



BSI Standards Publication

Heating boilers

Part 5: Heating boilers for solid fuels, manually and automatically stoked, nominal heat output of up to 500 kW — Terminology, requirements, testing and marking

National foreword

This British Standard is the UK implementation of EN 303-5:2021+A1:2022. It supersedes BS EN 303-5:2021, which is withdrawn.

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 A1 is indicated by A1 A1.

The UK participation in its preparation was entrusted to Technical Committee RHE/10, Heating boilers.

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

The UK committee advises users that installation and operation of solid fuel heating boilers may be subject to UK legislation, specifically the Clean Air Act 1993 (and equivalent in Northern Ireland) and the Environmental Permitting (England & Wales) Regulations 2016 (and equivalents in Scotland and Northern Ireland).

National Annex NA (informative) outlines the UK's A-deviation from specific parts of EN 303-5:2020, where instead the UK legislation applies.

<http://www.legislation.gov.uk/ukpga/1993/11/contents>

Environmental Permitting (England & Wales) Regulations 2016

<http://www.legislation.gov.uk/uksi/2016/1154/contents/made>

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UK Government is responsible for legislation. For information on legislation and policies relating to that legislation, consult the relevant pages of www.gov.uk.

© The British Standards Institution 2023
Published by BSI Standards Limited 2023

ISBN 978 0 539 29128 5

ICS 01.040.91; 91.140.10

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2022.

Amendments/corrigenda issued since publication

Date	Text affected
30 November 2023	Implementation of CEN amendment A1:2022

English Version

Heating boilers - Part 5: Heating boilers for solid fuels,
manually and automatically stoked, nominal heat output of
up to 500 kW - Terminology, requirements, testing and
marking

Chaudières de chauffage - Partie 5 : Chaudières
spéciales pour combustibles solides, à chargement
manuel et automatique, puissance utile inférieure ou
égale à 500 kW - Définitions, exigences, essais et
marquage

Heizkessel - Teil 5: Heizkessel für feste Brennstoffe,
manuell und automatisch beschickte Feuerungen,
Nennwärmeleistung bis 500 kW - Begriffe,
Anforderungen, Prüfungen und Kennzeichnung

This European Standard was approved by CEN on 15 February 2021 and includes Amendment 1 approved by CEN on 14 September 2022.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 303-5:2021+A1:2022) has been prepared by Technical Committee CEN/TC 57 “Central heating boilers”, the secretariat of which is held by DIN.

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 May 2023, and conflicting national standards shall be withdrawn at the latest by May 2023.

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

This document includes Amendment 1 approved by CEN on 14 September 2022.

This document supersedes  EN 303-5:2021 .

The start and finish of text introduced or altered by amendment is indicated in the text by tags  .

This document has been prepared under a Standardization Request given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of EU Directive(s) / Regulation(s).

For relationship with EU Directive(s) / Regulation(s), see informative Annexes ZA, ZB and ZC, which are an integral part of this document.

In comparison with EN 303-5:2012, the following technical changes have been made:

- the scope was extended to condensing boilers with a heat output of ≤ 500 kW;
- the scope was extended to boilers with outside combustion air supply at a heat output of ≤ 100 kW;
- requirements for materials, weld joints and wall thicknesses have been revised and adapted to condensing and room sealed operations;
- general and electrical safety requirements have been revised and adapted to condensing and room sealed applications;
- tests were revised and new tests for condensing boilers, outside combustion air supply, secondary emission reduction systems and safety requirements were added;
- Annexes were re-structured;
- Consideration was given to the essential requirements of the Machinery Directive 2006/42/EC and REGULATION (EU) 2015/1189 (Eco-design) and COMMISSION REGULATION (EU) 2015/1187 (Energy labelling).

The following structure is intended for the European Standards for heating boilers:

- EN 303-1, *Heating boilers — Part 1: Heating boilers with forced draught burners — Terminology, general requirements, testing and marking*;
- EN 303-2, *Heating boilers — Part 2: Heating boilers with forced draught burners — Special requirements for boilers with atomizing oil burners*;

- EN 303-3, *Heating boilers — Part 3: Gas-fired central heating boilers — Assembly comprising a boiler body and a forced draught burner*;
- EN 303-4, *Heating boilers — Part 4: Heating boilers with forced draught burners — Special requirements for boilers with forced draught oil burners with outputs up to 70 kW and a maximum operating pressure of 3 bar — Terminology, special requirements, testing and marking*;
- EN 303-5, *Heating boilers — Part 5: Heating boilers for solid fuels, manually and automatically stoked, nominal heat output of up to 500 kW — Terminology, requirements, testing and marking*;
- EN 303-6, *Heating boilers — Part 6: Heating boilers with forced draught burners — Specific requirements for the domestic hot water operation of combination boilers with atomizing oil burners of nominal heat input not exceeding 70 kW*;
- EN 303-7, *Heating boilers — Part 7: Gas-fired central heating boilers equipped with a forced draught burner of nominal heat output not exceeding 1 000 kW*;
- EN 304, *Heating boilers — Test code for heating boilers for atomizing oil burners*.

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

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, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Introduction

This document is a type-C standard as stated in EN ISO 12100:2010.

The machinery concerned, and the extent to which hazards, hazardous situations and hazardous events are covered, are indicated in the scope of this document.

This document does deal with boilers which are within the Scope Machinery Directive and boilers that are outside of the Scope Machinery Directive.

The manufacturer is responsible for identifying all additional hazards outside of the scope of this document.

When provisions of this type-C standard are different from those which are stated in type-A or -B standards, the provisions of this type-C standard take precedence over the provisions of the other standards, for machines that have been designed and built according to the provisions of this type-C standard.

1 Scope

1.1 General

This document applies to heating boilers including safety devices up to a nominal heat output of 500 kW which are designed for the burning of solid fuels only and are operated according to the instructions supplied with the boiler and misuse reasonably foreseeable by the manufacturer.

This document applies also for solid fuel boilers taking the combustion air from outside the building and room sealed appliances.

This document does deal with significant hazards, hazardous situations and events relevant to heating boilers used as intended and under the conditions specified in the technical documentation of the boiler (see Clause 4).

