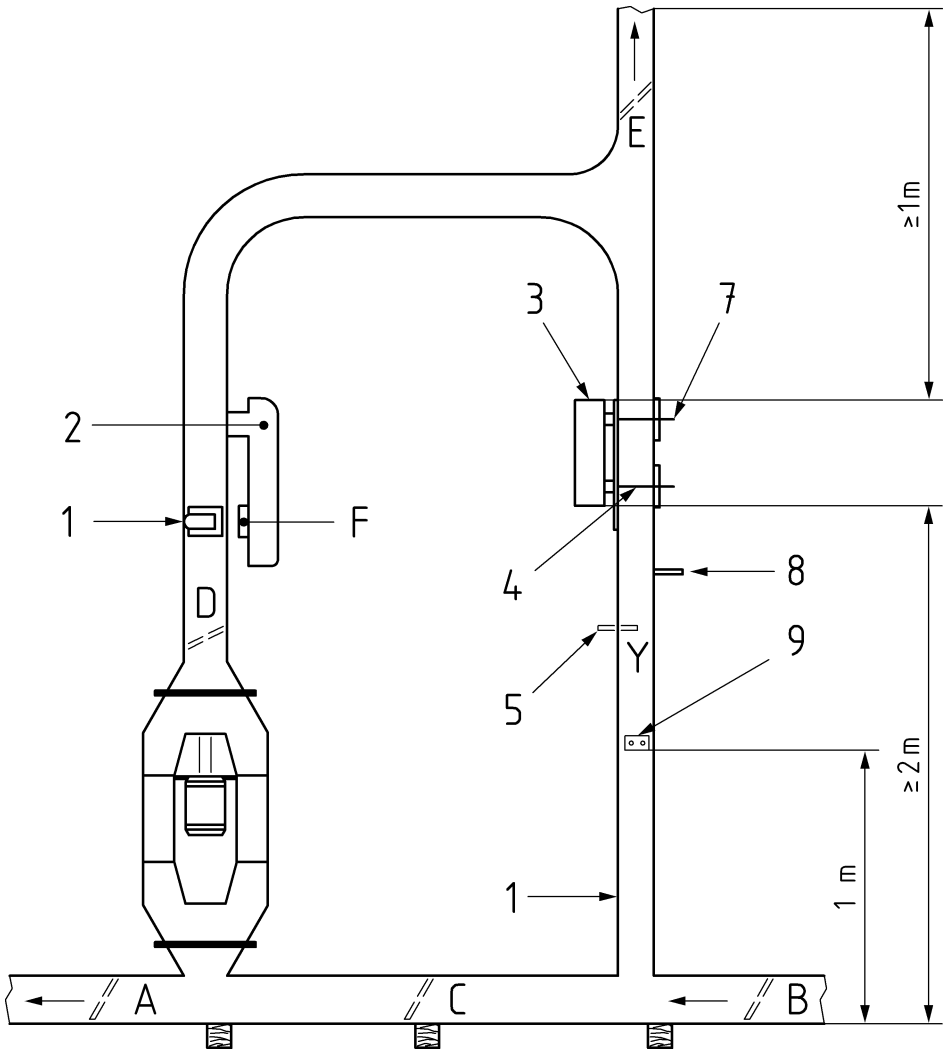
Key

1 *n* = 3 per branche

2 n holes Ø 0,5 distributed symmetrically

The angle between the arms shall be chosen so as to obtain a representative sample.

Figure 3 —Probe for sampling the combustion products of appliances of types B_{11} and B_{11BS} (see 6.9.2.1)

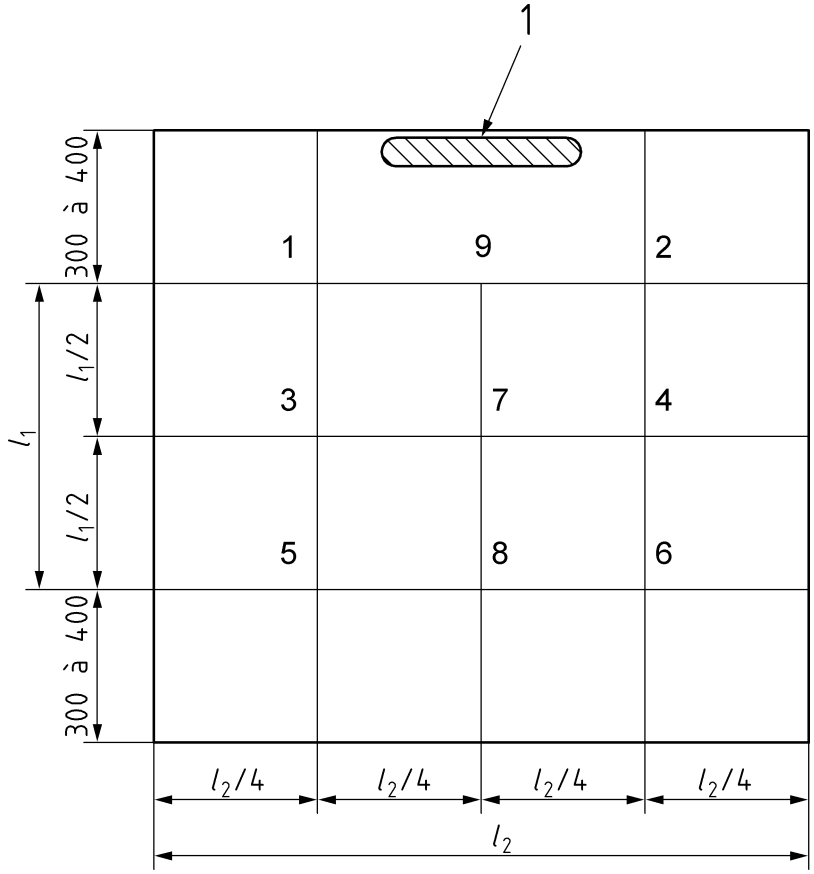


Key

1	duct of rectangular section 225 mm × 400 mm	6	appliance under test
2	temperature probe	7	thermocouple and sampling tube for connection to CO and CO_2 analysers
3	2 recording anemometers (interchangeable)	8	heat exchanger
4	pressure probe	9	length ≥ 1 m
5	connection to CO and CO_2 analysers for upflow vitiation tests	10	length ≥ 2 m
	A, B, C, D, E, F, Y: see Annex C		

Figure 4 —Test of a type C_2 appliance mounted on the common duct (see 6.7.4.2)

Dimensions in millimetres

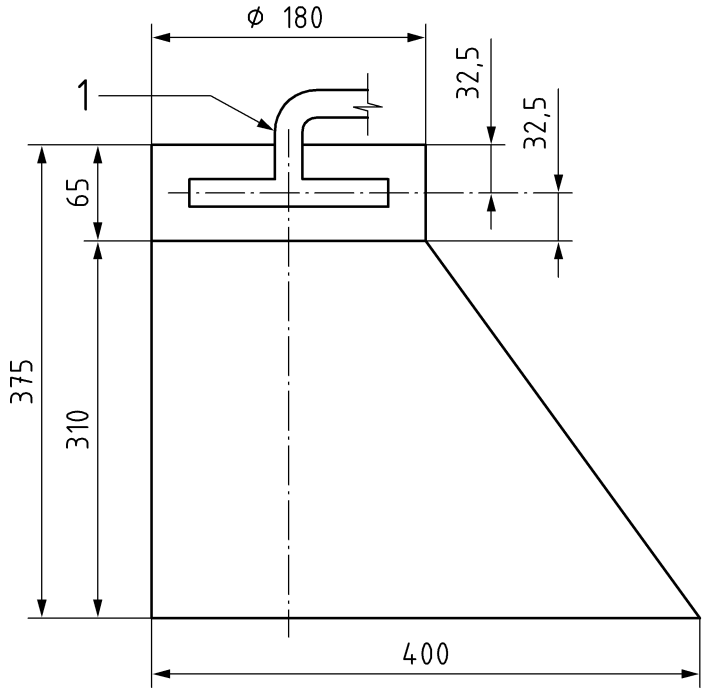


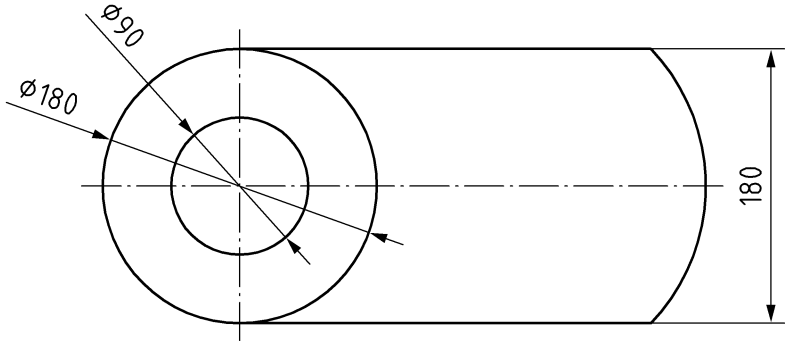
Key

1 appliance under test

Figure 5 —Position of the sampling points in the horizontal plane of the sealed room (see 6.8.10.1.2.1 and Annex D)

