

BS EN 15420:2010



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Gas-fired central heating boilers — Type C boilers of nominal heat input exceeding 70 kW, but not exceeding 1 000 kW

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National foreword

This British Standard is the UK implementation of EN 15420:2010.

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

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

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English Version

Gas-fired central heating boilers - Type C boilers of nominal heat input exceeding 70 kW, but not exceeding 1 000 kW

Chaudières de chauffage central utilisant les combustibles gazeux - Chaudières de type C dont le débit calorifique nominal est supérieur à 70 kW mais inférieur ou égal à 1 000 kW

Heizkessel für gasförmige Brennstoffe - Heizkessel der Bauart C mit einer Nennwärmebelastung größer als 70 kW aber gleich oder kleiner als 1 000 kW

This European Standard was approved by CEN on 23 October 2010.

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Foreword

This document (EN 15420:2010) has been prepared by Technical Committee CEN/TC 109 "Central heating boilers using gaseous fuels", 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of an identical text or by endorsement, at the latest by June 2011, and conflicting national standards shall be withdrawn at the latest by June 2011.

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

It was established to deal with aspects related to:

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

Other types of boilers are dealt with in separate standards.

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 Directives 90/396/EEC and 92/42/EEC.

For relationship with EU Directives 90/396/EEC "Approximation of the laws of Member States concerning gas appliances" and 92/42/EEC "Efficiency requirements for new hot water boilers fired with liquid or gaseous fuels" see informative Annex ZA, which is an integral part of this standard.

This standard covers only type testing.

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

It is impractical to use the full range of test gases to EN 437 for type testing since their availability, for inputs over 300 kW, may present problems for test houses and manufacturers. Informative Annex O gives guidance on the use of gases for tests in order to ensure conformity with EU Directive 90/396/EEC "Approximation of the laws of Member States concerning gas appliances".

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, 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 document 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 fully premixed burners, and are hereafter referred to as "boilers".

This document applies to boilers of type C, as listed in 4.2:

- that use one or more combustible gases of the three gas families at the pressures stated in Tables 14 and 15;
- that have a nominal heat input (on the basis of net calorific value) exceeding 70 kW, but not exceeding 1 000 kW, including modular boilers;
- where the temperature of the heat transfer fluid does not exceed 105 °C during normal operation;
- where the maximum operating pressure in the water circuit does not exceed 6 bar;
- which can give rise to condensation under certain circumstances.

The document applies to boilers designed for sealed water systems or for open water systems.

The document does not contain all the requirements necessary for boilers:

- intended to be installed in the open or in living rooms;
- permanently fitted with more than one flue outlet;
- of the condensing type;
- intended to be connected to a common flue having mechanical extraction;
- type C21, C41, C51, C61, C7 and C81 boilers;
- fitted with a forced draught burner in accordance with EN 676;
- producing hot water for domestic purposes.

This document only covers type testing.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 88-1, *Pressure regulators and associated safety devices for gas appliances — Part 1: Pressure regulators for inlet pressures up to and including 500 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 257, *Mechanical thermostats for gas-burning appliances*

EN 298, *Automatic gas burner control systems for gas burners and gas burning appliances with or without fans*

EN 437:2003, *Test gases — Test pressures — Appliance categories*

EN 483, *Gas-fired central heating boilers — Type C boilers of nominal heat input not exceeding 70 kW*

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

EN 1092-1, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1: Steel flanges*

EN 1092-2, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 2: Cast iron flanges*

EN 1092-3, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 3: Copper alloy flanges*

EN 1561, *Founding — Grey cast irons*

EN 1643, *Valve proving systems for automatic shut off valves for gas burners and gas appliances*

EN 1854, *Pressure sensing devices for gas burners and gas burning appliances*

EN 10029, *Hot rolled steel plates 3 mm thick or above — Tolerances on dimensions, shape and mass*

EN 12067-1, *Gas/air ratio controls for gas burners and gas burning appliances — Part 1: Pneumatic types*

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

EN 50165, *Electrical equipment of non-electric appliances for household and similar purposes — Safety requirements*

EN 60335-1:1992, *Safety of household and similar electrical appliances — Part 1: General requirements (IEC 60335-1:2001, modified)*

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

EN 60730-2-9, *Automatic electrical controls for household and similar use — Part 2-9: Particular requirements for temperature sensing controls (IEC 60730-2-9:2000, modified)*

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

EN ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes (ISO 3166-1:2006)*

EN ISO 4063, *Welding and allied processes — Nomenclature of processes and reference numbers (ISO 4063:2009)*

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

ISO 857, *Welding, brazing and soldering processes — Vocabulary — Bilingual edition*

ISO 2553, *Welded, brazed and soldered joints — Symbolic representation on drawings*

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

CR 1472, *General guidance for the marking of gas appliances*

3 Terms and definitions

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

3.1 Combustible gases

3.1.1 test gases

gases that are intended for the verification of the operational characteristics of appliances using combustible gases and that consist of reference gases and limit gases

3.1.2 reference gases

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

3.1.3 limit gases

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

3.1.4 reference conditions

conditions corresponding to 15 °C 1 013,25 mbar, unless otherwise specified

3.1.5 relative density

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

Symbol: d

3.1.6 calorific value

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

NOTE A distinction is made between:

- a) The gross calorific value: the water produced by combustion is assumed to be condensed

Symbol: H_s

- b) The net calorific value: the water produced by combustion is assumed to be in the vapour state

Symbol: H_i

c) Unit:

- 1) either in megajoules per cubic metre (MJ/m^3) of dry gas under the reference conditions;
or in megajoules per kilogram (MJ/kg) of dry gas.