The boilers may operate under natural draught or forced draught. The fuel feed may work manually or automatically. The boilers may operate in non-condensing operation or condensing operation.

NOTE 1 This document does deal with boilers which are within the scope of the Machinery Directive 2006/42/EC or outside of the scope of the Machinery Directive 2006/42/EC (manual stoked natural draught boiler).

NOTE 2 There is a risk of freezing condensate in the condensate drainage at low temperatures.

This document contains requirements and test methods for safety, combustion performance, operating characteristics, marking and maintenance of heating boilers. It also covers all external equipment that influences the safety systems (e.g. back burning safety device, integral fuel hopper).

This document covers only boilers that include burners as a unit. The document applies to the combination of a boiler body with a solid fuel burner according to EN 15270:2007 as a unit only when the whole unit is tested in accordance with this document.

Heating boilers in accordance with this document are designed for central heating installations where the heat carrier is water and the maximum allowable temperature is 110 °C, and which can operate at a maximum allowable operating pressure of 6 bars. For heating boilers with a built-in or attached water heater (storage or continuous flow heater), this document only applies to those parts of the water heater which are necessarily subject to the operating conditions of the heating boiler (heating part).

This document does not apply to:

- heating boilers and other heating appliances which are also designed for the direct heating of the place of installation, also according to the European regulation 2015/1185/EU;
- cooking appliances;
- the design and construction of external fuel storage and transportation devices prior to the safety devices of the boiler;
- manual stoked straw bale boilers;
- CHP appliances (combined heat and power).

This document specifies the necessary terminology for solid fuel heating boilers, the control and safety related requirements, the design requirements, the technical heating requirements (considering the environmental requirements) and testing, as well as the marking requirements.

This document is not applicable to heating boilers which are tested before the date of its publication as an EN (European Standard).

For evaluation of the requirements of this document test results of former versions of the standard may be used if applicable.

NOTE 3 This document can be used as a reference for boilers > 500 kW for safety evaluation.

This document does deal with all significant machine hazards, hazardous situations and events relevant to solid fuel boilers, when they are used as intended and under conditions of misuse which are reasonably foreseeable, except noise hazards.

NOTE 4 The document contains requirements regarding noise but not in its full extent to cover the Essential Health and Safety Requirements (EHSR, Annex I of the Machinery Directive 2006/42/EC).

1.2 Fuels

These boilers may burn either fossil fuels, biogenic fuels or other fuels such as peat, as specified for their use in the technical documentation, in accordance with the requirements of this document.

Solid fuels included in this document are categorized as follows.

Biogenic fuels

Biomass in a natural state, in the form of:

- **log wood** with moisture content $\leq M25$, according to EN ISO 17225-5:2014;
- **chipped wood $\leq M35$** with moisture content from M15 to M35, according to EN ISO 17225-4:2014;
- **chipped wood $> M35$** with moisture content exceeding M35, according to EN ISO 17225-4:2014;
- **wood pellets** according to EN ISO 17225-2:2014;
- **wood briquettes** according to EN ISO 17225-3:2014;
- **sawdust** with moisture content $\leq M20$;
- **sawdust** with moisture content M20 to M50;
- **sawdust** with moisture content $\leq M20$ is dangerous against back burning;
- **non-woody biomass**, such as straw, miscanthus, reeds, kernels and grains according to EN ISO 17225-6:2014.

Fossil fuels

- **a** bituminous coal;
- **b** brown coal;
- **c** coke;
- **d** anthracite.

Other solid fuels

- Other solid fuels such as peat or processed fuels according to EN ISO 17225-1:2014.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 303-1:2017, *Heating boilers - Part 1: Heating boilers with forced draught burners - Terminology, general requirements, testing and marking*

EN 304:2017, *Heating boilers - Test code for heating boilers for atomizing oil burners*

EN 1561:2011, *Founding - Grey cast irons*

EN 1563:2018, *Founding - Spheroidal graphite cast irons*

EN 10204:2004, *Metallic products - Types of inspection documents*

EN 10226-1:2004, *Pipe threads where pressure tight joints are made on the threads - Part 1: Taper external threads and parallel internal threads - Dimensions, tolerances and designation*

EN 10226-3:2005, *Pipes threads where pressure tight joint are made on the threads - Part 3: Verification by means of limit gauges*

EN 12619:2013, *Stationary source emissions - Determination of the mass concentration of total gaseous organic carbon - Continuous flame ionisation detector method*

EN 12828:2012+A1:2014, *Heating systems in buildings - Design for water-based heating systems*

EN 13284-1:2017, *Stationary source emissions - Determination of low range mass concentration of dust - Part 1: Manual gravimetric method*

EN 13384-1:2015+A1:2019, *Chimneys - Thermal and fluid dynamic calculation methods - Part 1: Chimneys serving one combustion appliance*

EN 13501-1:2018, *Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests*

EN 14597:2012, *Temperature control devices and temperature limiters for heat generating systems*

EN 14789:2017, *Stationary source emissions - Determination of volume concentration of oxygen - Standard reference method: Paramagnetism*

EN 14792:2017, *Stationary source emissions - Determination of mass concentration of nitrogen oxides - Standard reference method: chemiluminescence*

EN 15058:2017, *Stationary source emissions - Determination of the mass concentration of carbon monoxide - Standard reference method: non-dispersive infrared spectrometry*

EN 15259:2007, *Air quality - Measurement of stationary source emissions - Requirements for measurement sections and sites and for the measurement objective, plan and report*

EN 15270:2007, *Pellet burners for small heating boilers - Definitions, requirements, testing, marking*

EN 15456:2008, *Heating boilers - Electrical power consumption for heat generators - System boundaries - Measurements*

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

EN 60335-2-102:2016, *Household and similar electrical appliances - Safety - Part 2-102: Particular requirements for gas, oil and solid-fuel burning appliances having electrical connections (IEC 60335-2-102:2004, modified)*

EN 60730-1:2016, *Automatic electrical controls - Part 1: General requirements (IEC 60730-1:2013/COR1:2014)*²

EN 60730-2-5:2015, *Automatic electrical controls - Part 2-5: Particular requirements for automatic electrical burner control systems (IEC 60730-2-5:2013)*³

