

Gas-fired central heating boilers — Type C boilers of nominal heat input not exceeding 70 kW

ICS 91.140.10

National foreword

This British Standard is the UK implementation of EN 483:1999+A4:2007, incorporating corrigendum June 2006. It supersedes BS EN 483:1999+A2:2001, which is withdrawn, and it partially supersedes BS 5258-1:1986 and BS 6332-1:1988, which have been declared obsolescent.

NOTE An amendment A1 was never issued but the text of the draft amendment prA1 was incorporated into EN 483:1999. The development of an amendment A3 was abandoned.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A2 is indicated by A2 A2.

Conflicting national standards will be withdrawn once the series of domestic boiler standards being prepared by CEN/TC 109 have been adopted by BSI.

The UK participation in its preparation was entrusted to Technical Committee GSE/29, Domestic gas-fired central heating boilers.

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.

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

Amendments/corrigenda issued since publication

Amd. No.	Date	Comments
13369	13 February 2002	See national foreword
16504 Corrigendum No. 1	31 August 2006	Changes to Tables 18 and 19
	30 April 2008	Implementation of CEN amendment A4:2007 and change of BS EN publication date from 2000 to 1999

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English version

Gas-fired central heating boilers - Type C boilers of nominal heat input not exceeding 70 kW

Chaudières de chauffage central utilisant les combustibles gazeux - Chaudières des types C dont le débit calorifique nominal est inférieur ou égal à 70 kW

Heizkessel für gasförmige Brennstoffe - Heizkessel des Typs C mit einer Nennwärmebelastung gleich oder kleiner als 70 kW

This European Standard was approved by CEN on 2 August 1998.

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

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

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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Central Secretariat: rue de Stassart, 36 B-1050 Brussels

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 109, Central heating boilers using gaseous fuels, the Secretariat of which is held by NNI.

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

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

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

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

It was established to deal with aspects related to:

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

Other types of boilers such as boilers of higher nominal heat input, excluded from this draft European standard, are dealt with in separate standards.

In addition, amendments to this standard are being prepared and will modify EN 483 to include requirements and test methods supporting the Boiler Efficiency Directive and to extend the scope to operational conditions in which condensation can occur.

Questions related to quality assurance systems, tests during production, and certificates of conformity of auxiliary devices are not dealt with in this European Standard.

To fulfil the Gas Appliance Directive this standard contains normative paragraphs specifying requirements for combustion products evacuation ducts which are part of an appliance. Constructional requirements may arise from the Construction Products Directive.

Foreword to amendment A2

This amendment EN 483:1999/A2:2001 to the EN 483:1999 has been prepared by Technical Committee CEN/TC 109, Gas-fired central heating boilers, the Secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2002, and conflicting national standards shall be withdrawn at the latest by January 2002.

This amendment to the European Standard EN 483:1999 has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

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

This amendment has been prepared to incorporate the EU Directive 92/42/EEC on efficiency requirements in EN 483:1999.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

Foreword to amendment A4

This document (EN 483:1999/A4:2007) has been prepared by the Technical Committee CEN/TC 109 “Central heating boilers using gaseous fuels”, the secretariat of which is held by NEN.

This Amendment to the European Standard EN 483:1999 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2008, and conflicting national standards shall be withdrawn at the latest by June 2008.

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).

As shown in informative Annex S of this amendment the following essential requirements mentioned in mandate M105 are already covered by the essential requirements of the GAD.

- Fire resistance – integrity (I);
- Gas tightness/leakage;
- Flow resistance;
- Dimensioning;
- Flexural tensile strength;
- Compressive strength;
- Durability of tightness/leakage against chemicals/corrosion;
- Durability of flexural tensile strength against chemicals;
- Durability of compressive strength against chemicals
- Fire Reaction.

To fulfil the Gas Appliance Directive this standard contains normative paragraphs specifying requirements for combustion air supply and combustion products evacuation ducts, which are part of an appliance.

This Amendment has been prepared to amplify the requirements and test methods for air supply and combustion products evacuation duct designed by the boiler manufacturer and marketed as an integral part of the boiler to support the EU Directive 89/106/EEC on construction products.

Additionally, this Amendment specifies requirements, test procedures and reporting of information related to boilers that are to be connected to air supply and combustion products evacuation ducts that are not supplied as an integral part of the boiler.

If declared by the appliance manufacturer, air supply and combustion products evacuation ducts complying with the relevant harmonised standards of CEN/TC166 for chimneys, can also be used. It is essential that the combination of appliance and its ducts still fulfil all relevant requirements of this standard.

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

1. Scope

This standard specifies the requirements and test methods concerning, in particular, the construction, safety, fitness for purpose, and rational use of energy, as well as the classification and marking of gas-fired central heating boilers that are fitted with atmospheric burners, fan assisted atmospheric burners or premixed burners, and that are hereafter referred to as “boilers”.

This European Standard applies to type C boilers as listed in 4.2:

- types C₁, C₃ and C₅ boilers including their combustion air supply and combustion products evacuation ducts and their terminals;
- types C₂ and C₄ boilers including their connection ducts but without the shared duct system; this shared duct system is part of the building;
- type C₆ boilers without any ducts; these ducts are separately approved and marketed;
- type C₇ boilers until the draught diverter/air-inlet but without the secondary flue;
- type C₈ boilers with their connecting ducts but without the chimney, which is part of the building;

and those

- that are fitted with atmospheric burners, atmospheric burners assisted by a fan for the supply of combustion air or evacuation of combustion products, or fully premixed burners;
- that use one or more combustible gases corresponding to the three gas families and to the pressures stated in 7.1.2.4;
- that have a nominal heat input (on net calorific value) not exceeding 70 kW;
- where the temperature of the water does not exceed 95 °C during normal operation;
- where the maximum water-side operating pressure does not exceed 6 bar.

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

- type C₄₁, C₅₁, C₆₁, C₇₁ and C₈₁ boilers;
- boilers intended to be installed in the open;
- boilers of the condensing type;
- boilers of the combination type (central heating and production of domestic hot water).

This European Standard only covers type testing.

2. Normative references

This European Standard includes the provisions of other publications by undated reference. These normative references are quoted in appropriate places in the text and the publications are listed below. For the dated references, later amendments or revisions of any of these publications apply to this European Standard only where they have been incorporated in it by amendment or revision. For the undated references, the latest edition of the publication to which reference is made applies.

[A4] Footnote deleted **[A4]**

EN 88	Pressure governors for gas appliances for inlet pressures up to 200 mbar
EN 125	Flame supervision devices for gas burning appliances thermo-electric 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	Automatic gas burner control systems for gas burners and gas-burning appliances with or without fans
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 1057	Copper and copper alloys - Seamless, round copper tubes for water and gas in sanitary and heating applications
EN 1443	Chimneys - General requirements
EN 1561	Founding - Grey cast iron
 EN 1856-1:2003	Chimneys - Requirements for metal chimneys - Part 1: System chimney products
EN 1856-2	Chimneys - Requirements for metal chimneys - Part 2: Metal liners and connecting flue pipes
EN 1859:2000	Chimneys - Metal chimneys - Test methods 
EN 10029	Hot rolled steel plate 3 mm thick or above - Tolerances on dimensions, shape and mass
 EN 13216-1:2004	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 14241-1:2005	Chimneys - Elastomeric seals and elastomeric sealants - Material requirements and test methods - Part 1: Seals in flue liners
EN 14471:2005	Chimneys - System chimneys with plastic flue liners - Requirements and test methods 
EN 23166	Codes for the representation of names of countries (ISO 3166:1993)
EN 24063	Welding, brazing, braze-welding and soldering of metals - List of processes, for symbolic representation on drawings (ISO 4063:1990)
EN 50165	Electrical equipment of non-electric appliances for household and similar purposes - Safety requirements
EN 60335- 1:1991	Safety of household and similar electrical appliances - Part 1: General requirements (IEC 335-1:1991, modified)
EN 60529	Degrees of protection provided by enclosures (IP code) (IEC 529:1989)

EN 60730-2-9	Automatic electrical controls for household and similar use - Part 2: Particular requirements for temperature sensing controls (IEC 730-2-9:1992, modified)
EN 60742	Isolating transformers and safety isolating transformers - Requirements IEC 742:1983 + A1:1992, modified)
EN ISO 178	Plastics - Determination of flexural properties (ISO 178:2001)
EN ISO 179-1	Plastics - Determination of Charpy impact properties - Part 1: Non-instrumented impact test (ISO 179-1:2000)
EN ISO 527-1	Plastics - Determination of tensile properties - Part 1: General principles (ISO 527-1:1993 including Corr 1:1994)
EN ISO 527-2	Plastics - Determination of tensile properties - Part 2: Test conditions for moulding and extrusion plastics (ISO 527-2:1993 including Corr 1:1994)
EN ISO 1183	Plastics - Methods for determining the density of non-cellular plastics
EN ISO 9969	Thermoplastics pipes - Determination of ring stiffness (ISO 9969:1994)
ISO 7-1	Pipe threads where pressure-tight joints are made on the threads - Part 1: Designation, dimensions and tolerances
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 228-1	Pipe threads where pressure-tight joints are not made on the threads - Part 1: Designation, dimensions and tolerances
ISO 262	ISO general purpose metric screw threads - Selected sizes for screws, bolts and nuts
ISO 301	Zinc alloy ingots intended for casting
ISO 815	Rubber, vulcanized or thermoplastic - Determination of compression set at ambient, elevated or low temperatures
ISO 857	Welding, brazing and soldering processes; vocabulary
ISO 1817	Rubber, vulcanized - Determination of the effect of liquids
ISO 2553	Welded brazed and soldered joints; symbolic representation on drawings
ISO 2781	Rubber, vulcanized - Determination of density
ISO 6914	Rubber, vulcanized or thermoplastic - Determination of ageing characteristics by measurement of stress relaxation
ISO 7005-1	Metallic flanges; Part 1: Steel flanges
ISO 7005-2	Metallic flanges; Part 2: Cast iron flanges
ISO 7005-3	Metallic flanges; Part 3: Copper alloy and composite flanges
ISO 7619	Rubber, vulcanized or thermoplastic - Determination of indentation hardness

3. Definitions

For the purposes of this standard, the following definitions apply:

3.1 reference conditions

These correspond to 15 °C and 1 013,25 mbar, unless otherwise specified. [3.9 of EN 437:1993]

NOTE: 1 mbar = 10^2 Pa.

