BRITISH STANDARD

BS EN
303-4:1999

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

The European Standard EN 303-4:1999 has the status of a British Standard

ICS 91.140.10

National foreword

This British Standard is the English language version of EN 303-4:1999, *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*, published by the European Committee for Standardization (CEN).

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 under consideration fall within its scope, as BS 779:1989 and BS 855:1990 will not be valid for such heating 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 The scope of BS 779:1989 and BS 855:1990 will be amended to state that they are no longer valid for heating boilers falling within the scope of this standard.

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 European committee any enquiries on the interpretation, or proposals for change, and keep the 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 Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 21 and a back cover.

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EUROPEAN STANDARD

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EUROPÄISCHE NORM

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Descriptors: central heating, boilers, definitions, specifications, equipment specification, materials, steels, cast iron, copper, production control, chemical composition, mechanical properties, welded joints, welding, dimensions, performance evaluation, tests, marking, technical notices

English version

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

Chaudières de chauffage — Partie 4: Chaudières avec brûleurs à air soufflé — Exigences spécifiques pour chaudières avec brûleurs fioul à soufflé avec une puissance utile jusqu'à 70 kW et une pression de service maximale de 3 bar — Terminologie, prescriptions spéciales, essais et marquage

Heizkessel — Teil 4: Heizkessel mit Gebläsebrenner — Spezielle Anforderungen an Heizkessel mit Ölgebläsebrennern mit einer Leistung bis 70 kW und einem maximalen Betriebsdruck von 3 bar — Begriffe, besondere Anforderungen, Prüfung und Kennzeichnung

This European Standard was approved by CEN on 6 June 1998.

CEN

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

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

Ref. No. EN 303-4:1999 E

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 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 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.*

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.

Contents

1 Scope

This standard is applicable to heating boilers with forced draught oil burners up to a nominal heat output of 70 kW. They are operated, either with negative pressure (natural draught boiler) or with positive pressure (pressurized boiler) in the combustion chamber, in accordance with the boiler manufacturer's instructions.

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

The boilers are suitable for open vented systems up to a maximum allowable pressure of 1 bar (class 1 pressure) and open and closed water systems up to a maximum allowable pressure of 3 bar (class 2 pressure).

The boilers are capable of operating with either conventional flues or low level discharge flues as specified by the boiler manufacturer.

The boilers are provided as matched units with factory fitted burners for burning kerosene or gas oil. When using a low level flue gas discharge only kerosene may be used (see annex B).

The requirements of this standard apply to heating boilers which are tested on an authorized test rig in accordance with EN 304 and annex B of this standard.

Boilers in accordance with this standard are designed for the heating of central heating installations in which the heat carrier is water, and the temperature of which is restricted to 95 °C at normal operating conditions. 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).

This standard does not apply to gas boilers with atmospheric burners, boilers for solid fuels, oil or gas fired condensation boilers, boilers with oil vaporization burners and low temperature boilers. For these boilers there are further requirements.

NOTE Low temperature boilers are those operating with a (water) variable temperature up to 40 °C or less, or those which cannot be set at a temperature higher than 55 °C.

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.*

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

EN 304:1992, *Heating boilers — Test code for heating boilers for atomizing oil burners.*

EN 304:1992/prA1, *Heating boilers — Test code for heating boilers for atomizing oil burners.*
(Amendment 1)

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.*
(IEC 335-1:1991, modified)

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

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

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

[prEN 303-1]

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

[prEN 303-1]

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

[prEN 303-1]

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

[prEN 303-1]

3.5

heat output

Q

heat output range

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

[prEN 303-1]

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.

