BS EN 303-5:2012

BSI Standards Publication

Heating boilers

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

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National foreword

This British Standard is the UK implementation of EN 303-5:2012. It supersedes BS EN 303-5:1999 which is withdrawn.

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

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

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

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

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

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

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

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (EN 303-5:2012) has been prepared by Technical Committee /TC 57 “Heating boilers”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2012, and conflicting national standards shall be withdrawn at the latest by December 2012.

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

This document supersedes EN 303-5:1999.

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

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

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

a) the scope was extended to a nominal heat output of the heating boilers for ≤ 500 kW;

b) usable fuel to non-wood biomass and further solid fuels were extended;

c) requirements for materials, weld joints and wall thicknesses were revised;

d) risk analysis was implemented;

e) general and electrical safety requirements were revised;

f) emission class 1 and 2 were deleted and new emission class 4 and 5 were added;

g) tests were revised and new tests for safety requirements were added;

h) Annexes were re-structured;

i) Consideration was given to the essential requirements of the Machinery Directive 2006/42/EC.

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

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

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

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

— EN 303-4, *Heating boilers — Part 4: Heating boilers with forced draught burners — Special requirements for boilers with forced draught oil burners with outputs up to 70 kW and a maximum operating pressure of 3 bar — Terminology, special requirements, testing and marking*

— EN 303-5, *Heating boilers — Part 5: Heating boilers for solid fuels, manually and automatically stoked, nominal heat output of up to 500 kW — Terminology, requirements, testing and marking*

— EN 303-6, *Heating boilers — Part 6: Heating boilers with forced draught burners — Specific requirements for the domestic hot water operation of combination boilers with atomizing oil burners of nominal heat input not exceeding 70 kW*

— EN 303-7, *Heating boilers — Part 7: Gas-fired central heating boilers equipped with a forced draught burner of nominal heat output not exceeding 1 000 kW*

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

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

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

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

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

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

1 Scope

1.1 General

This European Standard applies to heating boilers including safety devices up to a nominal heat output of 500 kW which are designed for the burning of solid fuels only and are operated according to the instructions of the boiler manufacturer.

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

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

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

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

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

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

This European Standard does not apply to:

— heating boilers and other heating appliances which are also designed for the direct heating of the place of installation;

— cooking appliances;

— the design and construction of external fuel storage and transportation devices prior to the safety devices of the boiler;

— room sealed applications;

— condensing boilers.

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

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

1.2 Fuels

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

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

1.2.1 Biogenic fuels

Biomass in a natural state, in the form of:

— **A** log wood with moisture content w ≤ 25 %, according to EN 14961-5;

— **B1** chipped wood (wood chipped by machine, usually up to a maximum length of 15 cm) with moisture content from w 15 % to w 35 %, according to EN 14961-4;

— **B2** chipped wood as under B1, except with moisture content w > 35 %;

— **C1** compressed wood (e.g. pellets without additives, made of wood and/or bark particles; natural binding agents such as molasses, vegetable paraffins and starch are permitted), pellets according to EN 14961-2;

— **C2** compressed wood (e.g. briquettes without additives, made of wood and/or bark particles; natural binding agents such as molasses, vegetable paraffins and starch are permitted), briquettes according to EN 14961-3;

— **D** sawdust with moisture content w ≤ 50 %;

— **E** non-woody biomass, such as straw, miscanthus, reeds, kernels and grains according to EN 14961-6.

1.2.2 Fossil fuels

— **a** bituminous coal;

— **b** brown coal;

— **c** coke;

— **d** anthracite.

1.2.3 Other solid fuels

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

2 Normative references

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

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

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

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

EN 1561, *Founding — Grey cast irons*

EN 1563, *Founding — Spheroidal graphite cast irons*

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

EN 14778, *Solid biofuels — Sampling*

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

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

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

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

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

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

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

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

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

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

EN 60335-2-102:2006, *Household and similar electrical appliances — Safety — Part 2-102: Particular requirements for gas, oil and solid-fuel burning appliances having electrical connections (IEC 60335-2-102:2004, modified)*

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3 Terms and definitions

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

3.1
maximum allowable operating pressure
highest pressure at which the boiler can be operated safely

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

3.2
test pressure
pressure to which all boilers and their parts are subjected during production at the manufacturers plant or during setting up by the installer

3.3
type test pressure
pressure to which the heating boilers and their parts are first subjected before the start of mass production at the manufacturing plant

3.4
maximum allowable temperature
maximum allowable water temperature of the heating boiler limited by safety devices

3.5
operating temperature
temperature range at which the boiler can be operated under normal operating conditions, according to the setting on the boiler water temperature controller and the manufacturer's specifications

3.6
heat output
Q
usable heat to water output delivered by a boiler per unit time in accordance with the requirements of this European Standard

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

3.7
nominal heat output
Q_N
maximum continuous heat output specified by the manufacturer for a specific fuel in accordance with the requirements of this European Standard

3.8
minimum heat output
Q_{min}
minimum heat output which is maintained automatically by the control device specified by the manufacturer for each type of fuel in accordance with the requirements of this European Standard

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

3.9
minimum continuous heat output
Q_{minC}
minimum continuous heat output which is maintained automatically by the control device specified by the manufacturer for each type of fuel in accordance with the requirements of this European Standard

3.10
heat output range
range of output between minimum and nominal to which the boiler can be adjusted and meets the requirements of this European Standard

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

3.11
partial load
T
quotient of heat output in the heat output range over the nominal heat output, expressed in percentage

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

3.12
partial load operation
operating condition/state of the boiler where the heat output is less than the nominal heat output and which is reached using an automatic control device

3.13
intermittent operation
operating condition/state in which boiler heat output is controlled by the automatic connecting and disconnecting of the combustion air and/or fuel supply

3.14
heat input
Q_B
amount of heat in unit time which is supplied to the furnace of the heating boiler by the fuel based on its net calorific value H_i

3.15
boiler efficiency
η_K
ratio of the delivered useful heat output to the heat input, expressed in percentage

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

3.16
draught
pressure differential between the static air pressure in the place of installation and the static pressure of the exhaust gases (flue gas measuring section)

3.17
gas side resistance
difference in pressure that exists between the combustion chamber and the flue gas outlet of the boiler (flue gas measuring section)

3.18
gas side tightness
tightness of the hopper, combustion chamber, flueways and the boiler sections traversed by the flue gas in relation to the place of installation

3.19
exit flue temperature
temperature measured at the flue exit of the boiler (flue gas measuring section)

3.20
water side resistance
pressure loss in the boiler measured at the flow and return connections of the boiler, with a volume flow corresponding to the nominal heat output

3.21
temperature controller
device which detects and regulates the water flow temperature in the boiler

3.22
safety temperature limiter
STB
thermal cut out, protective control for heat generating systems which can only be reset manually or by a tool and which provides at least the following actions: type 2B, type 2K, type 2P and type 2V and optionally any of the following actions: type 2F and type 2N

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

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

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

3.23
safety heat exchanger
safety device for dissipating excess heat from the boiler to limit the boiler temperature to a specified maximum

3.24
thermal discharge safety device
STW
safety temperature limiter automatic reset (STW) used as a thermal bypass protection for solid fuel heat generating systems, which senses the heated media temperature and operates to cause energy to be carried off by opening a regulating unit, e.g. a valve

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

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

3.25
test fuel
fuel of commercial quality used for testing heating boilers and characteristic of the type of fuel specified by the boiler manufacturer

3.26
stoking device
device for feeding the fuel to the combustion chamber, which includes a safety device between stoking device and fuel line or an integral hopper

3.27
stoking by hand
fuel supplied by hand at intervals, depending on the burning rate or heat output

3.28
automatic stoking
fuel supplied automatically, according to thermal output

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

3.29
combustion period
necessary time taken by manual stoked boilers to burn the maximum fuel charge until the basic fire bed level specified by the manufacturer is reached again

3.30
nominal combustion period
T_B
combustion period at a nominal heat output

3.31
bypass device
device which, in the open position, allows combustion gases to pass directly to the exhaust stack

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

3.32
integral fuel hopper
fuel hopper linked to the automatically stoked heating boiler

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

3.33
fuel chamber
part of a heating boiler stoked by hand supplying fuel for combustion without a connecting fuel line to an external fuel storage

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

3.34
combustion chamber
boiler part for thermal preparation and/or burning of fuel

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

3.35
exhaust gas cleaning equipment
techniques used for reducing air pollutants contained in the exhaust gas

3.36
ash chamber
part of the boiler used for keeping combustion residues (ash/clinker)

3.37
accumulator storage tank
container which stores excess heat (resulting from the difference between the boiler heat output and the actual heat load to the heating system)

3.38
rapidly disconnectable firing system
firing system by which, in all instances of operation and malfunction (e.g. such as power failures or sudden absence of heat reduction), the generation of heat can be interrupted so rapidly that hazardous operating states cannot occur either on the water side or on the firing side

3.39
hazardous operating state
rise of the boiler temperature above 110 °C or, an accumulation of ignitable gases or gas mixtures (CO > volume fraction of 5 %) in the combustion chamber and/or in the flue gas passages of the boiler, a possible overheating of components, the escape of fire or gases into the place of installation and a back burning in the fuel supply

3.40
partly disconnectable firing system
firing system where a part of the heat output can be briefly interrupted by the action of control and safety devices without causing hazardous operating states on the firing side

3.41
residual heat output
remaining portion of heat output that is still transferred from the firing side to the water side after the control shut down or safety shut down of the boiler

3.42
ignition unit
device used to ignite the fuel in the combustion chamber

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

3.43
back burning
state in which the fuel ignites in direction to the fuel line and the burning spreads to the fuel storage or the integral hopper

Note 1 to entry: Back burning can be caused by three driving forces:
a) fuel ignition in direction to the fuel line or the integral hopper;
b) spreading and ignition of hot and ignitable gases into the fuel line or the integral hopper;
c) thermal conduction to the fuel line or the integral hopper.

3.44
back burning safety device
one or more self-acting certificated device to avoid a back burning, including extinguishing installations

3.45
extinguishing installation
device for the self-acting extinguishing of a back burn into the stoking device, fuel line or integral hopper

3.46
feeding direction
direction the fuel follows when transported to the combustion chamber (either horizontally inclined/declined)

3.47
dust
particles, of any shape, structure or density, dispersed in the gas phase at the sampling point conditions which may be collected by filtration under specified conditions after representative sampling of the gas to be analysed, and which remain upstream of the filter and on the filter after drying under specified conditions

3.48
control shut-down
process by which the fuel supply and/or combustion air supply is stopped as a result of a control function

3.49
safety shut-down
process by which the fuel supply and/or combustion air supply is stopped immediately as a response of a safety device or the detection of a fault in a safety device

3.50
non-volatile lock out
safety shut-down condition of a boiler, such that a restart can only be accomplished by a manual reset and by no other means

3.51
stand-by operation
operating mode without any heat demand, whereby the system immediately starts up in the required mode as soon as there is be a heat demand

4 Requirements

4.1 General requirements

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

a) they can withstand stresses arising during normal operation;

b) the heat carrier (water) does not become heated to a dangerous extent (≤ 110 °C);

c) gases do not leak from the boiler or the stoking device or from an integrated hopper in dangerous quantities into the place of installation or into the fuel line;

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

d) flames do not flare out and embers do not fall out when the boiler is operated correctly;

e) dangerous accumulations of combustible gases (> 5 % CO) in the combustion chamber and in the flues are prevented.