3.1.7

Wobbe index

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

Symbols: gross Wobbe index: W_s

net Wobbe index: W_i

NOTE The Wobbe indices are expressed:

- either in megajoules per cubic metre (MJ/m^3) of dry gas under the reference conditions;
- or in megajoules per kilogram (MJ/kg) of dry gas.

3.1.8

gas pressure

static pressure 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)

3.1.9

test pressures

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

[EN 437:2003, 3.5]

3.1.10

normal pressure

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

Symbol: p_n

3.1.11

limit pressures

pressures representative of the extreme variations in the appliance supply conditions

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

minimum pressure: $p_{\min}$

3.1.12

pressure couple

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

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

3.2 Constituent parts of the boiler

3.2.1 Gas supply

3.2.1.1

gas inlet connection

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

3.2.1.2

gas circuit

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

3.2.1.3

restrictor

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

3.2.1.4

injector

component that admits gas into the burner

3.2.1.5

gas rate adjuster

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

NOTE The action of operating this component is called "adjustment of the gas rate".

3.2.1.6

range rating device

component on the boiler intended to be used by the installer to adjust the 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

3.2.1.7

primary aeration adjuster

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

3.2.1.8

sealing an adjuster or a control

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

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

3.2.1.9

putting an adjuster or a control out of service

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

3.2.1.10 Burners

3.2.1.10.1

main burner

burner that is intended to assure the thermal function of the boiler and is generally called "the burner"

3.2.1.10.2

premixed burner

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

3.2.1.10.3

ignition device

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

3.2.1.10.4

manual ignition device

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

3.2.1.10.5

automatic ignition device

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

3.2.1.10.6

ignition burner

burner intended to ignite a main burner

3.2.1.10.7

permanent ignition burner

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

3.2.1.10.8

intermittent ignition burner

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

3.2.1.10.9

alternating ignition burner

ignition burner which is extinguished as soon as ignition of the main burner is effected, and which re-ignites at the main burner flame just before the latter goes out

3.2.1.10.10

interrupted ignition burner

ignition burner which operates only during the ignition sequence

3.2.2 Air supply and combustion products evacuation

3.2.2.1

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

3.2.2.2

combustion products circuit

circuit including the combustion chamber, the heat exchanger and the circuit permitting evacuation of the combustion products to the flue, up to and including the flue outlet

3.2.2.3

combustion chamber

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

3.2.2.4

flue outlet

part of the boiler through which the combustion products are evacuated to the flue system

3.2.2.5

air supply and combustion products evacuation ducts

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

NOTE 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.

3.2.2.6

terminal

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

- the air supply and combustion products evacuation ducts for type C1 and C3 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)

3.2.2.7

terminal guard

device that protects the terminal from mechanical damage from outside influences

3.2.2.8

fitting piece

device which allows the fitting of:

- the air supply and combustion products evacuation ducts to a single shared duct for type C2 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

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

3.2.2.9

damper

device placed in the air inlet duct or the flue products outlet duct to control the volume flow

3.2.3 Adjusting, control and safety devices

3.2.3.1

pressure regulator

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

3.2.3.2

adjustable pressure regulator

pressure regulator fitted with a means of adjusting the downstream pressure

NOTE This means is considered as an "adjusting device".

3.2.3.3

volume governor

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

3.2.3.4

water rate monitoring device

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 this value

3.2.3.5

flame supervision device

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

3.2.3.6

control thermostat

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

3.2.3.7

adjustable control thermostat

control thermostat that permits the operator to obtain setting temperatures between a minimum and a maximum value

3.2.3.8

safety temperature limiter

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

3.2.3.9

temperature sensing element

sensor

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

3.2.3.10

control knob

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

3.2.3.11

flame detector

device which detects and signals the presence of a flame and which can consist of a flame sensor, an amplifier and a relay for signal transmission

NOTE 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.

3.2.3.12

flame signal

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

3.2.3.13

flame simulation

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

3.2.3.14

programming unit

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

3.2.3.15

automatic burner control system

system that comprises a programming unit and all the elements of a flame detector, and all the functions of which may be assembled in one or more housings

3.2.3.16

start signal

signal causing the boiler to leave its start position and the predetermined programme of the programming unit to commence

3.2.3.17

programme

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

3.2.3.18

automatic shut-off valve

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

3.2.3.19

low pressure cut-off device

device that shuts off the gas supply when the upstream pressure falls below a predetermined value

3.2.3.20

high pressure cut-off device

device that shuts off the gas supply when the upstream pressure or the burner supply pressure rises above a predetermined value

3.2.3.21

multi-functional control

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

3.2.3.22

closure member

movable part of the valve or the thermoelectric device that opens, varies or shuts off the gas way

3.2.3.23

breather hole

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

3.2.3.24

diaphragm

flexible component that operates the valve by means of forces resulting from a pressure difference

3.2.3.25

external soundness

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

3.2.3.26

internal soundness

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

3.2.3.27

sealing force

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

3.2.3.28

gas/air ratio control

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

3.3 Operation of the boiler

3.3.1 Gas rates

3.3.1.1

volume flow rate

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

Symbols: V (under test conditions)

V_r (under reference conditions)

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

3.3.1.2

mass flow rate

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

Symbols: M (under test conditions)

M_r (under reference conditions)

Unit: kilograms per hour (kg/h) or grams per hour (g/h)

3.3.1.3

heat input

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)

3.3.1.4

nominal heat input¹⁾

value of the heat input declared by the manufacturer

Symbol: Q_n

Unit: kilowatt (kW)

3.3.1.5

ignition rate

average heat input during the ignition safety time

Symbol: Q_{ign}

Unit: kilowatt (kW)

3.3.2 Outputs

3.3.2.1

useful output

quantity of heat transmitted to the heat carrier in unit time

Symbol: P

Unit: kilowatt (kW)

3.3.2.2

nominal output

useful output stated by the manufacturer

Symbol: P_n

Unit: kilowatt (kW)

3.3.3 Efficiency

3.3.3.1

useful efficiency

ratio of the useful output to the heat input

Symbol: η_u

1) Boilers fitted with a range-rating device operate at a nominal heat input between the maximum and minimum adjustable heat inputs. Modulating boilers operate between the nominal heat input and the minimum controlled heat input.