[prEN 303-1]

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

[prEN 303-1]

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

[prEN 303-1]

3.8

boiler efficiency

η_K

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

[prEN 303-1]

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

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

[prEN 303-1]

3.10

gas side resistance

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

[prEN 303-1]

3.11

soundness of combustion system

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

[prEN 303-1]

3.12

exit flue temperature

t_A

is the temperature measured at the flue exit of the boiler

[prEN 303-1]

3.13

flue gas loss

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

[prEN 303-1]

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

[prEN 303-1]

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

[prEN 303-1]

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

[prEN 303-1]

3.17

control thermostat

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

[prEN 303-1]

3.18

safety temperature limiter

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

[prEN 303-1]

3.19

overheat cut-off device

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

3.20

room-sealed boilers

a boiler in which the combustion circuit is substantially sealed with respect to the room in which the appliance is installed

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 (fuel mixed with air) in the combustion chamber and in the flues are prevented;

— 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 **4.1.5.8**); 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 the material specifications in this standard. 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.

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 joint type (generally the symbol for the joint 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 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 welded 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

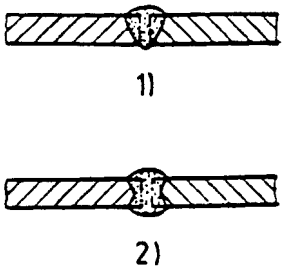
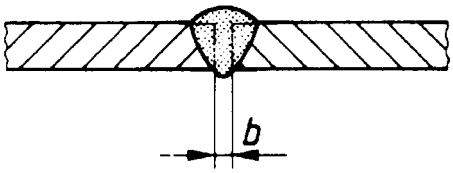
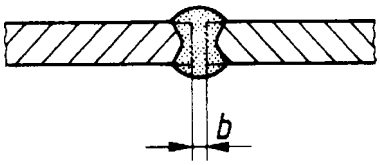
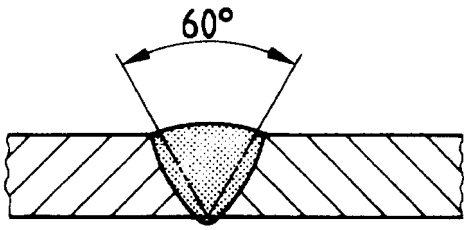
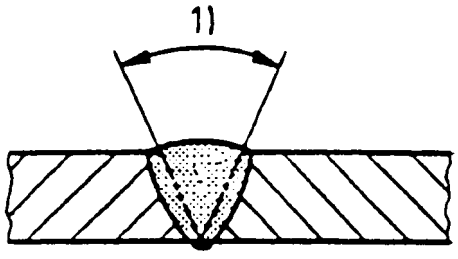
No.	Term	Material thickness t mm	Welding process*)	Remarks
1.1	Square butt weld  1) one side 2) both sides	≤ 6 (8)	135 12 131 (111)	Permissible up to t = 8 mm on use of deep penetration electrodes or welding on both sides
1.2	Square butt weld  	≥ 6 up to 12	12	Root gap 2 mm to 4 mm with stiffener, powder holder necessary
1.3	Square butt weld (double)  	> 8 up to 12	135 12 (111)	Root gap 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)*

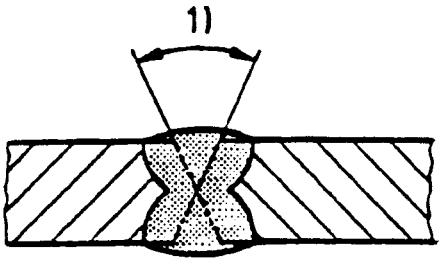
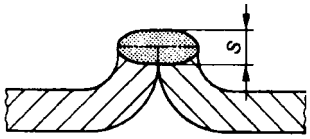
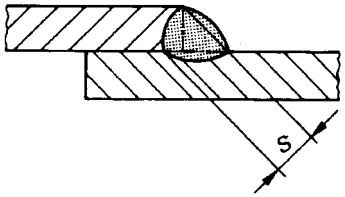
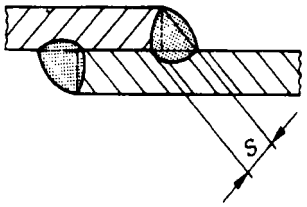
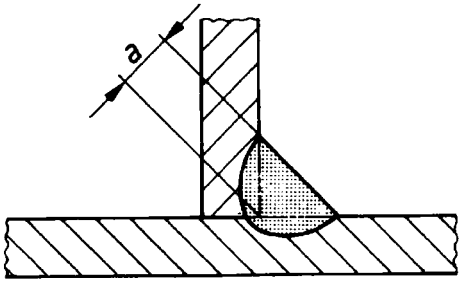
No.	Term	Material thickness t mm	Welding process*)	Remarks
1.6	Double-V butt weld  1) 30° to 50°	greater than 12	135 12	Weld preparation double V-seam 30° to 50° depending on material thickness
1.7	Butt weld between plates with raised edges  	≤ 6	135 141 131 (111)	Only permissible in exceptional cases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