Dimensions in millimetres



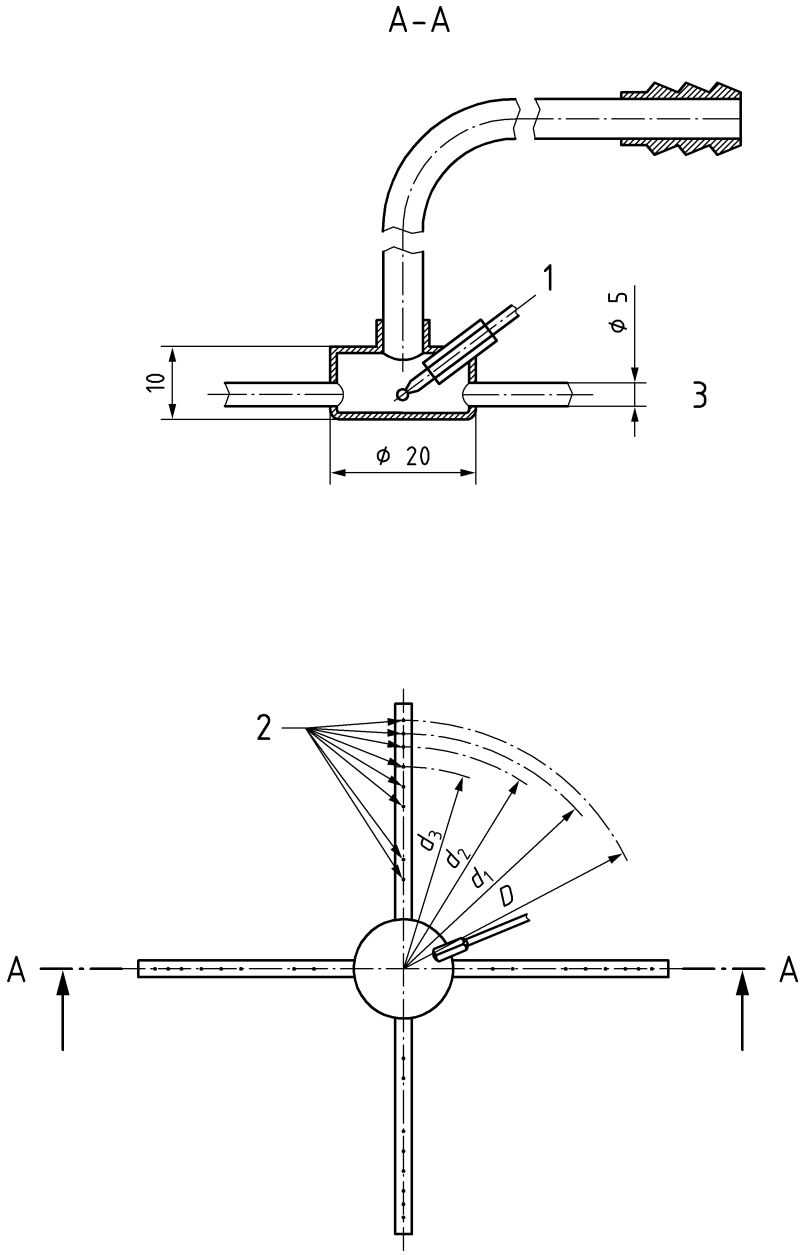


Key

1 sampling probe from Figure 7

Figure 6 —Device for sampling the combustion products above the deflector for type A_{AS} appliances (see 6.8.10.2.1.2 and 6.9.2.1)

Dimensions in millimetres

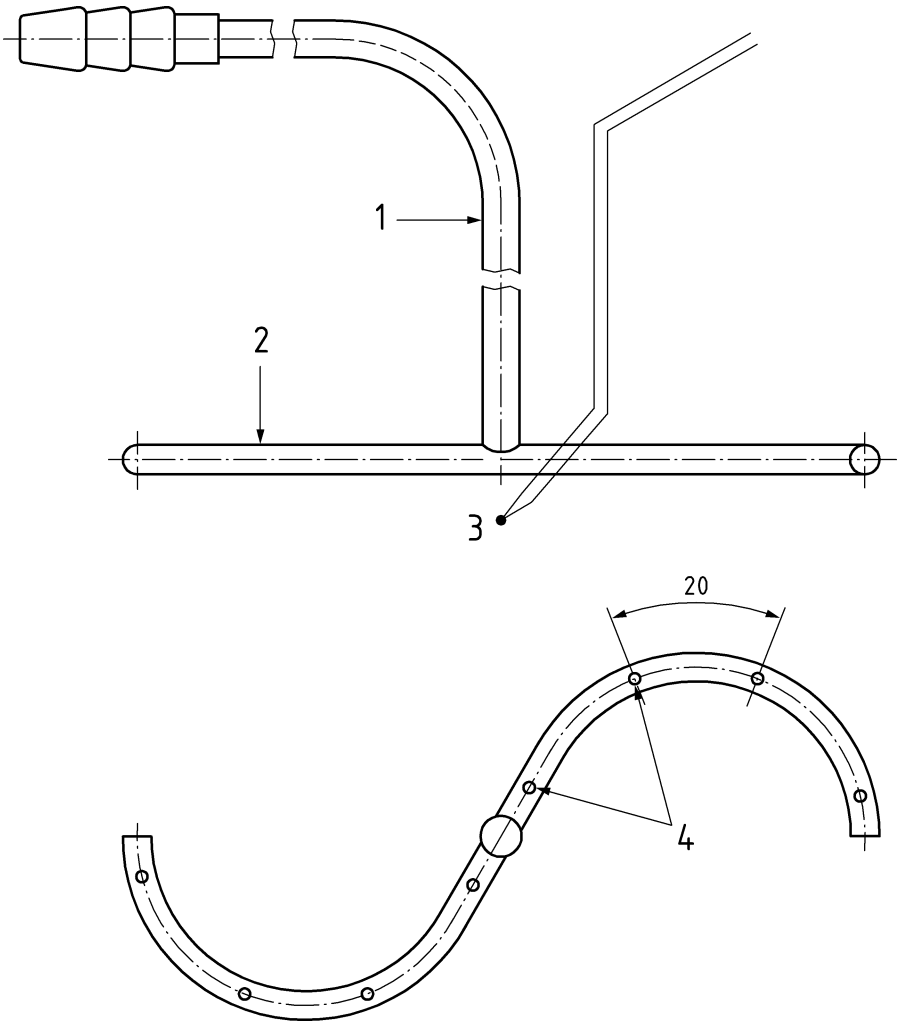


Key

1	thermocouple	d_4	= 0,75 *D*
2	holes in each branch: 8 by ∅ 1	d_5	= 0,66 *D*
d_1	= 0,97 *D*	d_6	= 0,56 *D*
d_2	= 0,90 *D*	d_7	= 0,43 *D*
d_3	= 0,83 *D*	d_8	= 0,25 *D*

Figure 7 —Sampling probe for test flues of diameter equal to or greater than DN 100 (see 6.9.2.1)

