



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 303-5:2012. It supersedes BS EN 303-5:1999 which is withdrawn.

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 secretary.

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

© The British Standards Institution 2012. Published by BSI Standards Limited 2012

ISBN 978 0 580 71785 7

ICS 01.040.91; 91.140.10

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

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 August 2012.

Amendments issued since publication

Date	Text affected
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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 303-5

June 2012

ICS 01.040.91; 91.140.10

Supersedes EN 303-5:1999

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, Nenn-Wärmeleistung bis 500 kW - Begriffe, Anforderungen, Prüfungen und Kennzeichnung

This European Standard was approved by CEN on 10 May 2012.

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Ref. No. EN 303-5:2012: E

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Foreword

This document (EN 303-5:2012) has been prepared by Technical Committee /TC 57 "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of an identical text or by endorsement, at the latest by December 2012, and conflicting national standards shall be withdrawn at the latest by December 2012.

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

This document supersedes EN 303-5:1999.

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

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

In comparison with EN 303-5:1999, the following technical changes were made:

- a) the scope was extended to a nominal heat output of the heating boilers for ≤ 500 kW;
- b) usable fuel to non-wood biomass and further solid fuels were extended;
- c) requirements for materials, weld joints and wall thicknesses were revised;
- d) risk analysis was implemented;
- e) general and electrical safety requirements were revised;
- f) emission class 1 and 2 were deleted and new emission class 4 and 5 were added;
- g) tests were revised and new tests for safety requirements were added;
- h) Annexes were re-structured;
- i) Consideration was given to the essential requirements of the Machinery Directive 2006/42/EC.

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.*

According to the CEN/CENELEC Internal Regulations, the national standards organisations 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, Turkey and the United Kingdom.

Introduction

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

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 standard deals with boilers which are within the Scope Machinery Directive and boilers that are outside of the Scope Machinery Directive.

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 European Standard 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 of the boiler manufacturer.

This European Standard deals with significant hazards, hazardous situations and events relevant to heating boilers used as intended and under the conditions foreseen by the manufacturer (see Clause 4).

The boilers may operate under natural draught or forced draught. The stoking may work manually or automatically.

NOTE This European Standard deals with boilers which are both within and outside of the scope of the Machinery Directive 2006/42/EC.

This European Standard contains requirements and test methods for safety, combustion quality, 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 European Standard covers only boilers that include burners as a unit. The standard applies to the combination of a boiler body with a solid fuel burner according to EN 15270 as a unit only when the whole unit is tested in accordance with this European Standard.

Heating boilers in accordance with this European Standard 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 European Standard only applies to those parts of the water heater which are necessarily subject to the operating conditions of the heating boiler (heating part).

This European Standard does not apply to:

- heating boilers and other heating appliances which are also designed for the direct heating of the place of installation;
- cooking appliances;
- the design and construction of external fuel storage and transportation devices prior to the safety devices of the boiler;
- room sealed applications;
- condensing boilers.

This European Standard specifies the necessary terminology for solid fuel heating boilers, the control and safety related requirements, the design requirements, the technical heating requirements (taking into account the environmental requirements) and testing, as well as the marking requirements.

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

1.2 Fuels

These boilers may burn either fossil fuels, biogenic fuels or other fuels such as peat, as specified for their use by the boiler manufacturer, in accordance with the requirements of this European Standard.

Solid fuels included in this European Standard are categorised as follows.

1.2.1 Biogenic fuels

Biomass in a natural state, in the form of:

- **A** log wood with moisture content $w \leq 25\%$, according to EN 14961-5;
- **B1** chipped wood (wood chipped by machine, usually up to a maximum length of 15 cm) with moisture content from $w 15\%$ to $w 35\%$, according to EN 14961-4;
- **B2** chipped wood as under B1, except with moisture content $w > 35\%$;
- **C1** compressed wood (e.g. pellets without additives, made of wood and/or bark particles; natural binding agents such as molasses, vegetable paraffins and starch are permitted), pellets according to EN 14961-2;
- **C2** compressed wood (e.g. briquettes without additives, made of wood and/or bark particles; natural binding agents such as molasses, vegetable paraffins and starch are permitted), briquettes according to EN 14961-3;
- **D** sawdust with moisture content $w \leq 50\%$;
- **E** non-woody biomass, such as straw, miscanthus, reeds, kernels and grains according to EN 14961-6.