EN IEC 60730-2-9:2019, *Automatic electrical controls - Part 2-9: Particular requirements for temperature sensing control (IEC 60730-2-9:2015)*⁴

EN IEC 61000-6-2:2019, *Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments (IEC 61000-6-2:2016)*

EN 61000-6-3:2007, *Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments (IEC 61000-6-3:2006)*⁵

EN ISO 228-1:2003, *Pipe threads where pressure-tight joints are not made on the threads - Part 1: Dimensions, tolerances and designation (ISO 228-1:2000)*

EN ISO 228-2:2003, *Pipe threads where pressure-tight joints are not made on the threads - Part 2: Verification by means of limit gauges (ISO 228-2:1987)*

EN ISO 4063:2010, *Welding and allied processes - Nomenclature of processes and reference numbers (ISO 4063:2009, Corrected version 2010-03-01)*

EN ISO 6506-1:2014, *Metallic materials - Brinell hardness test - Part 1: Test method (ISO 6506-1:2014)*

EN ISO 9606-1:2017, *Qualification testing of welders - Fusion welding - Part 1: Steels (ISO 9606-1:2012 including Cor 1:2012 and Cor 2:2013)*

EN ISO 9606-2:2004, *Qualification test of welders - Fusion welding - Part 2: Aluminium and aluminium alloys (ISO 9606-2:2004)*

EN ISO 12100:2010, *Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010)*

¹ As impacted by EN 60335-1:2012/A11:2014, EN 60335-1:2012/A13:2017, EN 60335-1:2012/A14:2019, EN 60335-1:2012/A1:2019 and EN 60335-1:2012/A2:2019.

² As impacted by EN 60730-1:2016/A1:2019.

³ As impacted by EN 60730-2-5:2015/A1:2019 and EN 60730-2-5:2015/A2:2021.

⁴ As impacted by EN IEC 60730-2-9:2019/A1:2019 and EN IEC 60730-2-9:2019/A2:2020.

⁵ As impacted by EN 61000-6-3:2007/A1:2011/AC:2012.

EN ISO 13732-1:2008, *Ergonomics of the thermal environment - Methods for the assessment of human responses to contact with surfaces - Part 1: Hot surfaces (ISO 13732-1:2006)*

EN ISO 13919-1:2019, *Electron and laser-beam welded joints - Requirements and recommendations on quality levels for imperfections - Part 1: Steel, nickel, titanium and their alloys (ISO 13919-1:2019)*

EN ISO 13919-2:2021, *Electron and laser-beam welded joints - Requirements and recommendations on quality levels for imperfections - Part 2: Aluminium, magnesium and their alloys and pure copper (ISO 13919-2:2021)*

EN ISO 14120:2015, *Safety of machinery - Guards - General requirements for the design and construction of fixed and movable guards (ISO 14120:2015)*

EN ISO 15609-4:2009, *Specification and qualification of welding procedures for metallic materials - Welding procedure specification - Part 4: Laser beam welding (ISO 15609-4:2009)*

EN ISO 15614-11:2002, *Specification and qualification of welding procedures for metallic materials - Welding procedure test - Part 11: Electron and laser beam welding (ISO 15614-11:2002)*

EN ISO 17225-1:2014, *Solid biofuels - Fuel specifications and classes - Part 1: General requirements (ISO 17225-1:2014)*

EN ISO 17225-2:2014, *Solid biofuels - Fuel specifications and classes - Part 2: Graded wood pellets (ISO 17225-2:2014)*

EN ISO 17225-3:2014, *Solid biofuels - Fuel specifications and classes - Part 3: Graded wood briquettes (ISO 17225-3:2014)*

EN ISO 17225-4:2014, *Solid biofuels - Fuel specifications and classes - Part 4: Graded wood chips (ISO 17225-4:2014)*

EN ISO 17225-5:2014, *Solid biofuels - Fuel specifications and classes - Part 5: Graded firewood (ISO 17225-5:2014)*

EN ISO 17225-6:2014, *Solid biofuels - Fuel specifications and classes - Part 6: Graded non-woody pellets (ISO 17225-6:2014)*

EN ISO 17225-7:2014, *Solid biofuels - Fuel specifications and classes - Part 7: Graded non-woody briquettes (ISO 17225-7:2014)*

EN ISO 18135:2017, *Solid Biofuels - Sampling (ISO 18135:2017)*

EN ISO 20023:2018, *Solid biofuels - Safety of solid biofuel pellets - Safe handling and storage of wood pellets in residential and other small-scale applications (ISO 20023:2018)*

CEN/TS 15883:2009, *Residential solid fuel burning appliances - Emission test methods*

ISO 857-2:2005, *Welding and allied processes — Vocabulary — Part 2: Soldering and brazing processes and related terms*

ISO 7005-1:2011, *Pipe flanges — Part 1: Steel flanges for industrial and general service piping systems*

ISO 7005-2:1988, *Metallic flanges — Part 2: Cast iron flanges*

ISO 7005-3:1988, *Metallic flanges — Part 3: Copper alloy and composite flanges*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 303-1:2017, and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

maximum allowable operating pressure

highest pressure at which the boiler can be operated safely

Note 1 to entry: The maximum operating pressure is less than the test pressure and the type test pressure.

3.2

test pressure

pressure to which all boilers and their parts are subjected during production at the manufacturers plant or during setting up by the installer

3.3

type test pressure

pressure to which the heating boilers and their parts are first subjected before the start of mass production

3.4

maximum allowable temperature

maximum allowable water temperature of the heating boiler limited by safety devices

3.5

operating temperature

temperature range at which the boiler can be operated under normal operating conditions, according to the setting on the boiler water temperature controller and the manufacturer's specifications

3.6

heat output

P

usable heat delivered to water output by a boiler per unit time in accordance with the requirements of this document

Note 1 to entry: The heat output data for solid fuel boilers are the average values over a related test period which are established in accordance with the requirements of this document.

3.7

nominal heat output

P_N

continuous heat output at nominal load as average related to the test duration specified in the technical documentation for a specific fuel in accordance with the requirements of this document

3.8 minimum heat output

$P_{\min}$

minimum heat output which is maintained automatically by the control device specified by the manufacturer for each type of fuel in accordance with the requirements of this document

Note 1 to entry: The minimum heat output can be achieved in intermittent operation.