For the evaluation of the hazardous situation, the CO-concentration in the flue gas measuring section should not exceed the critical values for a time period greater than 1 min.

Combustible materials shall be allowed for the following:

f) internal components of controls and safety equipment;

g) operating handles;

h) electrical equipment;

i) components of accessory (e.g. burner cover);

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

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

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

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

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

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

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

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

4.2 Construction requirements

4.2.1 Production documentation

4.2.1.1 Drawings

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

a) the specification of the material;

b) the welding process, the seam type (generally the symbol for the seam type is sufficient) and the welding fillers;

c) the maximum allowable operating temperature, in °C;

d) the maximum allowable operating pressure, in bar;

e) the type test pressure, in bar;

f) the nominal heat output or the heat output range for every boiler size, in kW, in accordance with the fuel(s) recommended for use in the boiler.

4.2.1.2 Manufacturing controls

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

The manual shall:

1) describe the inspection system;

2) specify the person responsible for quality assurance;

3) specify the necessary inspections and tests as well as the pertinent limit values and

4) lay down the requisite measuring and testing equipment and their inspection.

4.2.2 Heating boilers made of steel and non-ferrous materials

4.2.2.1 Execution of welding work

Boiler manufacturers who carry out welding work shall meet the requirements of EN 287-1 and EN ISO 9606-2 as follows:

— only welders who are qualified in the welding of the materials to be processed shall be used;

— equipment shall be available to allow defect-free welding to be carried out;

— supervision of the welding shall be carried out by staff qualified in welding (at least one supervisor shall be qualified).

4.2.2.2 Welding seams and welding fillers

The materials shall be suitable for welding.

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

The welded seams shall not show any cracks or lack of fusion and shall be defect free over the whole cross-section for butt welds. One-sided fillet welds, and half Y-welds which have been welded through, shall be kept substantially free from bending stresses. Smoke tubes, inserted stays and similar components need not be counter welded.

Double fillet welds are only permissible when sufficiently cooled. Projections into the flue gas side in areas of high thermal stresses shall be avoided.

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

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

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

Welding fillers shall be suitable for the material being used.

NOTE 2 The terms given in Table 2 are in accordance with EN 22553; the reference numbers of welding processes are in accordance with ISO 857-1, ISO 857-2 and EN ISO 4063.

4.2.2.3 Parts of steel subject to pressure

The steels listed in Table 1 shall be used.

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

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

Table 1 — Materials

References	Material type	Material numbers (in accordance with EN 10027-2)
EN 10025-1	E235	1.0308
	S235JR	1.0037
	S235JRG2	1.0038
	S235J0	1.0114
	S235J2G3	1.0116
	S275JR	1.0044
	S275J0	1.0143
	S275J2G3	1.0144
	S355J2H	1.0576
	S355JR	1.0045
	S355J0	1.0553
	S355J2G3	1.0570
	S355K2G3	1.0595
EN 10216-1	P195TR1	1.0107
	P235TR1	1.0254
	P235GH	1.0345
EN 10028-2	P265GH	1.0425
EN 10028-3	P355NL1	1.0566
	P295GH	1.0481
	P355GH	1.0473
	16Mo3	1.5415
	15NiCuMoNb5-6-4	1.6368
	13CrMo4-5	1.7335
	10CrMo9-10	1.7380
	11CrMo9-10	1.7383
EN 10120	P245NB	1.0111
	P265NB	1.0423
	P310NB	1.0437
	P355NB	1.0557
EN 10088-2	X5CrNi18-10	1.4301
	X5CrNi17-12-2	1.4401
	X2CrNiM017-13-2	1.4404
	X6CrNiTi18-10	1.4541
	X6CrNiNb18-10	1.4550
	X2 CrMnNiN 22-5-2	1.4162
	X2 CrNiN 23-4	1.4362
	X2 CrNiMoN 22-5-3	1.4462
	X1 NiCrMoCuN 25-20-7	1.4529
	X1 NiCrMoCu 25-20-5	1.4539
	X6CrNiMoTi17-12-2	1.4571
	X6CrNiMoNb17-12-2	1.4580
	X3CrNiMo17-3-3	1.4436
EN 10222-2	P245GH	1.0352

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

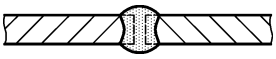
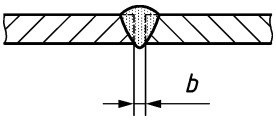
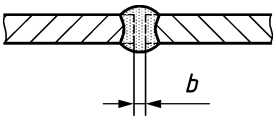
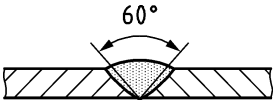
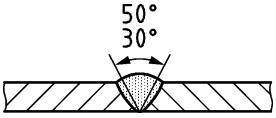
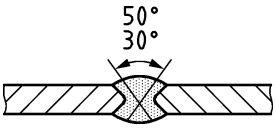
No.	Term	Material thickness (mm)	Welding process [a]	Remarks
1.1	Square butt weld  both sides: 	≤ 6 (8)	135 12 131 (111)	Permissible up to t = 8 mm on use of deep penetration electrodes or welding on both sides
1.2	Square butt weld 	≥ 6 up to 12	12	Root gap b = 2 mm to 4 mm with stiffener, power holder necessary
1.3	Square butt weld (double) 	> 8 up to 12	135 12 (111)	Root gap b = 2 mm to 4 mm Deep penetration electrodes shall be used for manual electro welding
1.4	Single-V butt weld 	up to 12	(111)	Weld preparation *V*-seam 60°
1.5	Single-V butt weld 	up to 12	135 12	Weld preparation *V*-seam 30° to 50° depending on thickness of material
1.6	Double-V butt weld 	greater than 12	135 12	Weld preparation double *V*-seam 30° to 50° depending on material thickness

Table 2 *(2 of 3)*

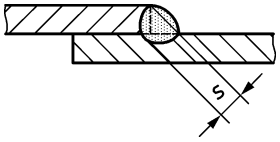
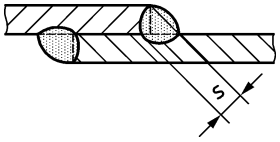
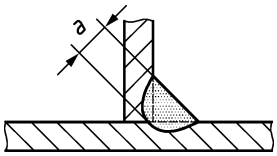
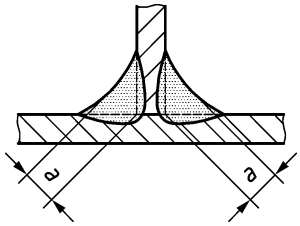
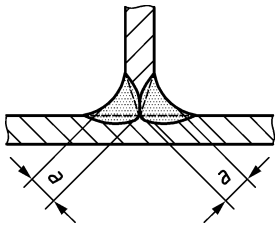
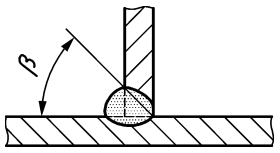
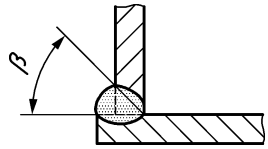
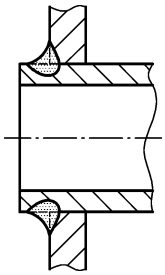
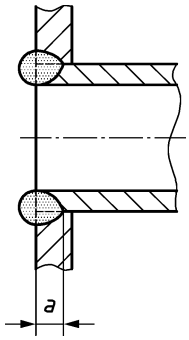
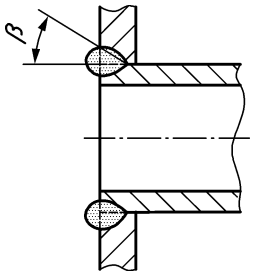
1.7	Overlap welding 	≤ 6	135 12	Welds of this type are to be kept largely free from bending stresses. Not suitable for directly fired wall parts $s = t$
1.8	Overlap welding (continued) 	≤ 6	135 12 (111)	Not suitable for directly fired wall parts $s = t$
2	Fillet weld 	≤ 6	135 12 (111)	Welds of this type are to be kept largely free from bending stresses $a = t$
2.1	Double fillet weld 	≤ 12 >12	135 12 (111) 135 12 (111)	$a = t$ a = 2/3 t
2.2	Double-bevel butt weld 	≤ 12 >12	135 12 (111) 135 12 (111)	$a = t$ a = 2/3 t
2.3	Single-bevel butt weld 	≤ 12 > 12	135 12 (111) 135 12	For (111) $\beta = 60°$ For 135,12 $\beta = 40°$ to $50°$

Table 2 *(3 of 3)*

2.4	Single-bevel butt weld 	≤ 12	135 12 (111)	For (111) β = 60° For 135,12 β = 40° to 50°
2.5		≤ 12	135 (111)	Tube end shall not project beyond fillet weld if it is subjected to heat radiation
2.6		≤ 6	135 (111)	Welding in of tube under high thermal stress $a \geq t$
2.7			135 (111)	Welding in of tube under high thermal stress For (111) β = 60° For 135 β = 40° to 50°

[a] Reference numbers of welding processes are in accordance with ISO 857-1, ISO 857-2 or EN ISO 4063.

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

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

4.2.2.4 Minimum wall thicknesses

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

a) the maximum allowable operating pressure;

b) the nominal heat output; and

c) the material properties.

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

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

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

Table 3 — Minimum wall thicknesses

Nominal heat output	Carbon steels					Stainless and corrosion protected steels				
	a	b	c	d	e	a	b	c	d	e
kW	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
$Q_N \leq 100$	5	4	3,2	3	4	3	2	1,5	2	3
$100 < Q_N \leq 300$	5	4	3,2	4	4	3	2	1,5	2	3
$300 < Q_N \leq 500$	6	5	3,2	4	4	4	2	1,5	2	3

Column a: for walls of the filling and combustion chamber in contact with fire and water
Column b: for walls of the convection heating surfaces outside the combustion chamber (except circular tubes)
Column c: for circular tubes in the convection heating surface area outside the combustion chamber
Column d: for walls which are only in contact with water
Column e: for water cooled grate tubes

4.2.3 Boilers made of cast materials

4.2.3.1 General

The manufacturer shall have personnel and equipment capable of carrying out the necessary material tests. During the manufacture of the boiler and other cast iron parts subject to pressure, the following tests shall be carried out using separate cast test pieces for each batch:

1) tensile test in accordance with EN 1561 and EN 1563; the values given in Table 4 are to be confirmed by the tensile test;

2) chemical analysis (C, Si, Mn, P, S);

3) brinell hardness test in accordance with EN ISO 6506-1;

4) izod impact (for graphite iron).

