

Heating boilers —

Part 1: Heating boilers with forced draught burners — Terminology, general requirements, testing and marking

The European Standard EN 303-1:1999, with the incorporation of amendment A1:2003, has the status of a British Standard

ICS 91.140.19

National foreword

This British Standard is the official English language version of EN 303-1:1998, including amendment A1:2003. It supersedes BS EN 303-1:1992 which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags **A1** **A1**. Tags indicating changes to CEN text carry the number of the amendment. For example, text altered by CEN amendment A1 is indicated in the text by **A1** **A1**.

This standard partially supersedes the following British Standards; BS 779:1989 and BS 855:1990. It is important to use this standard if the heating boilers being considered fall within its scope. The British Standards will not be valid for such boilers. The scope of BS 779:1989 and BS 855:1990 will be amended to state that they are no longer valid for heating boilers within the scope of this standard.

The UK voted against EN 303-1(Rev) for a number of reasons including concerns over the increase in the safety temperature limit to 120 °C and the possible need for over pressure protection. Manufacturers using this standard to produce heating boilers in the UK should take all the necessary steps to comply with the relevant national legislation.

The UK participation in its preparation was entrusted to Technical Committee RHE/10, Heating boilers, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the *BSI Electronic Catalogue* or of British Standards Online.

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

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 18, an inside back cover and a back cover.

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Amendments issued since publication

Amd. No.	Date	Comments
16720	31 October 2006	See national foreword

This British Standard, having been prepared under the direction of the Engineering Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 August 1999

Descriptors: central heating, boilers, definitions, specifications, equipment specification, materials, steels, cast iron, production control, chemical composition, mechanical properties, welded joints, welding, dimensions, safety, tests, marking, name plates

English version

Heating boilers —
Part 1: Heating boilers with forced draught burners —
Terminology, general requirements, testing and marking

Chaudières de chauffage — Partie 1: Chaudières
avec brûleurs à air soufflé — Terminologie,
prescriptions générales, essais et marquage

Heizkessel — Teil 1: Heizkessel mit
Gebläsebrenner — Begriffe, allgemeine
Anforderungen, Prüfung und Kennzeichnung

This European Standard was approved by CEN on 21 August 1998.

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

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

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

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 57, Central heating boilers, the Secretariat of which is held by DIN.

This European Standard supersedes EN 303-1:1992.

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 July 1999, and conflicting national standards shall be withdrawn at the latest by July 1999.

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

prEN 303-1, *Heating boilers — Part 1: Heating boilers with forced draught burners — Terminology, general requirements, testing and marking.*

prEN 303-2, *Heating boilers — Part 2: Heating boilers with forced draught burners — Special requirements for boilers with atomizing oil burners.*

prEN 303-3, *Heating boilers — Part 3: Gas fired central heating boilers — Assembly comprising a boiler body and a forced draught burner.*

prEN 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.*

prEN 303-5, *Heating boilers — Part 5: Heating boilers for solid fuels, hand and automatically fired, with a nominal heat output of up to 300 kW — Terminology, requirements, testing and marking.*

EN 304, *Heating boilers — Test code for heating boilers for atomizing oil burners.*

Concerning the required extension of the heat output from 300 kW up to 1 000 kW the following essential changes were agreed:

- a) modification of clause 1;
- b) amendments of Table 3 and Table 7;
- c) amendment in 4.1.5.8 “Burner matching dimensions”;
- d) revision of Table 1.

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

Foreword to amendment A1

This document (EN 303-1:1999/A1:2003) has been prepared by Technical Committee CEN/TC 57 “Central heating boilers”, the secretariat of which is held by DIN.

This Amendment to the European Standard EN 303-1:1999 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2004, and conflicting national standards shall be withdrawn at the latest by March 2004.

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.

This Amendment to the European Standard EN 303-1:1999 specifies the requirements for low-temperature central heating boilers. Its purpose is to complete, amend or shorten EN 303-1:1999. This does not affect the main standard.

WARNING : Other requirements and other EU Directives may be applicable to the products falling within the scope of this European Standard.

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

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1 Scope

A1 This European Standard applies to standard boilers and low-temperature boilers with forced draught burners with a nominal heat output not exceeding 1000 kW, which are operated either with negative pressure (natural draught boilers) or with positive pressure (pressurised boiler) in the combustion chamber, in accordance with the boiler manufacturers' instruction. **A1**

This standard specifies the necessary terminology, the requirements on the materials and testing of them, and marking requirements for heating boilers.

Particular requirements for boilers which can be used with open vented systems are contained in prEN 303-4.

The requirements of this standard apply to heating boilers which are tested on an authorized test rig.

Boilers in accordance with this standard are designed for the heating of central heating installations in which the heat carrier is water, and the maximum allowable operating temperature of which is restricted to 100 °C. The maximum allowable operating pressure is 8 bar. For boilers with a built-in or attached water heater (storage or continuous flow heater) this standard only applies to the parts of the water heater which are necessarily subject to the operating conditions of the heating boiler (heating part).

A1 This standard does not apply to gas boilers with atmospheric burners, boilers for solid fuels, oil or gas fired condensing boilers and boilers with oil vaporisation burners.

Note deleted **A1**

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 226, *Atomizing oil burners — Connecting dimensions between burners and heat generators.*

EN 287-1, *Approval testing of welders — Fusion welding — Part 1: Steels.*

EN 287-2, *Approval testing of welders — Fusion welding — Part 2: Aluminium and aluminium alloys.*

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

prEN 303-4, *Heating boilers — Heating boilers with forced draught burner — Part 4: 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 304, *Heating boilers — Test code for heating boilers for atomizing oil burners.*

EN 10003-1, *Metallic materials — Brinell hardness test — Part 1: Test method.*

EN 10021, *General technical delivery requirements for steel and iron products.*

EN 10025, *Hot rolled products of non-alloy structural steels — Technical delivery conditions* (includes amendment A1:1993).