3.9 minimum continuous heat output

$P_{\min C}$

minimum continuous heat output which is maintained automatically by the control device specified by the manufacturer for each type of fuel in accordance with the requirements of this document

3.10 heat output range

range of output between minimum and nominal to which the boiler can be adjusted and meets the requirements of this document

Note 1 to entry: The heat output range lies between nominal heat output and minimum heat output.

3.11 partial load operation

operating condition/state of the boiler where the heat output is less than the nominal heat output and which is reached using an automatic control device

3.12 intermittent operation

operating condition/state in which boiler heat output is controlled by the automatic connecting and disconnecting of the combustion air and/or fuel supply

3.13 heat input

Q_B

amount of heat per unit time which is supplied to the heating boiler by the fuel based on its net calorific value NCV or its gross calorific value GCV

3.14 boiler efficiency

η_K

ratio of the delivered useful heat output to the heat input, expressed in percentage

Note 1 to entry: $\eta_K = \frac{P}{Q_B} \times 100 \%$

3.15 draught

pressure differential between the static air pressure in the place of installation and the static pressure of the exhaust gases (flue gas measuring section)

3.16**gas side resistance**

difference in pressure that exists between the combustion chamber and the flue gas outlet of the boiler (flue gas measuring section)

3.17**gas side tightness**

tightness of the hopper, combustion chamber, flue ways and the boiler sections traversed by the flue gas in relation to the place of installation

3.18**exit flue temperature**

temperature measured at the flue exit of the boiler (flue gas measuring section)

3.19**water side resistance**

pressure loss in the boiler measured at the flow and return connections of the boiler, with a volume flow corresponding to the nominal heat output

3.20**temperature controller**

device which detects and regulates the water flow temperature in the boiler

3.21**safety temperature limiter****STB**

thermal cut out, protective control for heat generating systems which can only be reset manually or by a tool and which provides at least the following actions: type 2B, type 2K, type 2P and type 2V and optionally any of the following actions: type 2F and type 2N

Note 1 to entry: The settings of this control are unchangeably fixed or can be fixed with a tool or a special tool.

Note 2 to entry: Type 2K action will be considered to be provided if type 2N action is provided.

Note 3 to entry: The actions are defined in EN 60730-1:2016² and in EN IEC 60730-2-9:2019⁴.

3.22**safety heat exchanger**

safety device for dissipating excess heat from the boiler to limit the boiler temperature to a specified maximum

3.23**thermal discharge safety device****STW**

safety temperature limiter automatic reset (STW) used as a thermal bypass protection for solid fuel heat generating systems, which senses the heated media temperature and operates to cause energy to be carried off by opening a regulating unit, e.g. a valve

Note 1 to entry: The settings of this control are unchangeably fixed.

Note 2 to entry: Usually this is a mechanical device. This function could also be provided by an STW controlling a valve.

3.24

test fuel

fuel of commercial quality used for testing heating boilers and characteristic of the type of fuel specified by the boiler manufacturer

3.25

stoking device

device for feeding the fuel to the combustion chamber, which includes a safety device between stoking device and fuel line or an integral hopper

3.26

manual stoking

fuel supplied by hand at intervals, depending on the burning rate or heat output

3.27

automatic stoking

fuel supplied automatically, according to thermal output

Note 1 to entry: Automatic stoking can be done continuously or intermittently.

3.28

combustion period

necessary time taken by manual stoked boilers to burn the maximum fuel charge until the basic fire bed level specified in the technical documentation is reached again

The combustion period starts with the closing of the combustion chamber door after filling the combustion chamber and ends with the opening of the door when the basic fire bed is reached

3.29

nominal combustion period

t_B

combustion period at a nominal heat output

3.30

bypass device

device which, in the open position, allows combustion gases to pass directly to the exhaust stack

Note 1 to entry: A bypass device acts as a preheating aid or to overcome low temperature exhaust.

3.31

integral fuel hopper

fuel hopper linked to the automatically stoked heating boiler

Note 1 to entry: The filling of the hopper is a batch operation.

3.32

fuel chamber

part of a heating boiler stoked by hand supplying fuel for combustion without a connecting fuel line to an external fuel storage

Note 1 to entry: The fuel chamber is the storage space necessary for obtaining a sufficient combustion duration.

3.33**combustion chamber**

boiler part for thermal preparation and/or burning of fuel

Note 1 to entry: The combustion chamber may be part of the fuel chamber.

3.34**exhaust gas cleaning equipment**

techniques used for reducing air pollutants contained in the exhaust gas

3.35**ash chamber**

part of the boiler used for keeping combustion residues (ash/clinker)

3.36**accumulator storage tank**

container which stores excess heat (resulting from the difference between the boiler heat output and the actual heat load to the heating system)

3.37**rapidly disconnectable firing system**

firing system by which, in all instances of operation and malfunction (e.g. such as power failures or sudden absence of heat reduction), the generation of heat can be interrupted so rapidly that hazardous operating states cannot occur either on the water side or on the firing side

3.38**hazardous operating state**

rise of the boiler temperature above 110 °C or, an accumulation of ignitable gases or gas mixtures (CO volume fraction > of 5 %) in the combustion chamber and/or in the flue gas passages of the boiler, a possible overheating of components, the escape of fire or gases into the place of installation and a back burning in the fuel supply

3.39**partly disconnectable firing system**

firing system where a part of the heat output can be briefly interrupted by the action of control and safety devices without causing hazardous operating states on the firing side

3.40**residual heat output**

remaining portion of heat output that is still transferred from the firing side to the water side after the control shut down or safety shut down of the boiler

3.41**ignition unit**

device used to ignite the fuel in the combustion chamber

Note 1 to entry: Ignition can either be achieved manually, automatically or with a basic fire bed; and using, for example, a hot air fan, electric coil or electric glow plug.

3.42

back burning

state in which the fuel ignites in direction to the fuel line and the burning spreads to the fuel storage or the integral hopper

Note 1 to entry: Back burning can be caused by three driving forces:

- a) fuel ignition in direction to the fuel line or the integral hopper;
- b) spreading and ignition of hot and ignitable gases into the fuel line or the integral hopper;
- c) thermal conduction to the fuel line or the integral hopper.