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

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

4.2.3.2 Cast iron parts subject to pressure

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

Table 4 — Minimum mechanical requirements for cast irons

Grey cast iron (in accordance with EN 1561)	
- Tensile strength R_m	≥ 150 N/mm^2
- Brinell hardness	160 HB to 220 HB
Spheroidal graphite cast iron (in accordance with EN 1563)	
- Tensile strength R_m	≥ 400 N/mm^2
- Izod impact	≥ 23 J/cm^2

4.2.3.3 Minimum wall thicknesses

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

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

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

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

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

4.2.4 Design requirements

4.2.4.1 Venting of the water sections

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

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

NOTE Boiling can be detected by boiling noise.

4.2.4.2 Cleaning of heating surfaces

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

4.2.4.3 Inspection of the flame

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

NOTE The facility of an inspection window is recommended.

4.2.4.4 Water tightness

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

4.2.4.5 Replacement parts

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

4.2.4.6 Boiler shell tappings

Boiler shell tappings shall comply with EN 10226-1, ISO 7-2, EN ISO 228-1, EN ISO 228-2; flange connections shall comply with ISO 7005-1, ISO 7005-2 and ISO 7005-3. The arrangement of the tappings shall be such that they are easily accessible and the function of each respective connection can be adequately fulfilled. There shall be sufficient space around the connection to allow the installation of the connecting pipes (flanges, bolts) with the necessary tools.

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

The minimum size for flow outlet shall be DN 20.

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

— G 1/2 for nominal heat outputs up to 70 kW;

— G 3/4 for nominal heat outputs above 70 kW.

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

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

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

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

The immersion pockets shall be designed so that an unintended change of position of the temperature sensor is avoided.

The position of the immersion pocket shall be chosen in such a way that the highest temperature of the boiler water is recorded with sufficient accuracy. Where additional connections for safety devices such as a pressure detector, manometer, low water cut-out device or a safety valve are provided, then their size (especially the size of the safety valve), shall be determined according to the output of the boiler.

NOTE For further information on safety valves, see EN 12828.

4.2.4.8 Thermal insulation

All boilers shall be fitted with thermal insulation. The thermal insulation shall withstand normal thermal and mechanical stresses. It shall be made of non-combustible material and shall not give off fumes during normal running.

4.2.4.9 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 and shall correspond to the values indicated by the manufacturer.

4.2.4.10 Integral fuel hopper

A boiler with integral fuel hopper shall be made of fire resistant material according to EN 13501-2. The volume shall be limited to a maximum of 1,5 m^3. The hopper shall be designed in such a way that the fuel moves freely until the hopper is empty.

4.2.4.11 Fuel chamber

The fuel chamber shall be designed in such a way that the fuel moves freely and the duration of the combustion period is assured.

4.2.4.12 Ash chamber

The capacity of the ash chamber shall be adequate for a combustion period of at least 12 h using the stipulated fuel at nominal heat output. It shall be designed to ensure the unobstructed flow of combustion air under the grate.

If the system is designed with devices for automatic ash and clinker removal, the above requirement shall be considered as met.

4.3 Safety requirements

4.3.1 General

Potential hazards caused by the boiler, including the operation of the firing system and any stoking device, shall be avoided by either constructional means or by the use of safety devices. Safety shall be maintained in the event of possible failures in the safety device itself.

The manufacturer shall undertake a risk assessment covering all potential hazards of the boiler and the measures how to avoid or control them in a safety concept. Control functions within the safety concept shall be classified and realized accordingly. The risk assessment shall be performed according to EN ISO 12100 with particular emphasis on the type of the boiler and the fuel fired.

Control functions are classified as follows.

Class A: Control functions which are not intended to be relied upon for the safety of the application.

Class B: Control functions which are intended to prevent an unsafe state of the appliance. Failure of the control function will not lead directly to a hazardous situation. For devices used in a class B control function, a single fault assessment of the device including use of software class B according to EN 60730-1 is required.

Class C: Control functions which are intended to prevent special hazards such as explosion or whose failure could directly cause a hazard in the appliance. For devices used in a class C control function, a second fault assessment of the device including use of software class C according to EN 60730-1 is required.

In case of safety routines realised in a programmable logic control the software shall meet the requirements of the appropriate software class B or C (including fault assessment according to EN 60730-2-5 in connection with EN 60730-1).

This risk assessment shall cover at least the following:

— elements given in 4.3.4 to 4.3.9;

— boiler functions, including start-up, purge, ignition, flame supervision, flue gas flow, control of heat demand and combustion control.

In the risk assessment, one of the above mentioned classifications of the control function shall be allocated to any identified hazard.

The actuation of any control function class B or class C shall at least result in cutting off the fuel feed.

4.3.2 Manual stoking

Boilers with manual stoking shall be designed in such a way that, when the boiler is operated in accordance with the boiler manufacturer’s operating instructions, the operator does not run the risk of a hazardous operation mode. Such a mode might result in an injury when opening the fuel chamber door or the combustion chamber (e.g. by ignition of gases).

4.3.3 Safety against back burning for automatic stoked boilers

4.3.3.1 General

Automatic stoking systems shall be designed to prevent back burning.

The hazard of back burning is classified as a risk corresponding to safety level C in accordance with 4.3.1 and is related to the driving forces thermal conductance, backflow of ignitable gases and fire propagation

backwards (see 4.3.3.2, 4.3.3.3 and 4.3.3.4). Back burning shall be avoided by constructional means and the implementation of one or more back burn safety devices.

NOTE The handling of the risk for back burning at safety level C includes the specification that sufficient safety measures need to be available.

Adequate constructional means or safety devices shall:

a) work always in the closed circuit current principle;

b) avoid a back burning in the state of loss of power supply;

c) avoid a back burning in the state of failure of stoking device or interruption of stoking device.

In order to ensure that safety against back burning is adequately addressed, a risk assessment shall be undertaken. This assessment shall document the means employed to avoid the three driving forces for back burning and how they match the tested boiler. The documentation of the means employed shall include the specification of any chosen safety device.

At least one of the safety systems shall continue to provide protection in the event of interruption of the fuel feed (e.g. blockage of the feed screw).

The following mechanisms shall be avoided:

d) Thermal conductance (4.3.3.2);

e) Back flow of ignitable combustion gases (4.3.3.3);

f) Fire propagation into fuel line (4.3.3.4).

4.3.3.2 Thermal conductance

The surface temperature of the stoking device of the boiler (without insulation) or integrated hopper shall not exceed 85 °C in any operating state or in case of a failure. If this criterion is fulfilled by constructional means, no additional safety device is necessary.

Thermal conductance shall be verified during the tests specified in 5.7 (thermal performance for nominal load and partial load), 5.13 to 5.16 and after the stopping of the stoking device of the boiler, with a permanent temperature measurement until a maximum is reached. For further information on verification of this requirement, see 5.16.4.

Accepted solutions to prevent overheating in the stoking device due to thermal conductance are:

— an extinguishing device e.g. water sprinkler system and a safety temperature limiter adjusted to a maximum of 95 °C;

— an emergency discharge device emptying the stoking device without overfilling the boiler; which is reacting below 95 °C (alternatively 20 K increase to standard operation conditions);

— a stoking device which is cooled by a water circuit and the temperature of the water is limited by a cut out (e.g. water circuit is part of boiler circuit).

Accepted solutions to prevent overheating in the integrated hopper due to thermal conductance in combination with accepted solutions for stoking devices are:

— an extinguishing device directly in the hopper e.g. water sprinkler system and an STB adjusted to a maximum of 95 °C;

— sufficient insulation of the hopper from hot parts of the boiler;

— naturally ventilated space between hopper and boiler body (separate casing).

Criteria to verify the design of accepted solutions are listed in Table B.1.

No test needs to be performed according to 5.16.4 if the chosen design is an accepted solution and the risk assessment proves the suitability for the boiler burner unit and the control algorithm interaction. If the risk assessment fails, further tests shall be required.

4.3.3.3 Back flow of ignitable combustion gases into the fuel line or integral hoppers

No significant flow of combustion gases in an ignitable concentration or carrying a critical amount of energy to ignite wood (e.g. sparks or hot gases) shall pass the constructional means or safety device(s) into the fuel line or into the hopper. Due to other safety reasons (for example to hinder poisoning by CO), any back flow of combustion gases shall be avoided (see 4.1).

NOTE 1 Indications for significant back flow might include:
a) a temperature rise of more than 20 K compared to operation without back flow;
b) CO concentration of more than 1 vol. % CO (dry) in the fuel line caused by any operational status or failure;
c) accumulation of smoke in an integrated hopper.

This requirement applies during the tests according to 5.7 (thermal performance for nominal load and partial load including ignition, start up, continuous operation and shut down) and 5.13 to 5.16.

Accepted solutions to prevent back flow in the fuel line are listed as follows.

— Safety device to maintain a continuous seal between the stoking device and the fuel line, e.g. cell feeder.

— Safety device to seal the fuel line not during fuel supply but during all other phases of operation (e.g. lid) in combination with a boiler operating with a negative pressure (tightness requirements in closed state identical to continuously sealing safety devices).

— Tight fuel hopper lid in combination with pressure equalization that works during normal operation and in case of start up, shut down or power loss. Diffusion of hot gasses into the hopper shall be avoided by a connection for pressure equalization between the combustion air supply and the fuel hopper. The dimension of the connection shall only be sufficient to equalize pressure, not to accelerate fire propagation. Hopper lid shall be fitted with an interlock switch (according to H27 of EN 60730-2-5) which stops combustion air supply in case of an open lid.

— Tight fuel hopper lid in combination with negative pressure operation of the boiler. Diffusion of hot gasses into the hopper shall be avoided by natural draught (e.g. inclined auger). The hopper lid shall be fitted with an interlock switch (according to H27 of EN 60730-2-5) which stops combustion air supply in case of an open lid.

— Use of directed flow to create stable pressure conditions, e.g. injector, safety device to control fan rotation of supply fan or relevant pressure, which closes the fuel supply in case of failure.

NOTE 2 Other solutions include the use of a flue gas fan to assure negative pressure condition in the boiler compared to pressure in the fuel line or hopper. The flue gas fan operation is controlled by a safety device for rotation or for pressure in combination with an additional safety device that prevents back flow in case fan failure or power loss.

Criteria to verify the design of accepted solutions are listed in Table B.1.

No test needs to be performed according to 5.16.4 if the chosen design is an accepted solution and the risk assessment proves the suitability for the boiler burner unit and the control algorithm interaction. If the risk assessment fails, further tests shall be required.