Unit: percent (%)

3.3.4 Gas combustion

3.3.4.1

complete combustion

combustion with no more than traces of combustible constituents (hydrogen, hydrocarbons, carbon monoxide, carbon, etc.) in the combustion products

3.3.4.2

incomplete combustion

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

3.3.4.3

flame stability

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

3.3.4.4

flame lift

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

3.3.4.5

light-back

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

3.3.4.6

light-back at the injector

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

3.3.4.7

sooting

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

3.3.4.8

yellow tipping

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

3.3.4.9

condensate

liquid formed from the combustion products during the condensation process

3.3.5 Times

3.3.5.1

ignition opening time (T_{IA})

thermoelectric flame supervision device

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

3.3.5.2

extinction delay time (T_{IE})

thermoelectric flame supervision device

time that elapses between the disappearance of the flame and the interruption of the gas supply

3.3.5.3

ignition safety time (T_{SA})

time that elapses between the order to open and the order to close the gas supply to the burner in the event of no flame being detected

3.3.5.4

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

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

3.3.5.5

extinction safety time (T_{SE})

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

3.3.5.6

closing time

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

3.3.6 spark restoration

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

3.3.7 recycling

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

3.3.8 controlled shutdown

process by which the 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

3.3.9 safety shutdown

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

3.3.10 Locking out

3.3.10.1

lockout

complete interruption of the gas supply

3.3.10.2

non-volatile lockout

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

3.3.10.3

volatile lockout

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

3.3.11

de-energized to trip principle

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

3.3.12

nominal voltage

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

3.3.13

purge

mechanical introduction of air into the combustion circuit in order to displace any fuel/air mixture which could remain there

NOTE A distinction is made between:

- pre-purge: the purge that takes place between the start-up command and the ignition device being energized;
- post-purge: the purge that takes place following burner shutdown.

3.4 Auxiliary energy

3.4.1 electric auxiliary energy

electric energy consumed by the system components such as pump, fan, valves, heating elements and control unit required for the heat generator's designed operation

3.5 Country of destination

3.5.1 direct country of destination

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

3.5.2 indirect country of destination

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.

4.2 Mode of air supply and evacuation of the combustion products

4.2.1 Type C Boilers

A boiler in which the combustion circuit (air supply, combustion chamber, heat exchanger and evacuation of the products of combustion) is sealed with respect to the room (or space) in which the boiler is installed.

The air supply and the combustion products evacuation ducts and the terminal or the fitting piece that 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 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 D)²⁾.

The types are defined by two subscripts:³⁾

- 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 that is designed for connection via its ducts to a horizontal terminal, which at the same time admits fresh air to the burner and discharges the products of combustion to the outside through orifices that are either concentric or close enough to come under similar wind conditions.

4.2.2.2 Type C₂

A type C boiler connected via its two ducts to a common duct system serving more than one appliance. This system consists of a single duct, which supplies the combustion air and evacuates the products of combustion.

4.2.2.3 Type C₃

A type C boiler that is designed for connection via its ducts to a vertical terminal, which at the same time admits fresh air to the burner and discharges the products of combustion to the outside through orifices that are either concentric or close enough to come under similar wind conditions.

2) 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)*.

3) 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.

4.2.2.4 Type C₄

A type C boiler connected via its two ducts to a common duct system⁵ serving more than one appliance. This common duct system consists of two ducts connected to a terminal, which at the same time admits fresh air to the burner and discharges the products of combustion to the outside through orifices that are either concentric or close enough to come under similar wind conditions.

4.2.2.5 Type C₅

A type C boiler connected via its separate ducts to separate terminals for the supply of combustion air and the evacuation of the products of combustion. These ducts may terminate in zones of different pressure.

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 C₈

A type C boiler connected via one of its ducts to a single or common duct system. This duct system consists of a single natural draught duct (i.e. not incorporating a fan) that evacuates the products of combustion. The appliance is connected via a second of its ducts to a terminal, which supplies air to the appliance from outside the building.

4.2.3 Presence and position of a fan

A second subscript number of each specific variation indicates the absence or presence of an integral fan for the supply of combustion air and/or for the evacuation of the products of combustion. Where such a fan is present, the numbers 2 or 3 are given. These two numbers are used solely to identify the location of this 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 Classification according to operating conditions⁴⁾

4.3.1 Standard boiler

A boiler for which the average temperature of the water can be restricted by design.

4.3.2 Low-temperature boiler

A boiler which can work continuously with a water supply temperature of 35 °C to 40 °C, possibly producing condensation in certain circumstances, including condensing boilers using liquid fuel⁵⁾.

4) These definitions are in accordance with 92/42/EEC; however in this standard, definition 4.3.2 is limited to gas.

4.3.3 Gas condensing boiler⁶⁾

A boiler designed to condense permanently a large part of the water vapour contained in the combustion gases.

4.4 Modular boiler

A boiler consisting of an assembly of two or more generally identical modules, each of which consists of a heat exchanger, burner, control and safety devices. The assembly has a single flue outlet and a common gas connection, common electricity supply connection and common flow and return water temperature connections. Each module is capable of independent operation.

5 Constructional requirements

5.1 General

Unless otherwise indicated, constructional requirements are checked by examination of the boiler and its technical documentation.