3.43

back burning safety device

one or more self-acting certificated devices to avoid back burning, including extinguishing installations

3.44

extinguishing installation

device for the self-acting extinguishing of a back burn into the stoking device, fuel line or integral hopper

3.45

feeding direction

direction the fuel follows when transported to the combustion chamber (either horizontally inclined/declined)

3.46

PM (dust)

particulate matter dust; particles of any shape, structure or density, dispersed in the gas phase at the sampling point conditions which may be collected by filtration under specified conditions after representative sampling of the gas to be analysed, and which remain upstream of the filter and on the filter after drying under specified conditions

3.47

control shut-down

process by which the fuel supply and/or combustion air supply is stopped because of a control function

3.48

safety shut-down

process by which the fuel supply and/or combustion air supply is stopped immediately as a response of a safety device or the detection of a fault in a safety device

3.49

non-volatile lock out

safety shut-down condition of a boiler, such that a restart can only be accomplished by a manual reset and by no other means

3.50

stand-by operation

operating mode without any heat demand, whereby the system immediately starts up in the required mode as soon as there is a heat demand

3.51**accumulator storage tank integrated boiler**

heating boiler integrated in an accumulator storage tank as a unit with a minimum volume of 20 l/kW nominal heat output

3.52**condensate**

liquid formed from combustion products during the condensation process

3.53**nominal condensing heat output**

value of useful heat output at condensing mode declared by the manufacturer in kW

3.54**condensing boiler**

boiler that, under normal operating conditions and at certain operating water temperatures, partially condenses the water vapour in the combustion products to make use of the latent heat of water vapour for heating purposes

3.55**non-condensing boiler**

boiler that, under normal operating conditions is not intended to condense the water vapour in the combustion products

3.56**solid fuel boiler (category 1)**

boiler taking the combustion air from the place of installation inside the building

3.57**solid fuel boiler (category 2)**

boiler including a fan taking the combustion air mainly directly from outside the building using a pipe directly connected to the boiler air inlet

3.58**solid fuel boiler (category 3)**

boiler including a fan taking the air only directly from outside the building using a pipe directly connected to the boiler air inlet and being room sealed

3.59**terminal**

chimney component installed at the outlet of a chimney or a flue liner

[SOURCE: EN 1443:2019, 3.37]

Note 1 to entry: A terminal may include the air supply for the boiler.

3.60**combustion air connector**

Component to connect combustion air supply system to the boiler and which is part of the boiler

3.61**flue gas connector**

Component to connect the boiler to the chimney and which is part of the boiler

3.62

basic fire bed

State of the fuel bed for the ignition of a fuel batch as described in the technical documentation with at least no flames visible and a mass of less than 10 % of a full fuel batch of the boiler

4 Requirements

4.1 General requirements

4.1.1 General requirements for all boilers

Boilers shall comply with the safety requirements and/or protective/risk reduction measures of this document. In addition, the boilers shall be designed according to the principles of EN ISO 12100:2010 for risk reduction and risk assessment, including transport and installation. Boilers shall be fire-resistant and safe to operate.

They shall be made of non-combustible materials according to EN 13501-1 and shall be resistant to deformation. They shall be made such that:

- a) they can withstand stresses arising during normal operation. Any additional equipment of the boiler shall also comply with these material requirements especially with respect to temperature resistance;
- b) the heat carrier (water) does not become heated to a dangerous extent ($\leq 110\text{ °C}$);
- c) gases do not leak from the boiler or the stoking device or from an integrated hopper in dangerous quantities into the place of installation or into the fuel line;

NOTE Safety requirements regarding harmful gas concentrations of course need to be considered at all locations affected by the operation of the boiler. However, the accumulation to toxic concentration strongly depend the place of installation, the fuel line and the fuel storage. The installation is responsibility of the installer. Additional national legal regulations can apply.

- d) flames do not flare out and embers do not fall out when the boiler is operated correctly;
- e) dangerous accumulations of combustible gases ($>5\text{ % CO}$) in the combustion chamber and in the flues are prevented. For the evaluation of the hazardous situation, the CO-concentration in the flue gas measuring section shall not exceed the critical value (5 % CO) for a time period greater than 1 min.

Combustible materials shall be allowed for the following:

- internal components of controls and safety equipment;
- operating handles;
- electrical equipment;
- components of accessory (e.g. burner cover);
- additional or supplemental outer covers (e.g. an additional decorative cover);
- Insulations of water cooled parts according to 4.2.4.8 dangerous conditions can be excluded by a risk analysis.

Component parts of covers, operating controls, safety devices and electrical accessories shall fulfil the requirements of resistance against heat and fire in accordance with EN 60335-1:2012¹.

Guards and protective devices shall comply with EN ISO 14120:2015.

Control devices and electrical accessories shall be arranged in such a way that their temperatures, under steady-state conditions, do not exceed those specified either by the component manufacturer or in the component part standard.

The materials for the parts subject to pressure shall be in accordance with generally accepted technical requirements. They shall be suitable for the purpose and intended use. Documented proof of mechanical and physical properties of materials used and their chemical composition shall be obtained from the supplier. Documents proving conformity requirements shall be kept minimum 10 years.

The design of the boiler shall be such that it can be handled safely. It shall be designed and packaged so that it can be stored safely and without damage.

Where the weight, size or shape of the boiler or its components prevents them from being moved by hand, they shall be fitted with means to lift them easily.

If there is a service function to support maintenance or on-site measurement the technical documentation shall contain the full description of the functionality of the service function.

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

During design and development stage of the boiler system, measures to avoid noise emissions shall be implemented. This shall be done by:

- Selection of low noise electrical components as fans and motors,
- Motors and fans shall be mounted in such a way as to minimize noise and vibration,
- Constructive measures regarding components of the boiler like stoker, safety equipment and heat exchanger cleaning.

NOTE The sound power level can be determined according to EN 15036-1:2006, Clause 4.

4.1.2 General requirements for condensing boilers

4.1.2.1 Materials in contact with condensate

All parts of the boiler, which are expected to be in contact with condensate, shall be made of corrosion and condensate resistant materials.