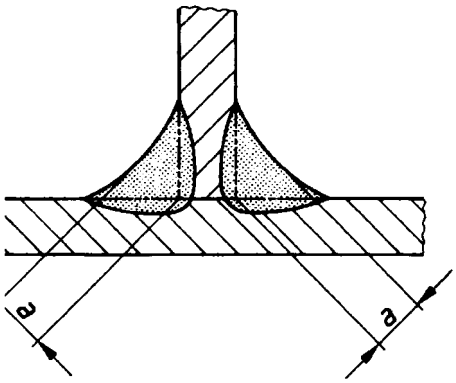
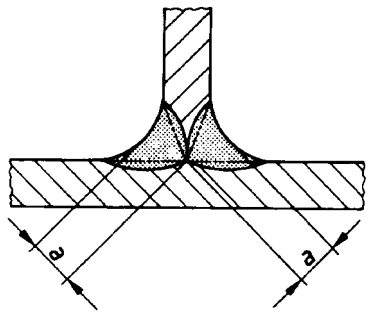
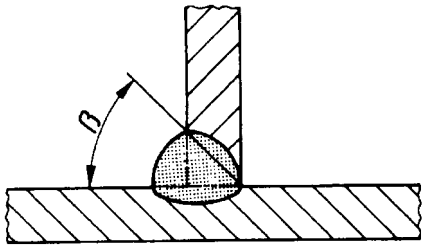
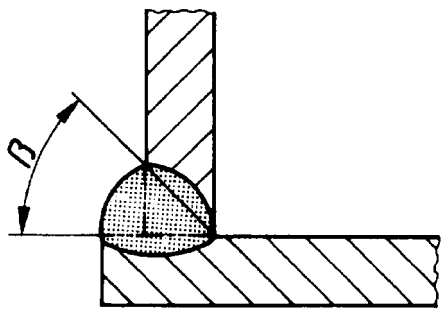
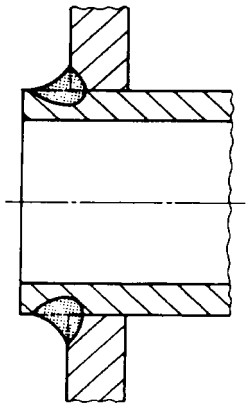
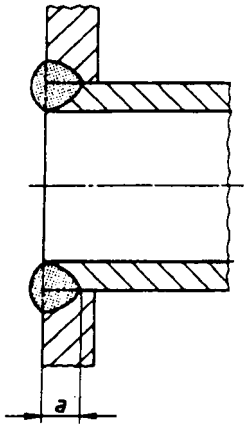
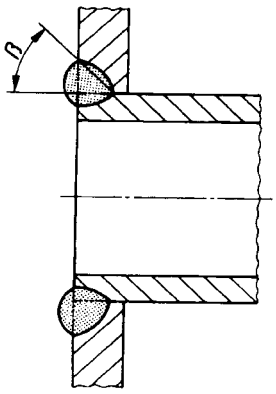
No.	Term	Material thickness t mm	Welding process*)	Remarks
2.1	Double fillet weld 	≤ 12	135 12 (111)	$a = t$
		> 12	135 12 (111)	$a = 2/3t$
2.2	Double-bevel butt weld 	≤ 12	135 12 (111)	$a = t$
		> 12	135 12 (111)	$a = 2/3t$
2.3	Single-bevel butt weld 	≤ 12	135 12 (111)	For (111) $\beta = 60°$
		> 12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