4.3.3.4 Fire propagation into the fuel line or integral hopper

Fire propagation into the fuel line or integral hopper shall be avoided in any operational state or in case of any failure. This does not include the thermal reaction of a small amount of fuel at the end of the stoking device, if there is no further reaction into the fuel line.

NOTE Indication for significant fire propagation might include:
a) a temperature raise of more than 20 K in the stoking device above normal operation;
b) a temperature of more than 85 °C on the surface of the stoking device;
c) an accumulation of smoke in an integral hopper.

This requirement shall be proven during the tests according to 5.7 (thermal performance for nominal load and partial load) and 5.13 to 5.16 with a permanent temperature measurement until the maximum temperature is reached.

Accepted solutions to hinder fire propagation to the fuel line are listed as follows.

— An extinguishing device, e.g. water sprinkler system and an STB adjusted to a maximum of 95 °C.

— A safety device to seal continuously the supply line and with a sufficient fuel free distance and fuel free cross section, (e.g. cell feeder, rotary air lock) in combination with a design to prevent overfilling.

— A safety device to seal the fuel line not during fuel supply but during all other phases of operation (e.g. lid) in combination with a boiler operating with a negative pressure (tightness requirements in closed state identical to continuously sealing safety devices), in combination with a design to prevent overfilling and with a sufficient fuel free distance and fuel free cross section.

— An emergency discharge device emptying the stoking device without overfilling the boiler, which is reacting at a temperature limit not exceeding 95 °C (alternatively 20 K increase to standard operation conditions).

— Inclined auger in combination with fuel transport slide to/in the combustion chamber and a safety limiter reacting at a temperature not exceeding 95 °C.

Criteria for accepted solutions to verify the design are listed in Table B.1.

No test needs to be performed according to 5.16.4 if the chosen design is an accepted solution and the risk assessment proves the suitability for the boiler burner unit and the control algorithm interaction. If the risk assessment fails, further tests shall be required.

4.3.3.5 Alternative verification of safety against back burning

In case of any deviations regarding 4.3.3.2 to 4.3.3.4, the safety against back burning shall be verified according to the following procedures, combining a risk assessment including reliable tests of the alternative safety devices with reference to the criteria in 5.16.1.

If:

— no accepted solution is chosen, or

— the risk assessment ensures no suitability of a accepted solution for the boiler design, or

— the accepted solutions against back burning are not applicable (e.g. the suitability of constructional means or devices or the tightness criterion for certain boiler designs),

further tests shall be performed (see 5.16.5).

The test shall be documented by the third party laboratory in a report which includes the description of the test sample and the test installation, the way to perform the back burning test, the test conditions and the test results.

4.3.4 Safety against fuel overload of the boiler or interruption in fuel supply

During start up and continuous operation of the boiler with the fuel feed rate of the stoking device set at maximum capacity or interruption of the stoking device, no dangerous situation shall occur.

The test at overload mode according to 5.16.2 may be omitted if a safety device, safety level C according to 4.3.1, prevents an overload mode.

The boiler shall be equipped with a safety device that stops the fuel supply in the event that there is either insufficient or no combustion in the burner head.

The test for interruption of fuel supply according to 5.16.2 may be omitted if a safety device, safety level B or C according to 4.3.1, is used.

In the ignition phase, a safety device shall stop the fuel supply after a safety time which shall be declared by the manufacturer of the burner start up function, if there is no or insufficient combustion. A failure in the safety device to detect insufficient combustion shall not lead to a dangerous situation.

4.3.5 Safety against lack of air supply or insufficient combustion

If the air supply includes fan assistance or adjustable devices to control the cross section of the air inlet, the tests according to 5.16.3 shall be performed. Neither a combination of a failure of the fan and the malposition of the adjustable devices nor the malpositions of adjustable devices with separate actuators at the same time shall be taken into account.

The CO concentration in the boiler shall not exceed 5 % volume.

4.3.6 Surface temperatures

The surface temperature on the outside of the boiler (including the bottom and doors but not including the flue gas outlet and maintenance openings of natural draft boilers) shall not exceed the room temperature by more than 60 K when tested in accordance with 5.12. The requirement for the bottom is not applicable for instances when the manufacturer declares that the boiler is to be installed on a non-combustible base.

When tested in accordance with 5.12, the surface temperature of operating levers and all parts which shall be touched by hand during operation of the boiler shall not exceed the room temperature by more than the following values:

— 35 K for metals and similar materials;

— 45 K for porcelain and similar materials;

— 60 K for plastics and similar materials.

4.3.7 Leakage of the combustion system

For boilers designed to operate with a positive pressure in the combustion chamber when tested in accordance with 5.6 at a test-pressure of 1,2 times the gas side resistance at nominal heat output, the leakage rate based on mass flow shall not exceed 2 % of the flue gas mass flow at the nominal heat output.

The gas side resistance shall be determined with the fuel chamber filled to maximum capacity (as specified by the manufacturer).

NOTE For boilers designed to operate with negative pressure, the leakage rate measured according to 5.6 characterises the boiler.

4.3.8 Temperature control and limiting devices

4.3.8.1 General

The control and safety devices described in the sections below as well as the appropriate installation options shall be provided for each boiler, depending on the type of firing system and the type of protection provided for the installations in which the boiler is to be fitted. The equipment required in each case shall be supplied by the boiler manufacturer along with the boiler. If equipment is not supplied, precise specifications shall be given in the installation instructions, in particular the limit values and time constants for the safety temperature limiter.

4.3.8.2 Temperature control and limiting devices for open vented systems

When used in physically protected heating installations (the temperature is limited by installation pressure) the following equipment shall be provided, according to the requirements of EN 14597:

— a temperature controller;

— a safety temperature limiter (manual reset).

The safety temperature limiter is not necessary in cases where the firing system is neither rapidly nor partly disconnectable. In these cases (e.g. for boilers without automatic force draft), the excess heat is dissipated in the form of steam through the open vented connection with the atmosphere.

4.3.8.3 Temperature control and limiting devices for closed vented system

When used in thermostatically protected heating installations, the firing system shall be either rapidly or partly disconnectable; and/or the heat or residual heat output not absorbed by the heating system shall be dissipated reliably using a safety heat exchanger or equivalent devices. Accordingly, a distinction is to be made between the following equipment variants, according to the requirements of EN 12828:

a) The firing system is rapidly disconnectable; the necessary equipment shall consist of:

   1) a temperature controller;

   2) a safety temperature limiter (manual reset).

b) The firing system is partly disconnect able; the necessary equipment shall consist of:

   1) a temperature controller;

   2) a safety temperature limiter (manual reset);

   3) a thermal discharge safety device in accordance with 4.3.8.4 for dissipating the maximum heat output possible in the event of a malfunction.

c) The heating system is not disconnectable and the nominal heat output is < 100 kW; the necessary equipment shall consist of:

   1) a temperature controller;

   2) a thermal discharge safety device in accordance with 4.3.8.4 for dissipating the maximum heat output possible in the event of a malfunction.

If the requirements are not fulfilled, the boiler shall be installed in an open vented system according to EN 12828.

4.3.8.4 Devices for dissipating excess heat

The safety heat exchanger or other devices for dissipating excess heat shall ensure that a maximum boiler water temperature of 110 °C is not exceeded in accordance with 5.14.

For this purpose, a thermal discharge safety device shall be used such as an STW type Th according to EN 14597, in combination with a heat exchanger integrated in the boiler. Admissible heat exchangers include storage or circulatory water heaters, provided they are designed and sized in such a way that the heat can be transferred without any additional auxiliaries and outside energy. Fixed integrated circulatory water heaters cannot be used as operating water heaters but only as safety heat exchangers. Additionally, the following conditions shall be met:

— the thermal safety discharge device and the heat exchanger shall be adapted to the design and thermal properties of the boiler and be capable of reliably dissipating the maximum heat output possible in the event of malfunction or, in the case of partly disconnectable heating systems, the residual heat output;

— if a storage water heater is used as the heat exchanger, it shall be designed so that it meets the aforementioned condition at its maximum operating temperature;

— in the case of safety heat exchangers used exclusively to dissipate heat in the event of malfunctions, the thermal safety discharge device shall be fitted ahead of the heat exchanger in the cooling water inlet.

Other solutions are not excluded provided they comply with the protection objectives and safety standards described above. In principle however, all devices for dissipating excess heat are only admissible for:

— boilers without a disconnectable firing system with rated heat outputs of maximum 100 kW;

— boilers with a partly disconnectable firing system with residual heat outputs of up to 100 kW.

4.3.9 Heating boiler accessories

4.3.9.1 General

If the boiler is factory equipped with additional fittings which need to be serviced to ensure their correct operation and the safety of the boiler, the design shall ensure ease of access without requiring extensive dismantling work.

4.3.9.2 Electrical safety

The electrical safety of the boiler and the interfaces (e.g. connectors) between control devices shall comply with EN 60335-2-102.

The electrical safety of control devices shall comply either with EN 60335-2-102, with EN 60730-1 or its relevant part 2 or with the electrical requirements of the standards listed in Annex ZBB of EN 60335-2-102:2006.

For abnormal operation as fault condition according to 19.11.2 f) of EN 60335-2-102:2006 (failure of integrated circuits), only output signals which cause only one malfunction in one actuator shall be considered as relevant. Combinations of output signals which cause malfunction in more than one actuator are not considered relevant in the sense of abnormal operation because it is unlikely that any hazardous situation can occur.

The documentation of the electrical connections for the individual components shall be provided by means of an electrical wiring and connection diagram.

4.3.9.3 Electromagnetic compatibility

The EMC requirements shall be fulfilled in accordance with EN 61000-6-2 and EN 61000-6-3.

For this testing, it is permissible to use an adapted version of the boiler software for simulating boiler operation.