1.2.2 Fossil fuels

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

1.2.3 Other solid fuels

- **e** such as peat or processed fuels, according to EN 14961-1.

2 Normative references

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

EN 287-1, *Qualification test of welders — Fusion welding — Part 1: Steels*

EN 303-1:1999+A1:2003, *Heating boilers — Part 1: Heating boilers with forced draught burners — Terminology, general requirements, testing and marking*

EN 304:1992+A1:1998+A2:2003, *Heating boilers — Test code for heating boilers for atomizing oil burners*

EN 1561, *Founding — Grey cast irons*

EN 1563, *Founding — Spheroidal graphite cast irons*

EN 10025-1, *Hot rolled products of structural steels — Part 1: General technical delivery conditions*

EN 10027-2, *Designation systems for steels — Part 2: Numerical system*

EN 10028-2, *Flat products made of steels for pressure purposes — Part 2: Non-alloy and alloy steels with specified elevated temperature properties*

EN 10028-3, *Flat products made of steels for pressure purposes — Part 3: Weldable fine grain steels, normalized*

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

EN 10088-2, *Stainless steels — Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes*

EN 10120, *Steel sheet and strip for welded gas cylinders*

EN 10204, *Metallic products — Types of inspection documents*

EN 10216-1, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 1: Non-alloy steel tubes with specified room temperature properties*

EN 10222-2, *Steel forgings for pressure purposes — Part 2: Ferritic and martensitic steels with specified elevated temperature properties*

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

EN 12828, *Heating systems in buildings — Design for water-based heating systems*

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

EN 13384-1:2002+A2:2008, *Chimneys — Thermal and fluid dynamic calculation methods — Part 1: Chimneys serving one appliance*

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

EN 13501-2, *Fire classification of construction products and building elements — Part 2: Classification using data from fire resistance tests, excluding ventilation services*

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

EN 14778, *Solid biofuels — Sampling*

EN 14961-1:2010, *Solid biofuels — Fuel specifications and classes — Part 1: General requirements*

EN 14961-2, *Solid biofuels — Fuel specifications and classes — Part 2: Wood pellets for non-industrial use*

EN 14961-3, *Solid biofuels — Fuel specifications and classes — Part 3: Wood briquettes for non-industrial use*

EN 14961-4, *Solid biofuels — Fuel specifications and classes — Part 4: Wood chips for non-industrial use*

EN 14961-5, *Solid biofuels — Fuel specifications and classe — Part 5: Firewood for non-industrial use*

EN 14961-6, *Solid biofuels — Fuel specifications and classes — Part 6: Non woody pellets for non-industrial use*

EN 15270, *Pellet burners for small heating boilers — Definitions, requirements, testing, marking*

EN 15456, *Heating boilers — Electrical power consumption for heat generators — System boundaries — Measurements*

CEN/TS 15883, *Residential solid fuel burning appliances — Emission test methods*

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

EN 60335-2-102:2006, *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, *Automatic electrical controls for household and similar use — Part 1: General requirements (IEC 60730-1)*

EN 60730-2-5, *Automatic electrical controls for household and similar use — Part 2-5: Particular requirements for automatic electrical burner control systems (IEC 60730-2-5)*

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

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

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

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

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

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

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

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

EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025)*

ISO 7-2, *Pipe threads where pressure-tight joints are made on the threads — Part 2: Verification by means of limit gauges*

ISO 857-1, *Welding and allied processes — Vocabulary — Part 1: Metal welding processes*

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

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 303-1:1999+A1:2003 and the following apply.

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 at the manufacturing plant

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

Q

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

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 European Standard.

3.7

nominal heat output

Q_N

maximum continuous heat output specified by the manufacturer for a specific fuel in accordance with the requirements of this European Standard

3.8

minimum heat output

$Q_{\min}$

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 European Standard

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

3.9 minimum continuous heat output

$Q_{\min C}$

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 European Standard

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 European Standard

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

3.11 partial load

T

quotient of heat output in the heat output range over the nominal heat output, expressed in percentage

Note 1 to entry: $T = \frac{Q}{Q_N} \times 100 \%$

3.12 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

3.13 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

3.14 heat input

Q_B

amount of heat in unit time which is supplied to the furnace of the heating boiler by the fuel based on its net calorific value H_i

3.15 boiler efficiency

η_K

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

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

3.16 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)

3.17 gas side resistance

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

3.18

gas side tightness

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

3.19

exit flue temperature

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

3.20

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

3.21

temperature controller

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

3.22

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 and in EN 60730-2-9.