Table 2 — Weld joints and welding processes *(continued)*

No.	Term	Material thickness t mm	Welding process*)	Remarks
2.5		≤ 12	135 (111)	Tube ends shall not project beyond fillet weld if it is subjected to heat radiation
2.6		≤ 6	135 (111)	Welding in of tube under high thermal stress $a \geq t$
2.7			135 (111)	Welding in of tube under high thermal stress For (111) $\beta = 60°$ For 135 $\beta = 45°$ 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 wleding
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 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.

Table 3 — Minimum wall thicknesses

Carbon steels etc.			Copper etc. and corrosion protected steel and stainless steel		
a mm	b mm	c mm	a mm	b mm	c mm
4	3	2,9	2	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. corrrugated) convection heating surfaces outside the combustion chamber.

Column c) For circular tubes which are used in the convection part of the heat exchanger.

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	≥	150 N/mm^2
— Brinell hardness		16B HB to 220 HB 2,5/187,5
Spheroidal graphite iron (ferritically annealed)		
— Tensile strength R_m	≥	400 N/mm^2
— Izod impact	≥	23 J/mm^2

4.1.4.2 *Cast parts of non-ferrous metals subject to pressure*

Table 5 — 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
CuNi30Fe	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 6. 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.

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 6 — 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

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 its and their water spaces can be well 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 *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.

4.1.5.4 *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.

4.1.5.5 *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.

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

4.1.5.6 *Connections for control and indicating equipment, and safety thermostat*

Each boiler shall have connections for the equipment specified in Table 7. 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.

Table 7 — Minimum nominal connection sizes for control and safety equipment

Pockets for temperature control,*)	
Safety temperature limiter,*)	
Thermometer,	
Pressure switch, pressure gauge	G 1/2
Low water cut out device, safety valve	

*) Necessary

4.1.5.7 *Burner matching dimensions*

The burner dimensions shall comply with those shown in EN 226.

4.1.5.8 *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.

4.1.5.9 *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 of 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.

4.1.5.10 *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.

4.1.5.11 *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.

4.1.5.12 *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.

4.1.5.13 *Soundness of the combustion system*

4.1.5.13.1 *Open flued 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.

4.1.5.13.2 *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 nominal heat output.

4.1.5.13.3 *Room sealed boilers*

The leakage rate for the boiler and ducts shall not exceed 5 m^3/h when a pressure of 0,5 mbar is applied. When it is not possible to test the boiler with its ducts assembled, then they shall be tested separately and in this case the leakage rate shall not exceed 3 m^3/h for the boiler and 2 m^3/h for the duct, both at a pressure of 0,5 mbar.

4.1.5.14 *Thermostats and water temperature limiting devices*

4.1.5.14.1 *General*

Boilers shall be fitted with a fixed setting or adjustable control thermostat complying with **4.1.5.14.2**.

In order to avoid the water flow temperature exceeding 110 °C following failure of the control thermostat, boilers shall be fitted with additional temperature limiting devices specified below.

4.1.5.14.1.1 *Boilers intended for central heating systems with either open or sealed expansion vessels (Pressure Class 2)*

a) A limit thermostat complying with **4.1.5.14.3** and an overheat cut-off device complying with **4.1.5.14.4** is required; or

b) a safety temperature limiter complying with **4.1.5.14.5**.

4.1.5.14.1.2 *Boilers only intended for central heating systems with an open expansion vessel (Pressure Class 1)*

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

4.1.5.14.2 *Control thermostat*

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

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

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

4.1.5.14.3 *Limit thermostat (automatic reset)*

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

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

The maximum set point temperature of this device shall not be adjustable.

When the water temperature falls below its set point, the burner may be restarted automatically.

4.1.5.14.4 *Overheat cut-off device*

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

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

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

Interruption of the link between the sensor and the device shall cause safety shutdown.