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

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

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

EN 24063, *Welding, brazing, soldering and braze welding of metals; nomenclature of processes and reference numbers for symbolic representation on drawings.* (ISO 4063:1990)

EN 60335-1, *Safety of household and similar electrical appliances — Part 1: General requirements.*

EN 60529, *Degrees of protection provided by enclosures (IP-Code).* (IEC 529:1989)

EN 60730-2-9, *Automatic electrical controls for household and similar use — Part 2: Particular requirements for temperature sensing controls.* (IEC 730-2-9:1992, modified)

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

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

ISO 185, *Grey cast iron — Classification.*

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

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

ISO 857, *Welding, brazing and soldering processes — Vocabulary.*

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

ISO 7005-1, *Metallic flanges — Part 1: Steel flanges.*

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

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

3 Definitions

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

3.1

operating pressure

the maximum allowable pressure at which the boiler is to be normally operated. The 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 in the works of the manufacturer or during setting up by the installer

3.3

type test pressure

pressure to which the pre-production heating boiler(s) and associated parts are subjected before start of mass production in the manufacturing works

3.4

operating temperature

the maximum allowable temperature at which the boiler can be operated under normal operating conditions at the maximum setting of the boiler's water temperature controller

3.5

heat output

Q

heat output range

is the amount of heat transferred to the heat carrier (water) per unit of time

The heat output range is the span of output below the nominal heat output specified by the manufacturer over which the boiler meets the requirements of this standard and over which it can be used.

3.6

nominal heat output

Q_N

is the continuous output specified by the manufacturer in accordance with the requirements of this standard. It is the maximum useful quantity of heat transferred to the heat carrier per hour

3.7

heat input

Q_B

is the 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

3.8

boiler efficiency

η_K

is the ratio of the heat output (Q) to the heat input (Q_B) supplied by the fuel

$$\eta_K = \frac{Q}{Q_B}$$

3.9

draught

is the pressure differential between the static air pressure in the place of installation and the static pressure of the exhaust gases, as measured in the exhaust gas measuring section, which is required for correct operation of the boiler at nominal output

3.10

gas side resistance

is the pressure differential between the combustion chamber and the boiler exit

3.11

soundness of combustion system

is the soundness of the combustion circuit through which the exhaust gases flow

3.12

exit flue temperature

t_A

is the temperature measured at the flue exit of the boiler

3.13

flue gas loss

is the quantity of heat per unit time which leaves the flue gas exit of the boiler unused

3.14

combustion circuit

comprises the combustion chamber, the heat exchanger, the air supply circuit and the combustion product circuit up to the flue exit

3.15

standby loss

q_B

is the quantity of heat which is necessary to maintain the boiler at a given temperature when no heat output is used. It is stated as q_B in relation to the heat input Q_B

3.16

water side resistance

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

3.17

control thermostat

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

3.18

safety temperature limiter

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

3.19

condensate

liquid formed from the combustion products during the condensation process

3.20

standard boiler

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

3.21

low temperature boiler

boiler which can work continuously with a water return temperature of 35 °C to 40 °C, possibly producing condensation in certain circumstances without impairing the boiler's operation

NOTE For oil condensing boilers see WI 0057021. \square

4 Requirements

4.1 Construction requirements

4.1.1 General requirements

Boilers shall be fire-resistant and safe to operate. They shall be made of non-combustible materials and shall be resistant to deformation and shall be such that

- they can withstand the stresses arising during normal operation;
- the burner and the boiler cannot become heated to create a hazard;
- dangerous accumulations of combustible gases (fuels mixed with air) in the combustion chamber and in the flues are prevented and
- gases cannot leak from the boiler in dangerous quantities.

Combustible materials are allowable for

- components of accessories e.g. burner covers, if the parts are fitted outside of the boiler;
- internal components of controls and safety equipment;
- operating handles;
- electrical equipment;
- thermal insulation (see 4.1.5.9); only asbestos-free materials are allowable.

Component parts of covers, operating, control and 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 treatment intended. The mechanical and physical properties as well as the chemical composition of the materials shall be guaranteed by the relevant material producer/supplier.

\square The boiler body of a low-temperature boiler must at least meet the requirements of EN 303-1.

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

Surfaces in contact with condensate shall be designed to prevent condensate retention. \square

4.1.2 Production documentation

4.1.2.1 Drawings

The following shall be specified in the boiler drawings or in the relevant documents:

- the specified materials;
- the welding process, the weld type (generally the symbol for the weld type is sufficient) and the welding fillers;
- the maximum allowable operating temperature in °C;
- the maximum allowable operating pressure in bar;
- the test pressure in bar;
- the nominal heat output or the heat output range for every boiler size in kW.

4.1.2.2 Manufacturing controls

Manufacturing control shall be carried out.

4.1.3 Heating boilers of steel and of non-ferrous materials

4.1.3.1 Execution of welding work

Boiler manufacturers who carry out welding work shall meet the following requirements of EN 287-1 and EN 287-2:

- only welders who are qualified in the welding of the materials to be processed may 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 so qualified).

4.1.3.2 Welded joints and welding fillers

The materials shall be suitable for welding. The materials in accordance with Table 1 are suitable for welding and do not require additional heat treatment after welding.

The welded joints shall not show any cracks or bonding faults and shall be defect free over the whole cross-section for butt welds. One-sided fillet welds, and half Y-welds which have been welded through, shall be kept substantially free from bending stresses. Smoke tubes, inserted stays and similar components need not be counterwelded. Double fillet welds are only permissible when sufficiently cooled. Projections into the flue gas side in areas of high thermal stresses shall be avoided.