3.23

safety heat exchanger

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

3.24

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.

3.25

test fuel

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

3.26

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

3.27

stoking by hand

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

3.28

automatic stoking

fuel supplied automatically, according to thermal output

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

3.29

combustion period

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

3.30

nominal combustion period

T_B

combustion period at a nominal heat output

3.31

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.

3.32

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.

3.33

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.

3.34

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.

3.35

exhaust gas cleaning equipment

techniques used for reducing air pollutants contained in the exhaust gas

3.36

ash chamber

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

3.37

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)

3.38

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

3.39

hazardous operating state

rise of the boiler temperature above 110 °C or, an accumulation of ignitable gases or gas mixtures ($\text{CO} > \text{volume fraction of } 5\%$) 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

3.40

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

3.41

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

3.42

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.

3.43

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.

3.44

back burning safety device

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

3.45

extinguishing installation

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

3.46

feeding direction

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

3.47

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

3.48

control shut-down

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

3.49

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

3.50

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

3.51

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

4 Requirements

4.1 General requirements

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;
- 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. Both these elements however strongly depend on the place of installation and the fuel storage discharge system and therefore fall outside of the scope of this standard. This requirement is deemed to be fulfilled if the requirements of the leakage of the boiler and of the emissions are met and there is no visible smoke emerging from the boiler into the test room at normal operation during type test.

- 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 should not exceed the critical values for a time period greater than 1 min.

Combustible materials shall be allowed for the following:

- f) internal components of controls and safety equipment;
- g) operating handles;
- h) electrical equipment;
- i) components of accessory (e.g. burner cover);

j) additional or supplemental optical outer covers (e.g. an additional decorative cover).

Component parts of Covers, operating controls, safety devices and electrical accessories shall fulfil the requirements of resistance against heat and fire in either EN 60335-1 or EN 60730-1.

Component parts of Covers, operating controls, safety devices and electrical accessories shall be arranged in such a way that their surface temperatures, under steady state conditions, do not exceed those specified either by the 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.

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.

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.

Motors and fans shall be mounted in such a way as to minimize noise and vibration.

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 made of steel and non-ferrous materials

4.2.2.1 Execution of welding work

Boiler manufacturers who carry out welding work shall meet the requirements of EN 287-1 and EN ISO 9606-2 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 terms given in Table 2 are in accordance with EN 22553; the reference numbers of welding processes are in accordance with ISO 857-1, ISO 857-2 and EN ISO 4063.

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. 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)
EN 10025-1	E235	1.0308
	S235JR	1.0037
	S235JRG2	1.0038
	S235J0	1.0114
	S235J2G3	1.0116
	S275JR	1.0044
	S275J0	1.0143
	S275J2G3	1.0144
	S355J2H	1.0576
	S355JR	1.0045
	S355J0	1.0553
	S355J2G3	1.0570
	S355K2G3	1.0595
EN 10216-1	P195TR1	1.0107
	P235TR1	1.0254
	P235GH	1.0345
EN 10028-2	P265GH	1.0425
EN 10028-3	P355NL1	1.0566
	P295GH	1.0481
	P355GH	1.0473
	16Mo3	1.5415
	15NiCuMoNb5-6-4	1.6368
	13CrMo4-5	1.7335
	10CrMo9-10	1.7380
	11CrMo9-10	1.7383
EN 10120	P245NB	1.0111
	P265NB	1.0423
	P310NB	1.0437
	P355NB	1.0557
EN 10088-2	X5CrNi18-10	1.4301
	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 10222-2	P245GH	1.0352

Table 2 — Weld joints and welding processes (1 of 3)