4.1.5.14.5 *Safety temperature limiter (manual reset)*

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

In addition to the requirements stated in **4.1.5.14.2**, the safety temperature limiter shall cause non-volatile lockout so that the water flow temperature does not exceed 110 °C.

4.1.5.15 *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.

4.1.5.16 *Electrical safety*

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

4.1.5.16.1 *General specifications*

— Type of electrical protection of the boiler (in accordance with EN 60529);

— details on electrical equipment (e.g. switches, relays).

4.1.5.16.2 *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;

— connection terminals for external conductors;

— provision for earthing;

— creepage distances, clearances and distances through insulation;

— safety requirements of the circuit diagram;

— non-interchangeability of plugs.

4.1.5.16.3 *Certificates*

The equipment manufacturer shall provide a detailed certificate of conformity for the following:

— heating;

— operation under overload conditions of appliances with heating elements;

— radio interference suppression (only for units);

— resistance to heat, fire and tracking.

5 Tests

5.1 General

Before the start of production, boilers shall be subjected to the rating test and combustion technology tests. Refer to EN 303-2 for performance requirements and EN 304 for test procedure.

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. Safety precautions shall be carried out when testing boilers.

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

5.2 Classification

Boilers are classified according to their maximum water-side operating pressure.

Pressure class 1 — maximum allowable operating pressure of 1 bar.

These boilers are designed to be installed exclusively with an open expansion vessel and a low head.

Pressure class 2 — maximum allowable operating pressure of 3 bar.

These boilers are designed for open and closed water systems.

5.3 Boilers of mild steel or non-ferrous metals

5.3.1 *Test to be carried out before production*

The type test pressure is $1{,}5p_1$ using water (p_1 is the maximum allowable pressure).

The test period shall be at least 10 minutes and if it is to apply to a range of boilers, the test shall be carried out on at least three 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.

5.3.2 *Testing during production*

For boilers of pressure class 1 each boiler shall be subjected to a test pressure of 1,5 bar.

For boilers of pressure class 2 each boiler shall be subjected to a test pressure of 4,5 bar.

5.4 Boilers of cast iron or non-ferrous metals

5.4.1 *Test to be carried out before production using water*

5.4.1.1 *Burst test on individual sections*

To assess the construction and to prove the design, three of each front, middle and back sections of each boiler type shall be subjected to a burst test before the start of full production; for boilers with a working pressure up to 3 bar the minimum achieved burst pressure shall be $4p_1 + 2$ 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.

5.4.1.2 *Hydraulic 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 hydraulic pressure test with a pressure of $2p_1$, (minimum 6 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 **5.3.1** for details.

5.4.2 ***Test during production***

5.4.2.1 *Cast sections*

Each boiler section shall be subjected to a hydraulic pressure test with a pressure of $2p_1$, (minimum 6 bar).

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 conformity (certification mark) if granted.

5.4.2.2 *Boiler block*

Each boiler shall be subjected to a hydraulic 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 shall occur during the water test.

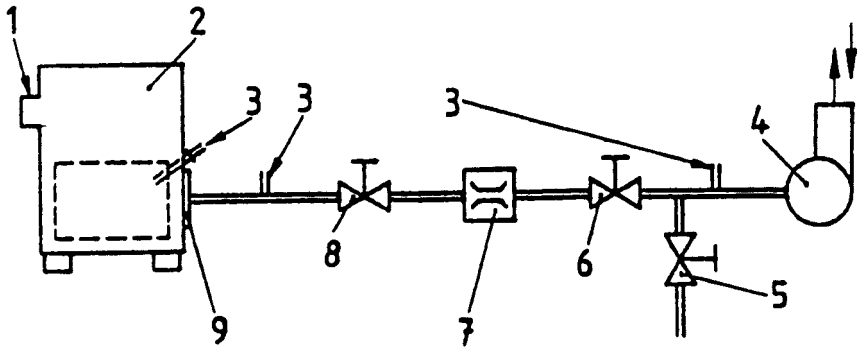
5.5 Test for gas-side soundness

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 1.

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).