3.2 Combustible gases

3.2.1 test gases

Gases intended for the verification of the operational characteristics of appliances using combustible gases.
[3.2 of EN 437:1993]

In each gas family or group, test gases are defined:

3.2.2 reference gas

Test gases on which appliances operate under nominal conditions, when they are supplied at the corresponding normal pressure. [3.3 of EN 437:1993]

3.2.3 limit gases

Test gases representative of the extreme variations in the characteristics of the gases for which appliances have been designed. [3.4 of EN 437:1993]

3.2.4 calorific value

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

A distinction is made between:

- gross calorific value in which the water produced by combustion is assumed to be condensed

Symbol: H_s

- net calorific value in which the water produced by combustion is assumed to be in the vapour state

Symbol: H_i

Unit:

- either megajoule per cubic metre (MJ/m^3) of dry gas brought to reference conditions,
- or megajoule per kilogram (MJ/kg) of dry gas.

[3.11 of EN 437:1993/A1:1997]

3.2.5 relative density

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

Symbol: d

[3.10 of EN 437:1993]

3.2.6 Wobbe index

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

Symbol: gross Wobbe index: W_s ;
 net Wobbe index: W_i

Unit:

- either megajoule per cubic meter (MJ/m^3) of dry gas at the reference conditions,
- or megajoule per kilogram (MJ/kg) of dry gas.

[3.12 of EN 437:1993/A1:1997]

3.2.7 Gas pressures

3.2.7.1 General

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.

Symbol: p

Unit: millibar (mbar).

3.2.7.2 test pressure

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

Unit: millibar (mbar).

[3.5 of EN 437:1993]

3.2.7.3 normal pressure

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

Symbol: p_n

[3.6 of EN 437:1993]

3.2.7.4 limit pressures

Pressures representative of the extreme variations in the appliance supply conditions.

Symbol: maximum pressure: $p_{\max}$

 minimum pressure: $p_{\min}$

[3.7 of EN 437:1993]

3.2.7.5 pressure couple

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

- the higher pressure corresponds only to gases of low Wobbe index;
- the lower pressure corresponds to gases of high Wobbe index.

[3.8 of EN 437:1993]

3.3 Constituent parts of the boiler

3.3.1 Gas supply

3.3.1.1 gas inlet connection

The part of the boiler intended to be connected to the gas supply.

3.3.1.2 gas circuit

An assembly of parts of the boiler that carry or contain the combustible gas between the boiler gas inlet connection and the point at which air is admitted.

3.3.1.3 restrictor

A device, 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 a given rate.

3.3.1.4 injector

A component that admits gas into the burner.

3.3.1.5 gas rate adjuster

A component allowing the gas rate of the burner to be brought to a predetermined value according to the supply conditions.

The action of operating this device is called “adjustment of the gas rate”.

3.3.1.6 range-rating device

A component on the boiler intended to be used by the installer to adjust the nominal heat input of the boiler within the range of maximum and minimum heat inputs stated by the manufacturer, to suit the actual heat requirements of the installation.

3.3.1.7 primary aeration adjuster

A device enabling the primary aeration of a burner to be set to the desired value according to the supply conditions.

3.3.1.8 sealing an adjuster or control device

Arrangements made to make evident any attempt to change its adjustment (e.g. breakage of a device or a sealing material).

A sealed adjuster or control device is considered to be non-existent.

3.3.1.9 putting an adjuster or a control device out of service

Action intended to put an adjuster or control (rate, pressure, etc.) out of service.

3.3.1.10 Burners

3.3.1.10.1 main burner

A burner that is intended to assure the thermal function of the boiler and is generally called “the burner”.

3.3.1.10.2 premixed burner

A 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.

3.3.1.10.3 ignition device

3.3.1.10.3.1 General

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

3.3.1.10.3.2 manual ignition device

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

3.3.1.10.3 automatic ignition device

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

3.3.1.10.4 ignition burner

A burner intended to ignite a main burner.

Those recognized are respectively:

- a) Permanent ignition burner:
An ignition burner that operates continuously throughout the whole period that the boiler is in use;
- b) Intermittent ignition burner:
An ignition burner that is ignited before and extinguished at the same time as the main burner;
- c) Alternating ignition burner:
An ignition burner that is extinguished as soon as ignition of the main burner is effected. It re-ignites at the main burner flame just before the latter goes out;
- d) Interrupted ignition burner
An ignition burner that operates only during the ignition sequence.

3.3.2 Air supply and combustion products evacuation

3.3.2.1 combustion circuit

Circuit including the air supply duct, the combustion chamber, the heat exchanger, the combustion products evacuation duct and either the fitting piece or the connection to the terminal, if any.

3.3.2.2 combustion products circuit

Circuit including the combustion chamber, the heat exchanger, the combustion products evacuation duct and either the fitting piece or the connection to the terminal, if any.

3.3.2.3 combustion chamber

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

3.3.2.4 protected combustion chamber

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

3.3.2.5 air supply and combustion products evacuation ducts

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

It is necessary to distinguish 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 completely surrounded ducts.

3.3.2.6 terminal

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

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

3.3.2.7 terminal guard

The device that protects the terminal from mechanical damage from outside influences.

3.3.2.8 fitting piece

A device which allows the fitting of:

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

The fitting piece may be part of the boiler or of the air supply and/or combustion products evacuation system.

3.3.2.9 secondary flue

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

3.3.2.10 roof space (sometimes called “loft”)

A ventilated part of a building between the uppermost inhabitable space of the building and the roof.

3.3.2.11 ducts support

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

3.3.3 Adjusting, control and safety devices

3.3.3.1 pressure governor

A device which maintains the downstream pressure constant to within fixed limits independent of variations, within a given range, of the upstream pressure and the gas rate.

3.3.3.2 adjustable pressure governor

A pressure governor fitted with a means of adjusting the downstream pressure.

This means is considered as an “adjusting device”.

3.3.3.3 volume governor

A device which maintains a rate between fixed limits independent of upstream and downstream pressures, within a range of given values.

3.3.3.4 water rate monitoring device

A device that shuts off the gas supply to the main burner when the water rate through the boiler is less than a predetermined value and automatically reopens the gas supply when the water rate reaches at least this value.

3.3.3.5 flame supervision device

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

3.3.3.6 ignition interlock

Part which prevents the operation of the igniter as long as the main gasway is open.

3.3.3.7 restart interlock

Mechanism which prevents the re-opening of the gasway to the main burner or to the main burner and the ignition burner until the armature plate has separated from the magnetic element.

3.3.3.8 control thermostat

A device enabling the water temperature to be kept automatically within a given range at a predetermined value.

3.3.3.9 adjustable control thermostat

A control thermostat that permits the user to obtain setting temperatures between a minimum and a maximum value.

3.3.3.10 limit thermostat

A device that shuts off the gas supply when a limit value of the temperature is reached, and automatically reopens the gas supply when the temperature returns below the fixed limit.

3.3.3.11 safety temperature limiter

A device that causes safety shutdown and non-volatile lockout so as to prevent the water temperature exceeding a preset limit.

3.3.3.12 overheat cut-off device

A device that causes safety shutdown and non-volatile lockout before the boiler is damaged and/or before safety is put in question.

3.3.3.13 temperature sensing element

A component that detects the temperature of the environment to be supervised or controlled.

3.3.3.14 control knob

A component intended to be moved by hand in order to act on a boiler control (tap, thermostat, etc.).

3.3.3.15 flame detector

A device which detects and signals the presence of a flame. It may consist of a flame sensor, an amplifier and a relay for signal transmission. These parts, with the possible exception of the actual flame sensor, may be assembled in a single housing for use in conjunction with a programming unit.

3.3.3.16 flame signal

The signal given by the flame detector, normally when its sensor reacts to a flame.

3.3.3.17 flame simulation

The condition which occurs when a flame signal is given by the flame detector although in reality there is no flame.

3.3.3.18 programming unit

A device that reacts to impulses from control and safety systems, gives control commands, controls the start-up program, supervises the burner operation and causes controlled shutdown, safety shutdown or lockout, if necessary. The programming unit follows a predetermined sequence of actions and operates in conjunction with the flame detector.

3.3.3.19 automatic burner control system

A system that comprises a programming unit and all the elements of a flame detector. All the functions of an automatic burner control system may be assembled in one or more housings.

3.3.3.20 start

The start signal causes the boiler to leave its start position and the predetermined programme of the programming unit commences.

3.3.3.21 programme

The sequence of control operations determined by the unit involving switching on, supervising and switching off the burner.

3.3.3.22 automatic valve²⁾

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

²⁾ Automatic valves are classified in accordance with EN 161 into classes A, B, C and D. Automatic valves that comply with the safety and operational requirements of this standard and which are integral parts of the boiler are designated as class A', B', C' and D', respectively.

3.3.3.23 multifunctional control

A device having at least two functions, one of which is a shut-off function, integrated in one housing, whereby the functional elements cannot operate if separated.

3.3.3.24 closure member

The movable part of the valve or the thermoelectric device that opens, varies or shuts off the gasway.