Dimensions in millimetres



Key

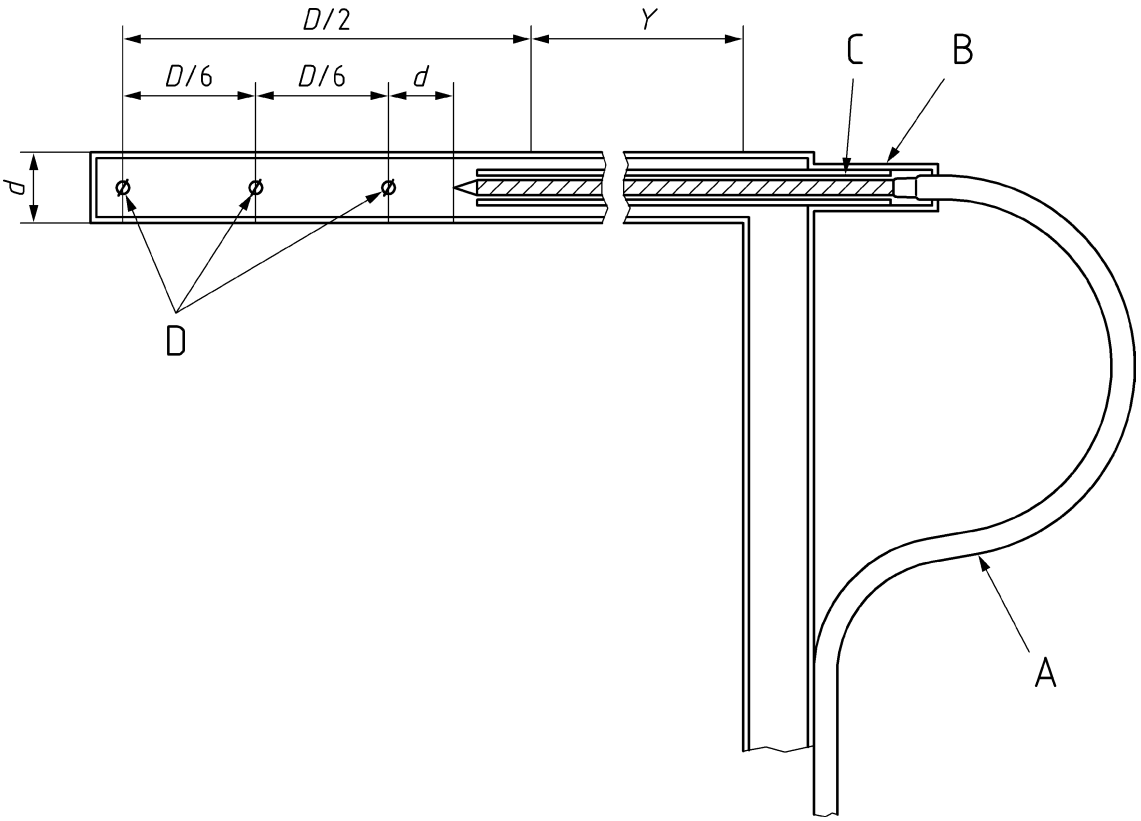
1 tube Ø 6

2 tube Ø 4,3

3 thermocouple

4 holes: 8 of Ø 1

Figure 8 —Sampling probe for test flues of diameter less than DN 100 (see 6.9.2.1)



Key

A thermocouple wires

B insulating cement

C ceramic tube with two ducts

D three sampling holes ø x mm

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 sampling holes (x) 1,0 mm;

— two channel ceramic tube 3 mm diameter with channels of 0,5 mm diameter;

— thermocouple wire 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:

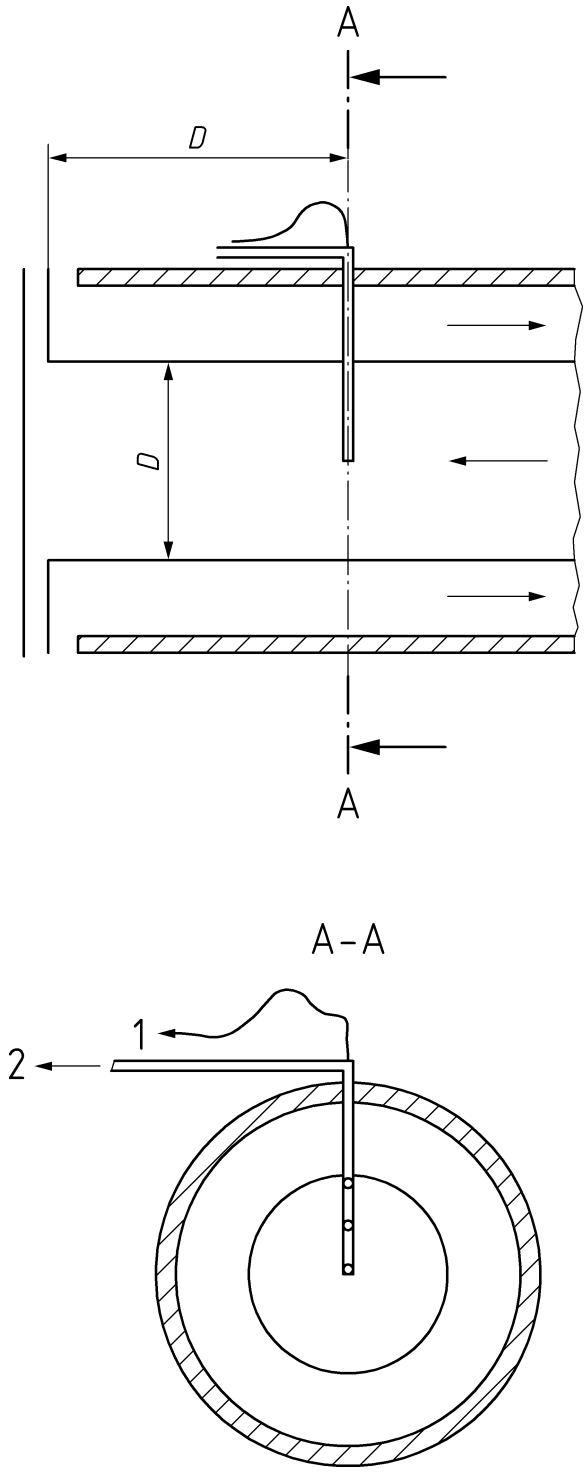
a) the cross-section of the probe shall be less than 5 % of the cross-section of the flue;

b) 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.

Figure 9 —Probe for sampling and measuring the temperature of the combustion products (see 6.9.2.1)

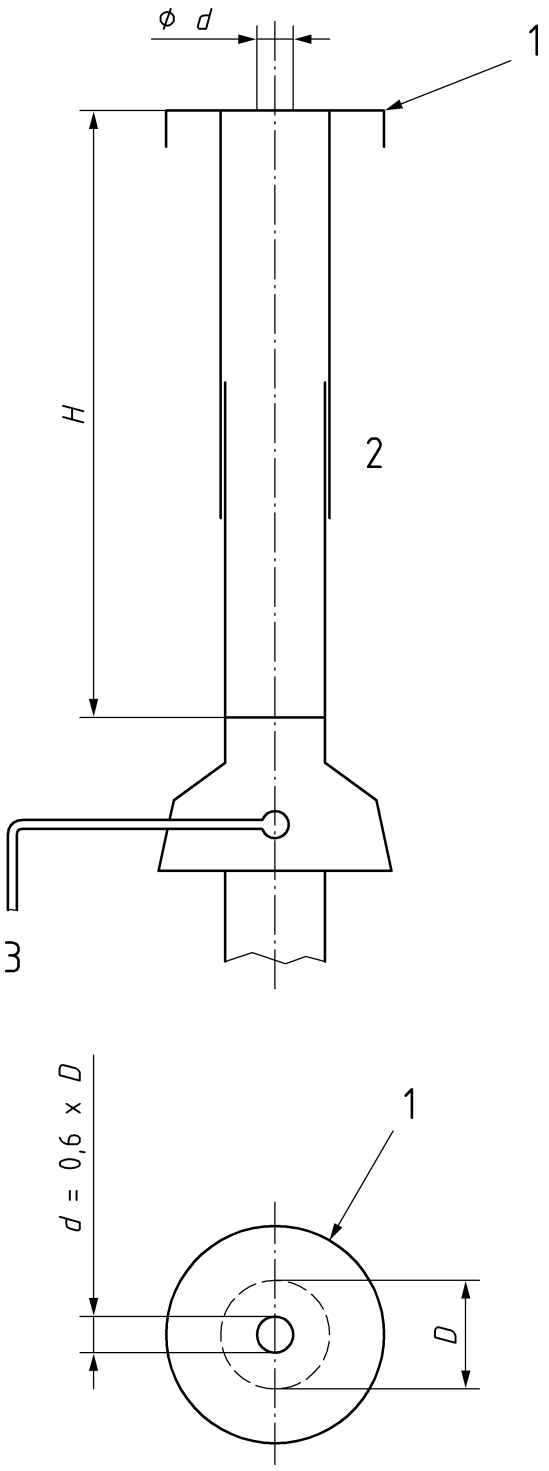


Key

1 to the temperature reader

2 to the sampling pump

Figure 10 —Location of the probe for type C appliances (see 6.9.2.1)