5.2 Conversion to different gases

The following operations are permitted when converting from a gas of one group or family to a gas of another group or family:

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

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

5.3 Materials and method of construction

5.3.1 General

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

In particular, all the boiler components, including air inlet and combustion outlet ducts, shall be appropriate for their intended purpose and shall withstand the mechanical, chemical and thermal conditions to which they will foreseeably be subjected.

5) Boilers using liquid fuels are not covered by this standard.

6) Specific requirements and test methods for condensing boilers with heat inputs exceeding 70 kW are covered in the scope of EN 15417.

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

Materials containing asbestos are forbidden.

Hard solder containing cadmium in its formulation shall not be used.

If there is a risk of condensation in the combustion products circuit, all parts of the heat exchanger(s) and other parts of the boiler likely to come into contact with condensate shall be constructed of sufficiently corrosion resistant materials or materials protected by a suitable coating in order to ensure a reasonable life for a boiler that is installed, used and maintained in accordance with the manufacturer's instructions.

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

5.3.2 Materials and thicknesses of walls or tubes under water pressure

5.3.2.1 General

The materials and the thicknesses of walls under pressure shall comply with 5.3.2.2, 5.3.2.3 and 5.3.2.4. If other materials and/or thicknesses are used, the manufacturer shall provide appropriate justification for their suitability of use.

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 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.

EN 15420:2010 (E)

Table 1 — Mechanical properties and chemical compositions of carbon and stainless steels

Materials	Steel type	Mechanical properties				Chemical compositions									
		Tensile strength	Yield point R_{oH}/R_p 0,2	Breaking elongation	Breaking elongation	% by mass									
		R_m		A_{long}	A_{transv}	C	P	S	Si	Mn	Cr	Mo	Ni	Ti	Nb/Ta
		N/mm ²	N/mm ²	%	%										
Pipes, sheets	carbon	≤ 520	≤ 0,7 ^a	≥ 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
^a Ratio yield point - tensile strength. An adequate high temperature yield point for the highest possible temperature of the components shall be guaranteed.															

Table 2 — Minimum requirements for cast iron

Flake graphite cast iron (EN 1561)	
Tensile strength	> 150 N/mm ²
Brinell hardness	160 to 220 HB 2,5/187,5
Spheroidal graphite cast iron (annealed ferritic):	
Tensile strength R_m	> 400 N/mm ²
Notch impact strength	> 23 J/cm ²

Table 3 — Aluminium and aluminium alloy parts

	Tensile strength R_m N/mm ²	Temperature range °C
Al 99,5	≥ 75	< 300
AlMg2Mn0,8	≥ 275	< 250

Table 4 — Copper or copper alloy parts

	Tensile strength R_m N/mm ²	Temperature range °C
SF – Cu	≥ 200	< 250
CuNi30Fe	≥ 310	< 350

5.3.2.3 Thicknesses

The minimum wall thicknesses are given in Table 5 and Table 6. For rolled steel the tolerances are given in EN 10029.

Table 5 — Minimum thicknesses for rolled parts

	Carbon steels, aluminium mm	mm	Protected steels, stainless steels, copper mm	mm
Boiler nominal heat input	> 70 kW to 300 kW	> 300 kW to 1 000 kW	> 70 kW to 300 kW	> 300 kW to 1 000 kW
Walls of the combustion chamber in contact with fire and water and flat walls of convection heating surfaces	4	6	2	4
Walls in contact only with water and rigidly formed (e.g. corrugated) convection heating surfaces outside the combustion chamber	3	5	2	2
Pipes used in the convection part of the heat exchanger	2,9	2,9	1	1

Table 6 — Nominal thicknesses of boiler sections of cast materials

	Flake graphite cast iron, aluminium	mm	Spheroidal graphite (annealed ferritic) cast iron, copper	mm
Boiler nominal heat input	> 70 kW to 300 kW	> 300 kW to 1 000 kW	> 70 kW to 300 kW	> 300 kW to 1 000 kW
	4,5 mm	5,5 mm	4,0 mm	5,0 mm

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 under 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 in accordance with Table 1 are suitable for welding and do not require additional heat treatment after welding.

Welded seams shall show no cracks or bonding faults and shall be defect free over the whole cross-section for butt welds.

One sided fillet welds and half Y-welds which have not been welded through shall be kept substantially free from bending stresses. Smoke tubes, inserted stays and similar components need not be counter-welded. Double fillet welds are only permissible when sufficiently cooled. Projections into the flue gas side in areas of high thermal stresses shall be avoided.

Corner welds, edge welds and similar welded connections which are subjected to high bending stresses during production and operation are to be avoided.

For welded in longitudinal stay bars or stay tubes the shearing cross-section of the fillet weld should be 1,25 times the required stay bar or stay tube cross-sectional area.

See Table 7 for details on the welding seams mentioned. Welding fillers shall be suitable for the material being used.

The terms given in Table 7 are in accordance with ISO 2553; the reference numbers of welding processes are in accordance with ISO 857 and EN ISO 4063, as appropriate.