3.3.3.25 breather hole

An orifice that allows atmospheric pressure to be maintained in a compartment of variable volume.

3.3.3.26 diaphragm

A flexible component that operates the valve by means of a force resulting from a pressure difference.

3.3.3.27 external soundness

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

3.3.3.28 internal soundness

The 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.

3.3.3.29 sealing force

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

3.4 Operation of the boiler

3.4.1 Gas rates

3.4.1.1 volume flowrate

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

Symbol V (under test conditions)
 V_r (under reference conditions)

Unit: cubic metre per hour (m^3/h).

[3.16 of EN 437:1993/A1:1997]

3.4.1.2 mass flow rate

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

Symbol M (under test conditions)
 M_r (under reference conditions)

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

[3.15 of EN 437:1993/A1:1997]

3.4.1.3 heat input

The 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.

Symbol Q

Unit: kilowatt (kW).

[3.13 of EN 437:1993]

3.4.1.4 nominal heat input³⁾

The value of the heat input declared by the manufacturer..

Symbol: Q_n

Unit:kilowatt (kW).

[3.14 of EN 437:1993]

3.4.1.5 ignition rate

The average heat input during the ignition safety time.

Symbol Q_{IGN}

Unit:kilowatt (kW).

3.4.2 Outputs

3.4.2.1 useful output

The quantity of heat transmitted to the heat carrier in unit time.

Symbol P

Unit:kilowatt (kW).

3.4.2.2 nominal output

The useful output stated by the manufacturer.

Symbol P_n

Unit:kilowatt (kW).

3.4.3 useful efficiency

The ratio of the useful output to the heat input, expressed in per cent.

Symbol η_u

3.4.4 Gas combustion

3.4.4.1 combustion

Combustion is said to be “complete” if there are no more than traces of combustible constituents (hydrogen, hydrocarbons, carbon monoxide, carbon, etc.) in the combustion products.

Conversely, combustion is said to be “incomplete” if at least one combustible constituent is present in significant proportions in the combustion products.

The amount of carbon monoxide, CO, in the dry, air-free combustion products is used as the criterion to distinguish between “hygienic” and “non-hygienic” combustion.

This standard specifies maximum CO limits according to the circumstances of use or of test. In each case, the combustion is regarded as hygienic if the CO concentration is below or equal to the permitted limit, but non-hygienic if it is above the limit.

3.4.4.2 flame stability

The characteristics of flames that remain on the burner ports or in the flame holding zone.

³⁾ Range-rated boilers operate at a nominal heat input between the maximum and minimum adjustable heat input. Modulating boilers operate between the nominal and minimum controlled heat inputs.

3.4.4.3 flame lift

A phenomenon characterized by the total or partial lifting of the base of the flame away from the burner port or the flame retention zone.

3.4.4.4 light-back

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

3.4.4.5 light-back at the injector

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

3.4.4.6 sooting

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

3.4.4.7 yellow tipping

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

3.4.5 Times

3.4.5.1 ignition opening time (T_{IA})

For a thermoelectric flame supervision device, the time that elapses between ignition of the supervised flame and the moment when the closure element is held open by the flame signal.

3.4.5.2 extinction delay time (T_{IE})

For a thermoelectric flame supervision device, the time that elapses between disappearance of the supervised flame and interruption of the gas supply concerned.

3.4.5.3 ignition safety time (T_{SA})

The time that elapses between the order to open and the order to close the gas supply to the burner in the event of ignition not taking place.

3.4.5.4 maximum ignition safety time ($T_{SA, max}$)

The ignition safety time measured under the least favourable conditions of ambient temperature and variation in supply voltage.

3.4.5.5 extinction safety time (T_{SE})

The time that elapses between extinction of the supervised flame and the order to shut off the gas supply to the burner.

3.4.5.6 closing time

The time interval between the interruption of the auxiliary energy or the voltage and the achievement of the closed position.

3.4.6 spark restoration

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

3.4.7 recycling

The automatic process by which, after loss of flame during operation, the gas supply is interrupted and the full start procedure is re-initiated automatically.

3.4.8 controlled shutdown

The process by which a control device (on the boiler or external to it) causes the gas supply to the burner to be stopped immediately; the boiler returns to its start position.

3.4.9 safety shutdown

The process which is initiated immediately in response to the signal from a limiting device or sensor and which causes the burner to shut down; the boiler returns to its start position.

3.4.10 locking out

3.4.10.1 General

Complete interruption of the gas supply with lockout.

3.4.10.2 non-volatile lockout

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

3.4.10.3 volatile lockout

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

3.4.11 de-energized to trip principle

The principle according to which neither auxiliary energy nor external action is required to activate a safety device.

3.4.12 purge

The mechanical introduction of air into the combustion circuit in order to displace any gas/air mixture which could remain there. A distinction is made between:

- pre-purge: the purge that takes place between the start command and the ignition device being energized;
- post-purge: the purge that is carried out after burner shutdown.

3.4.13 Air proving device

A device intended to cause safety shutdown in the event of abnormal conditions of air admission or of combustion products evacuation.

3.4.14 gas/air ratio control

A device that automatically adapts the combustion air rate to the gas rate or vice versa.

3.4.15 nominal voltage

The voltage or range of voltages stated by the manufacturer at which the boiler can operate normally.

3.4.16 living space dedicated boiler⁴⁾

A boiler with an effective rated output of less than 37 kW, designed to provide heat to the part of the living space in which it is installed by means of the emission of heat from the casing, having an open expansion chamber, supplying hot water using gravity circulation.

Ⓐ 3.4.17 overheat combustion products temperature

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

3.4.18 nominal working combustion products temperature

maximum temperature of the combustion products in case of normal functioning, at the exit of the boiler where it is intended to be connected to a duct or chimney. Normal functioning is considered to reflect the situation of running the boiler at inlet/outlet temperatures of 70/90 °C, and just at the point that the control thermostat is switching. (See also 7.4.1.1)

3.4.19 condensing operation mode of flue system

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

3.5 Country of destination

3.5.1 direct country of destination

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

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

⁴⁾ Definition from Directive 92/42/EEC.

3.5.2 indirect country of destination

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

4. Classification of boilers

4.1 Gases and categories

Gases are classified into families, groups and ranges in accordance with EN 437.

Boilers are classified into categories in accordance with EN 437.

The applicable categories for each country are given in annex A. Other categories can be defined with the information of annex B, in accordance with EN 437.

4.2 Mode of air supply and evacuation of the combustion products

4.2.1 General

Type C boilers are boilers in which the combustion circuit is sealed with respect to the inhabitable area of the building in which the appliance is installed.

The air supply and the combustion products evacuation ducts and the terminal or the fitting piece which is used to connect the boiler to a chimney or duct system are part of the boiler unless otherwise stated. They admit fresh air from outside the inhabitable part of the building to the burner as well as discharge the products of combustion to the outside.

Boilers are classified into several types according to the mode of evacuation of the combustion products and supply of the combustion air (see examples attached in informative annex C).⁵⁾

The types are defined by two subscripts:⁶⁾

- The first subscript number is based upon the possible installation of the boiler with respect to the mode of air supply and evacuation of the combustion products. (see 4.2.2)
- The second subscript number is based upon the presence and position of an integral fan in the boiler. (see 4.2.3)

4.2.2 Type of installation of the boiler

4.2.2.1 Type C₁

A type C boiler which is connected via its ducts to a horizontally installed terminal at the wall or on the roof. The orifices of the ducts are either concentric or close enough to come under similar wind conditions.

4.2.2.2 Type C₂

A type C boiler which is fitted via its ducts possibly by means of a fitting piece to a shared duct system consisting of a single duct for both supply of the combustion air and discharge of the combustion products.

4.2.2.3 Type C₃

A type C boiler which is connected via its ducts to a vertically installed terminal. The orifices of the ducts are either concentric or close enough to come under similar wind conditions.

4.2.2.4 Type C₄

A type C boiler which is fitted via its ducts possibly by means of a fitting piece to a shared duct system consisting of a duct for the supply of the combustion air and a duct for the discharge of the combustion products. The orifices of this shared duct system are either concentric or close enough to come under similar wind conditions.

4.2.2.5 Type C₅

A type C boiler which is connected via its separate ducts to two terminals that may terminate in zones of different pressure.

⁵⁾ The classification used in this standard is based upon the classification of CR 1749, “European scheme for the classification of gas appliances according to the method of evacuation of the products of combustion (types)”.

⁶⁾ Boilers in which the combustion circuit is under positive pressure and surrounded by the combustion air circuit may require identification by an additional subscript, in accordance with national regulations, if they are intended to be installed in non-ventilated areas.

4.2.2.6 Type C₆

A type C boiler which is intended to be connected to a separately approved and marketed system for the supply of combustion air and discharge of the combustion products.

4.2.2.7 Type C₇

A type C boiler which is connected via its vertical ducts and a draught diverter, located in the roof space, to a secondary flue. The combustion air is taken from the roof space.

4.2.2.8 Type C₈

A type C boiler which is connected via its ducts possibly by means of a fitting piece to an air supply terminal and fitted to an individual or shared chimney.

4.2.3 Presence and position of a fan

- A type C boiler that does not incorporate a fan is identified by the second subscript number “1” (e.g. C₁₁).
- A type C boiler that does incorporate a fan downstream of the combustion chamber/ heat exchanger is identified by the second subscript number “2” (e.g. C₁₂).
- A type C boiler that does incorporate a fan upstream of the combustion chamber/ heat exchanger is identified by the second subscript number “3” (e.g. C₁₃).

4.3 Maximum water-side operating pressure

Boilers are classified according to their maximum water-side operating pressure (PMS) as:

- pressure class 1: PMS = 1 bar;
- pressure class 2: PMS = 3 bar;
- pressure class 3: $3 \text{ bar} < \text{PMS} \leq 6 \text{ bar}$.