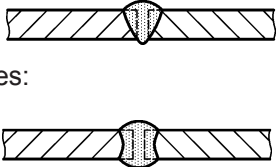
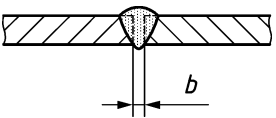
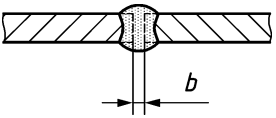
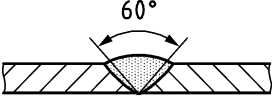
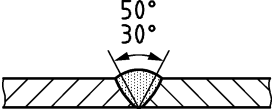
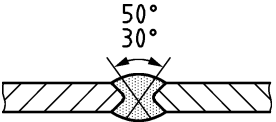
No.	Term	Material thickness (mm)	Welding process ^a	Remarks
1.1	Square butt weld  both sides:	≤ 6 (8)	135 12 131 (111)	Permissible up to $t = 8$ mm on use of deep penetration electrodes or welding on both sides
1.2	Square butt weld 	≥ 6 up to 12	12	Root gap $b = 2$ mm to 4 mm with stiffener, power holder 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

Table 2 (2 of 3)

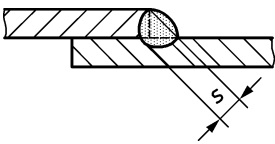
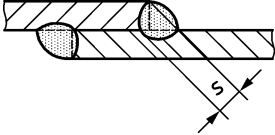
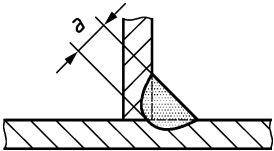
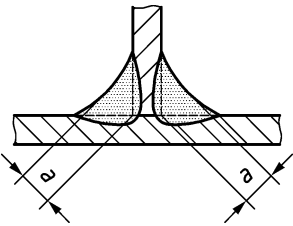
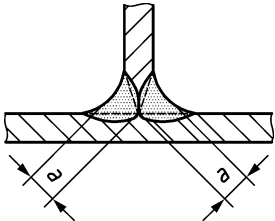
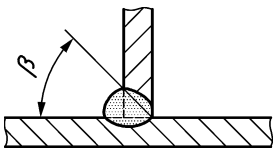
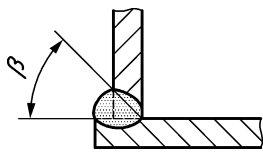
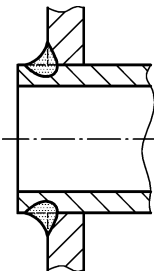
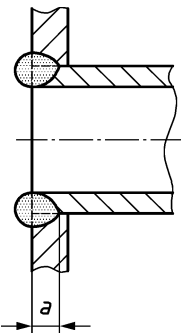
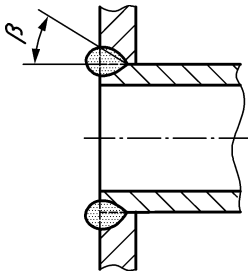
1.7	Overlap welding 	≤ 6	135 12	Welds of this type are to be kept largely free from bending stresses. Not suitable for directly fired wall parts $s = t$
1.8	Overlap welding (continued) 	≤ 6	135 12 (111)	Not suitable for directly fired wall parts $s = t$
2	Fillet weld 	≤ 6	135 12 (111)	Welds of this type are to be kept largely free from bending stresses $a = t$
2.1	Double fillet weld 	≤ 12 >12	135 12 (111) 135 12 (111)	$a = t$ $a = 2/3 t$
2.2	Double-bevel butt weld 	≤ 12 >12	135 12 (111) 135 12 (111)	$a = t$ $a = 2/3 t$
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°

Table 2 (3 of 3)

2.4	Single-bevel butt weld 	≤ 12	135 12 (111)	For (111) $\beta = 60^\circ$ For 135, 12 $\beta = 40^\circ$ to 50°
2.5		≤ 12	135 (111)	Tube end 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 $a \geq t$
2.7			135 (111)	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 857-1, ISO 857-2 or EN ISO 4063.				
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, EN ISO 15614-11, EN ISO 13919-1 and EN ISO 13919-2 are fulfilled.

4.2.2.4 Minimum wall thicknesses

The minimum wall thicknesses listed in Table 3 have been specified in order to take into account 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.

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 with regard to 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
$Q_N \leq 100$	5	4	3,2	3	4	3	2	1,5	2	3
$100 < Q_N \leq 300$	5	4	3,2	4	4	3	2	1,5	2	3
$300 < Q_N \leq 500$	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

The manufacturer shall have personnel and equipment capable of carrying out the necessary material tests. 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 and EN 1563; 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;
- 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 shall be drawn up. Works certificates and registers shall be kept for at least five years by the manufacturer and shall be accessible for examination.