Table 7 — Weld joints and welding processes

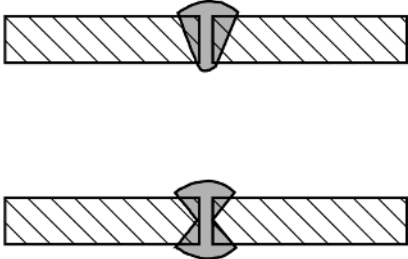
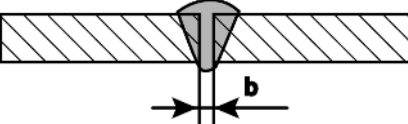
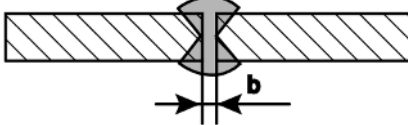
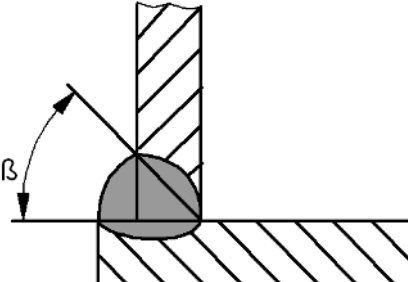
No	Weld joint type	Material Thickness t mm	Welding process ^a	Remarks
1.1	Square butt weld 	≤ 6 (8)	135 12 131 (111)	Permissible up to $t = 8$ mm on use of deep penetration electrodes or welding on both sides
1.2	Square butt weld 	≥ 6 up to 12	12	Root gap $b = 2$ mm to 4 mm with stiffener, powder holder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

Table 7 (continued)

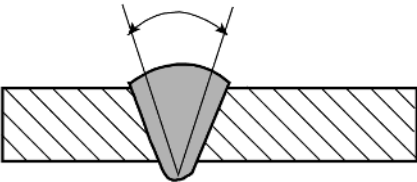
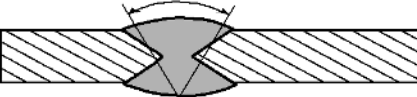
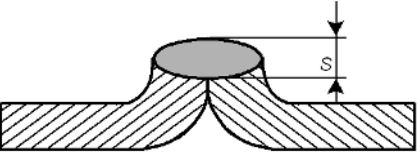
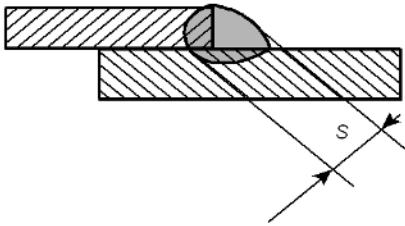
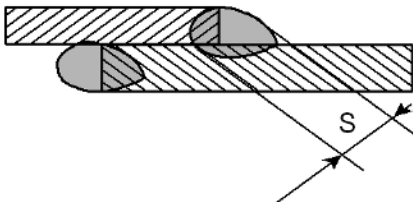
1.5	Single-V butt weld 	to 12	135 12	Seam preparation V-seam 30° to 50° depending on thickness of material.
1.6	Double-V butt weld 	> 12	135 12	Seam preparation double V-seam 30° to 50° depending on material thickness
1.7	Butt weld between plates with raised edges 	≤ 6	135 141 131 (111)	Only permissible 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 (continued) 	≤ 6	135 12 (111)	Not suitable for directly fired wall parts $s = t$

Table 7 (continued)

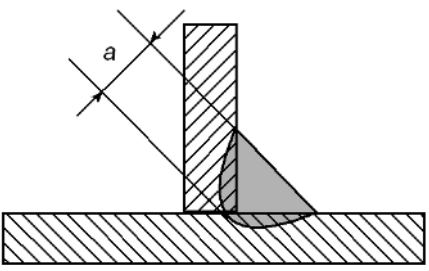
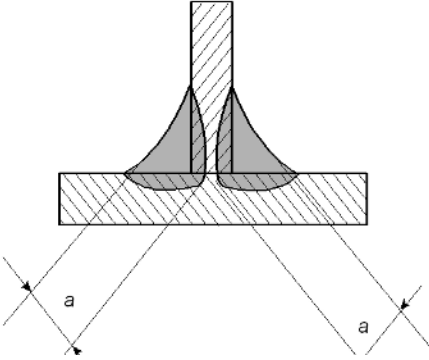
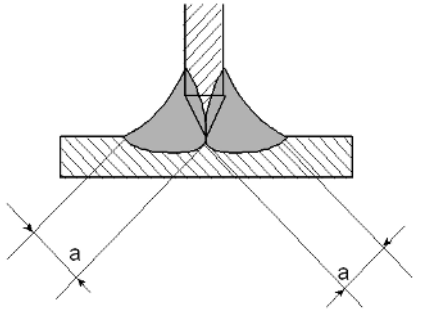
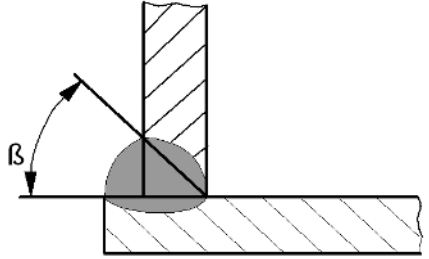
2	Fillet weld 	≤ 6	135 12 (111)	Welds of these types are to be kept largely free from bending stresses $a = t$
2.1	Double fillet weld 	≤ 12	135 12 (111)	$a = t$
		> 12	135 12 (111)	$a = \frac{2}{3}t$
2.2	Double-bevel butt weld 	≤ 12	135 12 (111)	$a = t$
		> 12	135 12 (111)	$a = \frac{2}{3}t$
2.3	Single bevel butt weld 	≤ 12	135 12 (111)	For (111) $\beta = 60^\circ$ For 135, 12 $\beta = 45^\circ$ to 50°
		> 12	135 12	

Table 7 (continued)