4.4 Expansion system

Boilers are classified according to the expansion system used for the central heating circuit as:

- a) open vented system
boiler intended exclusively for a central heating system with an open expansion vessel;
- b) sealed system
boiler intended for a central heating system with an open or sealed expansion vessel.

5. Constructional requirements

5.1 General

Except where otherwise stated, the constructional requirements are verified by inspection of the boiler and its technical documents.

5.2 Conversion to different gases

The following operations are allowed in order to convert from a gas of one family or group to a gas of another family or group (see 5.6.2.1, 5.6.4, 5.6.5.2.1 and 5.7):

- adjustment of the gas rate of the main burner and ignition burner;
- change of injectors or restrictor;
- change of the ignition burner or its components;
- change of the gas rate modulation system;
- putting out of service and sealing a gas rate adjuster and/or a governor.

These operations shall be possible without having to interfere with the connections of the boiler to its pipework (gas, water, duct system).

5.3 Materials and thicknesses

5.3.1 General

The quality and thickness of the materials used in the construction of the boilers, ^{A4}including connecting ducts, ducts and terminals, if any, ^{A4} and the method of assembling the various parts, shall be such that the constructional and performance characteristics are not significantly altered during a reasonable life and under normal conditions of installation and use.

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

Materials downstream of the heat exchanger shall be corrosion-resistant or be effectively protected against corrosion.

 Text deleted 

The use of asbestos-containing materials is forbidden.

Hard solder containing cadmium in its formulation shall not be used in the construction of boilers.

5.3.2 Materials and thicknesses of sheet metal walls or tubes under water pressure for boilers of pressure class 3

5.3.2.1 General

The characteristics of the materials and the thicknesses of walls under pressure shall comply with the requirements of 5.3.2.2, 5.3.2.3 and 5.3.2.4. If other materials and/or other thicknesses are used, the manufacturer shall provide appropriate justification in respect of fitness for purpose.

5.3.2.2 Materials

Materials for parts under pressure shall be appropriate for their duty and envisaged use.

The following materials satisfy these criteria:

- steels that have the properties and chemical composition detailed in Table 1;
- cast irons that have the mechanical properties detailed in Table 2;
- the non-ferrous materials detailed in Table 3 and Table 4.

5.3.2.3 Thicknesses

The minimum wall thicknesses of parts under water pressure are given in Table 5 and Table 6.

For rolled steel the tolerances are given in EN 10029.

The thicknesses of cast walls given in the production drawings shall not be less than the nominal minimum thicknesses given in Table 6 for parts of cast iron or of cast materials which are subjected to pressure. The actual minimum thickness of the boiler sections and of parts subjected to pressure shall be greater than 0,8 times those given in the drawings.

5.3.2.4 Welded seams and welding fillers

Materials shall be suitable for welding. The materials given in Table 1 may be used and do not require additional heat treatment for welding.

Welded seams shall show no cracks or bonding faults and butt welded seams shall be faultlessly welded over the whole cross-section.

Single-sided fillet welds and half Y-welds without full penetration into the base metal shall not be subjected to bending stresses. Flue pipes, set-through stays and similar components need not to be welded from both sides. Double fillet welds are permissible if sufficiently cooled.

Projections into the flueways in areas of high thermal stresses shall be avoided.

Corner welds, edge welds and similar welds which are subject to considerable bending stresses under unfavourable manufacturing or operating conditions are to be avoided.

For welded-in longitudinal stays, stay tubes or stay bolts, the shearing cross-section of the fillet weld shall be at least 1,25 times the required cross-section of the bolt or stay tube.

Details of the welds mentioned are given in Table 7. Welding fillers shall permit a joint appropriate to the base material to be made.

The terms given in Table 7 are in accordance with ISO 2553; the reference numbers of welding processes are respectively in accordance with ISO 857 and EN 24063.

Table 1: Mechanical and chemical compositions of carbon and stainless steels

Mechanical Properties						Chemical composition by mass %									
Materials	Steel type	Tensile strength R_m N/mm ²	Yield point $R_{0.01}/R_p$ 0,2 N/mm ²	Breaking elongation A_{long} at $L_0 = 5d_0$ %	Breaking elongation A_{transv} at $L_0 = 5d_0$ %	C	P	S	Si	Mn	Cr	Mo	Ni	Ti	Nb/Ta
Pipes, sheets	carbon	≤ 520	≤ 0,7 ¹⁾	≥20	—	≤0,25	≤0,05	≤0,05	—	—	—	—	—	—	—
	ferritic	≤600	≥250	≥20	≥15	≤0,08	≤0,045	≤0,030	≤1,0	≤1,0	15,5 to 18	≤1,5	—	≤7 × %C	≤12 × %C
	austenitic	≤800	≥180	≥30	≥30	≤0,08	≤0,045	≤0,030	≤1,0	≤2,0	16,5 to 20	2,0 to 3,0	9 to 15	≤5 × %C	≤8 × %C
1) Ratio yield point-tensile strength. An adequate high temperature yield point for the highest possible temperature of the steel shall be guaranteed.															

Table 2: Minimum requirements for cast iron

Flake graphite cast iron (prEN 1561):	
– Tensile strength R_m	$\geq 150 \text{ N/mm}^2$
– Brinell hardness	160 to 220 HB 2,5/187,5
Spheroidal graphite cast iron (annealed ferritic):	
– Tensile strength R_m	$\geq 400 \text{ N/mm}^2$
– Notch impact strength	$\geq 23 \text{ J/cm}^2$

Table 3: Parts in aluminium and aluminium alloys

	Tensile strength R_m N/mm ²	Temperature range °C
Al 99,5	≥ 75	up to 300
Al Mg2 Mn 0,8	≥ 275	up to 250

Table 4: 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

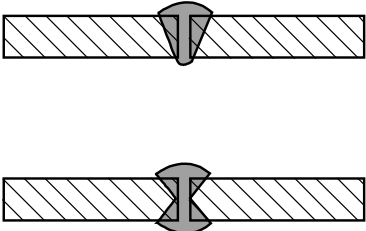
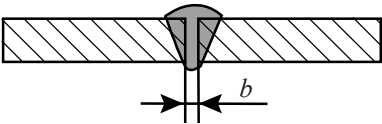
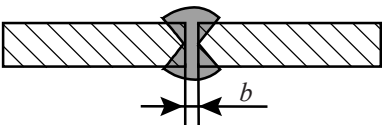
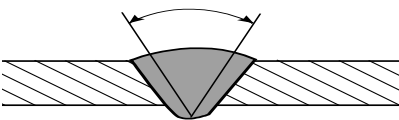
Table 5: Minimum thicknesses for rolled parts

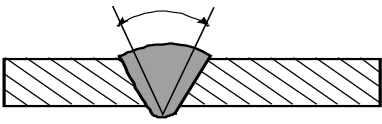
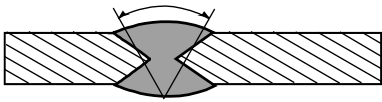
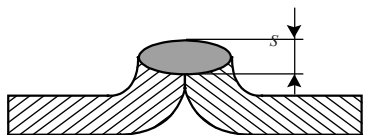
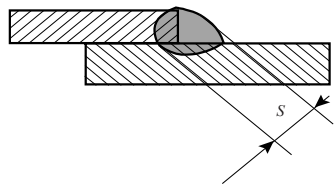
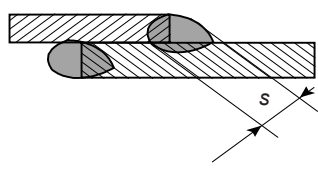
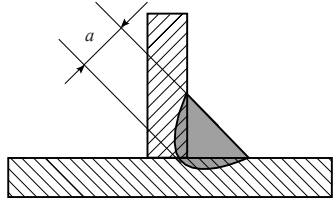
carbon steels; aluminium			protected steels; stainless steels; copper		
a ¹⁾ mm	b ²⁾ mm	c ³⁾ mm	a ¹⁾ mm	b ²⁾ mm	c ³⁾ mm
4	3	2,9	2	2	1
¹⁾ Column a: for walls of combustion chambers exposed to water and fire, and for horizontal walls of convection heating surfaces. ²⁾ Column b: for walls exposed only to water and for rigid shapes, for example convection heating surfaces outside the combustion chamber ³⁾ Column c: tubes of convection heat exchangers.					