4.4 Performance requirements

4.4.1 General

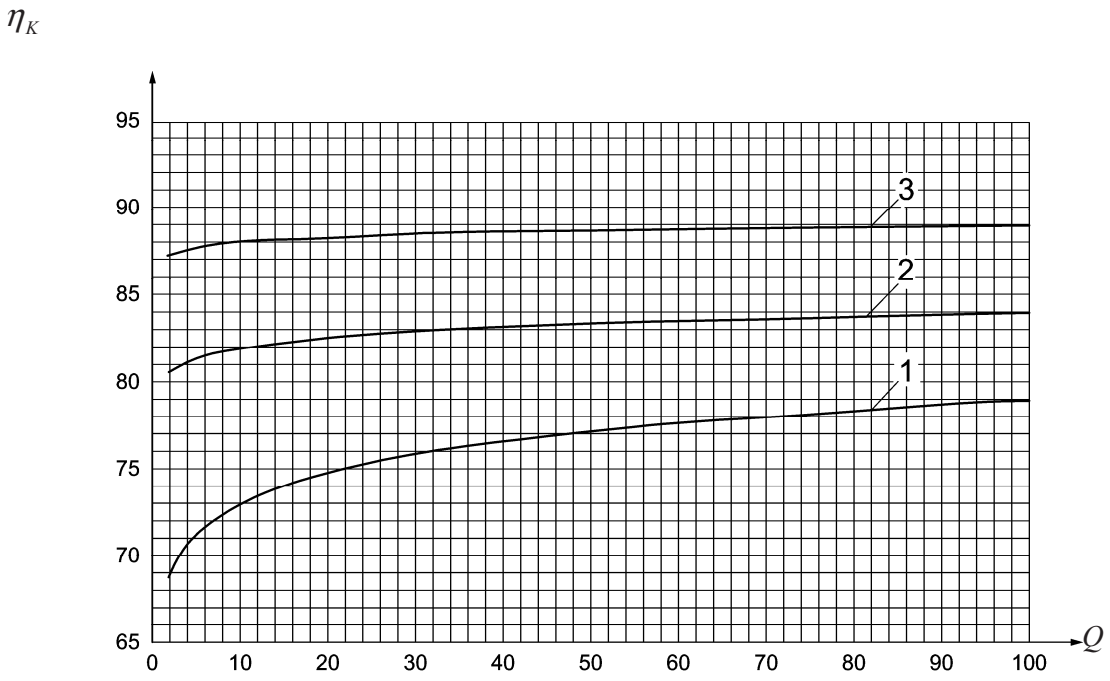
The following performance requirements shall be assessed in tests using the appropriate test fuel(s) specified in Table 7. These shall be selected to represent the recommended fuel(s) which it is claimed the boiler can burn.

NOTE The nominal heat output and the heat output range might vary depending on the fuel.

The requirements for the boiler efficiency and the emission limits are divided into 3 classes. To meet the class requirements, all the efficiency and emission limits of that class shall be fulfilled.

4.4.2 Boiler efficiency

The boiler efficiency, when tested in accordance with 5.7, 5.8 and 5.10, shall not be less than the formula shown in Figure 1 for the nominal heat output. For boilers above 100 kW, the requirement for class 4 is given at 84 % and class 5 is given at 89 %. For boilers above 300 kW, the requirement of class 3 is given at 82 %.



Key

Q	heat output in kW	1	class 3
η_K	efficiency in %	2	class 4
		3	class 5

Figure 1 — Boiler efficiency in percent

class 5 Q < 100 kW

η_K = 87 + log Q (in percent) (1)

class 4 Q < 100 kW

η_K = 80 + 2 log Q (in percent) (2)

class 3 Q < 300 kW

η_K = 67 + 6 log Q (in percent) (3)

where η_K is the boiler efficiency in percent and Q is the heat output in kilowatts.

NOTE 1 Q is heat output Q_N respectively minimum continuous heat output Q_{min}.

NOTE 2 The legislation of some countries requires the efficiency values to be given on a gross basis.

4.4.3 Flue gas temperature

For boilers which operate with a flue gas temperature below 160 K and above room temperature at nominal heat output, the boiler manufacturer shall make recommendations regarding the flue installation in order to ensure sufficient draught and to prevent the chimney sooting up and condensation.

4.4.4 Draught

The manufacturer shall specify the minimum draught at the flue gas outlet of the boiler needed for correct operation of the boiler. Where the manufacturer gives no detailed values, the figures according to Table B.2 of EN 13384-1:2002+A2:2008 shall apply.

4.4.5 Combustion period

The combustion period for hand-stoked boilers at nominal heat output shall be stated by the manufacturer and shall be at least:

— 2 h for biogenic and other solid fuels ;

— 4 h for fossil fuels.

4.4.6 Minimum heat output

For automatically stoked boilers, the minimum heat output shall not exceed 30 % of the nominal heat output. This requirement on limiting the maximum heat output shall be achieved automatically by a control device.

The control of the fuel and/or the air supply may be either continuous or intermittent.

For manually stoked boilers where the manufacturer specifies that the boiler shall be connected to an accumulator tank, the minimum continuous heat output can be greater than 30 % of nominal heat output, provided that the manufacturer specifies in the technical documentation how the amount of heat generated is to be dissipated.

Manually stoked boilers do not require testing at minimum heat output if the manufacturer claims that they shall always be connected to accumulator tank.

The following applies as a reference for the minimum accumulator tank volume:

$$V_{Sp} = 15 T_B \times Q_N \left(1 - 0{,}3 \frac{Q_H}{Q_{min}} \right) \quad (4)$$

where

V_{sp} is the accumulator tank volume, in litres;

Q_N is the nominal heat output, in kilowatts;

T_B is the burning period, in hours;

Q_H is the heating load of the premises, in kilowatts;

Q_{min} is the minimum heat output, in kilowatts.

For heating boilers using several allowable fuels, the tank size shall be based on the fuel which requires the largest accumulator tank. The minimum volume of the accumulator tank shall be 300 l.

4.4.7 Emission limits

Combustion shall be of low-emission. This requirement shall be satisfied if the emission values shown in Table 6 are not exceeded when operating at nominal heat output or, in the case of boilers with heat output range, when operating at nominal heat output and minimum heat output, in accordance with 5.7, 5.9 and 5.10.

Table 6 — Emission limits

Stoking	Fuel	Nominal heat output	Emission limits								
			CO			OGC			Dust		
			mg/m^3 at 10% O_2[a]								
		kW	class 3	class 4	class 5	class 3	class 4	class 5	class 3[b]	class 4	Class 5
manual	biogenic	≤ 50	5 000	1200	700	150	50	30	150	75	60
		> 50 ≤ 150	2 500			100			150		
		>150 ≤ 500	1 200			100			150		
	fossil	≤ 50	5 000			150			125		
		> 50 ≤ 150	2 500			100			125		
		>150 ≤ 500	1 200			100			125		
automatic	biogenic	≤ 50	3 000	1000	500	100	30	20	150	60	40
		> 50 ≤ 150	2 500			80			150		
		>150 ≤ 500	1 200			80			150		
	fossil	≤ 50	3 000			100			125		
		> 50 ≤ 150	2 500			80			125		
		>150 ≤ 500	1 200			80			125		

NOTE 1 The dust values in this Table are based on the experience of the gravimetric filter method. The method used needs to be referred to in the test report. The particulate matter emission measured according to this European Standard does not include condensable organic compounds which may form additional particulate matter when the flue gas is mixed with ambient air. The values are therefore not directly comparable with values measured by dilution tunnel methods. Neither can they be directly translated into ambient air particulate concentrations.

NOTE 2 Additional test methods and emission limits which apply in some countries are given in the A-Deviations in Annex C.

[a] Referred to dry exit flue gas, 0 °C, 1013 mbar.

[b] Boilers of class 3 for type E-fuels according to 1.2.1 or e-fuels according to 1.2.3 in this Table and marked with the classification E-fuels and e-fuels do not need to fulfil the requirements for the dust emissions. The actual value shall be stated in the technical documentation and shall not exceed 200 mg/m^3 at 10 % O_2.

5 Test

5.1 Test conditions

5.1.1 General

The test shall be conducted by a third party meeting the EN ISO/IEC 17025 requirements for testing to this European Standard.

NOTE 1 Organisations or test laboratories holding EN ISO/IEC 17025 accreditation for the testing of solid fuel boilers to this European Standard should be used for undertaking the type testing.

Prior to CE-marking, boilers shall be subjected to the rating test, design test, combustion test, safety test and electrical tests.

The manufacturer shall ensure that the materials used in construction and welds are in conformity with the requirements of the Quality Control System, and that the results of all necessary tests conform to those requirements.

All boilers and their parts shall be subjected to a hydraulic or pneumatic pressure test in the works of the manufacturer. No leakage shall occur.

NOTE 2 All appropriate safety precautions should be taken into account.

All tests, except for those described in 5.4.2 and 5.5.2, shall be undertaken as part of the type testing of the boiler.

5.1.2 Choice of boiler and fittings to be tested

Fittings and accessories supplied by the manufacturer shall be installed and used correctly. The operating and installation instructions shall be referred to and be taken into account during testing.

5.1.3 Condition of the boiler

The condition and the equipment of the boiler to be tested shall conform to the normal supply specification. The use of additional thermal insulation to parts in contact with water, products of combustion and fire shall not be permitted.

When determining the thermal output of a boiler fitted with a water heater (either storage or instantaneous), no domestic hot water shall be drawn off during the test. The thermal output shall be determined from the heating circuit only.

5.1.4 Type test

The type test shall determine whether the individual boiler sizes of a type or range meet the requirements laid down in this standard. During the type test, the boiler shall be representative of production in its design and equipment.

For boilers which consist of a boiler body which has been previously tested against and meets the requirements of this standard and a burner which has already been tested against and meets the requirements of EN 15270, only the following tests shall be performed: the tests specified in sub-clauses 5.6, 5.7, 5.8, 5.9, 5.10, 5.12, 5.13, 5.14 and 5.15.

For boilers in a product range which have the same constructional design, the testing of only the smallest and the largest boiler shall be sufficient, provided the ratio of the nominal heat output of the smallest to largest boiler is less than or equal to 2 : 1. If, however, within the same product range, this ratio is larger than 2 : 1, then so many intermediate sizes shall be tested so that the ratio of 2 : 1 from the higher performance size to the lower performance size is not exceeded.

The boiler manufacturer shall ensure that all boilers of a product range, even those which have not been tested, conform to the requirements of this standard. The results of non-tested boilers shall be determined by interpolation based on the nominal heat output. The test rigs shall conform to the general requirements of EN 304.

5.2 Measuring instruments and methods

The tolerances for test equipment given in A.1 and A.2 of EN 304:1992+A1:1998+A2:2003 shall be taken into account. In addition, the measuring instruments shall be selected in such a way that the error limits do not exceed the following:

— for efficiency: ± 3 % points;

— CO: ± 10 % of the measured value or ± 10 ppm (whichever is greater);

— THC: ± 10 % of the measured value or ± 5 ppm (reference gas: Propane or Methane) (whichever is greater);

— NO_x: ± 5 % of the measured value or ± 15 ppm (whichever is greater);

— O_2: ± 5 % of the measured value or ± 0,4 % volume (whichever is greater);

— CO_2: ± 5 % of the measured value or ± 0,4 % volume (whichever is greater);

— dust: ± 10 mg/m^3 of the measured value.

The uncertainty shall be calculated with a 95 % confidence interval.

Measurements of THC and NO_x can be taken with reference to CEN/TS 15883.

NOTE The measuring instruments for the determination of gaseous emissions should be in accordance with EN 12619, EN 13526, EN 14789, EN 14792 and EN 15058.

The calculation of the OGC emissions shall be performed according to CEN/TS 15883.