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

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

See Table 2 (dimensions in mm) for details on the welding joints mentioned. Welding fillers shall be suitable for the material being used.

The terms used in Table 2 are in accordance with ISO 2553. The reference numbers of welding processes are in accordance with ISO 857 and EN 24063.

4.1.3.3 Parts of steel subject to pressure

The steels listed in Table 1 shall be used.

The specification of the materials shall be documented by a works certificate (see EN 10021). These certificates shall be obtained by the boiler manufacturer. This does not apply to small 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	S235JR	1.0037
	S235JRG2	1.0038
	S235J0	1.0114
	S235J2G3	1.0116
	S275JR	1.0044
	S275J0	1.0143
	S275J2G3	1.0144
	S355JR	1.0045
	S355J0	1.0553
	S355J2G3	1.0570
	S355K2G3	1.0595
EN 10028-2	P235GH	1.0345
	P265GH	1.0425
	P295GH	1.0481
	P355GH	1.0473
	16Mo3	1.5415
	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
	X6CrNi17-12-2	1.4401
	X6CrNiTi18-10	1.4541
	X6CrNiNb18-10	1.4550
	X6CrNiMoTi17-12-2	1.4571
	X6CrNiMoNb17-12-2	1.4580
	X3CrNiMo17-3-3	1.4436

Table 2 — Weld joints and welding processes

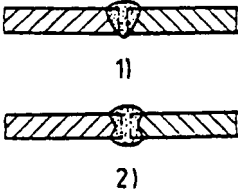
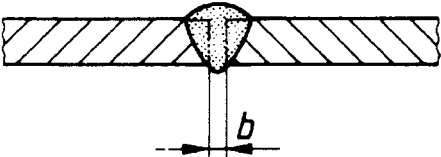
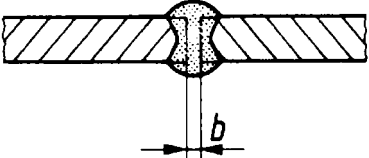
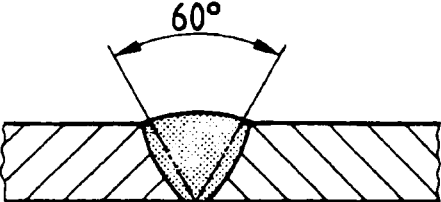
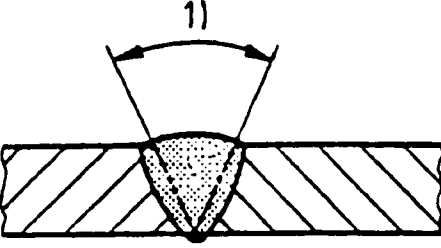
No.	Term	Material thickness t in mm	Welding process ^{*)}	Remarks
1.1	Square butt weld  1) 2) 1) one side 2) both sides	≤ 6 (8)	135 12 131 (111)	Permissible up to $t = 8$ mm on use of deep penetration electrodes or welding on both sides
1.2	Square butt weld 	≥ 6 up to 12	12	Root gap $b = 2$ mm to 4 mm with stiffener, powder holder necessary
1.3	Square butt weld (double) 	> 8 up to 12	135 12 (111)	Root gap $b = 2$ mm to 4 mm Deep penetration electrodes must be used for manual electro welding
1.4	Single-V butt weld 	up to 12	(111)	Weld preparation V-seam 60°
1.5	Single-V butt weld  1) 30° to 50°	up to 12	135 12	Weld preparation V-seam 30° to 50° depending on thickness of material

Table 2 — Weld joints and welding processes (continued)

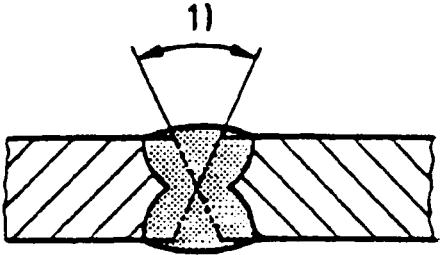
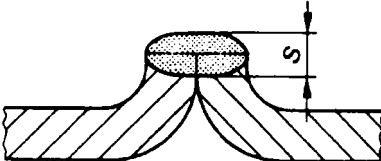
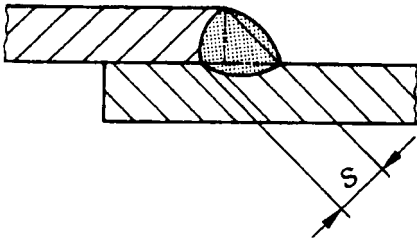
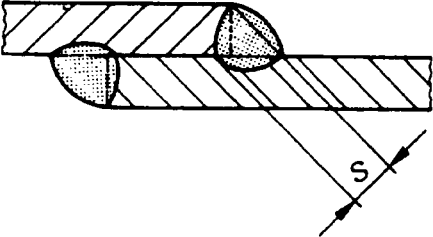
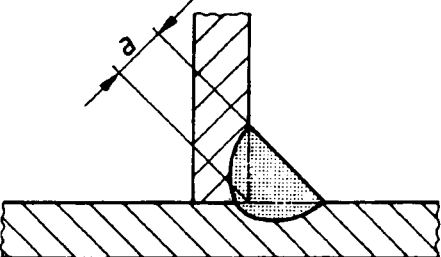
No.	Term	Material thickness t in mm	Welding process ³⁾	Remarks
1.6	Double-V butt weld  1) 30° to 50°	greater than 12	135 12	Weld preparation double V-seam 30° to 50° depending on material thickness
1.7	Butt weld between plates with raised edges 	≤ 6	135 141 131 (111)	Only permissible in exceptional cases for parts welded in. Moreover, the welds have to be kept largely free from bending stresses. Not suitable for directly fired wall parts $s = 0,8t$
1.8	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 $s = t$
1.9	Overlap welding (cont) 	≤ 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 $a = t$