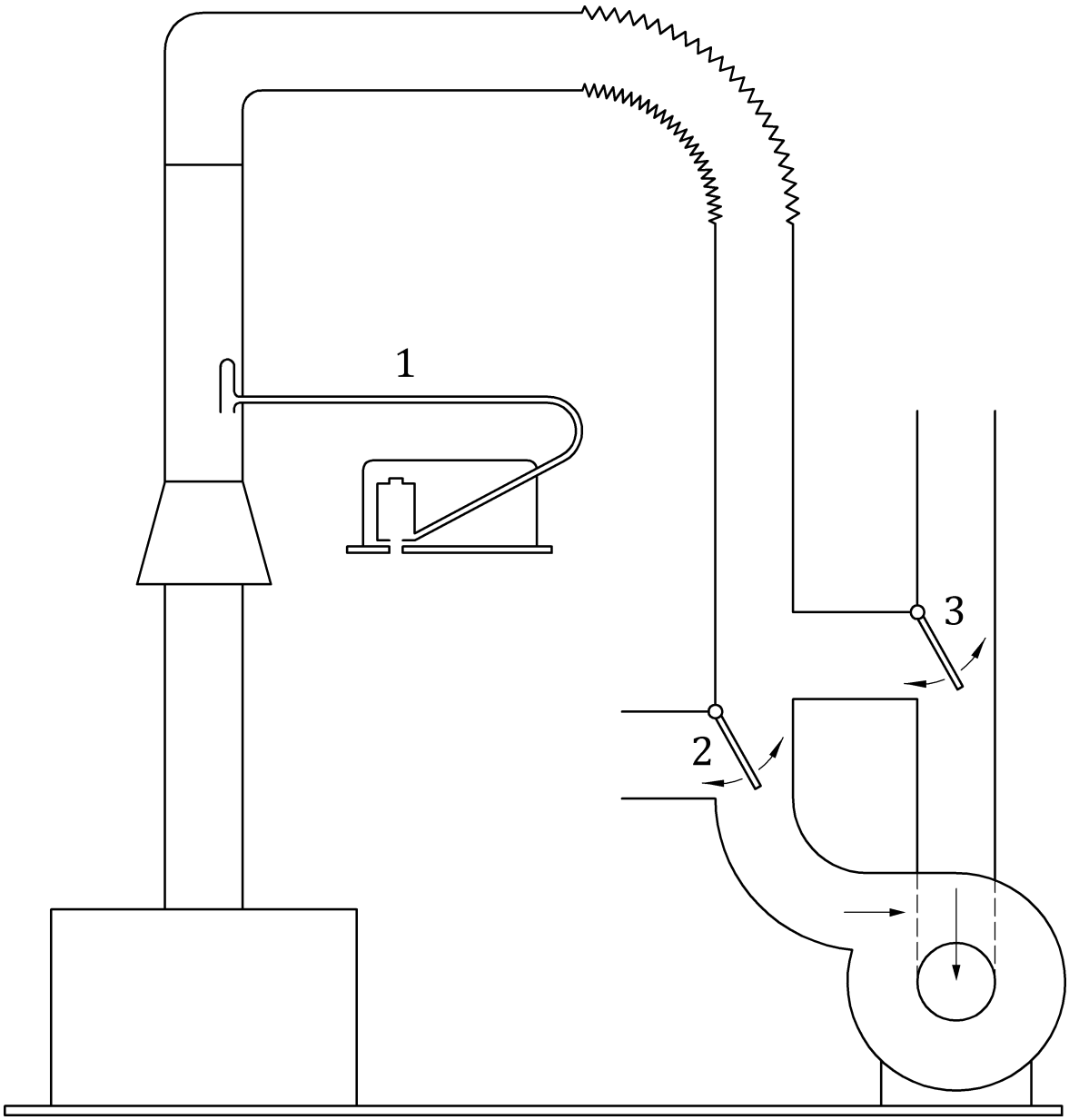
Key

1 plate

2 telescopic test flue

3 detector

Figure 11 —Combustion products discharge safety device for type B_{11BS} appliances (see 6.8.11.4.2.1 and 6.8.11.4.2.2)



Key

1 pilot tube for velocity measurement

2 diverter valve to obtain down draught

3 diverter valve to obtain down draught

Figure 12 —Down-draught test for the type C_7 water heaters (see 6.7.9.2 and 6.9.2.4.10)

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 4.2;

— 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 4.3;

— 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

On an additional plate, the appliance shall carry visible and indelible information relating to its state of adjustment:

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

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

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

9.1.3 Supplementary marking and instructions in the case of water heaters to be installed in partially protected places

9.1.3.1 General information

For appliances intended to be installed in a partially protected place the minimum declared installation temperature, and if necessary the maximum declared installation temperature, shall be indicated.

For example as follows: “This water heater is able to operate in a partially protected place, within the ambient temperatures [minimum ambient temperature] and [maximum ambient temperature]”.

9.1.3.2 Warning on the water heaters and the packaging

Additional to the existing requirements of 9.1.5, the information shall be added that the water heater is intended to be installed in a partially protected place.

9.1.3.3 Technical instructions

Additional to the existing requirements of 9.2, more information shall be added concerning the installation in a partially protected place. All necessary instructions and requirements for a correct installation location, including exterior pipe work, shall be specified.

The frost protection system, if any, shall be described in general terms in the technical instructions for the installer. It shall be included in the technical instructions for the installer that materials used in the installation of the water heater should be such as to maintain their function within the declared installation temperatures (see 9.1.3.1).

This information may be carried on the data plate.

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

9.1.4 Packaging

The packaging shall carry the category(ies), the appliance type and information given on the addition data plate (see 9.1.2) as well as warnings in accordance with 9.1.5.

9.1.5 Warnings on the appliance and the packaging

9.1.5.1 General

One or more labels shall give at least the following warnings, such that they are visible and readable.

Warnings carried on the appliance shall be visible to the user.

9.1.5.2 For all appliances

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

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

and for the appliances intended only for indoor installation:

— “the appliance may only be installed in a room which complies with the appropriate ventilation requirements”;

or for appliances only intended to be installed in a partially protected place or for appliances intended to be installed both indoor and in a partially protected place, a label shall also contain the following information:

— “the appliance may be installed only in a room which complies with the appropriate ventilation requirement or in a partially protected place”.

9.1.5.3 For type A_{AS} appliances

— “appliance fitted with an atmosphere sensing devices”;

— “important:

  — this appliance shall not be connected to a flue,

  — this appliance shall only be used for short delivery periods.”

9.1.5.4 For type B_{11}, B_{12} and B_{13} appliances

— “this appliance shall only be installed outside or in a room separated from inhabited rooms, incorporating appropriate ventilation”.

9.1.5.5 For type A_{AS}, B_{11BS}, B_{12BS} and B_{13BS} appliances

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

9.1.6 Other information

No other information shall be carried on the appliance or the 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.

9.2 Instructions

9.2.1 Installation instructions

9.2.1.1 Introduction

Each appliance shall be accompanied by installation instructions intended for the installer.

These instructions shall at least include the following instructions:

9.2.1.2 General

— the information on the data plate, with the exception of the serial number and the year of manufacturer;

— the meaning of the symbols used on the appliance and its packaging, in accordance with 8.2.1 and 8.2.2;

— reference to certain European Standards and/or particular regulations if these prove to be necessary for the correct installation and use of the appliance;

— where appropriate, the minimum distances to be met from inflammable materials;

— if necessary, information that walls sensitive to heat, for example wood, shall be protected by suitable insulation, such that the clearance between the wall on which the appliance is installed and the hot parts on the outside of the appliance are observed;

— a general description of the appliance, with an illustration of the principal parts (sub-assemblies) which shall be removed to rectify operational faults;

— for electrical installation:

  — the obligation to earth appliances incorporating mains supplied electrical equipment;

  — a circuit diagram with terminals (including those for external control);

  — the recommended method for cleaning the appliance;

  — information on the necessary servicing;

  — the instructions shall also specify the air rate necessary for combustion stating that the appliance is to be installed in a suitably ventiled room, in accordance with the regulations in force.

9.2.1.3 For installation and adjustment of the gas circuit

— checks that the information of 8.2.2 concerning the state of adjustment given on the data plate or the additional plate shall be compatible with the local supply conditions;

— adjustment instructions for appliances which are adjustable, incorporating an adjustment table in which the volume or mass rates in metres cubed per hour (m^3/h) or kilograms per hour (kg/h) are stated, or the burner pressure in relation to the possible adjustment data in accordance with the category(ies). The reference conditions for the volume rates are 15 °C; 1 013,25 mbar, dry gas;

— 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

— the minimum water pressure at which the appliance can operate;

— the minimum water rate for appliances with automatic output variation;

— the maximum pressure for which the appliance is designed, stating that even with the effects of water dilation, the water pressure in the appliance shall not exceed this value.