The dust content shall be determined using a filter method according to CEN/TS 15883 and EN 13284-1 in combination with Annex A of this standard, or using a gravimetric or electrostatic method according to Annex C. Other national methods or practices meeting the error limits requirements given above may be used.

In order to minimize the errors of measurement, the instruments shall be installed in a zone of as constant a temperature as is possible and shall be in operation some time before the commencement of the tests (see A.5 of EN 304:1992+A1:1998+A2:2003).

5.3 Test fuel

Fuel of commercial quality is used for testing heating boilers and characteristics of the type of fuel as declared by the manufacturer according to Table 7. For the purposes of wood test fuels, either beech, birch, oak, spruce or hornbeam can be used as declared by the manufacturer. Sampling shall be carried out according to EN 14778.

Testing with chipped wood B2 replaces testing with chipped wood B1. For fuels of class E, the analysis of the parameters listed in Table 7 shall be stated in the test report and the fuel shall be classified according to EN 14961 (all parts).

NOTE For the installation and operation of boilers using fuels of class "E, e" national regulations might give rules in which test fuels cover commercial fuels, as available in the relevant country. Criteria might also be different regarding calorific value, moisture content, ash content, bulk density and elemental content.

A distinction is made between the following test fuels (Table 7) and the fuels listed in the scope:

Table 7 — Test fuels

	Bituminous coal		Brown coal (incl. briquettes)		Coke		Anthracite	Wood logs	Chipped wood		Compressed wood	Saw-dust	Non woody biomass or other solid fuels
	a1	a2	b1	b2	c1	c2	d	A	B1	B2	C	D	E, e
Water content (as received)	≤ 11 %		≤ 20 %		≤ 5 %		≤ 5 %	12 % to 20 %	20 % to 30 %	40 % to 50 %	≤ 12 %	35 % to 50 %	According to the range specification of the manufacturer or EN 14961 (all parts)
Ash content[a] (as received)	2 % to 7 %		5 % to 20 %		5 % to 15 %		5 % ± 3 %	≤ 1 %	≤ 1,5 %		≤ 0,5 %	≤ 0,5 %	
Volatiles[a] (as received)	15 % to 30 %	> 30 %	40 % to 50 %	50 % to 60 %	< 6 %	8 % ± 2 %	< 10 %	-	-	-	-	-	
Chlorine content[a]	-		-		-		-	-	-	-	-	-	
Sulphur content[a]	-		-		-		-	-	-	-	-	-	
N-content[a]	-		-		-		-	-	-	-	-	-	
Net calorific value[b]	> 28 MJ/kg		> 12,5 MJ/kg		> 28 MJ/kg		> 28 MJ/kg	> 17 MJ/kg	> 17 MJ/kg		> 17 MJ/kg	> 17 MJ/kg	> 16 MJ/kg
Size/length	According to the manufacturer's instruction[c]												-

[a] % of mass on dry base.
[b] Dry base.
[c] Maximum 5 % of mass of the test fuel may have an oversize or an undersize.

$$H_{\text{iw}} = \frac{H_{\text{iwf}}(100 - w) - 2{,}442w}{100} \quad (5)$$

where

H_{iw} is the net calorific value of the wet fuel, in MJ/kg;

H_{iwf} is the net calorific value of the fuel on a dry base, in MJ/kg;

w is the water content as proportion of total mass, in %;

2,442 is the evaporation heat of water in MJ/kg, referred to 25 °C.

The water content and the calorific value of the fuel shall be analysed.

NOTE If accepted by the manufacturer, moisture contents between two classes can be used. The test results are valid for the class with the lower water content.

5.4 Pressure test for boilers of sheet or sheet metal of non-ferrous metal

5.4.1 Tests to be carried out before production

The type test pressure is 2 × PS using hydraulic pressure where PS 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, and largest size). No leakage or noticeable permanent deformation shall occur during the test.

A record shall be made of the test, including the following details:

— exact description of the boiler tested by stating the drawing number;

— test pressure in bar and duration of the test;

— test result;

— 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.

5.4.2 Test during production

Each boiler shall be tested during the production and the test pressure shall be at least 1,43 × PS.

5.5 Pressure test for boilers of cast iron or non-ferrous metals

5.5.1 Test to be carried out before production

5.5.1.1 Burst test on individual sections

To assess the construction and to approve the design, three front, middle and back sections of each boiler type shall be subjected to a hydraulic burst test before the start of full production. For boilers with a maximum operating pressure up to 6 bar, the minimum burst pressure shall be > 4 x PS + 2 bar (minimum 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;

— description and position of the damage which occurred.

5.5.1.2 Water pressure tests on boiler block

For each boiler type which is intended for mass production, the following tests apply:

— one boiler block of average size shall be subjected to a water pressure test with a pressure of 2 × PS, (minimum 8 bar);

— the strength of the tie bars shall be calculated and tested to withstand an internal boiler pressure of 4 × PS.

A record shall be drawn up of the result. See 5.4.1 for details.

5.5.2 Test during production

5.5.2.1 Cast sections

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

The wall thickness at the individual boiler sections shall be subjected to an examination during production in accordance with a quality control.

The limiting value of wall thickness at each measuring point shall be the 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, if granted.

5.5.2.2 Boiler block

Each boiler is to be subjected to a water pressure test with a test pressure of 1,3 *x* PS (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.

5.6 Test for gas side soundness

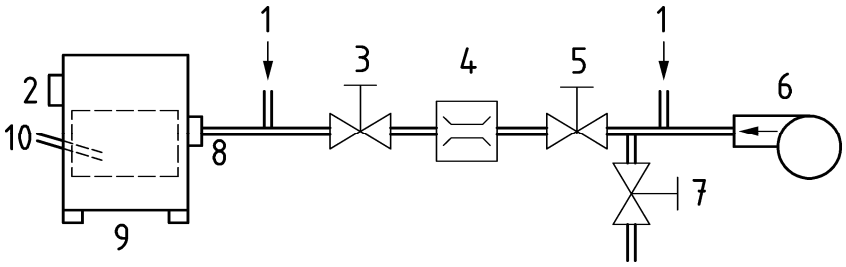
This test is for boilers with a positive pressure in the combustion chamber.

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 is determined using air at ambient temperature and using a test rig in accordance with (for example) Figure 2.

Exhaust connection is to be sealed tightly, and the doors set as in normal use. The test rig is connected to the air input of the test boiler.

The leakage rates measured are to be converted in accordance with the standard test condition (0 °C, 1013 mbar). The requirements of 4.3.7 shall be reached.



Key

1 pressure measuring point
2 flue gas outlet
3 valve 1 (regulating)
4 flow meter
5 valve 2
6 fan
7 valve 3 (bypass)
8 firing air inlet
9 boiler
10 pressure measuring point

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

NOTE The test for boilers operating with negative pressure can be performed under a pressure of 20 Pa (see Figure 2, measuring point 10). The test should be performed after safety and performance test (5.7 to 5.15)

5.7 Conducting the boiler performance test

5.7.1 General

To determine the heat output, boiler efficiency, combustion period, composition of the combustion gas, exit flue temperature, draught and emission properties, the boiler is operated throughout the tests within the heat output range. At nominal heat output, the boiler shall be operated in such a way that continuous running is possible (with thermostat cut-off prevented). The minimum heat output on boilers shall be regulated automatically by a control device without a manual intervention. The boiler shall be brought to operating temperature before the start of any measurements.

The appliance shall be operated in accordance with the manufacturer's operating instructions during the tests. The ambient air temperature shall be between 15 °C and 30 °C.

The draught is to be set according to the minimum draught of the manufacturer's instructions.

In the test period, the mean value of the draught shall not vary from the specified value of the manufacturer by more than ± 3,0 Pa.

During the test period, manual intervention in the form of poking or raking or any adjustment shall not be permitted.

If approximately 95 % of expected combustion period has elapsed for hand stoked boilers, brief raking is allowed before the datum fire bed is created This serves to distribute unburned fuel prior to the refill operation and is not to be considered as a manual intervention during the combustion period; it is therefore permissible in every valid test.

The test procedure according 5.8 and 5.9 shall be performed at the same time.

5.7.2 Setting up the test rig

The test rig shall be set up as shown in A.6 of EN 304:1992+A1:1998+A2:2003 and the efficiency shall be determined within a tolerance of ± 3 % points.

Other equivalent arrangements of rigs may be used.

The flue gas measuring section shall be carried out in accordance with Figure 3 of EN 304:1992+A1:1998+A2:2003.

5.7.3 Measured quantities

The following one-off measurement parameters shall be undertaken and recorded in the type test report:

— water content of the fuel;

— net calorific value of the fuel;

— fuel mass added;

— combustion period during hand stoking;

— surface temperatures (at nominal heat output in a typical operating condition).

The following measured quantities shall be continuously measured and recorded in the type test report:

— heat output;

— flow temperature;

— return temperature;

— temperature of the entering cold water according to Figure A.2 of EN 304:1992+A1:1998+A2:2003;

— ambient temperature;

— flue gas temperature;

— draught;

— oxygen (O_2) or carbon dioxide (CO_2) content;

— carbon monoxide (CO) content;

— organic gaseous substances THC (total hydro carbon);

— dust content (intermittent measurement);

— auxiliary energy demand.

NOTE The state of the art is such that limit values for nitrogen oxides cannot be stated. It is recommended to measure NO_x-values. In addition, the nitrogen should be determined of the test fuel: NO and NO_2 are measured and the result is shown as NO_2.

All the measured quantities to be determined continuously are at maximum intervals of 20 s and recorded as mean values at maximum intervals of 1 min. The time intervals are to be chosen in such a way that fluctuations in the measured values are recorded with sufficient accuracy.

The recorded mean values are the basis for making the mean value for the test period.

5.7.4 Test method and test duration

5.7.4.1 Heating boilers with manual stoking

Before the start of the test, the boiler shall be brought to its stable working condition. The duration of this initial period shall be at minimum 2 h and sufficient to ensure the necessary basic fire bed is established. The necessary basic fire bed shall be described prior to testing by the manufacturer and shall be stated in the technical documentation. This shall be described in the test report, e.g. by the duration of the combustion period.

The test period shall begin when the basic fire bed is either judged visually to be achieved or, if using a platform scale, when the mass of basic fire bed is indicated on the scale. Other indicators like the CO_2 content or the flue gas temperature shall be also taken into account when judging the basic fire bed.

The test shall start immediately after placing a complete fuel charge up to the maximum filling height on the basic fire bed. The test time runs from the time when the fuel is placed on the basic fire bed until the next refill. The refill and the stoking are included in the test time and calculation of the mean value.

— Test duration at nominal heat output: 2 consecutive combustion periods;

— Test duration at minimum heat output: 1 combustion period.

Both combustion periods at nominal heat output shall show similar test results (i.e. heat output ± 10 % of the mean value).