4.1.2.2 Condensate drainage

Condensate produced during operation of a condensing boiler, including condensate formed in the flue and its connecting pipes, shall be removed by means of a discharge pipe (or pipes).

The internal diameter of the piping system of the condensation discharge system shall be at least 40 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 technical documentation;
- it cannot transmit combustion products into the room, where the boiler is installed, and in the locations affected by the boiler; this requirement is satisfied if the disposal system incorporates a water trap;

— the water trap has a seal of at least 25 mm in height at any operation state.

In the case where an external condensate pump is installed, the requirements of the technical documentation of the boiler regarding the pump shall be met.

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

4.1.2.3 Chemical composition of condensate

If required, the condensate shall be collected according to 5.12 and shall be analysed.

NOTE Some references are given in the Annex D and Annex E.

4.2 Construction requirements

4.2.1 Production documentation

4.2.1.1 Drawings

The drawings and/or the relevant documentation shall include at least the following information:

- a) the specification of the material;
- b) the welding process, the seam type (generally the symbol for the seam type is sufficient) and the welding fillers;
- c) the maximum allowable operating temperature, in °C;
- d) the maximum allowable operating pressure, in bar;
- e) the type test pressure, in bar;
- f) the nominal heat output or the heat output range for every boiler size, in kW, in accordance with the fuel(s) recommended for use in the boiler.

4.2.1.2 Manufacturing controls

A Quality Manual shall be compiled on the inspections and tests necessary during the manufacturing process.

The manual shall:

- 1) describe the inspection system;
- 2) specify the person responsible for quality assurance;
- 3) specify the necessary inspections and tests as well as the pertinent limit values and
- 4) lay down the requisite measuring and testing equipment and their inspection.

4.2.2 Heating boilers (parts) made of steel

4.2.2.1 Execution of welding work

Boiler manufacturers who carry out welding work shall meet the requirements of EN ISO 9606-1:2017 and EN ISO 9606-2:2004 as follows:

- only welders who are qualified in the welding of the materials to be processed shall be used;
- equipment shall be available to allow defect-free welding to be carried out;
- supervision of the welding shall be carried out by staff qualified in welding (at least one supervisor shall be qualified).

4.2.2.2 Welding seams and welding fillers

The materials shall be suitable for welding.

NOTE 1 The materials in Table 1 are suitable for welding and do not require additional heat treatment after welding.

The welded seams shall not show any cracks or lack of fusion and shall be defect free over the whole cross-section for butt welds. One-sided fillet welds, and half Y-welds which have 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 shall only be subject to high bending stresses during production and operation, are to be avoided.

When welding longitudinal stay bars or stay tubes, the shearing cross section of the fillet weld shall be 1,2 times the required stay bar or stay tube cross sectional area.

The permissible types of weld and appropriate material thicknesses are given in Table 2 and these parameters shall be met.

Welding fillers shall be suitable for the material being used.

NOTE 2 The reference numbers of welding processes are in accordance with ISO 857-2:2005 and EN ISO 4063:2010.

4.2.2.3 Parts of steel subject to pressure

The steels listed in Table 1 shall be used.

Materials and wall thicknesses other than those specified shall only be used on the production of appropriate evidence, with regard to (at least) their equivalent corrosion resistance, heat resistance and strength to non-alloy steel at the material thicknesses specified in Table 1 for the particular application/usage.

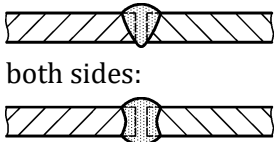
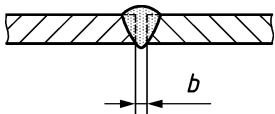
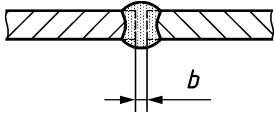
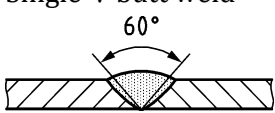
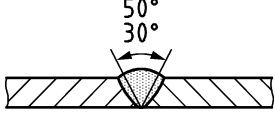
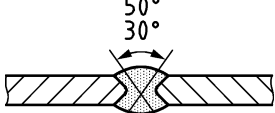
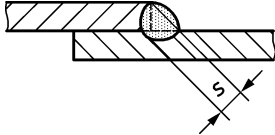
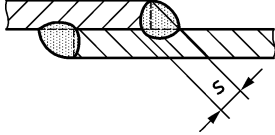
The specification of the materials shall be documented by a works certificate in accordance with EN 10204:2004. These certificates shall be obtained by the boiler manufacturer. This does not apply to components, e.g. sockets up to DN 50, screws and nuts.

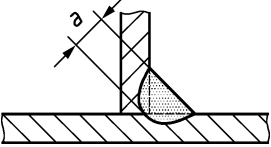
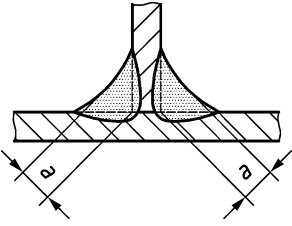
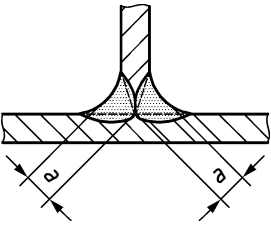
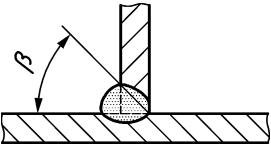
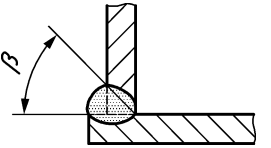
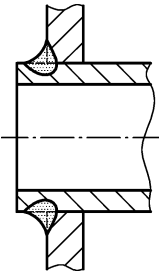
Table 1 — Materials