9.2.1.5 For installation on the combustion products circuit

a) for type A_{AS} appliances:

  — give the necessary information concerning maintenance of the atmosphere sensing device and explain the means of identification appearing on the parts likely to be replaced;

  — state the appliance maintenance operations necessary to enable it to be put back into service after these devices have operated;

  — explain that if this device or one of their parts are dismantled previously existing seals shall be re-made;

  — state that only manufacturer's original parts should be used for replacements;

  — state that the safety device shall not be put out of operation;

  — draw attention to the seriousness of inappropriate interference with the safety device.

b) for type B_{11} and B_{11BS} appliances:

- the diameter(s) of the flues which can be used, in accordance with Table A.2, possibly with an adapter;
- for flue calculations, the mass rate of combustion products, in g/s, and their average temperature measured under the conditions of 6.2.2;
- state clearly that type B_{11} appliances shall only be installed in the open air or in a room which is separated from inhabited rooms and supplied with appropriate ventilation directly to the outside.

c) for type B_{11BS}, B_{12BS}, B_{13BS} 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 should 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 actual waiting time for appliances with an automatic reset.

d) for type C_{11} and C_{21} appliances:

- state the nature of the air supply and combustion products discharge system to which the appliances can be fitted;
- give the particular characteristics of the terminal guard and information on its installation relative to the terminal;
- state the maximum number of bends to be used and the maximum length of the air supply and combustion products discharge ducts.

e) for type C appliances with a fan:

- information about the type of installation for which the water heater is approved;
- give the instruction that the water heater has to be installed with the necessary accessories (e.g. ducts, terminal, duct adapter) supplied with the water heater or give the specification of the necessary accessories that shall be applied;
- give the instructions for the installation of parts intended to be fitted to the water heater;
- state the maximum number of bends to be used and the maximum length and, if necessary, the minimum length of the air supply and combustion products evacuation ducts;
- give the particular characteristics of the terminal guard, where provision for this is made, and information on its installation relative to the terminal;

— in case of separated air supply and combustion products evacuation ducts, and if their tightness characteristics are different, indicate the way of identifying the ducts;

— for type C_1 water heaters, the installation instructions shall state:

  — if the terminal can be installed on the wall and/or on the roof;

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

— for type C_2 water heaters, the installation instructions shall state:

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

— for type C_3 water heaters, the installation instructions shall state:

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

— for type C_4 water heaters, the installation instructions shall state:

  — the minimum and maximum pressure losses permitted in the air supply and combustion products evacuation ducts, or the minimum and maximum lengths 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 can be connected;

— for type C_5 water heaters, the installation instructions shall state:

  — if the terminals for the supply of combustion air and for the evacuation of combustion products are to be installed on opposite walls of the building ; this can be only on the condition that the ignition, cross-lighting, flame stability have been tested with an overpressure on the combustion products evacuation duct (see 6.7.7.2);

— for type C_6 water heaters, the installation instructions shall state:

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

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

  — that the water heater is to be installed with terminals that comply with the requirements of EN 1856 and EN 1859, and whose openings are in zones of similar pressure;

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

— for type C_7 water heaters, the installation instructions shall state:

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

  — that the water heater is not intended to be installed in cases where the roof space is in use, or to be used, as living accommodation;

— for type C_8 water heaters, the installation instructions shall state:

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

f) for type B_2 appliances:

— the diameter(s) of the flues which can be used, in accordance with Table A.2, possibly with an adapter;

— for flue calculations, information on the mass rate of combustion products in g/s and the average temperature measured under the conditions of 7.3.2.

g) for types B_4 and B_5 appliances:

— information about the type of installation for which the water heater is approved;

— give the instruction that the water heater shall be installed with the necessary accessories (e.g. ducts, terminal, fitting piece) supplied with the water heater or give the specification of the necessary accessories that shall be fitted;

— give the instruction for the installation of parts intended to be fitted to the water heater;

— indicate the maximum number of bends to be used and the maximum length and, if necessary, the minimum length of the air supply and combustion products evacuation ducts;

— give the particular characteristics of the terminal guard, where provision for this is made, and information on its installation relative to the terminal.

h) for the appliances intended to be installed in a partially protected place, all necessary instructions and requirements for a correct installation location, including exterior pipe work, shall be specified.

The frost protection system, if any, shall be described in general terms in the technical instructions for the installer. It shall be included in the technical instructions for the installer that materials used in the installation of the water heater should be such as to maintain their function within the declared installation temperatures (see 9.1.3.1).

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, the technical instructions shall state the flue ducts and their accessories to be used, otherwise the technical instructions shall state 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.

9.2.2 User's instructions

9.2.2.1 Introduction

Each appliance shall be accompanied by instructions for the user. They shall include the necessary information on using and maintaining the appliance and incorporate at least the following:

9.2.2.2 General

— point out that an installer should be called on to install and adjust the appliance, where appropriate. Conversion to other gases shall be carried out by a qualified installer, as described in installation instructions;

— specify the operations to start and stop the appliance;

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

— explain any necessary precautions to be taken against frost;

— warn against incorrect use;

— forbid any interference with a sealed component;

— point out that appliances should be checked and maintained periodically by a competent person;

— if necessary, draw the user's attention to the risks of burning if in direct contact with the viewing window, or its immediate surroundings, or other parts likely to reach temperature rises greater than 40 K under the conditions of 6.6.2.

9.2.2.3 For type A_{AS} appliances

— point out the role of the atmosphere sensing device;

— explain the normal conditions of use of appliances not connected to a flue, in particular, specify that the use shall be intermittent;

— draw attention to the need to have this device periodically maintained by a specialist;

— state the conditions under which an attempt can be made to put the appliance back into service after shutdown caused by the atmosphere sensing device (in particular state that the room in which the appliance is installed shall then be ventilated);

— explain that only a specialist may attend to the appliance if it persistently cannot be put back into service;

— specify that in the event of repeated locking out or of difficulties in putting the appliance back into service, the ventilation shall be checked and a specialist called.

9.2.2.4 For type B_{11BS}, B_{12BS}, B_{13BS} 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;

— recommend that a specialist is called if there are repeated interruptions.

9.2.2.5 For type C appliances

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

Mention that a water heater of type C_7 is not intended to be installed in cases where the roof space is in use, or to be used, as living accommodation.

9.2.2.6 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.

9.2.3 Conversion instructions

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

The instructions shall:

— specify the parts necessary to carry out the conversion and their means of identification;

— clearly specify the operations necessary to change the parts and make the correct adjustment, where appropriate;

— specify that any broken seals shall be re-made and/or any adjusters shall be sealed;

— state that for appliances operating with a pressure couple, any governor shall either be made inoperative within the range of normal pressures, or be put out of operation and sealed in that position;

— for type A_{AS} appliances, describe the measures to be taken with respect to the vitiation sensing device.

A self-adhesive label which is intended to be fitted on the appliance shall be supplied with the parts and the conversion instructions. The supplementary marking specified in 9.1.2, indicating the appliance conversion, shall be stated on the label.

9.3 Presentation

All the 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 boiler 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 6.9.3.

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 not exceed the value given in the existing regulation.

10.3 Additional product information

Additional product information shall include the data listed in the existing regulation.

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 with one of the reference gases or distributed gases for the category concerned at the nominal heat input and at the nominal water temperature (see 6.1.6.6.2, with (40 ± 1) K temperature rise).

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.

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 Table A.1.

Table A.2 shows the national situations concerning European Standard flue pipe diameters.

A.2 Gas connections in common use in the various countries

Table A.1 shows the national situations concerning the various types of gas connections specified in 5.1.6.

Table A.1 — Gas connections in common use

Country code	Category I3						Other categories				
	Threaded connections		Plain connections	Compression joints	Other connections in 5.1.6	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

Table A.2 shows the national situations concerning European Standard flue pipe diameters.

Table A.2 — Flue pipe diameters marketed

Dimensions in millimetres

Country	Diameter	Diameters of combustion products flues
AT	internal	60 - 70 - 80 - 90 - 100 - 110 - 120 - 130 - 140 - 150 - 160 - 170 - 180 - 200
BE		No standards
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 flutes 92 - 117 - 146 - 171 fibre cement flues
GR	?	
IE	internal	75 - 101 - 126 - 152 metal flutes 84 - 109 - 136 - 162 fibre cement flues
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 standards
PT		83 - 97 - 111 - 125 - 139 - 153 - 167 - 180
SE	?	
SI	internal	60 - 70 - 80 - 90 - 100 - 110 - 120 - 130 - 140 - 150 - 160 −170- 180 - 200
SK		

Annex B
(normative)

Test apparatus for type C_1, C_3, B_4 and B_5 water heaters (see 6.7.3.2)