1	flue gas outlet	6	valve 2
2	boiler under test	7	flowmeter
3	pressure/draught measuring points	8	valve 1 (regulating)
4	fan	9	burner plate
5	valve 3 (bypass)		

Figure 1 — Measuring point for determination of the gas-side soundness

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, make, 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) maximum allowable pressure in bar;

f) maximum allowable temperature in °C.

6.1.2 *Requirements on 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 and 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;

— 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;

— range of temperature control in °C;

— fuel type;

— boiler type: ON/OFF; modulating.

The installation instructions shall give information on the following:

— assembly of the boiler and if necessary the water pressure test (see **5.3.2** or **5.4.2.2**);

— 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 needed for the required heat output.

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 operation 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.

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

Annex A (normative)
Special requirements for boilers with atomizing oil burners

The performance requirements contained in prEN 303-2 shall be met except where the boiler is used with a low level discharge flue or where a manufacturer specifies the use of kerosene then the following differences shall apply:

— see prEN 303-2:1997, clause **1**:

kerosene fuel shall be used, having a viscosity of 1,3 mm^2/s to 2,9 mm^2/s at 20 °C and a density of 0,77 g/cm^3 to 0,82 g/cm^3 at 15 °C;

— see prEN 303-2:1997, subclause **3.2**:

if the excess air chosen by the manufacturer is different to that shown in Figure 2 of prEN 303-2:1997, it shall be within the tolerance of ±10 % and this value shall be used to determine the thermal efficiency and the flue gas emissions;

— see prEN 303-2:1997, subclause **3.5**:

when the boiler is used with a low level discharge flue, the proportion of unburnt hydrocarbons in the exit flue gas shall not exceed 5 ppm except during the first 10 s of firing.

Annex B (normative)
Test

B.1 Test requirements

The test requirements contained in EN 304:1992/prA1 shall be met except where the boiler is used with a low level discharge flue or where the manufacturer specifies for use with kerosene then the following differences shall apply:

— see EN 304:1992, subclause **4.1**:

the test shall be carried out using commercially available kerosene as selected by the boiler manufacturer. The viscosity of the kerosene shall be 1,3 mm^2/s to 2,9 mm^2/s at 20 °C and a density of 0,77 g/cm^3 to 0,82 g/cm^3 at 15 °C;

— see EN 304:1992, subclause **4.1.2**:

if the NET calorific value is not determined calorimetrically and in the absence of a complete analysis, the value for kerosene can, with sufficient accuracy, be assumed as follows:

H_i = 43,3 MJ/kg

where

C = 0,85 kg/kg (carbon);

H = 0,141 kg/kg (hydrogen);

S = 0,000 4 kg/kg (sulfur);

— see EN 304:1992, subclause **5.4.2.2**;

where the boiler is used with a low level discharge flue, the boiler manufacturer's outlet pressure shall be used;

— fuel - gas oil:

the test shall be carried out using commercially available gas oil as selected by the boiler manufacturer. The viscosity of the gas oil shall be (5,5 ± 0,5) mm^2/s at 20 °C and a density of 0,83 g/cm^3 to 0,86 g/cm^3 at 15 °C.

If the NET calorific value is not determined calorimetrically and in the absence of a complete analysis, the value for gas oil can, with sufficient accuracy, be assumed as follows:

H_i = 42,689 MJ/kg.

where

C = 0,86 kg/kg (carbon);

H = 0,136 kg/kg (hydrogen);

S = 0,000 3 kg/kg (sulfur).

B.2 Test procedure for boilers fitted with a low level discharge flue

The following additional tests shall be carried out on boilers designed for and fitted with a purpose made low level discharge flue.

Kerosene shall be used for low level discharge of combustion gases.

B.2.1 *Test procedure*

The boiler's flue terminal is subjected to a variety of wind tests to determine the effect on combustion. The measurement of the unburnt hydrocarbon in the flue gases indicates the degree of incomplete combustion.

Figure B.1 shows the wind generator arrangement for testing low level discharge flue terminals.