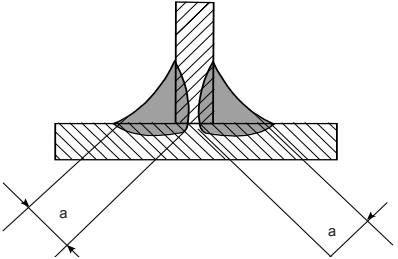
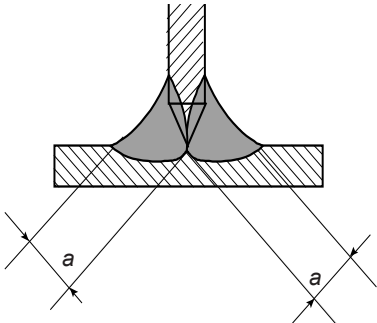
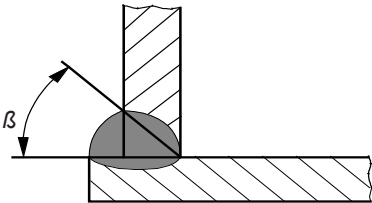
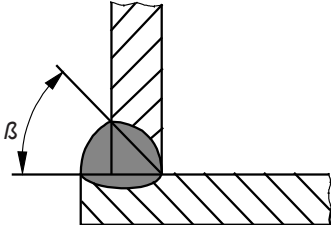
Table 6: Nominal minimum thicknesses of boiler sections

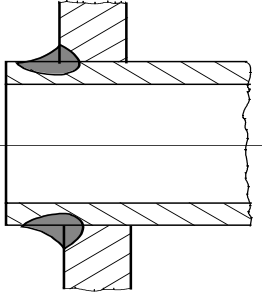
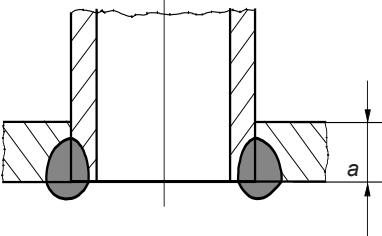
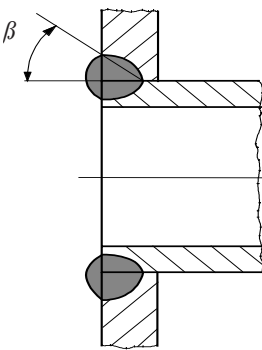
Nominal heat input Q_n kW	Flake graphite cast iron aluminium mm	Spheroidal graphite annealed ferritic cast iron, copper mm
≤ 35	3,5	3,0
> 35	4,0	3,5

Table 7: Weld joints and welding processes

No	Weld joint type	Material thickness t mm	Welding process ⁵⁾	Remarks
1.1	Square butt weld 	≤ 6 (8)	135 12 131 (111)	Permissible up to $t = 8$ mm on use of deep penetration electrodes or welding on both sides
1.2	Square butt weld 	≥ 6 up to 12	12	Root gap $b = 2$ mm to 4 mm with stiffener, powder holder necessary
1.3	Square butt weld (double) 	> 8 up to 12	135 12 (111)	Root gap $b = 2$ mm to 4 mm Deep penetration electrodes must be used for manual electro welding
1.4	Single-V butt weld 	to 12	(111)	Seam preparation V-seam 60° .

No	Weld joint type	Material thickness t mm	Welding process ⁵⁾	Remarks
1.5	Single-V butt weld 	to 12	135 12	Seam preparation V-seam 30° to 50° depending on thickness of material.
1.6	Double-V butt weld 	greater than 12	135 12	Seam preparation double V-seam 30° to 50° depending on material thickness
1.7	Butt weld between plates with raised edges 	≤ 6	135 141 131 (111)	Only permissible in exceptional cases for parts welded in. Moreover, the welds have to be kept largely free from bending stresses. Not suitable for directly fired wall parts $s = 0,8 \times t$
1.8	Overlap welding 	≥ 6	135 12	Welds of these type are to be kept largely free from bending stresses. Not suitable for directly fired wall parts $s = t$
1.9	Overlap welding (cont) 	≤ 6	135 12 (111)	Not suitable for directly fired wall parts $s = t$
2.1	Fillet weld 	≤ 6	135 12 (111)	Welds of these type are to be kept largely free from bending stresses $a = t$

No	Weld joint type	Material thickness t mm	Welding process ³⁾	Remarks
2.2	Double fillet weld 	≤ 12 > 12	135 12 (111) 135 12 (111)	$a = t$ $a = 2/3 t$
2.3	Double-bevel butt weld 	≤ 12 > 12	135 12 (111) 135 12 (111)	$a = t$ $a = 2/3 t$
2.4	Single bevel butt weld 	≤ 12 > 12	135 12 (111) 135 12	for (111) $\beta = 60^\circ$ for 135, 12 $\beta = 45^\circ$ to 50°
2.5	Single-bevel butt weld 	≤ 12	135 12 (111)	for (111) $\beta = 60^\circ$ for 135, 12 $\beta = 45^\circ$ to 50°

No	Weld joint type	Material thickness t mm	Welding process ^{*)}	Remarks
2.6		≤ 12	135 (111)	Tube ends shall not project beyond fillet weld if it is subjected to heat radiation
2.7		≤ 6	135 (111)	Welding in of tube under high thermal stress $a \geq t$
No	Weld joint type	Material thickness T mm	Welding process ^{*)}	Remarks
2.8			135 (111)	Welding in of tube under high thermal stress For (111) $\beta = 60^\circ$ For 135 $\beta = 45^\circ$ to 50°

^{*)} Reference numbers of welding processes in accordance with ISO 857 or EN 24063:

Reference number	Process
12	Submerged arc welding
111	Metal-arc welding with covered electrode
131	Metal-arc inert gas welding; MIG welding
135	Metal-arc-active gas welding; MAG welding
141	Tungsten inert gas arc welding TIG welding

5.3.3 Thermal insulation

Any thermal insulation shall withstand a temperature of at least 120 °C without deformation and shall retain its insulating properties under the influences of heat and ageing.

The insulation shall withstand the normally expected thermal and mechanical stresses.

The insulation shall be of non-combustible material. However inflammable materials are permitted provided that:

- the insulation is applied to surfaces in contact with water,
- or the temperature of the surface to which it is applied does not exceed 85 °C in normal operation,
- or the insulation is protected by a non-combustible case having an appropriate wall thickness.

If flame can come into contact with the insulation or if the insulation is applied close to the combustion products outlet, the insulation shall be non-combustible or protected by a non-combustible case having an appropriate wall thickness.

5.3.4 Control and safety devices

5.3.4.1 Housing

The parts of the housing that directly or indirectly separate an enclosure containing gas from the atmosphere shall be made only of metallic materials.

Nevertheless, an enclosure part containing gas may be made of non-metallic materials provided that in the event of this non-metallic part being detached or broken, under any circumstances, no more than 30 dm³/h of air can escape at the highest normal pressure. This requirement does not apply to toroidal seals, governor diaphragms, sealing gaskets and other means of sealing.

Zinc alloys may only be used if they are of the chemical composition ZnAl₄, as specified in ISO 301, and if the parts are not liable to be exposed to a temperature above 80 °C. Only external threads in accordance with ISO 228-1 are accepted for principal inlet and outlet connections made of zinc alloy.

5.3.4.2 Spring(s) providing the closing force and the sealing force

The closing force and the sealing force shall be assured by the action of a spring or springs. The spring(s) assuring the closing force and the sealing force shall be designed for oscillatory action and shall withstand fatigue.

The springs shall be made from corrosion resistant material.

5.3.4.3 Resistance to corrosion and surface protection

All parts in contact with gas or with the ambient atmosphere, as well as springs other than those specified in 5.3.4.2, shall be made of corrosion-resistant materials or be suitably protected. The corrosion protection for springs and other moving parts shall not be affected by any movement.

5.3.4.4 Impregnation of the body

Treatment during manufacture (impregnation) by an appropriate process, for example treatment under vacuum or internal pressure, using suitable sealing products is permitted.

5.3.5 Separate combustion products evacuation duct

[A4] Subclause deleted **[A4]**

5.3.5.2 Stability under exposure to heat

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

5.3.5.3 Corrosion resistance

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

5.3.5.4 Resistance to condensate and moisture under normal operating conditions

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

5.3.6 Design

The boiler shall be designed such that when it is installed and used in accordance with the manufacturer's instructions, it shall be possible to vent the air from the boiler waterways, if it is not self-venting.

In addition, the boiler shall be designed in such a way that there is no condensation at the operating temperature provided by the controls.

If condensation is produced at start-up, this shall not:

- affect the operational safety;
- drop outside the appliance.

This requirement does not apply to the flow of condensate which is produced at the outlet of the combustion products evacuation duct.

Constructional parts accessible during use and servicing, in accordance with the manufacturer's instructions, shall be free from sharp edges and corners that might cause damage or personal injury during use and servicing.

5.4 Method of construction

5.4.1 Use and servicing

The user shall be able to gain access to and operate all control knobs and buttons necessary for normal use of the boiler without having to remove any part of the case. However, part of the case may be removed provided that this part can be handled safely by the user, that this part can be removed without the use of tools and that incorrect replacement is difficult (e.g. by the provision of stops).

All markings intended for the user shall be easily visible and shall be made in a clear and indelible manner.

Parts which are required to be inspected or removed for servicing shall be easily accessible, possibly after removal of the case, in accordance with the manufacturer's instructions.

Removable parts shall be designed or marked so that they are difficult to re-assemble incorrectly.

In accordance with the manufacturer's instructions, it shall be possible to clean the burner, combustion chamber and parts in contact with combustion products easily and/or remove them easily for servicing with the use of commercially available tools. This shall not involve disconnection of the boiler from the gas or water pipes. The gas circuit shall be designed so as to permit separate removal of the burner or of the burner and control assembly.

For boilers connected to an air supply system and/or combustion products evacuation system that forms part of the construction of the building, it shall be possible to carry out servicing of the boiler without dismantling the permanent connections to the duct.

The soundness of the combustion circuit shall be maintained after reassembly and, if necessary, in accordance with the manufacturer's instructions, after replacement of the seal(s) following cleaning and servicing operations.

5.4.2 Connections to the gas and water pipes

5.4.2.1 General

The boiler connections shall be easily accessible. They shall be clearly identified in the installation instructions and possibly on the boiler. The clearance around the connections, after removing the case if necessary, shall be adequate to allow easy use of the tools required to make the connection. It shall be possible to make all the connections without special tools.

5.4.2.2 Connection to the gas pipe

It shall be possible to connect the boiler by a rigid or a flexible metallic pipe to the gas supply pipe.

If the boiler has a threaded connection, this thread shall comply with ISO 228-1, ISO 7-1 or EN 1057. In the first case (ISO 228-1), the end of the boiler inlet connection shall offer a sufficiently flat annular surface to allow the use of a sealing washer.

If flanges are used, they shall comply with ISO 7005 and the manufacturer shall provide the counter-flanges and sealing gaskets.