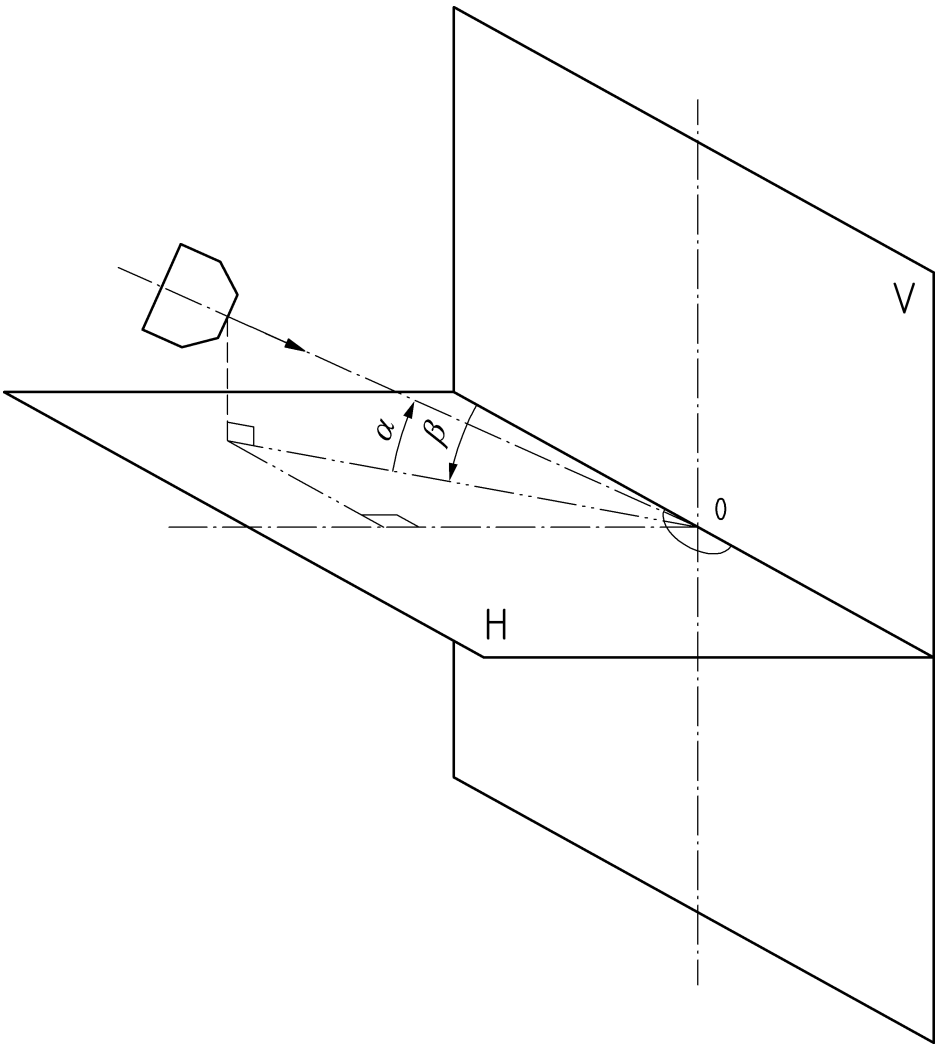
The characteristics of the wind generator and the distance from the test wall at which it is placed are chosen such that the following criteria are met at the level of the test wall, after the central panel has been removed:

— the wind front is either approximately 90 cm square of circular section with a diameter of 60 cm;

— wind speeds of 1 m/s, 5 m/s and 10 m/s with an accuracy of 10 % shall be obtained;

— the wind stream is essentially parallel and has no residual rotational movement.

If the central removable panel is not large enough to allow checking of these criteria, they are 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

H horizontal

V vertical

α = 0° (horizontal winds) + 30° and - 30°

ß = 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 ß 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 m x 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 described in the installation instructions.

Figure B.1 —Test apparatus for type C_1, B_4 and B_5 water heaters fitted with a horizontal terminal installed on a vertical wall

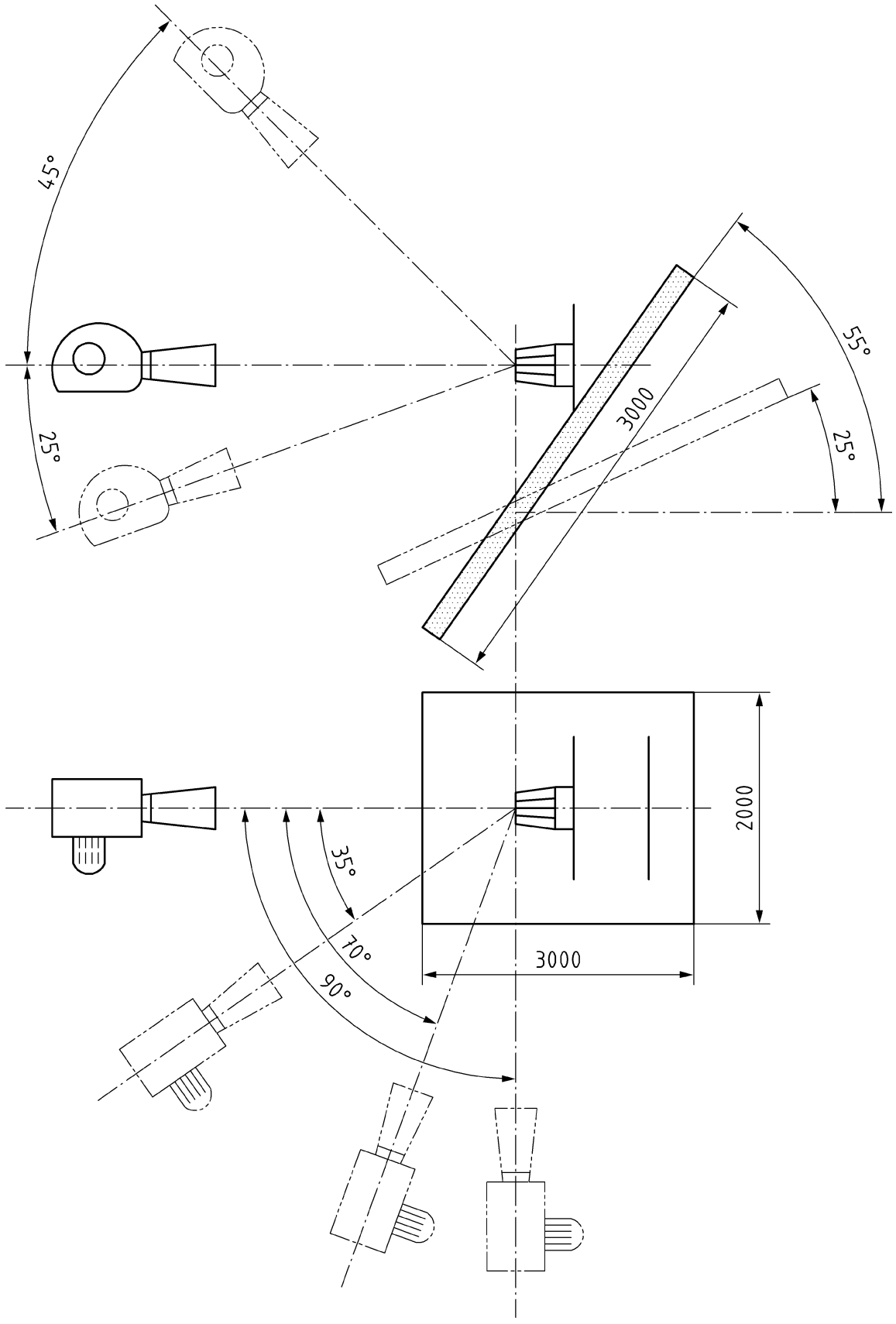


Figure B.2 —Test apparatus for type C_1, B_4 and B_5 water heaters fitted with a horizontal terminal installed on an inclined wall