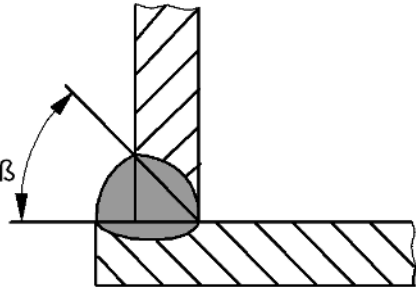
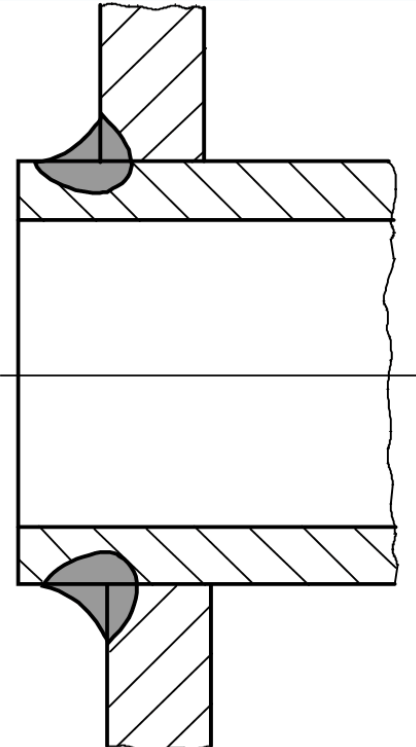
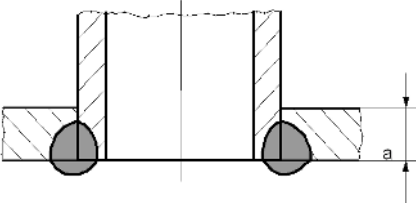
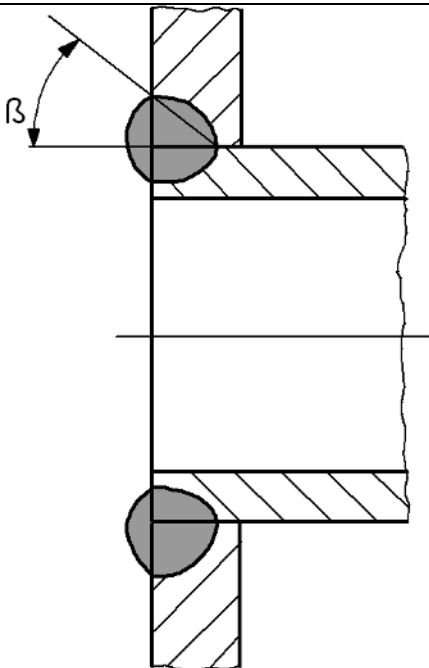
2.4	Single bevel butt weld 	≤ 12	135 12 (111)	For (111) $\beta = 60^\circ$ For 135, 12 $\beta = 45^\circ$ to 50°
2.5		≤ 12	135 (111)	Tube ends shall not project beyond fillet weld if it is subjected to heat radiation
2.6		≤ 6	135 (111)	Welding in of tube under high thermal stress $a \geq t$

Table 7 (continued)

2.7			135 (111)	Welding in of tube under high thermal stress For (111) $\beta = 60^\circ$ For 135 $\beta = 45^\circ$ to 50°
^a Reference numbers of welding processes in accordance with ISO 857 and EN ISO 4063:				
Reference no.	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 materials. 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.

5.4 Combustion products evacuation duct

5.4.1 Stability under mechanical loading

The duct shall be capable of withstanding horizontal and vertical loads. The following aspects shall be considered:

- compressive strength --- tensile strength;
- where applicable, resistance to lateral load for a reference wind velocity pressure of $1,5 \text{ kN/m}^2$.

5.4.2 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.

5.4.3 Corrosion resistance

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

5.4.4 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.

5.5 Design

5.5.1 General

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

For boilers which are designed not to give rise to condensation, there shall be no indication of condensation at the operating temperatures provided by the controls.

Low temperature boilers are considered to be designed to give rise to condensation.

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 maintenance shall be free from sharp edges and corners that might cause damage or personal injury during use and servicing.

5.5.2 Modular boilers

Each module shall be fitted with its own control system and automatic valves, including flame safeguard equipment, control thermostat and safety temperature limiter. The requirements in relation to control and safety devices depend on the nominal heat input (Q_n) of the module (e.g. when $Q_n \leq 70$ kW, the requirements are those of EN 483).

Where it is possible to close off the water flow to individual modules, it shall not be possible to operate the isolated module(s) unless provision is made for the modules to be installed in a manner similar to individual boilers.

5.6 Use and servicing

The operator shall be able to gain access to and operate all control knobs, buttons, etc., necessary for normal use of the boiler without having to remove any part of the case. However, part of the case may be removable provided that:

- this part can be handled easily and safely by the operator;
- this part can be removed without the use of tools;
- incorrect replacement is difficult (e.g. by the provision of stops).

All markings intended for the operator 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.

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 by mechanical means or to remove them easily for cleaning: this shall not involve disconnection of the boiler from the gas or water pipes, or the use of other than commercially available tools. The gas circuit shall be designed so as to permit separate disconnection of the burner or of the whole 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.

5.7 Connections to the gas and water pipes

5.7.1 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.

5.7.2 Connections to the gas pipe

It shall be possible to connect the boiler by rigid metallic means to the gas supply pipe.

If the boiler has a threaded connection, this thread shall comply with EN ISO 228-1 or ISO 7-1. In the first case (EN 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 EN 1092-1, EN 1092-2 or EN 1092-3, as appropriate, and the manufacturer shall provide the counter-flanges and sealing gaskets.

The conditions of connections prevailing in the various countries are given in A.5.

5.7.3 Connections to the central heating circuit

Threaded connections shall comply with EN 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.

5.8 Soundness

5.8.1 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 gas ways. The wall thickness between drillings and gas ways shall be at least 1 mm. This does not apply to orifices for measurement purposes. It shall not be possible for water to penetrate into the gas circuit.

The soundness of parts and assemblies making up the gas circuit and likely to be dismantled for routine maintenance in situ shall be achieved by means of mechanical joints, e.g. metal to metal joints, gaskets or toroidal seals, i.e. excluding the use of all sealing materials such as tape, paste or liquid. However, the sealing materials mentioned above may be used for permanent assemblies. These sealing materials shall remain effective under normal conditions of 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 adhesive.