Table 2 — Weld joints and welding processes (continued)

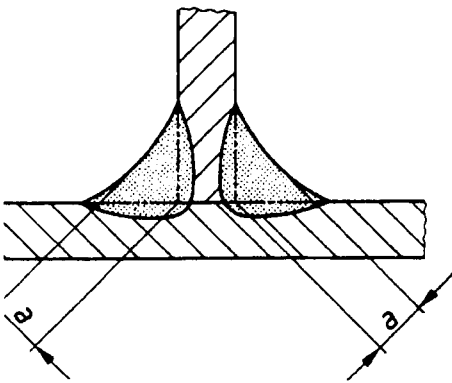
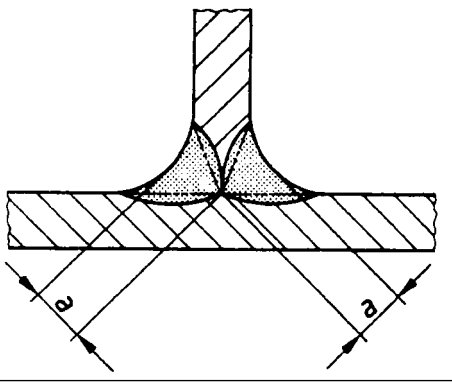
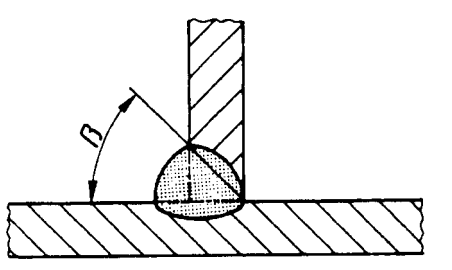
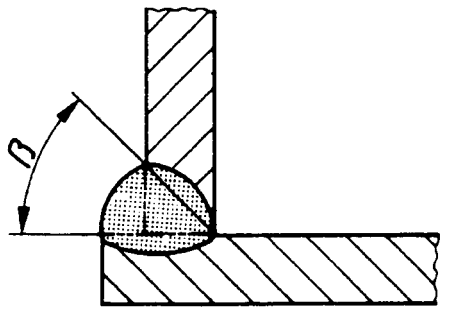
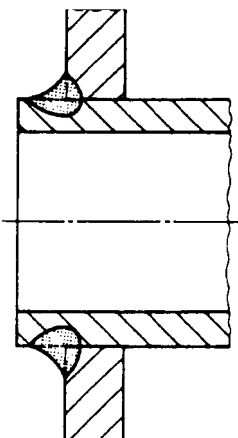
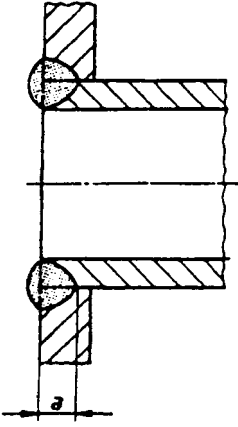
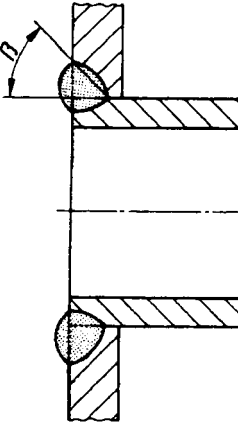
No.	Term	Material thickness <i>t</i> in mm	Welding process ^{a)}	Remarks
2.1	Double fillet weld 	≤12	135 12 (111)	$a = t$
		>12	135 12 (111)	$a = 2/3t$
2.2	Double-bevel butt weld 	≤12	135 12 (111)	$a = t$
		>12	135 12 (111)	$a = 2/3t$
2.3	Single-bevel butt weld 	≤12	135 12 (111)	For (111) $\beta = 60^\circ$
		>12	135 12	For 135, 12 $\beta = 45^\circ$ to 50°
2.4	Single-bevel butt weld 	≤12	135 12 (111)	For (111) $\beta = 60^\circ$ For 135, 12 $\beta = 45^\circ$ to 50°

Table 2 — Weld joints and welding processes (continued)

No.	Term	Material thickness t in mm	Welding process ^{*)}	Remarks
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 $\beta = 45^\circ$ to 50°

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

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

4.1.3.4 Minimum wall thicknesses

The minimum wall thicknesses listed in Table 3 are specified having taken into consideration:

- the maximum allowable operating pressure;
- the nominal heat output; and
- the material properties.

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

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

The nominal minimum wall thicknesses of Table 3 apply to sheets, tubes and forgings. Smaller wall thicknesses are only permissible on production of evidence showing equivalent performance.

4.1.4 Boilers of cast materials

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 separately cast test pieces for each batch:

- 1) tensile test in accordance with ISO 185, Type A; 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 10003-1;
- 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 10021 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. The repair of parts subject to pressure by welding is not permissible.

4.1.4.1 Parts of cast iron 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 requirements on cast iron

Cast iron with lamellar graphite (see ISO 185)	
— Tensile strength R_m	$\geq 150 \text{ N/mm}^2$
— Brinell hardness	160 HB to 220 HB 2,5/187,5
Spheroidal graphite iron (ferritically annealed)	
— Tensile strength R_m	$\geq 400 \text{ N/mm}^2$
— Izod impact	$\geq 23 \text{ J/cm}^2$

4.1.4.2 Cast parts of non-ferrous metals subject to pressure

Table 5 — Examples of aluminium and aluminium alloys

	Thickness mm	Tensile strength R_m N/mm ²	Temperature range °C
Al 99,5	up to 50	75 min.	up to 300
Al Mg2 Mn 0,8	up to 50	275 min.	up to 250

Table 6 — Examples for copper and copper alloys

	Thickness mm	Tensile strength R_m N/mm ²	Temperature range °C
SF-Cu	up to 5	200	up to 250
Cu Ni 30 Fe	up to 10	310	up to 350

4.1.4.3 Minimum wall thicknesses

The wall thicknesses given in the production drawing shall not be less than the minimum wall thicknesses listed in Table 7. The actual minimum wall thicknesses during manufacture of the boiler sections and other parts subject to pressure shall be greater than 0,8 times the thickness given in the drawing. Smaller wall thicknesses are only permissible on production of evidence showing equivalent performance.