5.7.4.2 Heating boilers with automatic stoking

Before the start of the test, the boiler shall be brought to operating temperature using the appropriate quantity of fuel; the necessary stable operating conditions are established. The following specifications apply:

— test duration at nominal heat output shall be at least 6 h;

— test duration at minimum continuous heat output shall be at least 6 h;

— test duration at minimum heat output in intermittent operation shall be at least 6 h plus the time taken to finish the last on-off period.

For automatically fed wood log boilers, the test conditions shall be applied according to boilers with automatic stoking devices for pellets and chipped wood.

For automatically fed wood log boilers, the testing period shall include at least two stoking intervals.

5.8 Determination of the heat output and the efficiency of the boiler

5.8.1 Method for the measurement of the heat output

5.8.1.1 General

The amount of useful heat transmitted to the heat carrier (water) is measured. It can be determined directly in the boiler circuit or indirectly by means of a heat exchanger.

When hand stoked boilers are tested with a heat output greater than 30 % of nominal heat output, the test rig shall be controlled in accordance with the boiler heat output produced.

5.8.1.2 Determination of heat output in the boiler circuit

The useful heat output transmitted to the water is determined either by measuring the mass flow of cold water entering the boiler circuit and the rise of temperature to the outlet temperature, or by measuring the flow of the water circulating in the boiler circuit and its temperature rise.

5.8.1.3 Determination of heat output by means of a heat exchanger

The heat produced by the boiler is transferred to the cooling water by means of a heat exchanger. The heat received by the latter is calculated from the throughput and the temperature rise of the cooling water. The heat losses from the well-insulated connections between the boiler and the heat exchanger and those of the heat exchanger itself are determined either by preliminary tests or by test rig specific heat loss curves.

The heat output of the boiler shall be determined as the sum of the two amounts of heat.

5.8.2 Determining the nominal heat output

The heat output specified by the manufacturer shall be determined within ± 8 % during testing. For manually stoked boilers, the manufacturer's claimed nominal heat output shall be achieved in at least one of the combustion periods. If not, the specified nominal heat output shall be corrected.

During tests at nominal heat output, the mean value of flow temperature shall be between 70 °C and 90 °C. During the test, the mean temperature difference between flow and return shall be between 10 K and 25 K.

A temperature rise of:

$$\frac{t_V + t_R}{2} - t_L \geq 35{,}0K \qquad (6)$$

shall be maintained, where

t_V is the flow temperature, in °C;

t_R is the return temperature, in °C;

t_L is the ambient temperature, °C.

5.8.3 Determining the minimum heat output

The minimum heat output test is to be conducted at the lowest output specified by the manufacturer, and the requirements of 4.4.6 shall be achieved.

The waterside flow temperatures stated under 5.8.2 shall also be taken into consideration for this test, with the exception of the difference between flow and return temperature.

The minimum heat output shall be controlled before the start of the test. For this reason, the heat output at the test stand shall be reduced. The boiler shall reach the heat output automatically by the control device.

5.8.4 Determination of the boiler efficiency (direct method)

The efficiency shall be determined using the direct measurement method on the basis of the net calorific value H_{iw}.

NOTE The indirect method allows an additional check of test accuracy of the test rig to be made by means of a heat balance. From this the values of other losses e.g. case losses can also be determined. These losses should not be credited to the output or the efficiency of the boiler.

5.8.5 Electrical consumption

During the tests, the electrical consumption shall be determined according to EN 15456.

The values for maximum consumption, for stand by, nominal heat output and minimum heat output shall be stated in the test report. For boilers with automatic feeding systems (fuel line), the electrical consumption of the boiler and the fuel line shall be determined and stated separately.

The average electrical power consumption during stand by shall be measured for a minimum duration of 10 min and shall be stated in watts. In cases where control operations influence the intrinsic energy consumption, a longer duration might be necessary.

5.9 Determination of the emission values

5.9.1 Heating boiler with manual stoking

The arithmetic average CO_2 or O_2, CO, OGC (and NO_x where appropriate) contents are determined over the entire test period. With manual stoking, the measurement at nominal heat output covers two consecutive combustion periods. The refill operation is included in the test results and the mean values.

At minimum heat output, the measurements are made over one combustion period.

Each combustion period is divided into, at minimum, two equal time sections. The measurements for determining the dust content start in each case at the beginning of a time section, with the first measurement beginning immediately after the fuel is placed and the door closed in deviation from CEN/TS 15883. The suction time per filter shall be ≥ 30 min. The average dust content is determined from a minimum of four measured values.

5.9.2 Heating boiler with automatic stoking

The arithmetic average CO_2 or O_2, CO, OGC (and NO_x where appropriate) contents are determined over the entire test period at nominal heat output.

To determine the dust content, each test period is divided into, at minimum, four equal time sections. The measurements begin in each case at the start of the sections, with the first measurement taken when the test begins. The suction time per filter shall be ≥ 30 min. The average dust content is determined from a minimum of 4 measured values.

At intermittent operation, only complete on-off phases shall be considered.

5.9.3 Determination of the emissions at minimum heat output

At minimum heat output the measurements are made over one combustion period.

The arithmetic average CO_2 or O_2, CO and OGC contents are determined over the entire test period.

NOTE Legislation in some countries requires measurement of NO_x and dust at minimum heat output.

5.10 Calculation

5.10.1 Boiler heat output

The boiler heat output is the average during the test period.

The necessary formulae relevant to the individual test methods are given in A.7 of EN 304:1992+A1:1998+A2:2003.

5.10.2 The heat input

For these calculations, formulae in A.8.1 of EN 304:1992+A1:1998+A2:2003 shall be used.

5.10.3 Boiler efficiency

The boiler efficiency shall be stated in percent in the report.

5.10.3.1 Direct method

In the direct method, the boiler efficiency is determined by:

$$\eta_K = \frac{Q}{Q_B} \times 100\,\% \quad (7)$$

5.10.3.2 Indirect method (only to be used for checking purposes, see A.9 of EN 304:1992+A1:1998+A2:2003)

In the indirect method, the boiler efficiency is given by:

$$\eta_K = (1 - q_A - q_U - q_S - q_B) \times 100\,\% \quad (8)$$

where

q_A is the loss through sensible heat of the products of combustion (values relative to the heat input);

q_U is the loss through incomplete combustion (values relative to the heat input);

q_S is the loss through radiation, convection and conduction (values relative to the heat input);

q_B is the loss through unburned fuel in ash (values relative to the heat input).

5.10.4 Emissions

5.10.4.1 Emissions at nominal heat output and minimum continuous heat output

The calculation of the mean values shall be performed over the entire testing period only with regard to time, independent of the flue gas flow rate.

The recorded emission values of the volume parts in the dry flue gas shall be used to calculate the mean value for the entire testing period.

These mean values of the volume parts (ppm) shall be used to calculate the mass values (mg/m^3). For the rate of exchange from ppm to mg/m^3, the following values should be used:

— f_{CO} = 1,25;

— f_{OGC} = 1,64 (if propane is the calibration gas);

— f_{OGC} = 0,54 (if methane is the calibration gas);

— f_{NO_2} = 2,05.

The concentrations of gaseous organically bound carbon (OGC) are reported as carbon. The determined oxides of nitrogen (NO_x) concentration are reported as nitrogen dioxide (NO_2).

All reported emission concentrations are reported as a mass concentration (mg/m^3) standardised to a dry flue gas basis at 10 % oxygen and standard condition (mg/m^3) at 0 °C and 1013 mbar.

5.10.4.2 Emissions at minimum heat output at intermittent operation

The calculation of the mean values according to 5.10.4.1 shall be performed over the entire testing period only with regard to time, independent of the flue gas flow rate.

The minimum heat output test shall be conducted at maximum 30 % of nominal heat output. The heat consumption of the test rig shall be continuous according to the lowest output specified by the manufacturer.

5.11 Determination of the waterside resistance

The water side resistance (measured in mbar) shall be determined for the flow which is equivalent to the rated output of the boiler at a temperature difference of Δt = 10 K and 20 K between the flow and return.

5.12 Surface temperature

The mean surface temperature shall be measured at nominal heat output. In order to do this, a minimum of 5 points on each boiler surface shall be measured. Under the same conditions, the critical temperatures (e.g. boiler doors, operating levers) shall be measured.

5.13 Function check of the temperature controller and safety temperature limiter at the boiler

The water-side flow rate shall comply with that specified for the nominal heat output test. The flow temperature of 75 °C shall not be exceeded at the start of the test.

Adjust the firing so that it corresponds to the nominal heat output Q_N of the boiler. A steady state condition shall be reached and the outlet pressure at the flue gas section shall be according to the nominal heat output setting. For manual stoked boilers, the boiler shall be refuelled after reaching steady state with a full batch before starting the test.

The dissipated output shall be reduced to (40 ± 5) % of the nominal heat output of the boiler; circulating pump running in continuous operation; temperature controller adjusted to maximum set value.

When the temperature controller is operating normally, the measured flow temperature shall not exceed 100 °C; the safety temperature cut out or limiter or the device for dissipating excess heat shall not trigger.

Repeat the test with the temperature controller out of function. This time, check if the safety temperature limiter/detector switches off the firing system at the highest value specified by the boiler manufacturers and if all hazardous operation states are avoided (see 4.1).

5.14 Function test for the rapidly disconnectable firing system

— Sudden absence of heat dissipation

The water-side flow rate shall comply with that specified for the nominal output test. The flow temperature of 75 °C shall not be exceeded at the start of the test.

Adjust the firing so that it corresponds to the nominal heat output Q_N of the boiler, a steady state condition is reached and the outlet pressure at the flue spigot is according to the rated heat output.

The heat consumption is set to 0; water circulation in the boiler is permitted; temperature controller is adjusted to manufacture recommended maximum set value.

Check if the safety temperature limiter or the temperature controller switches off the firing system and all hazardous operation states are avoided.

— Loss of the electrical power supply

The water-side flow rate shall comply with that specified for the nominal heat output test. The flow temperature of 75 °C shall not be exceeded at the start of the test.

Adjust the firing so that it corresponds to the nominal heat output Q_N of the boiler, a steady state condition is reached and the outlet pressure at the flue gas section is according to the rated heat output.

The electrical supply including the circulation is cut off, check that no hazardous operation conditions occur.

For the evaluation of the temperatures and the CO-concentrations, only mean values at a maximum average time of one minute shall be considered.

5.15 Function test on the device for dissipating excess heat (partly or non-disconnectable firing system)

Adjust the firing so that it corresponds to the nominal heat output Q_N of the boiler, a steady state condition is reached and the outlet pressure at the flue gas section is according to the nominal heat output.

Put the temperature controller out of function. Maintain the function of the safety temperature limiter.

The heat consumption is set to 0; water circulation in the boiler is permitted.

Check if the safety temperature limiter switches off the firing system and the device for dissipating excess heat works properly and all hazardous operation states are avoided.