5.8.2 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 re-assembly.

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.

5.9 Supply of combustion air and the evacuation of the combustion products

5.9.1 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.

5.9.2 Air supply and combustion products evacuation duct⁷⁾

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 100 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.

5.9.3 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.

5.9.4 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.

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

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.

5.9.5 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.

5.9.6 Control dampers in the air or combustion products circuit

Moveable components of the damper shall interlock and shall have no relative motion with respect to one another.

Any limit switch shall be designed and arranged so that incorrect signals about the open position of the damper are eliminated.

The damper system shall be provided with a means of proving that the position of any interlocks is correct prior to the damper being operated. This requirement is deemed to be met by limit switches which are protected against the effects of short circuits by suitable protective devices. These devices shall operate before the short circuit current exceeds 50 % of the rated current of the switches.

At the start-up and at every operating state, it shall be ensured that the damper is or has been moved to a position in which the air flow rate and heat input are in the specified ratios.

If the ratio of heat input to air flow rate is not as specified or if there is a fault in the switching system:

- either the damper shall be moved to a position which increases the excess air;
- or there shall be a safety shutdown of the gas supply to the main burner.

5.9.7 Special requirements for certain components of boilers with a fan

5.9.7.1 Fan

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

5.9.7.2 Air proving

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

- 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.

5.9.7.3 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.

Pneumatic gas/air ratio controls shall comply with the relevant requirements of EN 12067-1.

Electronic gas/air ratio controls shall comply with the relevant requirements of EN 12067-2.

Control tubes may be made of metal with suitable mechanical connections or of other materials with at least equivalent properties. In this case, they are considered immune to breakage, accidental disconnection and leakage after initial soundness checks. As such, they are not subject to the tests in 7.5.5.4.2.

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.

5.9.8 Condensate discharge

A means of condensate discharge shall be provided if the condensate:

- impairs safety or correct operation;
- results in spillage from the appliance;
- causes deterioration of materials.

A pipe or pipes shall be used to discharge condensate when this is necessary. The internal diameter of the outside connection of the condensate discharge system shall be at least 13 mm.

The disposal system, forming part of the boiler or supplied with the boiler, shall be such that:

- it can be easily inspected and cleaned in accordance with the manufacturer's instructions;
- it cannot transmit combustion products into the room where the boiler is installed; this requirement is satisfied if the disposal system incorporates a water trap;

- a water trap has a seal of at least 25 mm at the maximum pressure in the combustion chamber at the maximum flue length specified by the manufacturer.

5.10 Checking the state of operation

The ignition and operation of the burner(s) and also the length of the flame(s) of the ignition burner, if any, shall be able to be observed visually by the installer. The momentary opening of a door or the removal of a case shall not disturb the operation of the burners.

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.

5.11 Drainage

If it is not possible to drain the boiler by means of the water connections, it shall carry a device that enables it to be drained and which can be operated by means of a tool such as a spanner or screwdriver. Adequate directions for drainage shall be included in the instructions.

5.12 Electrical equipment

The electrical equipment shall comply with the requirements of EN 50165 except where reference is made to another electrical standard in 5.14.

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 with regard to electromagnetic compatibility immunity levels.

If the manufacturer specifies the nature of the electrical protection of the boiler on the data plate, this specification 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 due to water penetration.

Where a three-phase supply is used, all control and safety devices shall be supplied by the same single-phase conductor which shall be identifiable without any possibility of ambiguity.

5.13 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 abnormal fluctuations or failure of the auxiliary energy, or following its restoration.

5.14 Adjusting, control and safety devices

5.14.1 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 never possible to perform two or more actions which would be 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 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 could result in confusion.

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

Control and safety devices shall comply with relevant CEN/TC 58 standards such as EN 88, EN 125, EN 126, EN 161, EN 257, EN 298, EN 12067-1, EN 12067-2 and EN 1643.

5.14.2 Adjusters and range rating devices

5.14.2.1 General

Adjusters shall be designed so that they are protected against accidental maladjustment by the operator once the appliance has been installed and put into service. It shall be possible to seal them (e.g. with paint) after adjustment; this sealing shall resist the heat to which it is subjected during normal operation of the boiler. Adjusting screws shall be located so that they cannot fall into the gas ways.

The soundness of the gas circuit shall not be put at risk by the presence of adjusters.

5.14.2.2 Adjusters

Boilers shall be fitted with a gas rate adjuster and/or gas regulator.

An adjuster shall:

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

The adjusters shall be sealed by the manufacturer for boilers which are intended to operate on a gas of group 2E or 3 and include a "+" sign (e.g. 2E+ or 3+).

5.14.2.3 Range rating devices

The boiler may have a range rating device.

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

5.14.3 Gas circuit

5.14.3.1 General

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.

5.14.3.2 Control devices

Every boiler shall be provided with at least one device that enables 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 signs shall be used:

— Off	:	Full disc	●
— Ignition	:	Stylised star	★
— Full rate of the burner	:	Stylised 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 control to cut off the gas supply operates by turning, it shall turn off in a clockwise direction as seen by an observer facing the knob.

5.14.3.3 Composition of the gas circuit

The gas circuit shall be fitted with automatic shut-off valves in accordance with EN 161 and Table 8.

Table 8 — Composition of the gas circuit

Heat input of the individual gas line within the gas circuit kW	Boiler without fan	Boiler with fan		
		With pre-purge	Without pre-purge but with a leakage control device or permanent or alternating ignition flame	Without pre-purge
Input ≤ 0.250	C ^a			C ^a
Input ≤ 150	C ^{a b} + J			C ^{a b} + C or B + J
150 < input ≤ 300	B + C			B + B
300 < input ≤ 1 000	B + B			A + A
^a Or the valve of the flame supervision device.				
^b For heat inputs ≤ 1 000 W which meet the criteria of 6.5.3.3.1 b), only one Class C valve is needed.				