Table 3 — Minimum wall thicknesses

Nominal heat output Q_N kW	Carbon steels aluminium, etc.			Copper, stainless steel and corrosion protected steel		
	a mm	b mm	c mm	a mm	b mm	c mm
$Q_N \leq 100$	4	3	2,9	2	2	1
$100 < Q_N \leq 300$	5	4	2,9	3	2	1
$300 < Q_N \leq 1\ 000$	6	5	2,9	4	2	1
Column a)	for walls of the combustion chamber in contact with fire and water and flat walls of the convection heating surface.					
Column b)	for walls only in contact with water and for rigidly stable (e.g. corrugated) convection heating surfaces outside the combustion chamber.					
Column c)	for circular tubes which are used in the convection part of the heat exchanger.					

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

Table 7 — Minimum wall thicknesses of boiler sections of cast material

Nominal heat output Q_N kW	Minimum wall thickness for cast iron with	
	lamellar graphite, aluminium mm	spheroidal graphite / annealed ferritic copper mm
$Q_N \leq 30$	3,5	3,0
$30 < Q_N \leq 70$	4,0	3,5
$70 < Q_N \leq 300$	4,5	4,0
$300 < Q_N \leq 1\ 000$	5,5	5,0

4.1.5 Further requirements

4.1.5.1 Venting of the water space and flue gas passages

The boiler and its parts shall be designed in such a way that the water spaces can be properly vented. The boiler shall be so designed that under normal operation in accordance with the manufacturer's instructions no undue boiling noises occur.

The combustion chamber and the flue gas passages shall be designed in such a way that no dangerous accumulation of combustible gases is possible.

4.1.5.2 Cleaning of heating surfaces

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

4.1.5.3 Inspection of the flame

A facility shall be provided which allows inspection of the flame. It shall permit assessment of the flame and shall be arranged or designed in such a way that the automatic flame safety device of the burner cannot be affected, by for example other sources of light. If the burner is attached to a hinged boiler door which can be opened by the operator without tools, burner operation shall not be possible if the door is open.

4.1.5.4 Water tightness

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

4.1.5.5 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 in accordance with the manufacturer's instructions is correct.

4.1.5.6 Water connections

Connecting sockets shall comply with ISO 7-1 and ISO 7-2 and ISO 228-1 and ISO 228-2 and flange connections shall comply with ISO 7005-1, ISO 7005-2 and ISO 7005-3. The arrangement of the connections shall be such that they are easily accessible and shall be chosen in such a way that 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 with the necessary tools.

Threaded pipe connections above DN 50 are not recommended. Threaded pipe connections with nominal diameters above DN 80 are not permissible. If connections are fitted with flanges, the mating flanges and seals shall also be supplied. Each boiler shall have at least one connection for filling and draining. 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 draining of the boiler can be assured.

4.1.5.7 Connections for control and indicating equipment, and safety thermostat

Each boiler shall have connections for pockets for temperature control, safety temperature limiter and a thermometer with a minimum nominal connection of G 1/2. If the control equipment is supplied with the boiler, these requirements need not apply. In this case the control equipment shall not be replaced by other equipment.

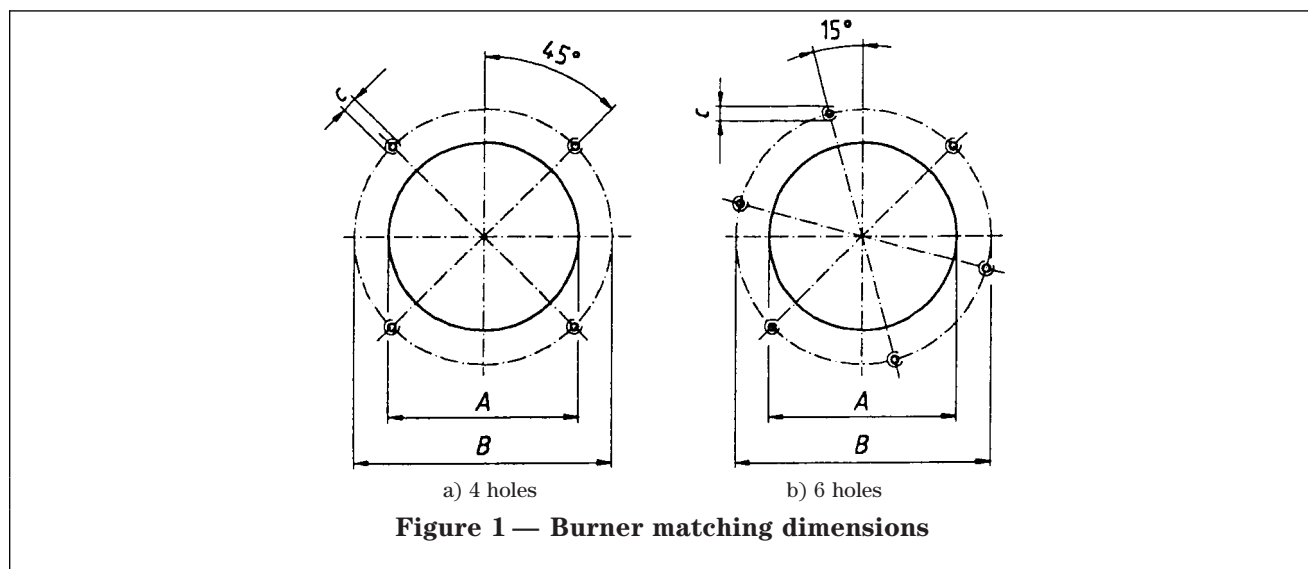
The connections shall be so positioned that the temperature measured is representative of the boiler temperature. If other connections are designated for safety devices, such as pressure switch, manometer, low water cut-out or safety valve, the nominal connection, especially for the safety valve, shall be designed for the range of capacity and the range of service