The different national gas connection conditions are given in Table A.3

5.4.2.3 Connections to the central heating circuit

Threaded connections shall comply with ISO 228-1 or ISO 7-1.

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

If other than metallic materials are used, the manufacturer shall provide the appropriate justification for their suitability of use.

5.4.3 Soundness

5.4.3.1 Soundness of the gas circuit

The gas circuit shall consist of metallic parts.

Holes for screws, studs, etc., intended for the assembly of parts shall not open into gasways. The wall thickness between drillings and gasways 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 during a normal routine servicing operation in situ or during gas conversion shall be achieved by means of mechanical joints, for example 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 boiler 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.

5.4.3.2 Soundness of the combustion circuit

Parts which have to be removed during routine service and affect the soundness of the boiler 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 manufacturer, is permitted.

Where the boiler case forms part of the combustion circuit and it can be removed without the use of tools, either the appliance shall not operate, or there shall be no leakage of combustion products into the room where the appliance 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 assured during continuous service under normal conditions of use.

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

5.4.4 Supply of combustion air and evacuation of the combustion products

5.4.4.1 General

All boilers 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 manufacturer. A gas/air ratio control is permitted.

Unless otherwise stated, fan assisted boilers may be fitted with a means of adjustment in the combustion circuit intended to adapt the boiler to the pressure losses in the installed ducts either by restrictors or by setting the means of adjustment to predetermined positions in accordance with detailed instructions from the manufacturer.

According to the appliance type, the manufacturer shall supply any terminal and/or fitting piece, with the boiler for test.

5.4.4.2 Air supply and combustion products evacuation ducts⁷⁾

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 boiler.

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

The terminal outlets from separate ducts for the supply of combustion air and the evacuation of combustion products:

- shall fit inside a square of 50 cm for type C₁ and C₃ boilers;
- may terminate in zones of different pressure for type C₅ boilers, but not on opposite walls of the building.

5.4.4.3 Terminal

No opening in the external surfaces of the terminal shall permit the entry of a 16 mm diameter ball applied with a force of 5 N.

Any horizontal terminal shall be designed in such a way that any condensate is discharged away from the wall.

5.4.4.4 Terminal guard

If the manufacturer prescribes, in the installation instructions, a protective guard for the terminal for use when the outlets for evacuation of the combustion products open on to a walkway, this device shall be supplied to the laboratory for test.

The dimensions of the terminal guard, when installed in accordance with the manufacturer's instructions, 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.

5.4.4.5 Fitting piece

For boilers of types C₂, C₄ and C₈, the fitting piece shall be designed so that it is possible to obtain the distances specified by the manufacturer 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.

5.4.4.6 Special requirements for certain components of boilers with a fan

5.4.4.6.1 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.

⁷⁾ In accordance with national regulations sampling points in the combustion circuit may be required.

5.4.4.6.2 Air proving device

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

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

- supervision of the combustion air pressure or the combustion products pressure. This supervision of pressure is only allowed for boilers fitted with a constant speed fan during the operation of the main burner and where the combustion products evacuation duct is 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.
- 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 boilers with more than one fan speed in which the flows associated with each fan speed are monitored by separate supervision devices;
- gas/air ratio control;

Only for boilers where the combustion products circuit is completely surrounded by the air supply circuit or for separate ducts when the leakage rates of the combustion products evacuation ducts meets the requirements of 6.2.2.4, the following two indirect supervision methods are also allowed:

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

5.4.4.6.3 Gas/air ratio controls

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

Control tubes may be made of metal with suitable mechanical connections or of other materials with at least equivalent properties and in this case are considered immune to breakage, accidental disconnection and leakage after initial soundness checks. As such they are not subject to the tests in 7.5.8.4.2.

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

5.4.5 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 boiler is operating, either by visual observation of the flame or by some other indirect means.

5.4.6 Drainage

If it is not possible to drain the boiler by means of its water connections, it shall carry a device that enables it to be drained and can be operated by means of a tool such as a spanner or screwdriver.

Suitable directions for drainage shall be included in the instructions.

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

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

5.5 Electrical equipment

The electrical equipment of the boiler shall comply with the electrical safety requirements of EN 50165, except where reference is made to another electrical standard in 5.6.

If the boiler is fitted with electronic components or electronic systems providing a safety function, these shall comply with the relevant requirements of EN 298 concerning electromagnetic compatibility immunity levels.

If the manufacturer states, on the data plate, the nature of the electrical protection of the boiler, this statement shall comply with EN 60529:

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

5.6 Requirements for adjusting, control and safety devices

5.6.1 General

Safety systems shall be designed in accordance with the de-energized to trip principle.

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

The design of the control and safety system shall be such that it is not possible to perform two or more actions which are unacceptable in combination. The order of the actions shall be fixed in such a manner that it is not possible to change it.

All the following devices in 5.5 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. Adjusters for the devices shall not be interchangeable if this can result in confusion.

When there are several control knobs (taps, thermostats, etc.), they shall not be interchangeable if this could lead to confusion and their function shall be clearly indicated.

Rubbers used in adjusting, supervision, control and safety devices shall comply with the relevant requirements of EN 549.

Adjusting, supervision, control and safety devices that comply with EN 88, EN 125, EN 126, EN 161 and EN 298 are presumed to comply with the relevant requirements of this standard, as appropriate.

5.6.2 Adjusters and range-rating devices

5.6.2.1 General

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

The adjusting screws shall be arranged in such a way that they cannot fall into the gasways.

The soundness of the gas circuit shall not be put at risk by the presence of adjusters and range-rating devices.

Adjustment of the adjuster and/or of the range rating device may be continuous (e.g. use of an adjusting screw) or discrete (e.g. change of restrictors).

5.6.2.2 Adjuster

Gas rate adjusters are mandatory for boilers using several groups of first family gas and optional for other boilers.

An adjuster shall:

- be sealed if adjustment is made by the manufacturer;
- be able to be sealed if adjustment is carried out by the installer.

For boilers in a category which include a “+” sign, the adjusters shall be sealed by the manufacturer.

5.6.2.3 Range-rating devices

The boiler may have a range-rating device.

If this device and the gas rate adjuster are one and the same, the manufacturer shall give instructions for the use of the adjuster in his installation instructions.

5.6.3 Gas circuit

5.6.3.1 General

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.

Breather holes shall be so designed that, if the diaphragm is perforated, the air leakage rate does not exceed 70 dm³/h at the maximum upstream pressure. This requirement is deemed to be satisfied if, for a maximum gas supply pressure of 30 mbar, the diameter of the breather hole does not exceed 0,7 mm.

The use of bellows as the sole sealing element with respect to atmosphere is permitted only if the air leakage rate in the event of fracture does not exceed 70 dm³/h at the maximum upstream pressure.

Breather holes shall be protected against blockage or shall be located so that they cannot be easily blocked. They shall be so arranged that the diaphragm cannot be damaged by a device inserted for cleaning purposes.

Seals for moving parts which pass through the body to atmosphere and the seals for the closure member shall only be made of solid material (e.g. synthetic materials with proper mechanical support and of proper mechanical stability) of a type which does not deform permanently (e.g. no sealing paste).

Manually adjustable packing glands shall not be used for sealing moving parts. An adjustable gland adjusted only by the valve manufacturer and protected against further adjustment and which need not be readjusted is not considered adjustable.

There shall be no accessible shafts or operating levers that could be interfered with in such a way as to prevent closure of the valves.

A device to protect against dust shall be positioned near the gas inlet. The maximum dimension of the mesh of the filter shall not exceed 1,5 mm; furthermore the mesh shall not allow passage of a 1 mm pin gauge. However if the gas line includes a class D or D' automatic valve, the maximum diameter of the pin gauge is 0,2 mm.

5.6.3.2 Control devices

Every boiler shall be provided with at least one device to enable the user to control the gas supply to the burner and to the ignition burner, if any.

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

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

Off:	Full disc	●
Ignition:	Stylized star	★
Full rate of the burner:	Stylized flame	

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

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

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

5.6.3.3 Composition of the gas circuit

When the heat input of the ignition burner is not greater than 0,250 kW, the gas circuit shall comprise at least one class C' valve or a thermoelectric flame supervision device.

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

- a first valve of class C' or a thermoelectric flame supervision device;
- a second valve of class D'.

Additional requirements for the composition of the gas circuit of fan assisted boilers for which pre-purge is not obligatory are given in 6.4.5.

Safety devices which require non-volatile lockout to occur shall give rise to simultaneous signal to close the two valves. However, for a thermoelectric device, the safety devices may act only on this device.

In the case of direct ignition of the main burner and if the order to close in response to a control device is not given simultaneously to the two valves, the two valves shall be class C'.

In response to a control device, if the delay between the signals to close the two valves is not greater than 5 s, the signals are considered to be simultaneous.

A class C' valve may be replaced by a class C, a class B, a class B' or a class A valve; a class D' valve may be replaced by a class D valve with a closure time of not greater than 5 s or by a class C, a class C', a class B, a class B' or a class A valve.

Illustrations of the composition of the gas circuit are given in informative annex D.

5.6.4 Gas governor

Boilers intended to operate with first family gases shall have a gas governor; for other boilers a governor is optional.

A governor intended for operation with a pressure couple shall be, or shall be able to be adjusted in a manner such that it cannot operate between the two normal pressures.

However, when operating with a pressure couple, a non-adjustable gas governor for the ignition burner is permitted.

The design and accessibility of the governor shall be such that it can be easily adjusted or put out of operation when another gas is supplied, but precautions shall be taken to make unauthorized interference with the adjuster difficult.

5.6.5 Ignition devices

5.6.5.1 Ignition of the ignition burner

It shall be possible to ignite the ignition burner, without interfering in the combustion products circuit.