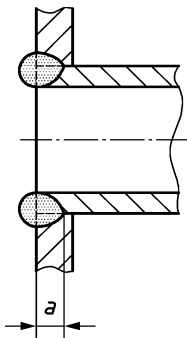
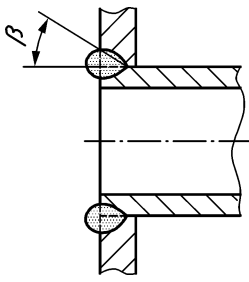
References	Material type	Material numbers (in accordance with EN 10027-2)	Materials not to be used for condensing appliances
EN 10025-1:2004	E235	1.0308	X
	S235JR	1.0037	X
	S235JRG2	1.0038	X
	S235J0	1.0114	X
	S235J2G3	1.0116	X
	S275JR	1.0044	X
	S275J0	1.0143	X
	S275J2G3	1.0144	X
	S355J2C	1.0579	X
	S355J2H	1.0576	X
	S355JR	1.0045	X
	S355J0	1.0553	X
	S355J2G3	1.0570	X
	S355K2G3	1.0595	X
EN 10025-2:2019	S235J2 + N	1.0117	X
EN 10216-1:2013	P195TR1	1.0107	X
	P235TR1	1.0254	X
	P235GH	1.0345	X
EN 10028-2:2017	P265GH	1.0425	X
EN 10028-3:2017	P355NL1	1.0566	X
	P295GH	1.0481	X
	P355GH	1.0473	X
	16Mo3	1.5415	
	15NiCuMoNb5-6-4	1.6368	
	13CrMo4-5	1.7335	
	10CrMo9-10	1.7380	
	11CrMo9-10	1.7383	
EN 10095:1999	X15CrNiSi25-21	1.4841	
EN 10120:2017	P245NB	1.0111	X
	P265NB	1.0423	X

References	Material type	Material numbers (in accordance with EN 10027-2)	Materials not to be used for condensing appliances
	P310NB	1.0437	X
	P355NB	1.0557	X
EN 10088-2:2014	X5CrNi18-10	1.4301	
	X10CrAlSi7	1.4713	
	X5CrNi17-12-2	1.4401	
	X2CrNiMo17-13-2	1.4404	
	X6CrNiTi18-10	1.4541	
	X6CrNiNb18-10	1.4550	
	X2 CrMnNiN 22-5-2	1.4162	
	X2 CrNiN 23-4	1.4362	
	X2 CrNiMoN 22-5-3	1.4462	
	X1 NiCrMoCuN 25-20-7	1.4529	
	X1 NiCrMoCu 25-20-5	1.4539	
	X6CrNiMoTi17-12-2	1.4571	
	X6CrNiMoNb17-12-2	1.4580	
	X3CrNiMo17-3-3	1.4436	
EN 10210-2:2019	S235JRH	1.0039	X
	S355J2H	1.0576	X
EN 10217-1:2019	S235JRH, S355J2H, P195TR1, P235TR1, P235GH -TC1	1.0107, 1.0254, 1.0345	X
EN 10222-2:2017	P245GH	1.0352	X
	P250GH	1.0460	X
EN 10255:2004+A1:2007	S195T	1.0026	X
NOTE This table lists grades of steel which are not suitable for condensing applications. The other grades need to be verified considering also conditions like design, exposure to temperature, manufacturing process and others influencing the corrosion behaviour.			

Table 2 — Weld joints and welding processes

No.	Term	Material thickness (mm)	Welding process ^a	Remarks
1.1	Square butt weld  both sides:	≤ 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, power 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 	up to 12	(111)	Weld preparation V-seam 60°
1.5	Single-V butt weld 	up to 12	135 12	Weld preparation V-seam 30° to 50° depending on thickness of material
1.6	Double-V butt weld 	greater than 12	135 12	Weld preparation double V-seam 30° to 50° depending on material thickness
1.7	Overlap welding 	≤ 6	135 12	Welds of this type are to be kept largely free from bending stresses. Not suitable for directly fired wall parts $s = t$
1.8	Overlap welding (continued) 	≤ 6	135 12 (111)	Not suitable for directly fired wall parts $s = t$

No.	Term	Material thickness (mm)	Welding process ^a	Remarks
2	Fillet weld 	≤ 6	135 12 (111)	Welds of this type are to be kept largely free from bending stresses $a = t$
2.1	Double fillet weld 	≤ 12 > 12	135 12 (111) (141) 135 12 (111) (141)	$a = t$ $a = 2/3 t$
2.2	Double-bevel butt weld 	≤ 12 > 12	135 12 (111) (141) 135 12 (111) (141)	$a = t$ $a = 2/3 t$
2.3	Single-bevel butt weld 	≤ 12 > 12	135 12 (111) 135 12	For (111) $\beta = 60^\circ$ For 135,12 $\beta = 40^\circ$ to 50°
2.4	Single-bevel butt weld 	≤ 12	135 12 (111) (141)	For (111) $\beta = 60^\circ$ For 135,12 $\beta = 40^\circ$ to 50°
2.5		≤ 12	135 (111) (141)	Tube end shall not project beyond fillet weld if it is subjected to heat radiation

No.	Term	Material thickness (mm)	Welding process ^a	Remarks
2.6		≤ 6	135 (111) (141)	Welding in of tube under high thermal stress $a \geq t$
2.7			135 (111) (141)	Welding in of tube under high thermal stress For (111) $\beta = 60^\circ$ For 135 $\beta = 40^\circ$ to 50°
^a Reference numbers of welding processes are in accordance with ISO 857-2:2005 or EN ISO 4063:2010.				
NOTE () Use needs further consideration				
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		

Laser Welding is also accepted if the requirements of EN ISO 15609-4:2009, EN ISO 15614-11:2002, EN ISO 13919-1:2019 and EN ISO 13919-2:2021 are fulfilled.

4.2.2.4 Minimum wall thicknesses

The minimum wall thicknesses listed in Table 3 have been specified to consider the following:

- a) the maximum allowable operating pressure;
- b) the nominal heat output; and
- c) the material properties.

For boilers which consist of a combination of individual geometrically identical parts (sections), the requirements of the minimum wall thickness for the complete range of the nominal heat output of the boiler shall be in accordance with the individual boiler sections as specified in Table 3.

The wall thickness tolerance for carbon steels shall be as specified in EN 10029:2010.

The minimum wall thicknesses according to Table 3 apply to pressure-loaded sheets, tubes (except immersion coils and safety heat-exchangers) and forgings. Smaller wall thicknesses shall be permitted upon the production of evidence demonstrating equivalence regarding corrosion, heat resistance and strength.