4.1.5.8 Burner matching dimensions

EN 226 is applicable for boilers up to or equal to 150 kW and furthermore the requirements listed in Table 8 are required. These requirements are not applicable to package boiler/burner units.

Table 8 — Burner matching dim

Heat input Q_B kW	Number of holes	Thread diameter C	Pitch circle diameter $B \pm 5$ mm	Orifice diameter A_{\min} mm
$150 < Q_B \leq 300$	4	M 10	270	240
$300 < Q_B \leq 600$	4	M 12	330	290
$600 < Q_B \leq 1\,000$	6	M 12	400	350



4.1.5.9 Thermal insulation

If thermal insulation is used it shall not markedly change its insulation properties at any place due to the effect of heat and ageing, and shall withstand normal thermal and mechanical stresses. Under normal conditions it shall not release any harmful substances. It shall be made of non-combustible material.

Combustible insulation, for example polyurethane foam, is allowed on water cooled surfaces if:

- it is temperature resistant up to 120 °C, is equipped with a cover of non-combustible material which is rigid and a minimum of 0,5 mm thick;
- the flow temperature control and safety temperature limiter have a maximum setting limit of 85 °C and 100 °C respectively;
- the operation of the boiler without water is prevented (for example by building in a low water flow switch);
- no danger of fire exists from electrical equipment.

The minimum distance from the surfaces of the flue gas carrying parts to combustible material shall be 100 mm

4.1.5.10 Surface temperature

The average surface temperature of the boiler covers on the operator side shall not exceed the ambient temperature by more than 100 K.

The surface temperature of operating levers and all parts which are capable being touched during operation of the boiler shall not exceed the room temperature by more than the following values:

- 35 K for metals and similar materials;
- 48 K for porcelain and similar materials;
- 60 K for plastics and similar materials.

4.1.5.11 Limiting temperature of the boiler sides, front and top

The temperature of the sides, front and top of the boiler shall not exceed the ambient temperature by more than 80 K.

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

4.1.5.12 Floor temperatures

The temperature of the surface beneath the boiler shall not exceed 80 °C at any point.

If this temperature is between 50 °C and 80 °C the manufacturer shall advise in the installation instructions on the type of protection which is to be fitted between the boiler and the floor if this is made of a combustible material.

4.1.5.13 Water side resistance of the boiler

The water side resistances are to be determined for those flows which correspond to the nominal heat output with two temperature differences of 10 K and 20 K between the flow and return connections of the boiler. The results are to be stated in mbar for each boiler size.

4.1.5.14 Soundness of the combustion system

The combustion systems of all boilers shall be sound.

4.1.5.14.1 Boilers with negative pressure

With a negative pressure in the combustion chamber of 0,05 mbar, the air leakage on a mass basis shall be a maximum of 1 % of the flue gas mass flow at nominal heat output.

4.1.5.14.2 Boilers with positive pressure

With a positive pressure in the combustion chamber of 1,2 times the operating pressure stated by the manufacturer the leakage rate based on mass flow shall not exceed 2 % of the flue gas mass flow at the nominal heat output.

4.1.5.15 Safety temperature limiter and control thermostat

Each boiler shall be fitted with a safety temperature limiter and a control thermostat whose operation is checked in accordance with clause 5.8 of EN 304:1992.

The control thermostat shall comply with the requirements of EN 60730-2-9 for type 1 devices with a maximum operating temperature of 100 °C.

The safety temperature limiter shall comply with the requirements of EN 60730-2-9 for type 2 devices with the value stated by the manufacturer, which shall be less than 120 °C, or a lower value stated by the manufacturer.

4.1.5.16 Accessories for the boiler

If additional fittings have been fitted to the boiler by the manufacturer and if their maintenance is required for safe and correct operation it shall be possible for this to be carried out easily without major dismantling.

4.1.5.17 Electrical safety

Testing of electrical safety is carried out on the basis of EN 60335-1.

4.1.5.17.1 General specifications

- Type of electrical protection of the boiler (in accordance with EN 60529);
- details on electrical equipment (e.g. switches, relays).

4.1.5.17.2 Tests

To be checked by a visual test, a functional test or by measurement:

- protection against access to live parts;
- leakage current and electric strength;
- internal wiring;
- supply connection and external flexible cords;
- terminals for external conductors;
- provision for earthing;
- creepage distances, clearances and distances through insulation;
- safety requirements of the circuit diagram;
- non-interchangeable plugs.

4.1.5.17.3 Certificates

If a detailed declaration of conformity is necessary, the equipment manufacturer can provide the following information:

- heating;
- operation under overload conditions of appliances with heating elements;
- radio interference suppression (only for units);
- resistance to heat, fire and tracking.

A1 4.1.5.18 Condensation

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

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

4.1.6 Special requirements for low-temperature boilers

4.1.6.1 Low-temperature boilers without lower boiler inlet temperature limit

Some low temperature boilers are capable of being operated with the regulation equipment of the boiler without any fixed lower boiler inlet temperature limit in which case the water temperature may fall to ambient temperature. This type of boiler shall not operate when there is no demand for heat from an external control, except under frost protection control.