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

5.6.5.2 Ignition device for the main burner

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

5.6.5.2.1 Ignition burners

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

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

Admission of gas to the ignition burner ($Q_{IB} \leq 250 \text{ W}$) during the pre-purge is permitted, if ignition is effected after the pre-purge period.

5.6.5.2.2 Direct ignition

Devices for direct ignition shall ensure safe ignition even if the voltage is varied from 85 % to 110 % of the nominal voltage. The order to energize ignition devices shall be given no later than the order to open the automatic valve controlling the gas to be ignited.

Excluding flame detection, the ignition device shall be de-energized no later than at the end of the ignition safety time.

5.6.6 Flame supervision devices

5.6.6.1 General

The presence of a flame shall be detected:

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

At least one flame detector is required.

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

5.6.6.2 Thermoelectric flame supervision device

The device shall cause non-volatile lockout of the boiler in the event of flame failure, and in the event of damage to the sensing element or to the connection between the sensing element and the device responding to its signal.

The device shall incorporate either an ignition interlock or a recycling interlock.

5.6.6.3 Automatic burner control system

Automatic burner control systems shall comply with the appropriate requirements of EN 298, with the exception of requirements for degree of electrical protection, endurance, marking and instructions.

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

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

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

5.6.7 Thermostats and water temperature limiting devices

5.6.7.1 General

Boilers shall be fitted with a fixed setting or adjustable control thermostat complying with 5.6.7.2. In addition, boilers shall be fitted with the appropriate temperature limiting devices specified below.

5.6.7.1.1 Boilers intended exclusively for central heating systems with an open expansion vessel

Temperature limiting devices are not required when the boiler is designed to be installed exclusively with an open expansion vessel and when a failure of the control thermostat does not cause a dangerous situation for the user or damage to the boiler. Appropriate information shall be given in the technical instructions.

5.6.7.1.2 Boilers intended for central heating systems with open or sealed expansion vessels

5.6.7.1.2.1 Boilers of pressure class 1 and 2

Boilers of pressure classes 1 and 2 shall be fitted with:

- either a safety temperature limiter in accordance with 5.6.7.5
- or a limit thermostat in accordance with 5.6.7.3 and an overheat cut-off device in accordance with 5.6.7.4. Instead of this limit thermostat, other devices (e.g. water rate monitoring device, low water detector safety device) are possible in as much as all the requirements of 6.5.7 are satisfied.

5.6.7.1.2.2 Boilers of pressure class 3

Boilers of pressure class 3 shall be fitted with a safety temperature limiter in accordance with 5.6.7.5.

5.6.7.2 Control thermostat

The control thermostat shall comply with the requirements of EN 60730-2-9 for type 1 devices.

If the control thermostat is adjustable, the manufacturer shall at least state the maximum temperature in the instructions. The positions of the temperature selector shall be recognizable and it shall be possible to ascertain in which direction the water temperature rises or falls. If numbers are used for this purpose, the highest number shall correspond to the highest temperature.

At its maximum setting, it shall cause at least controlled shut-down before the water flow temperature exceeds 95 °C.

5.6.7.3 Limit thermostat

The limit thermostat shall comply with the requirements of EN 60730-2-9 for type 1 devices.

The limit thermostat shall cause at least safety shut-down before the water flow temperature exceeds 110 °C.

It shall not be possible to alter the maximum set point of this device.

When the water temperature falls below its set point, the gas supply to the burner may be restored automatically.

5.6.7.4 Overheat cut-off device

The overheat cut-off device shall comply with the requirement of EN 60730-2-9 for type 2 devices.

This device shall cause non-volatile lockout before the boiler is damaged and/or before a dangerous situation for the user occurs.

This device shall not be adjustable and normal operation of the boiler shall not give rise to a change in its set point temperature.

Interruption of the link between the sensor and the device responding to its signal shall cause at least safety shutdown.

5.6.7.5 Safety temperature limiter

The safety temperature limiter shall comply with the requirements of EN 60730-2-9 for type 2 devices.

In addition to the requirements stated in 5.6.7.4, the safety temperature limiter shall cause non-volatile lockout before the water flow temperature exceeds 110 °C.

5.6.7.6 Sensors

Thermostats, limit thermostats, overheat cut-off devices and safety temperature limiters shall have independent sensors; with an electronic system, thermostats and limit thermostats may have the same sensor, provided that a failure of the sensor cannot lead to a dangerous situation for the user or damage to the boiler.

The sensors shall withstand the thermal overload resulting from an overheat condition specified in this standard, without the predetermined set point being affected.

5.6.8 Remote control

The boiler shall be designed so that it can be controlled remotely (for example by a room thermostat, a clock, etc.), except when the boiler operates without using electrical energy.

Connection of any remote controls recommended by the manufacturer shall be possible without disturbing the internal electrical connections except for purpose-designed removable links.

5.6.9 Expansion vessel and pressure gauge

If the boiler incorporates a sealed system expansion vessel, this shall be located or protected in such a way that heat cannot damage the diaphragm and the boiler shall be fitted with a pressure gauge stating the maximum water-side operating pressure (PMS).

5.7 Burners

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

Every removable injector and/or removable restrictor shall carry an indelible means of identification preventing any confusion. In the case of non-removable injectors and/or restrictors, the marking may be on the manifold.

It shall be possible to change injectors and restrictors without the need to disconnect the boiler. When the injectors and restrictors are removable, their position shall be well defined and their method of fixing shall be such that it is difficult to position them incorrectly.

Burners shall be accessible without the need to dismantle a major part of the boiler. If the burners or a part of the burners are removable, their position shall be well defined and their method of fixing shall be such that it is difficult to position them incorrectly.

Aeration adjusters are forbidden.

5.8 Pressure test points

Boilers shall be fitted with at least two pressure test points. These shall be arranged in a position carefully selected so as to permit measurement of the inlet pressure and the burner pressure.

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

It shall be possible to measure the gas pressure without affecting the soundness of the combustion circuit.

6. Operational requirements

6.1 General

Except where otherwise stated, the following requirements are checked under the test conditions of 7.1.

6.2 Soundness

6.2.1 Soundness of the gas circuit

The gas circuit shall be sound.

Soundness is verified before and after all the tests of this standard.

Soundness is assured if, under the test conditions of 7.2.1, the leakage of air does not exceed:

- for test n° 1: 0,06 dm³/h;
- for tests n° 2 and n° 3: 0,06 dm³/h for each relevant shut-off device;
- for test n° 4: 0,14 dm³/h.

6.2.2 Soundness of the combustion circuit

6.2.2.1 General

Boilers shall be sound in accordance with 6.2.2.2 or 6.2.2.3. Ducts shall be sound in accordance with 6.2.2.4, 6.2.2.5 and 6.2.2.6.

^{A4} Soundness is verified before and after all the tests of this standard, except the tests specified in 7.10. ^{A4}

6.2.2.2 Air supply and combustion product circuit

Soundness with respect to the room where the boiler is installed is ensured if, under the test conditions of 7.2.2.2, the leakage rates do not exceed the values in Table 8.

Table 8: Maximum admissible leakage rates

Test object	Surrounding of the combustion products circuit by the combustion air circuit	Maximum leakage rate m ³ /h
Boiler with its air supply and combustion products evacuation ducts and all their joints	completely	5
	not completely	1
Boiler and the joint to the air supply and combustion products evacuation duct	completely	3
	not completely	0,6
Combustion products evacuation ducts, not completely surrounded by combustion air, with all its joints excluding the joint tested above		0,4
Air supply duct with all its joints excluding the joint tested above		2

6.2.2.3 Combustion products circuit

Soundness is ensured if under the test conditions of 7.2.2.3 the leakage rate of the boiler and the combustion products evacuation ducts does not exceed 0,4 m³/h.

However, for boilers designed as living space dedicated boilers and their ducts, this value shall not exceed 1,0 m³/h.

6.2.2.4 Combustion products evacuation duct for alternative control systems (see 5.4.4.6.2 indirect supervision methods)

The soundness of the combustion products evacuation duct for installation both inside and outside the room where the boiler is installed, permitted for alternative control systems, is ensured if, under the test conditions of 7.2.2.4, the leakage rate per surface area of the duct does not exceed $0,006 \text{ dm}^3/\text{s}\cdot\text{m}^2$ ⁸⁾.

6.2.2.5 Separate combustion products evacuation duct

The soundness of a separate combustion products evacuation duct with respect to areas other than the room where the boiler is installed is ensured if under the test conditions of 7.2.2.5, the leakage rate per surface area of the duct does not exceed $0,006 \text{ dm}^3/\text{s}\cdot\text{m}^2$.

6.2.2.6 Separate and concentric air supply ducts

The soundness of the air supply duct with respect to all areas other than the room where the boiler is installed, is ensured if under the test conditions of 7.2.2.6 the leakage rate per surface area of the duct does not exceed $0,5 \text{ dm}^3/\text{s}\cdot\text{m}^2$.

A4 6.2.2.7 Durability against corrosion

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

- the requirements in Table A4-1 or
- a corrosion test method from normative Annex A of EN 1856-1:2003.

Table A4-1 — Flue duct material specification

	Material	Symbol	Minimum Nominal Thickness non-condensing ^{b)} mm	Minimum nominal Thickness condensing ^{b)} mm
	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
	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)} According to declaration of manufacturer, see definition 3.4.19				
^{c)} Flexible liners only allowed when installed in an existing chimney				

The actual minimum thickness of the materials shall always be greater than 90 % of the minimum nominal thicknesses. **A4**

⁸⁾ This figure should be revised after the finalizing of the relevant product standard by CEN/TC 166.

6.2.3 Soundness of the water circuit

Under the test conditions of 7.2.3 there shall be neither leakage nor permanent visible distortion.