Table 3 — Minimum wall thicknesses

Nominal heat output	Carbon steels					Stainless and corrosion protected steels				
	a	b	c	d	e	a	b	c	d	e
kW	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
$P_N \leq 100$	5	4	3,2	3	4	3	2	1,5	2	3
$100 < P_N \leq 300$	5	4	3,2	4	4	3	2	1,5	2	3
$300 < P_N \leq 500$	6	5	3,2	4	4	4	2	1,5	2	3
Column a: for walls of the filling and combustion chamber in contact with fire and water Column b: for walls of the convection heating surfaces outside the combustion chamber (except circular tubes) Column c: for circular tubes in the convection heating surface area outside the combustion chamber Column d: for walls which are only in contact with water Column e: for water cooled grate tubes										

4.2.3 Boilers made of cast materials

4.2.3.1 General

During the manufacture of the boiler and other cast iron parts subject to pressure, the following tests shall be carried out using separate cast test pieces for each batch:

- 1) tensile test in accordance with EN 1561:2011 and EN 1563:2018; the values given in Table 4 are to be confirmed by the tensile test;
- 2) chemical analysis (C, Si, Mn, P, S);
- 3) brinell hardness test in accordance with EN ISO 6506-1:2014;
- 4) izod impact (for graphite iron).

The results of the tests shall either be recorded in registers countersigned by the works tester responsible or works certificates in accordance with EN 10204:2004 shall be drawn up. Works certificates and registers shall be kept for at least ten years by the manufacturer and shall be accessible for examination.

Repairs undertaken by the welding of parts subject to pressure is not permissible.

4.2.3.2 Cast iron parts subject to pressure

The mechanical properties of cast iron used for parts subject to pressure shall, as a minimum, correspond to the values listed in Table 4.

Table 4 — Minimum mechanical requirements for cast irons

Grey cast iron (in accordance with EN 1561:2011)	
— Tensile strength R_m	$\geq 150 \text{ N/mm}^2$
— Brinell hardness	160 HB to 220 HB
Spheroidal graphite cast iron (in accordance with EN 1563:2018)	
— Tensile strength R_m	$\geq 400 \text{ N/mm}^2$
— Izod impact	$\geq 23 \text{ J/cm}^2$

4.2.3.3 Minimum wall thicknesses

The wall thicknesses given in the production drawing shall not be less than the minimum wall thicknesses listed in Table 5. The actual minimum wall thicknesses during manufacture of the boiler sections and other parts subject to pressure shall be more than 0,8 times the thickness given in the drawing.

Smaller wall thicknesses shall be permitted upon the production of evidence demonstrating equivalence with regard to corrosion, heat resistance and strength for the particular application/usage.

Table 5 — Minimum wall thicknesses of boiler sections of cast material

Nominal heat output kW	Minimum wall thickness ^a for cast iron with	
	lamellar graphite	spheroidal graphite/annealed ferritic
	mm	mm
$P_N \leq 30$	3,5	3,0
$30 < P_N \leq 70$	4,0	3,5
$70 < P_N \leq 300$	4,5	4,0
$300 < P_N \leq 500$	5,5	5,0
^a Heating boilers for fossil fuels; for biogenic fuels: add 0,5 mm.		

For boilers which consist of a combination of individual geometrically identical parts (sections) the requirements of the minimum wall thickness for the complete range of the nominal heat output of the boiler shall be in accordance with the individual boiler sections in accordance to Table 5.

4.2.4 Design requirements

4.2.4.1 Venting of the water sections

The boiler and its components shall be designed in such a way that their respective water sections can be fully vented.

The boiler shall be designed in a way that under normal operation in accordance with the manufacturer's instructions no undue boiling occurs.

4.2.4.2 Cleaning of heating surfaces

The heating surfaces shall be accessible from the flue gas side for inspection and cleaning with chemical agents and brushes. A sufficient number and appropriate arrangement of cleaning openings shall be provided. If special tools (for example special brushes) are required for cleaning and maintenance of the boiler, these shall be supplied.

4.2.4.3 Inspection of the flame

A facility shall be provided which allows inspection of the flame or fire bed. If this facility is a door, then hazard-free inspection shall be possible. The facility of an inspection window is recommended.

4.2.4.4 Water tightness

Holes for screws and similar components which are used for the attachment of removable parts shall not enter into spaces through which water flows. This does not apply to pockets for measuring or control and safety equipment.

4.2.4.5 Replacement parts

Replacement and spare parts (e.g. inserts, shaped firebricks, turbulators etc.) shall be designed, made or marked in such a way that their installation shall be correct in accordance with the manufacturer's instructions.

4.2.4.6 Boiler shell tapplings

Boiler shell tapplings shall comply with EN 10226-1:2004, EN 10226-3:2005, EN ISO 228-1:2003, EN ISO 228-2:2003, flange connections shall comply with ISO 7005-1:2011, ISO 7005-2:1988 and ISO 7005-3:1988. The arrangement of the tapplings shall be such that they are easily accessible, and the function of each respective connection can be adequately fulfilled. There shall be sufficient space around the connection to allow the installation of the connecting pipes (flanges, bolts) with the necessary tools.

Threaded pipe connections above 2 inches (DN 50) are not recommended. Threaded pipe connections with nominal diameters above 3 inches (DN 80) shall not be permitted. This information shall be supplied with the boiler. If connections are fitted with flanges, the mating flanges and seals shall also be supplied except where standardized flanges and seals are available.

The minimum size for flow outlet shall be DN 20.

The boiler shall have at least one connection for filling and emptying. This connection may be common. The size of the connection shall be as a minimum:

- G 1/2 for nominal heat outputs up to 70 kW;
- G 3/4 for nominal heat outputs above 70 kW.

It is possible to provide these connections outside the boiler if satisfactory filling and emptying of the boiler can be ensured.

4.2.4.7 Immersion pockets for control and indicating equipment, and safety temperature limiter

Every boiler shall be equipped with at least one immersion pocket which is used for temperature control, a safety temperature limiter and a thermometer. If a threaded pipe connection is required, the minimum nominal diameter shall be G 1/2.

Alternative arrangements are allowed, provided that the control devices are supplied with the boiler, and that they cannot be substituted by other components.