B.2.2 *Measurements*

Horizontal plane.

With wind at 48 km/h, measurements are taken at 15° intervals through an arc of 180°. This is repeated at a wind velocity of 16 km/h.

Vertical plane.

Measurements are taken with the wind at an angle of incidence of 45° at velocities of 48 km/h and 16 km/h.

At the most sensitive location in each of the above conditions, i.e. where the greatest increase in smoke number is measured, the performance of the appliance is noted regarding flame stability, CO_2, CO, unburnt hydrocarbons, smoke and flue gas temperature.

The surface temperature shall be recorded of accessible areas on the flue terminal or guard when this is below 2 m from ground level.

B.2.3 ***Apparatus***

Measuring equipment required for the determination of:

a) smoke number;

b) flue gas composition (CO_2, CO);

c) flue gas temperature in °C;

d) flue draught/pressure in mbar;

e) degree of incomplete combustion (FID);

f) wind velocity in km/h;

g) oil flow rate in l/h;

h) surface temperature in °C.

The following apparatus is also required:

— wind generator and turntable;

— an appropriately sized motor/fan combination with ducting shall be used to act as a wind generator capable of providing a uniform pressure profile over an area of the test wall greater than the size of the exhaust gas terminal under test.

Where the air inlet and exhaust gas outlet are concentric or adjacent, i.e. their centres are not more than 500 mm apart, the uniform pressure profile shall encompass both terminals.

B.2.4 ***Preparation of apparatus***

The uniform pressure profile is checked by blowing the wind at 21 km/h horizontally at right angles onto the test wall at a distance of 1,5 m from the generator exit. Measure, with a sensitive manometer, the pressure differential between the central test point and a number of other test points. This should not exceed $\pm 2{,}5\ N/m^2$ in the area intended for the terminal. In the event of this reading not being obtained, the air stream in the generator should be straightened until the air pressure is within tolerance.

When a uniform pressure has been obtained, insert the terminal through the wall in the manner recommended by the appliance manufacturer.

Pre-firing.

Operate the appliance at rated output for a minimum period of 30 min to achieve stable conditions before carrying out the wind tests.

B.2.5 ***Tests***

With the appliance mounted on the turntable and the wind generator delivering wind at 48 km/h in the horizontal plane, rotate the appliance and take measurements of smoke number at 15° intervals through an arc of 180°.

Reduce the wind velocity to 16 km/h and repeat the procedure.

Apply a wind velocity of 48 km/h in the vertical plane at an angle of 45° as indicated in Figure B.1.

Repeat the procedure at a wind velocity of 16 km/h.

When the worst position of the wind has been identified by the highest smoke number, note the performance of the appliance regarding flame stability, CO, CO_2, smoke number and unburnt hydrocarbons.

B.2.6 ***Combustion requirements***

The following maximum limits shall not be exceeded:

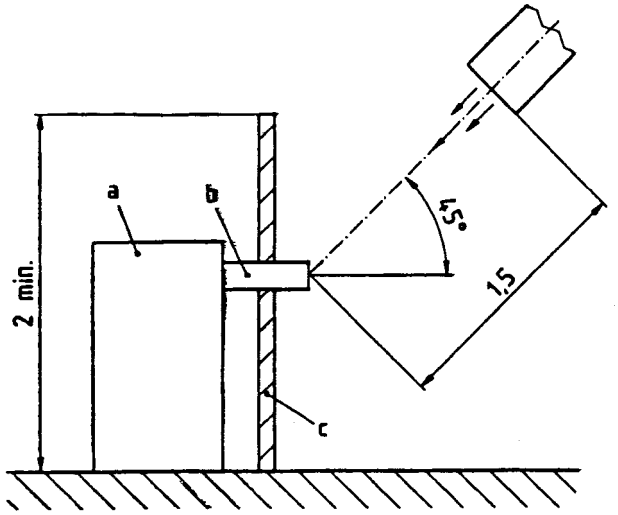
	Maximum limit
a) highest CO %	0,2 %
b) smoke number	2
c) unburnt hydrocarbons under most arduous conditions	Not exceed 5 ppm except during the first 10 s of firing.