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 at least Class C (B for > 150 kW and A for > 300 kW).

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

Illustrations of the composition of the gas circuit are given in Annex H.

5.14.4 Gas pressure regulator

The gas regulator, if fitted, shall comply with EN 88-1.

Boilers using first family gases and boilers in excess of 300 kW nominal heat input using second family gases shall be fitted with a regulator. For other boilers this regulator is optional.

A regulator intended for operation with a pressure couple shall be adjusted 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 regulator for the ignition burner is permitted.

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

5.14.5 Ignition devices

5.14.5.1 Ignition of the ignition burner

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

Ignition devices for the ignition burner shall be designed and fitted in a 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.

5.14.5.2 Ignition device for the main burner

Main burners shall be fitted with an ignition burner or a device for direct ignition.

Direct ignition shall not cause deterioration of the burner.

5.14.5.3 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 gas rate of the ignition burner is not governed, a gas rate adjuster is mandatory for boilers operating on first family gases, optional for second family gases and third family gases without a pressure couple. 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.

5.14.5.4 Direct ignition

Direct ignition devices 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.

5.14.6 Flame supervision systems

5.14.6.1 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.

Where the main burner is ignited by an ignition burner, the presence of the ignition burner flame shall be detected before gas is admitted to the main burner.

5.14.6.2 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 shut-off valve.

The device shall include:

- either an ignition interlock,

— or a restart interlock.

It is permitted to use a burner ≤ 150 kW using a thermo-electric flame supervision device provided that the additional heat input is supervised by an automatic burner control system (see 6.5.3.3).

5.14.6.3 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.

In the case of recycling a waiting time of at least 30 s shall be included for appliances without a fan.

5.14.7 Thermostats and water temperature limiting devices

5.14.7.1 General

Boilers shall be fitted with at least:

- an adjustable or fixed control thermostat (in accordance with 5.14.7.2), and
- a safety temperature limiter (in accordance with 5.14.7.3).

5.14.7.2 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 of the temperature range. The positions of the temperature selector shall be easy to establish 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 shutdown before the water flow temperature exceeds 105 °C.

5.14.7.3 Safety temperature limiter

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

This device shall cause non-volatile lockout before the water flow temperature exceeds 110 °C.

Normal operation of the boiler shall not give rise to a change in the set point temperature of the device. However, the manufacturer may adjust the set point temperature to achieve a maximum water flow temperature of less than 110 °C provided that once the adjustment has been made, re-adjustment above the new set point is not possible without the use of a tool.

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

5.14.7.4 Sensors

Thermostats and safety temperature limiters shall have independent sensors.

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

5.14.7.5 Remote control

The boiler shall be designed so that it can be controlled remotely.

Connection of any remote controls recommended by the manufacturer shall be possible without disturbing any internal electrical connections except for purpose designed removable links. The necessary information shall be given in the installation instructions.

5.15 Burners

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

Every 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 such that it is difficult to position them incorrectly.

Primary aeration adjusters are not allowed.

5.16 Pressure test points

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

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

5.17 Chemical composition of the condensate

The manufacturer shall communicate the possible chemical composition of the condensate (pH, heavy metals, etc.) if the composition is required by national regulations.

6 Operational requirements

6.1 General

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.

The soundness is checked on delivery of the boiler and after all the tests of this standard.

Soundness is assured if, under the conditions specified in 7.2.1, the air leakage rate does not exceed:

- for Test No. 1: 0,06 dm³/h;
- for Test No. 2: 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.

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

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 9.

Table 9 — 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	$5Q_n/40$
	not completely	$Q_n/40$
Boiler and the joint to the air supply and combustion products evacuation duct	Completely	$3Q_n/40$
	not completely	$0,6Q_n/40$
Combustion products evacuation ducts, not completely surrounded by combustion air, with all its joints excluding the joint tested above		$0,4Q_n/40$
Air supply duct with all its joints excluding the joint tested above		$2Q_n/40$

6.2.2.3 Combustion products evacuation duct for alternative control systems (see 5.8.7 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 7.2.2.3, the leakage rate per surface area of the duct does not exceed 0,006 dm³/s·m² ⁸⁾.

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

6.2.2.4 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 conditions of 7.2.2.4, the leakage rate per surface area of the duct does not exceed $0,006 \text{ dm}^3/\text{s}\cdot\text{m}^2$.

6.2.2.5 Separate and concentric air supply duct

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 7.2.2.5 the leakage rate per surface area of the duct does not exceed $0,5 \text{ dm}^3/\text{s}\cdot\text{m}^2$.

6.2.3 Soundness of the water circuit

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

6.3 Nominal, maximum and minimum heat inputs, and nominal output

6.3.1 Nominal heat input or maximum and minimum heat inputs

The heat input obtained under the test conditions of 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; where this minimum heat input is less than 10 kW, a tolerance of 500 W is acceptable.

6.3.2 Adjustment of the heat input by the downstream 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.

6.3.3 Ignition rate

Under the test conditions of 7.3.3, it is checked that the heat input necessary for ignition of the burner 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.

6.3.5 Gas pressure regulator

Under the test conditions of 7.3.5, the gas rate of boilers fitted with a regulator shall not differ from the gas rate obtained at normal pressure by more than:

- + 7,5 % and – 10 % for first family gases;
- + 5 % and – 7,5 % for second family gases without a pressure couple;
- $\pm 5 \%$ for second and third family gases with a pressure couple;