Dimensions in millimetres

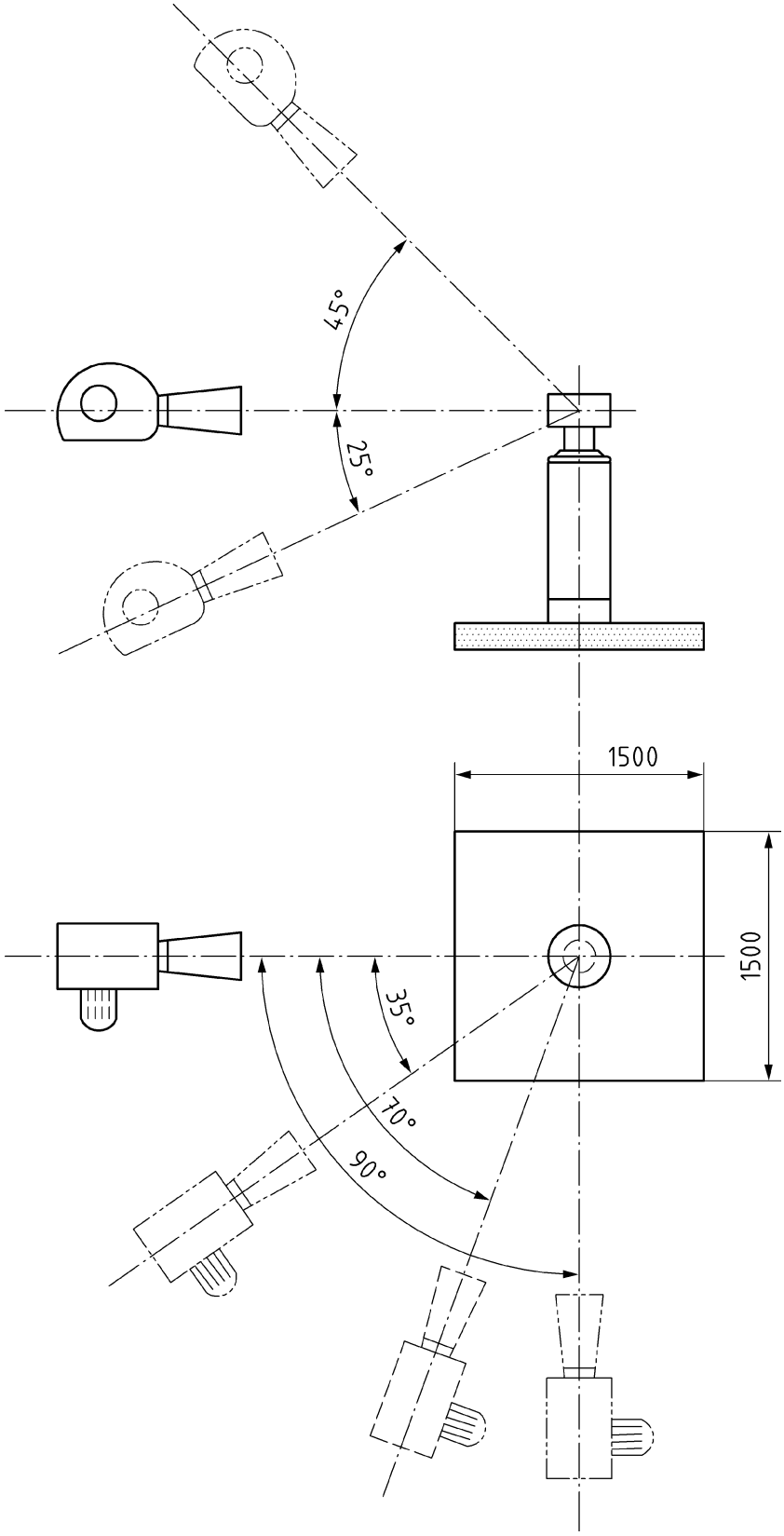


Figure B.3 —Test apparatus for type C_3, B_4 and B_5 water heaters fitted with a vertical terminal installed on a horizontal wall

Dimensions in millimetres

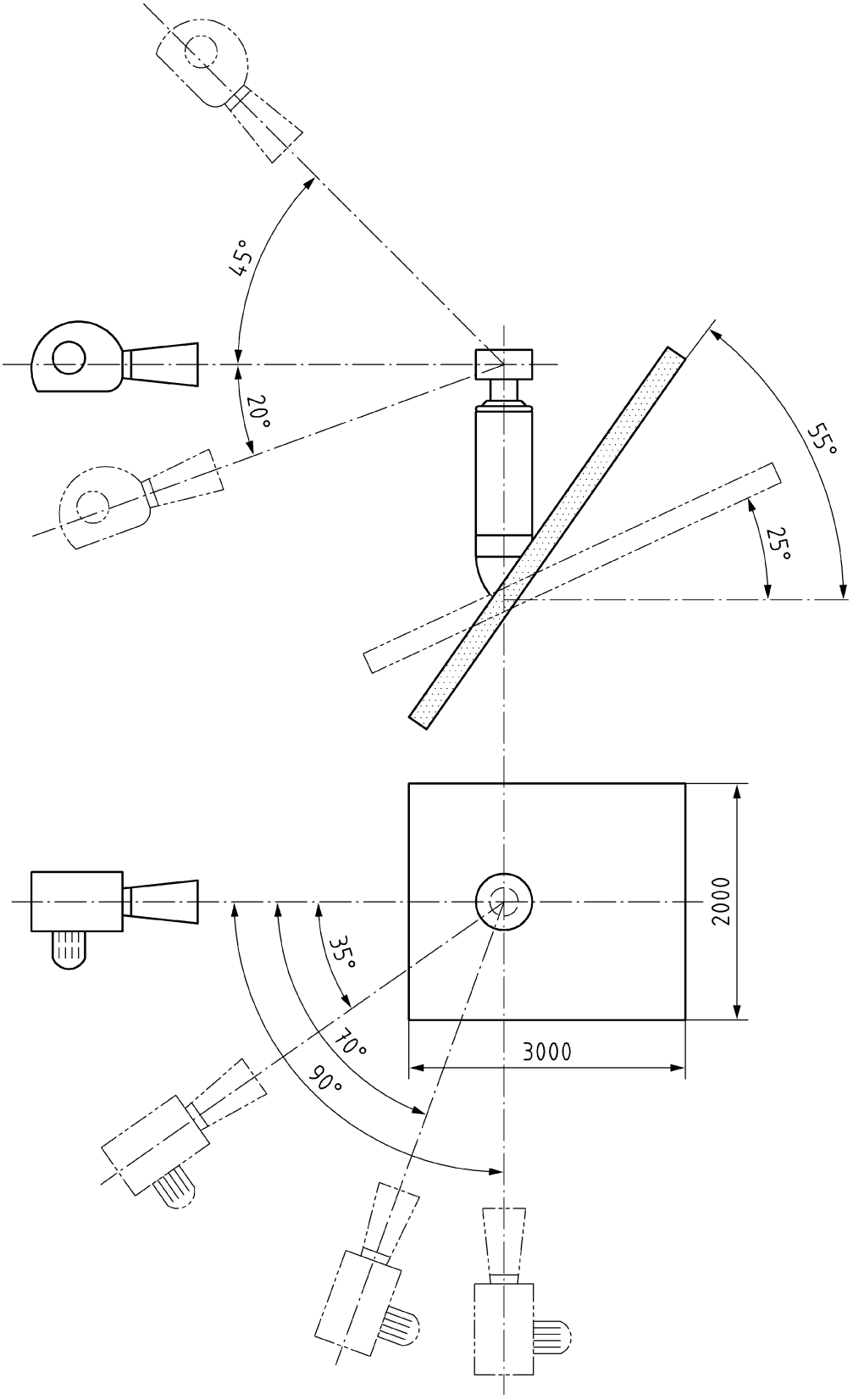


Figure B.4 —Test apparatus for type C_3, B_4 and B_5 water heaters fitted with a vertical terminal installed on an inclined wall

Annex C
(normative)

Test apparatus for type C_{21} appliances (see 6.7.4.2)

A suitable test rig is shown diagrammatically in Figure 4. 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 slide F.

The appliance tested is mounted on the longest side of the duct. It is positioned at least 2 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 6.7.4.2 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 (1) in order to reduce the temperature of the circulated combustion products, measured at Y, to within the limits specified in 6.7.4.2. In practice, if the duct is made of metal it is probable that this heat exchanger will not be required.

Annex D
(normative)

Description of the sealed room for the tests of type A_{AS} appliances (see 6.8.10.1.2.1)

D.1 Configuration of the sealed room

Volume: (9 ± 1) m^3

Height to ceiling: (2,5 ± 0,2) m

Maximum difference between length and width (internal surfaces): 0,50 m

D.2 Soundness of the room

A homogeneous content of (4,0 ± 0,2) % of CO_2 is established in the test room by releasing CO_2 from a cylinder, and it is verified that after one hour this content has decreased by less than 0,15 % of CO_2.

D.3 Effectiveness of mixing

The atmosphere of the room is mixed so as to obtain good reproducibility of the results. The rate of circulation of the air is (80 ± 10) m^3/h. The effectiveness of the mixing is verified by measuring the percentage of CO_2 at various points.

The sampling points are distributed as follows:

Horizontally, at three levels located 0,7 m, 1,5 m and 2 m from the floor.

Vertically, in three vertical planes of which one passes through the geometric centre of the room, and the other two are equidistant from the first and at least 30 cm from the walls (see Figure 5).

The mixing is regarded as good if the CO_2 contents at all the sampling points do not differ by more than 0,1 % CO_2.

D.4 Equipment of the room

In addition to means of mixing, the test room shall contain:

— supplies of the various gases;

— a sink having the following approximate useful dimensions:

  — width: (40 ± 10) cm;

  — length: (50 ± 10) cm;

  — depth: (10 ± 3) cm;

and with its base located 0,7 m from the floor,

— a drain for the waste water.

Annex E
(informative)

Soundness of the gas circuit test - Volumetric method (see 6.1.6.5 and 6.2.1.3)

E.1 Equipment

A piece of apparatus can be 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 steady state.

Any leak is shown by an overflow of water from tube G into the burette H.