4.1.6.2 Low-temperature boilers with lower boiler inlet temperature limit

Suitably identified low-temperature boilers are allowed the following deviations from the provisions of 4.1.6.1:

- a) the "lower boiler inlet temperature limit" can be set to a value ≤ 40 °C ,
- b) the boiler water temperature shall be held at the specified value, ≤ 40 °C, during interruptions of operation without any heat being transmitted to the heating system.

4.1.6.3 Resistance of the materials to pressure

For low-temperature boilers, corrosion resistant coatings shall be designed in a way that they show no sign of damage after the tests of resistance of the materials to pressure during manufacture in accordance with 5.2.2 or 5.3.2. **A1**

5 Tests

5.1 General

Before the start of production, boilers shall be subjected to the rating test and combustion technology tests. During production the construction and water pressure tests shall be carried out.

The manufacturer shall ensure that the construction materials and welds are in conformity with the requirements of his factory production control system and that the results of all necessary tests conform to those requirements.

Tasks for the manufacturer:

- factory production control;
- further testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan.

All boilers and their parts shall be subjected to a cold water pressure test in the works of the manufacturer. No leakage and no permanent deformation shall occur.

5.2 Boilers of mild steel or non-ferrous metal

5.2.1 Tests to be carried out before production

A hydraulic pressure of $2p_1$ is required (p_1 is the maximum permissible operating pressure).

The test period shall be at least 10 min and if it is to apply to a range of boilers, the test shall be carried out on at least 3 boiler sizes (smallest, medium size and largest). No leakage or noticeable permanent deformation shall occur during the test.

A record shall be made of the test giving the following details:

- exact description of the boiler tested stating the drawing number;
- test pressure in bar and duration of the test;
- test result and
- place and date of the test including the names of persons carrying out the test. The test report shall be signed by, as a minimum the works tester responsible and one witness.

5.2.2 Test during production

The test pressure shall be $1,3p_1$ with a minimum of 4 bar.

5.3 Boilers of cast iron or non-ferrous metals

5.3.1 Test to be carried out before production

5.3.1.1 Burst test on individual sections

To assess the sections comply with the design requirements, three of each front, middle and back sections of each boiler shall be subjected to a burst test. Before the start of full production for boilers achieved burst pressure shall be $4p_1 + 2$ bar, with a minimum of 8 bar.

The result shall be recorded in a report which gives the following details:

- test date and name of tester;
- model, type and number of sections;
- model number of the individual sections or other proof of identity;
- cast date;
- burst pressure achieved in bar; and
- description and position of the damage which occurred.

5.3.1.2 Water pressure tests on boiler block

For each boiler type which is intended for mass production

- one boiler block of average size shall be subjected to a water pressure test with a pressure of $2p_1$, (minimum 8 bar);
- the strength of the tie bars shall be calculated and tested to withstand an internal boiler pressure of $4p_1$.

No leakage shall occur. A record shall be drawn up of the result. see 5.2.1 for details.

5.3.2 Test during production

5.3.2.1 Cast sections

Each boiler section shall be subjected to a cold water pressure test with a pressure of $2p_1$, (minimum 8 bar). The highest permissible test pressure is 10 bar.

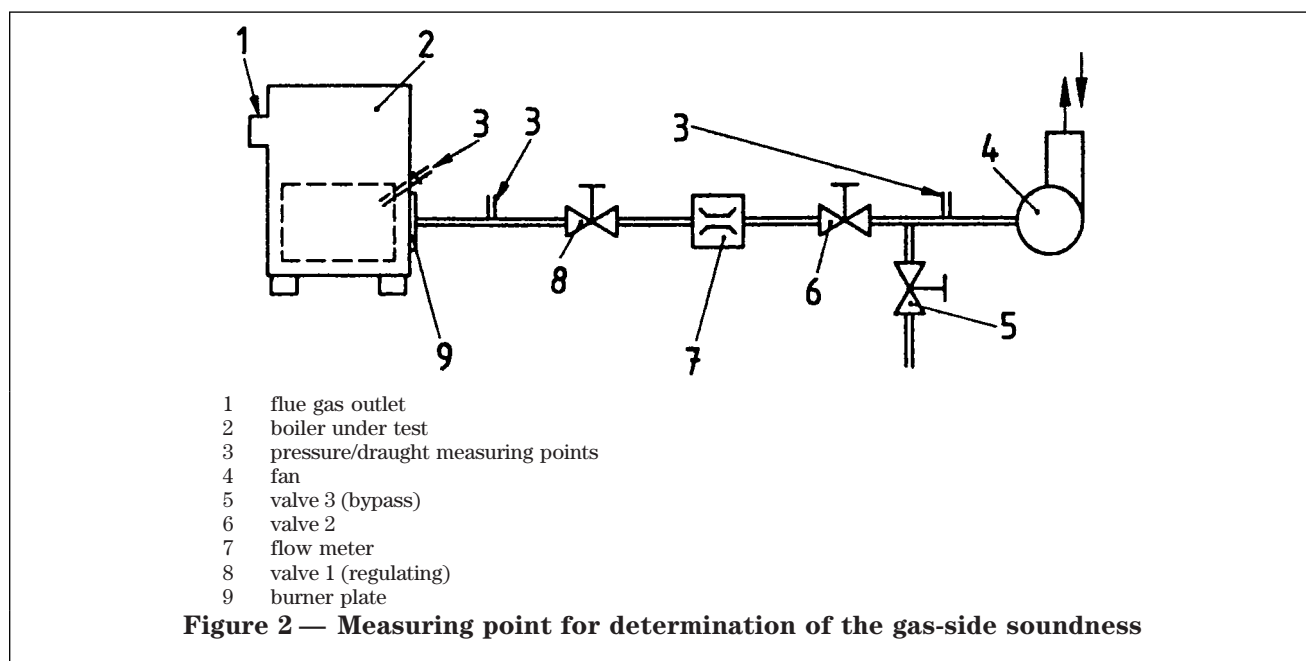


Figure 2 — Measuring point for determination of the gas-side soundness

The wall thicknesses of the individual boiler sections shall be subjected to an examination during production in accordance with a quality system. The limiting value of wall thickness at each measuring point shall be the nominal wall thickness less the permissible tolerance.