B.2.7 ***Terminal guard test***

The terminal guard shall withstand a load of 15,0 kg ± 25 g over a disc of (100 ± 1) mm diameter placed midway between the fixing points for 1 min. No permanent deformation shall be visible.

No opening in the terminal guard shall accept a sphere greater than 16 mm diameter.

The dimensions of the terminal guard, when installed in accordance with the manufacturer's instructions, shall be such that the distance between any part of the guard and the terminal, except the wall plate, exceeds 50 mm. The guard shall not have any sharp edges likely to cause injury.



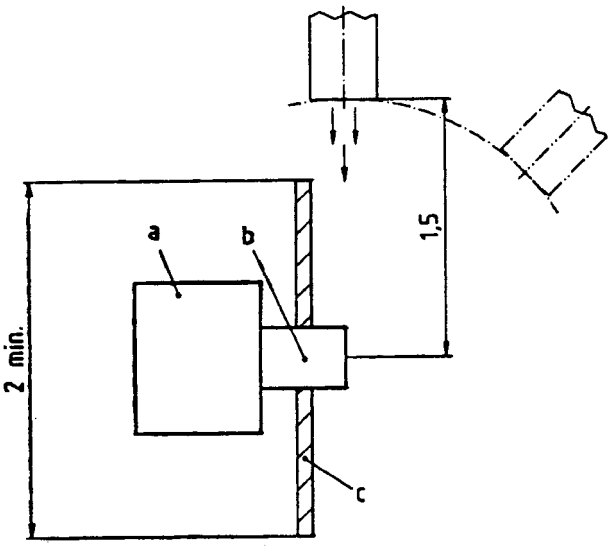
side view

Wind direction in vertical plane

a appliance

b terminal

c test wall



plan view

Wind direction in a horizontal plane. The angle of the wind generator is varied at 15° intervals through an arc of 180°

a appliance

b terminal

c test wall

Figure B.1 — Wind generator arrangement for testing low level discharge flue terminals

Annex C (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.

The requirements of annexes A and B of this European Standard do 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.

C.1 Switzerland

Deviations from the stipulations of annexes A and B

In Switzerland the limit values for emissions of NO_x and CO, the limit values for flue gas losses and standby losses, the information on the rating plate are laid down in the Swiss federal ordinance on Air Pollution Control of 1985-12-16 (as at 1992-01-01) are authoritative.

The tests are performed in accordance with EN 304 and additionally in accordance with the Swiss test code for heating installations (type approval recommendations) of 1994-04-25.

C.2 Germany

Deviations from the stipulations of annexes A and B

In Germany the fuels and the limit values for emissions of NO_x in the 1. BImSchV of 1988-07-15 (with Änderungsverordnung of 1994-7-20 and 1996-08-07) paragraph 3 and paragraph 7, subclause 2 apply.

Therefore only fuels appropriate to 1.BImSchV, paragraph 3 are permissible.

Oilfiring systems with a nominal heat input up to 120 kW - build up after 1st January 1998 - shall only operate if the manufacturer confirms by a test certificate that the boiler-/burner-unit, boilers and burners not exceed a NO_x-value of 120 mg/kWh using fuel EL (measured as NO_2) tested in accordance with Anlage IIIa, No 2.

C.3 Austria

Deviations from the stipulations of annexes A and B

EN 303-4 conflicts with the Austrian law (Art. 15 a Vereinbarung über Schutzmaßnahmen betreffend Kleinfeuerungsanlagen). Austria will have stricter emission limits at nominal heat output and minimum partial load of the heat output range.

Nominal heat output kW	**Emission limits in** mg/MJ		
	CO	**NO_x**	**OGC**
≤ 350	20	35	6
Smoke number = 1 OGC: organic combined carbon			

C.4 Sweden

Basically this European Standard is in conflict with the general provisions of the Swedish Ordinance for Pressure Equipments. 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.

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