Annex F
(informative)

Principal symbols and abbreviations used

Net calorific value	H_i
Gross calorific value	H_s
Density	d
Wobbe index gross	W_i
Wobbe index net	W_s
Normal test pressure	p_n
Minimum test pressure	p_{min}
Maximum test pressure	p_{max}
Water pressure	p_w
Minimum water rate	D_m
Specific rate	D
Volume gas rate under test conditions	V
Volume gas rate under reference conditions	V_r
Volume gas rate	V_n
Mass rate	M
Nominal mass rate	M_n
Heat input	Q
Nominal heat input	Q_n
Minimum heat input	Q_m
Corrected heat input	Q_c
Useful output	P
Nominal useful output	P_n
Minimum useful output	P_m
Useful efficiency	η_u
Volume consumption	V_η
Mass consumption	M_η
Ignition opening time	T_{IA}
Ignition safety time	T_{SA}
Maximum ignition safety time	T_{SAmax}
Extinction delay time	T_{IE}
Extinction safety time	T_{SE}

Annex G
(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 H
(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 (Gas Appliance Directive).

NOTE (from 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 instantaneous water heaters for the production of domestic hot water fitted with atmospheric burners and having heat inputs over 35 kW, the limit values for the energy requirements (flue losses, standby 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 I
(normative)

Lists of materials currently used

I.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 this European Standard.

NOTE The lists of materials provided by this annex are not an exhaustive list of materials to be used in the context of the present document.

I.2 Special types of steel

Table I.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

I.3 Copper and copper alloys

Table I.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

I.4 Plastic materials

Table I.3 — Examples of plastic materials

Material	Abbreviation	Area of application
Unplasticized polyvinylchloride High and medium-density polyethylene	PVC-U PE-HD, PE-MD	Cold water systems
Cross-linked polyethylene Polybutylene Propylene copolymer (Polypropylene) Chlorinated polyvinylchloride	PE-X PB PP-H, PP-R PVC-C	Cold and hot water systems
Composite pipes (plastic-metal-plastic)	Various	Cold and hot water systems
Polyamides	PA, PPA	Cold and hot water systems

Annex J
(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 K
(informative)

NOx conversion calculation

Table K.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 K.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 K.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 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:

$$Q_c = H_i \cdot \frac{10^3}{3\,600} \cdot V \cdot \frac{1\,013,25 + p_g}{1\,013,25} \cdot \sqrt{\frac{288,15}{273,15 + t_g} \cdot \frac{273,15 + t_a}{293,15} \cdot \frac{d}{d_r}}$$

— 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 8.5.1 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)

Relationship between this European Standard and the requirements of EU Directive 2009/142/EC

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 26 with the essential requirements of the 2009/142/EC — Directive relating to appliances burning gaseous fuels

Essential Requirement	Object	Clauses in this standard
	ANNEX I of the Directive EU	
1	GENERAL CONDITIONS	
1.1	Safety of operation	Clause 1 - Clause 2 - Clause 3 - Clause 4 - 5.1.2 - 5.1.4 (except 1st and 4th paragraphs) - 5.1.5 - 5.1.6 - 5.1.7 - 5.1.9 - 5.1.11 (except 5th paragraph) - 5.2.1 (except 1st, 2nd, 3rd and 4th paragraphs) - 5.2.4 (except 3rd paragraph) - 5.2.5 - 5.2.6 - 5.2.7.1 (except 2nd and 4th paras) - 5.2.7.2 - 5.2.7.3 - 5.3 - 6.1 - 6.3 - 6.8.1 - 6.8.2 - 6.8.3.1 - 6.8.3.4 - 6.8.4.2 and 6.8.6
1.2	Marking and instructions	
	Installation instructions	9.2.1 (1st paragraph)
	User's instructions	9.2.2 (2nd paragraph)
	Warnings on the appliance	9.1.4 and 9.1.3
	Official languages	9.3
1.2.1	Information in the installation instructions	9.2.1
	Gas type	9.1.2 (1st paragraph, 3rd indent) and 9.2.3 (1st paragraph)
	Supply pressure	9.1.2 (1st paragraph, 4th indent) and 9.2.3 (1st paragraph)
	Combustion air rate	9.2.1.2
	Discharge of combustion products	9.1.1 (1st para, 8th indent)
	Other requirements	Not applicable
1.2.2	Contents of the user's instructions	9.2.2

Essential Requirement	Object	Clauses in this standard
1.2.3	Warnings on the appliance and packaging	9.1 - 9.1.3 and 9.1.4
1.3	Equipments	9.2.3
	- 1st paragraph	5.1.11 (4th paragraph) - 5.1.12 and 5.2.1 (3rd and 4th paragraphs)
	- 2nd paragraph	Not applicable
2.	MATERIALS	
2.1	Characteristics	5.1.3
2.2	Guarantee	Clause 1
3.	DESIGN AND CONSTRUCTION	
3.1	General	
3.1.1	Resistance to constraints	5.1.4 (1st paragraph) - 5.1.10 - 5.2.7.1 (4th paragraph) and 5.2.10 (1st and 7th paragraphs)
3.1.2	Condensation	5.1.4 (4th paragraph)
3.1.3	Risk of explosion	5.1.3 (3rd paragraph)
3.1.4	Water and air penetration	5.2.6 (2nd paragraph) not applicable
3.1.5	Normal fluctuation of auxiliary energy	5.2.1 (3rd paragraph) - 6.8.3.2 - 6.8.3.3 - 6.8.4.1 and 6.8.5.3.1
3.1.6	Abnormal fluctuation of auxiliary energy	5.1.12 - 5.2.1 (3rd paragraph) and 6.8.3.2
3.1.7	Hazards of electrical origin	5.1.11 (except 4th paragraph)
3.1.8	Pressurized parts	5.1.3 (1st paragraph) and 5.1.4 (1st paragraph) and 6.2.3
3.1.9	Failure of safety devices	5.2.1 (4th paragraph)
	- flame supervision device	5.2.8 (5.2.8.1, 2nd, 4th and 5th paragraphs)
	- automatic water operated gas valve	6.8.7 - 6.8.3.1 and 6.8.3.4
	- atmosphere sensing device (type A_{AS})	5.2.9 (5th and 6th paragraphs)
	- combustion products discharge safety device (type B_{11BS})	5.2.10 (4th paragraph)
	- automatic burner control systems	5.2.8.4 (1st paragraph)
	- overheat protection	5.2.11 - 6.8.8 and 6.8.9
	- gas circuit	5.2.12
3.1.10	Safety/adjustment	5.2.1 (1st and 2nd paragraphs)
3.1.11	Protection of parts set by the manufacturer	9.2.3 (2nd and 3rd paragraphs) - 5.2.3 - 5.2.4 (4th paragraph) - 5.2.9 (1st and 2nd paragraphs) and 5.2.10 (4th paragraph)
3.1.12	Marking of taps, adjusting or control devices	5.2.2

Essential Requirement	Object	Clauses in this standard
3.2	Unburnt gas release	
3.2.1	Risk of gas leakage	5.1.7.1 and 6.2.1
3.2.2	Risk of gas accumulation in the appliance	5.2.8 - 5.2.12 and 6.8.5
3.2.3	Risk of gas accumulation in rooms	not applicable
3.3	Ignition	6.7
	- ignition and reignition	5.2.8.2
	- cross-lighting	5.2.7.1 (2nd paragraph) and 5.2.8.3
3.4	Combustion	
3.4.1	Flame stability	6.7
	Concentration of substances harmful to health in the combustion products	5.1.7 −6.9 and 6.10
3.4.2	Release of combustion products	5.1.7.2 and 6.2.2
3.4.3	Release of combustion products into the room for appliances connected to a flue (type B_{11BS}) under abnormal draught conditions	Clause 1 - 5.1.8.3 - 5.2.10 and 6.8.11
3.4.4	CO limit in the room for type A_{AS} water heaters	5.2.9 and 6.8.10
3.5	Rational use of energy	Clause 7
3.6	Temperatures	
3.6.1	Floor and adjacent walls	6.6.1 and 6.6.2 (test n° 2)
3.6.2	Knobs	6.4
3.6.3	Temperature of external surfaces	6.6.1 and 6.6.2 (test n° 1)
3.7	Foodstuffs and water used for sanitary purposes	5.1.3 (final paragraph)
	ANNEX II of the Directive EU	Clause 1
	ANNEX III of the Directive EU	
1.	CE mark	—
2.	Appliance or its date plate	—
	- CE mark	Clause 9
	- manufacturer's name or identification symbol	9.1.1 (1st paragraph - 1st indent)
	- trade name	9.1.1 (1st paragraph - 3rd indent)
	- electrical supply	9.1.1 (1st paragraph - 13th indent)
	- appliance category	9.1.1 (1st paragraph - 6th indent)
	- installation information	9.1

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 water storage 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

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 Delegated 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 of water heaters, hot water tanks and packages of water heaters and solar service.

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 ZC.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 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 15502-1:2012, *Gas-fired heating boilers — Part 1: General requirements and tests*

[2] EN ISO 8256, *Plastics — Determination of tensile-impact strength (ISO 8256)*

[3] CR 1472:1994, *General guidance for the marking of gas appliances*

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™