6.3 Heat inputs and heat output

6.3.1 The nominal heat input or the maximum and minimum heat input

The heat input obtained under the test conditions from 7.3.1 shall not differ by more than 5 % from:

- the nominal heat input, for boilers without a range rating device, or,
- the maximum and minimum heat input for boilers with a range rating device.

If this 5 % is less than 500 W, a tolerance of 500 W is acceptable.

6.3.2 Adjustment of the heat input by the downstream gas pressure

When the manufacturer's instructions specify the value of the downstream pressure that enables the nominal heat input to be obtained, the heat input obtained under the test conditions of 7.3.2 shall not differ by more than 5 % from the nominal heat input. If this 5 % is less than 500 W, a tolerance of 500 W is acceptable.

6.3.3 Ignition rate

For boilers which may be ignited at a heat input less than the nominal heat input under the test conditions of 7.3.3, it is verified that the ignition rate of the boiler (see 3.4.1.5) does not exceed the ignition rate declared by the manufacturer.

6.3.4 Nominal output

It is verified that the output determined under the test conditions of 7.3.4 is not less than the nominal output.

6.4 Safety of operation

6.4.1 Limiting temperatures

6.4.1.1 Limiting temperatures of the adjusting, control and safety devices

Under the test conditions of 7.4.1.2 the temperature of the adjusting, control and safety devices shall not exceed the value stated by the manufacturer and their operation shall remain satisfactory.

The surface temperatures of the control knobs and of all the parts that have to be touched during normal use of the boiler, measured only in the zones intended to be gripped, and under the conditions stated in 7.4.1.2, shall not exceed the ambient temperature by more than:

- 35 K for metals;
- 45 K for porcelain;
- 60 K for plastics.

A4 6.4.1.2 Limiting temperatures of the side walls, the front and the top of the outside of the boiler and of the ducts A4

The temperature of the side walls, front and top of the boiler shall not exceed the ambient temperature by more than 80 K, when measured under the test conditions of 7.4.1.3.

Nevertheless, parts of the case within 5 cm of the edge of the sight glass, and within 15 cm of the flue duct are exempt from this requirement.

6.4.1.3 Limiting temperatures adjacent to the boiler casing and ducts

The temperature of the floor on which the boiler is eventually placed, where appropriate, that of the panels placed at the side of and behind the boiler and the surfaces adjacent to ducts and/or terminal shall not, at any point, exceed the ambient temperature by more than 80 K under the test conditions of 7.4.1.4.

If this temperature rise is between 60 K and 80 K, the manufacturer shall state in the technical instructions for the installer the nature of the protection which has to be applied between the boiler and the adjacent surfaces when these latter are made of inflammable materials.

This protection shall be supplied to the test laboratory, which shall check that, with the boiler fitted with it, the surface temperatures measured under the test conditions of 7.4.1.4 do not exceed the ambient temperature by more than 60 K. 

6.4.1.4 External temperature of the ducts

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 under the test conditions of 7.4.1.5.

However, when this temperature rise exceeds 60 K, the manufacturer shall state in the technical instructions for the installer the nature of the protection which has to be applied between the ducts and the walls in case they are constructed from inflammable materials. This protection shall be supplied to the test laboratory which shall check that, with the boiler fitted with it, the external surface temperature in contact with the wall measured under the test conditions of 7.4.1.5 does not exceed the ambient temperature by more than 60 K.

6.4.2 Ignition - Cross lighting - Flame stability

6.4.2.1 Limit conditions

Under the test conditions specified in 7.4.2.2. and in still air, ignition and cross lighting shall be capable of being effected correctly, rapidly and quietly. The flames shall be stable. A slight tendency to lift at the moment of ignition is permissible, but the flames shall be stable thereafter.

Ignition of the burner shall occur at all gas rates which can be given by the controls as stated by the manufacturer and there shall be neither light-back nor prolonged flame lift. However, brief light-back during ignition or extinction of the burner is accepted if this does not affect correct operation.

A permanent ignition burner shall not be extinguished during ignition or extinction of the burner; while the boiler is operating, the ignition burner flame shall not change to such an extent that it can no longer fulfil its function (ignition of the burner, operation of the flame supervision device).

When the ignition burner has been alight for a sufficient time for normal and regular operation of the boiler to be obtained, it shall always be ready to operate without fail, even if the gas supply to the burner is turned off and on by several quick and successive adjustments of the thermostat.

In addition, to test flame stability for boilers which have an indirect means of indicating the presence of the flame, the carbon monoxide concentration, at thermal equilibrium, of the dry, air-free combustion products using flame lift limit gas shall not be more than 1 000 ppm.

NOTE: $1 \text{ ppm} = 1 \text{ cm}^3/\text{m}^3$

The above requirements shall also be fulfilled where spark restoration or recycling is provided.

6.4.2.2 Special conditions

Under the test conditions of 7.4.2.3, ignition of the ignition burner, ignition of the main burner by the ignition burner or direct ignition of the main burner, complete cross lighting of the main burner and also stability of the ignition burner when it alone is alight or of the ignition burner and main burner operating simultaneously shall be assured. Slight flame disturbance is permitted but there shall be no flame extinction.

6.4.2.3 Reduction of the gas rate of the ignition burner

Under the test conditions of 7.4.2.4. and when the gas rate of the ignition burner is reduced to the minimum required to keep open the gas valve of the flame supervision device, ignition of the main burner shall be assured without damage to the boiler.

6.4.3 Reduction of the gas pressure

Under the test conditions of 7.4.3, there shall be no dangerous situation for the user or damage to the boiler.

6.4.4 Defective closure of the gas valve immediately upstream of the main burner

Where the gas line is designed such that the gas supply to the ignition burner is taken from between the two main burner gas valves, it is checked under the test conditions of 7.4.4 that no dangerous situation can arise in the event of defective closure of the gas valve immediately upstream of the main burner when the ignition burner is ignited.

6.4.5 Pre-purge

6.4.5.1 General

For fan-assisted boilers, pre-purge is mandatory before each ignition of the main burner (a single ignition attempt or several consecutive automatic ignition attempts) unless one of the following conditions is fulfilled:

- The boiler is fitted with a permanent or alternating ignition burner;
- if the heat input is greater than 0,250 kW and the gas circuit is fitted with two valves which are of at least class C' or classes B' and D', which close simultaneously;
- the boiler satisfies 6.4.5.2 (Verification of the protected nature of a combustion chamber);
- the boiler satisfies 6.4.5.3 (Verification of normal ignition in a combustible air/gas mixture for type C boilers incorporating a fan). This condition is only applicable for type C₁₂ and C₁₃ boilers.

Under the test conditions of 7.4.5.1, the volume or the duration of the pre-purge shall be at least:

- for boilers where the pre-purge air is induced over the whole cross-section of the combustion chamber inlet: at least the volume of the combustion chamber or at least 5 s at the air rate corresponding to the nominal heat input,
- for other boilers: at least three times the volume of the combustion chamber or at least 15 s.

Illustrations of the composition of the gas circuit are given in informative annex D.

6.4.5.2 Verification of the protected nature of a combustion chamber

Under the test conditions of 7.4.5.2 it is checked that an ignition within the combustion chamber does not ignite a combustible mixture of air and gas outside the combustion chamber.

6.4.5.3 Verification of normal ignition in a combustible air/gas mixture for type C boilers incorporating a fan

Under the test conditions of 7.4.5.3 it is checked that ignition occurs correctly without deterioration of the boiler when the combustion chamber is first filled with a combustible air/gas mixture.

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

Under the test conditions of 7.4.6 the flame stability of the ignition burner shall be correct.

6.4.7 Leakage of combustion products for type C₇ boilers

Under the test conditions of 7.4.7 combustion products shall only escape from the secondary flue outlet.

6.5 Adjusting, control and safety devices

6.5.1 General

The devices shall operate correctly under extreme conditions, namely, at the maximum temperature to which they are subjected in the boiler and when the voltage is varied between 1,10 times and 0,85 times the nominal voltage, and under any combination of these conditions.

For voltages below 85 % of the nominal value, the devices shall either continue to assure safety or cause safety shutdown.

Devices that do not comply with EN 88, EN 125, EN 126, EN 161 or EN 298 shall comply with the following requirements.

6.5.2 Control devices

6.5.2.1 Rotary knob

Under the test conditions of 7.5.2.1 the operating torque of a knob shall not exceed 0,6 N·m or 0,017 N·m/mm of knob diameter.

6.5.2.2 Push-button

Under the test conditions of 7.5.2.2 the force required to open and/or to keep open the closure element shall not exceed 45 N or 0,5 N/mm² of the area of the button.

6.5.3 Automatic valves

6.5.3.1 Sealing force

Under the test conditions of 7.5.3.1 the air leakage rate shall not exceed 0,04 dm³/h when the valve is subjected to a back pressure of:

- class B' valve: 50 mbar;
- class C' valve: 10 mbar.

6.5.3.2 Closing function

Under the test conditions of 7.5.3.2 the valves shall close automatically before the voltage reaches 15 % of the minimum of the voltage range stated by the manufacturer.

Valves using an auxiliary fluid shall close automatically on reducing the actuating pressure to 15 % of the maximum pressure stated by the manufacturer.

The valves shall close automatically on interruption of the electricity supply when the electrical supply voltage is between 15 % of its nominal minimum value and 110 % of its nominal maximum value.

6.5.3.3 Closing time

Under the test conditions of 7.5.3.3. it is checked that the closing time of the automatic valve does not exceed:

- 1 s for class B' and C' valves;
- 5 s for class D' valves.

6.5.3.4 Endurance

Valves that are operated at each controlled shutdown are subjected to an endurance test of 250 000 cycles.

Valves that remain permanently open and that are closed only by a safety device are subjected to an endurance test of 5 000 cycles.