Boiler sections and parts which are subjected to pressure shall have the following information cast onto them:

- manufacturer or manufacturer's symbol;
- details of the material;
- cast date;
- model number;
- mark of approval if granted.

5.3.2.2 Boiler block

Each boiler shall be subjected to a water pressure test with a test pressure of $1,3p_1$, (minimum 4 bar) before fitting the thermal insulation at the manufacturer's works; for boilers which are site assembled by the installer, the boiler manufacturer shall provide instructions to carry out the pressure test. No leakage must occur during the water test.

5.4 Test for gas side soundness

The specified limit values for permissible leakage rates are determined with the mass of the gases equivalent to the rated output.

The actual leakage rate of the boiler shall be determined using air at ambient temperature using a test rig in accordance with for example Figure 2.

The flue outlet shall be sealed and the doors and dampers shall be in their normal positions. The test rig is connected to the combustion chamber of the boiler under test either at the burner entry or a special entry.

The leakage rates obtained shall be corrected to standard conditions (0 °C and 1 013 mbar).

5 Test methods

Add the following clause after 5.4:

A₁ 5.5 Additional tests for low-temperatures boilers

5.5.1 Additional tests by using of corrosion resistant coatings

After each test according 5.2.2 resp. 5.3.2 corrosion resistant coatings have to be checked for symptoms of damage.

5.5.2 Additional tests for oil-fired low-temperatures boilers

For oil-fired low-temperatures boilers additional tests are necessary, which are written in EN 303-2/A1. **A₁**

6 Marking

6.1 Boiler data plate

Each boiler shall be fitted with a data plate. The data plate shall be written in the language of the country of destination and attached to an accessible place.

6.1.1 Information on the data plate

The following information shall be given as a minimum:

- a) name and address of manufacturer and manufacturer's symbol, if applicable;
- b) trade name, type, under which the boiler is sold;
- c) serial number and year of manufacture (the manufacturer is free to use a code);
- d) nominal heat output or heat output range in kW;
- e) permissible operating pressure in bar;
- f) permissible operating temperature in °C.

6.1.2 Requirements of the data plate

The plate shall be durable with regard to material and lettering. The lettering shall be abrasion resistant. Under normal conditions the plate shall not discolour in such a way that the information becomes illegible.

Self-adhesive plates shall not lift off due to humidity or temperature.

7 Technical documentation, scope of supply

7.1 General

The documents listed below shall be available for each boiler in the relevant language. The documents in accordance with 7.2 and 7.3 shall be supplied with every boiler.

7.2 Technical information and installation instructions

These documents shall include at least those details necessary for planning:

- the required draught in mbar;
- gas side resistance and combustion chamber pressure for boilers operating with positive pressure in mbar;
- exit flue gas temperature in °C;
- exit flue gas temperature for the range of output in °C;
- exit flue gas mass flow in kg/s;
- exit flue connection diameter in mm;
- water resistance in mbar;
- maximum heat input in kW;
- nominal heat output or heat output range in kW;
- standby loss;
- gas volume of the boiler in m³;
- range of temperature control in °C;
- fuel type;
- combustion chamber type;
- the combustion chamber dimensions and the combustion chamber volume;
- direct flame operation or flame reversal;
- boiler type: ON/OFF, modulating, multi stage;
- burner matching dimensions.

The installation instructions shall give information on the following:

- assembly of the boiler and if necessary the water pressure test (see 5.2.2 or 5.3.2.2);
- where the temperature beneath the boiler can exceed 50 °C information shall be given on additional insulation required if the floor is of combustible material;
- information on the installation and positioning of probes for control, indication and safety;
- commissioning, including information on the heat input input needed for the required heat output;

A1 — if appropriate, the possible chemical composition of the condensate in the case of low-temperature boilers (pH, heavy metals, etc.). **A1**

In addition reference shall be made to the standards and regulations to be observed in respect of the installation safety equipment.

7.3 Operating instructions

The operating instructions shall contain information on:

- the operating of the boiler;
- cleaning and intervals between cleaning;
- action in case of faults;
- the reasons for maintenance by a competent person and the intervals between maintenance;
- type of fuel;

A1 — if necessary, national regulations regarding the condensate waste disposal. **A1**

Other printed matter (leaflets etc) shall not contain information contradicting the operating instructions.

Annex A (informative)

A-deviations

A-deviation: National deviation due to regulations, the alteration of which is for the time being outside the competence of the CEN/CENELEC member.

This European Standard does not fall under any Directive of the EC. In the relevant CEN/CENELEC countries these A-deviations are valid instead of the provisions of the European Standard until they have been removed.

A.1 Deviation for Sweden

Basically this European Standard is in conflict with the general provisions of the Swedish Ordinance for Pressure Equipment. Materials of the pressure-retaining parts and safety accessories do not fulfil the requirements in Chapter 3, Section 1, in the Ordinance AFS 1994:39.

The design criteria in general and weld joints no. 1.7 and no. 1.8 in particular are not in accordance with Chapter 8, Section 1.

Annex B (informative)

Conformity evaluation

The conformity evaluation of the heating boilers should be carried out if necessary by a third party on the basis of:

- initial type-testing of the product;
- initial inspection of factory and factory production control;
- continuous surveillance, assessment and approval of factory production control.

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