The cold water shall be kept at a temperature of (10 ± 5) °C and a pressure of maximum 2 bar. (Deviations are permissible if they are specified in the installation instructions.)

For the evaluation of the temperatures and the CO-concentrations, only mean values at a maximum average time of one minute shall be considered.

5.16 Check of the safety and risk assessment

5.16.1 General

A risk analysis shall be performed by the manufacturer according to EN ISO 12100. "Force majeure risks" shall not be taken into consideration.

Completeness, correctness and plausibility of the risk analysis of the manufacturer shall be verified by a third party.

The verification does not generally require testing. If tests are performed, the following conditions shall be applied.

a) Adjust the firing so that it corresponds to the nominal heat output Q_N of the boiler, a steady state condition shall be reached and the outlet pressure at the flue gas section shall be according to the nominal heat output setting.

b) For manual stoked boilers, the boiler shall be refuelled after reaching steady state with a full batch before starting the test.

The verification of the risk analysis can be done on the basis of one or more of the following:

— implementation of accepted solutions according to this standard;

— implementation of safety functions with verification of the shut-off function;

— check of the characteristics of the boiler at normal operation and in the case of failures;

— relevant references to other standards or associated test results.

The risk analysis shall at least provide risk assessments for the following tasks and take into account possible failures in the components of the fuel supply, the air supply, the combustion and combustion control, the flue gas exit, the heat dissipation, fire prevention and the risk of injuries of persons.

The following risks shall be evaluated in detail:

c) fuel feed operation continuously at maximum speed, fuel overload;

d) feed rate too low;

e) loss of air supply;

f) loss of power;

g) unstable combustion chamber pressure;

h) unclosed doors and openings within the boiler or the stoking device;

i) open integral fuel hopper;

j) empty integral fuel hopper;

k) ignition failure during start up;

l) check of the strategy for safety against back burning;

m) safety check regarding effect of emptiness or a blockage of the stoking device;

n) voltage variation;

o) leakage of combustion products (e.g. flue gas fan failure, power loss, pressurized combustion chamber);

p) lockout and restart;

q) electric safety (documents and certificates have to be provided);

r) risk of injuries of persons.

NOTE Additional tests are recommended.

5.16.2 Safety test of consequences of fuel overload and effect of a blockage of the fuel supply

The safety of the boiler shall be checked at continuous operation of the boiler with the fuel feed rate of the stoking device set at possible maximum capacity, taking into account failures according to the risk analyses and the electrical safety. If other fuel feed rates lower than the maximum are categorised as critical by the risk analysis, these shall also be tested.

The functionality of the safety device for the shut-down of the fuel line shall occur by prevention of the ignition after release of fuel if no or insufficient combustion in the combustion chamber occurs.

The test for blocked fuel line shall be achieved by deactivating the stoking device.

The requirements specified in 4.3.4 shall be satisfied.

5.16.3 Loss of combustion air supply

The safety of the heating boiler shall be checked at maximum heat input under the following conditions:

— failure of the combustion air fan;

— failure to close of the adjustable combustion air supply.

In each case, only one failure shall be simulated.

The CO concentrations in the boiler shall not exceed 5 % volume.

The measurement of CO concentration shall be carried out in the flue gas measuring section.

5.16.4 Resistance to thermal conductance

Temperature measurement shall be performed on the surface of the stoking device at the place next to the fuel line but within a maximum distance which shall be less than 1 m against the feeding direction from the inner wall of the combustion chamber.

For boilers with integrated hopper, the temperature measurement shall be performed on the surface of the stoking device at the place next to the integrated hopper but within a maximum distance which shall be less than 1 m against the feeding direction from the inner wall of the combustion chamber. In addition, the highest surface temperature of the hopper shall be measured.

5.16.5 Additional tests for alternative verification of the safety against back burning

This test shall be performed only if the criteria in 4.3.3.5 are applied. The tests shall be carried out with reference to the risks listed in 5.16.1.

These tests shall include at least the verification of the geometrical, physical, mechanical and electrical properties that are required for this device by applying the risk assessment performed. The device shall be tested in respect of the interaction of the device in the functional safety concept and the control algorithms of the boiler.

A test for the simulation of a back burning shall at least fulfil the following criteria:

a) using the original boiler or test samples which simulate the firing system and the fuel line of the boiler on one hand and which allow the performance of back burning tests on the other hand;

b) by generating hot gases in the original combustion chamber or using devices to produce hot gases like a forced draught burner at the fuel entrance into the combustion chamber;

c) by producing a pressure drop from the combustion chamber to the fuel line, representing the most critical situation due to the risk assessment. The pressure drop shall be at least 8 Pa.

The test shall be documented in a report including the description of the test sample and the test installation, the way to perform the back burning test, the test conditions and the test results.

6 Test report and other documents

Test reporting shall be issued on the basis of EN ISO/IEC 17025 requirements.

The test report shall include at least:

a) name and address of the test laboratory and the location were the tests have been carried out;

b) identification number of test report;

c) name and address of customer;

d) test method;

e) description of the boiler or the series of boilers which are tested including:

   1) general construction;

   2) supply of fuel;

   3) supply of combustion air;

   4) safety devices with identification (type, certification, supplier, adjustment, size);

   5) relevant components (fan, ignition device, inserts in heat exchangers);

f) parts list (where appropriate);

g) period of testing;

h) test results as mean value of the test period and for manually stoked boilers of each combustion period;

i) specification of the test method used for particles measurement

j) picture of the boiler.

The following documents shall be handed over to the test institute:

— drawings showing clearly the type of construction of the boiler (or boiler series);

— drawings showing clearly the material, welding (where appropriate) and wall thickness of pressurized parts;

— installation and operating manual as well as other relevant documents of the manufacturer;

— a description of the boiler including the draft of the boiler data plate.

The test report shall be signed by the head of the test station or the test engineer responsible for carrying out the test.

The test report shall not be published in abbreviated form.

7 Marking

7.1 General

Each heating boiler shall have a data plate. The boiler data plate shall be written in the language of the country of destination and be affixed in an accessible spot.

7.2 Information on the boiler plate

The boiler plate shall contain at least the following information:

a) name and company domicile of the manufacturer and, where available, the manufacturer's symbol;

b) trade designation, type under which the boiler is marketed;

c) production number and year of construction (coding is permissible at the manufacturer’s discretion);

d) nominal heat output and heat output range in kilowatts for each type of fuel;

e) boiler class regarding each fuel type that was tested;

f) maximum allowable operating pressure, in bar;

g) maximum allowable operating temperature, in degrees Celsius;

h) water content, in litres;

i) electrical connection (V, Hz, A) and wattage, in watts;

j) the fuel class according to Clause 1 and for fuels of class E the tested fuel.

7.3 Boiler plate requirements

The material and labelling used for the plate shall be durable. The labelling shall be abrasion-proof. Under normal operating conditions the plate shall not discolour so as to make its information difficult to read. Self-adhesive plates should not become detached as a result of moisture and temperature.

8 Technical documentation, supplied with boiler

8.1 General

For each boiler, the documents listed below shall be made available in the language of the boiler's country of destination; the documents specified under 8.2 and 8.3 shall be enclosed with every boiler.

8.2 Technical information and installation instructions

These documents shall contain at least the following indications:

a) necessary draught, in millibars;

b) water content, in litres;

c) exhaust gas temperature at nominal heat output and minimum heat output, in degrees Celsius;

d) exhaust mass flow at nominal heat output and at minimum heat output, in kilograms per second;

e) flue pipe diameter, in millimetres;

f) water-side resistance, in millibars;

g) nominal heat output and heat output range, in kilowatts;

h) boiler class;

i) combustion period in hours at Q_N;

j) setting range for the temperature controller, in degrees Celsius;

k) minimal return temperature at boiler return tapping, in degrees Celsius;

l) fuel type and water content as well as fuel size and detail information according to Table 7 for fuels type E resp. e;

m) filling chamber capacity in litres and filling opening dimensions, in millimetres;

n) necessary accumulator storage, in litres if $Q_{min} > 0{,}3\ Q_N$;

o) auxiliary power requirement at Q_N and Q_{min}, in watts;

p) stand by power, in watts;

q) cold water temperature and pressure for safety heat exchanger, in bars;

r) electrical connections including appliance and main-switch-off;

s) whether the heating appliance is running with or without using a fan;

t) whether the heating appliance is working under over pressure or under pressure at flue gas outlet;

u) whether the heating appliance is working under condensing or non-condensing conditions;

v) information about the boiler's emission of airborne noise, the method to measure the airborne noise level and the possibilities of means of reducing the noise emission of the boiler.

NOTE Noise measurements should be made according to EN 15036-1.

Furthermore, the installation instructions shall contain information concerning:

w) the on-site assembly of the boiler (if necessary) and the required water pressure test as per 5.4.2 or 5.5.2.2;

x) the installation;

y) the commissioning, with information on the boiler output to be set in the output range;

z) instructions on the location and fitting of the sensors for the control, display and safety equipment.

In addition, the technical information and installation instructions shall contain general references to the standards and regulations to be observed on the safety equipment of the installation:

— take care of installed ventilations systems in the same heating room;

— take care there is sufficient amount of clean (i.e. uncontaminated) combustion air;

— measuring points should be self locking and thigh;

— emission control after first installation;

— verbal instruction by a competent person before first using;

— take care of the correct storage of the used fuels;

— regularly checks if the heating appliance is in good condition;

— take care of the correct dimensioning of the System;

— take care of the correct dimensioning of the chimney including the connecting flue pipe;

— take care of the necessary distances to combustible materials, if required;

— require a shielding construction, if necessary;

— take care of the necessary minimum distance to walls and ceilings (related to cleaning).

8.3 Operating instructions

The operating instructions shall contain references to:

— the operation of the boiler, stoking and opening doors without risk;

— cleaning and cleaning intervals, including the equipment required for the cleaning operations;

— measures to be taken in the event of malfunction;

— the reasons for recommending a regular, competent maintenance service and the necessary maintenance intervals;

— the type of fuel and water content and the fuel size (with the direction of the layers in the case of wood logs);

— the maximum filling height for fuel in the filling chamber;

— the nominal combustion period for fuel types at nominal heat output.

Other documents (brochures, etc.) shall not contain any information that is in contradiction with that of the operating instructions.

Annex A
(informative)

Manual measurement of particles in the gas flow, gravimetric determination of particle load with filter systems

This informative annex describes the procedure for the determination of particle emissions on the test item. It provides the basic requirements for testing.

Before and after the sampling, the used filter shall be dried in a drying oven until a constant mass is reached (drying temperature at least (110 ± 5) °C). After the drying of the filters and prior to the weighing process, the filters shall be stored in a desiccator. The desiccator shall be placed in the room where the weighing takes place until the temperature of the desiccator reaches ± 3 K of the temperature of the room.

To provide traceability regarding the pre-treatment of the weighed sample parts, the following results shall be stated in the test report:

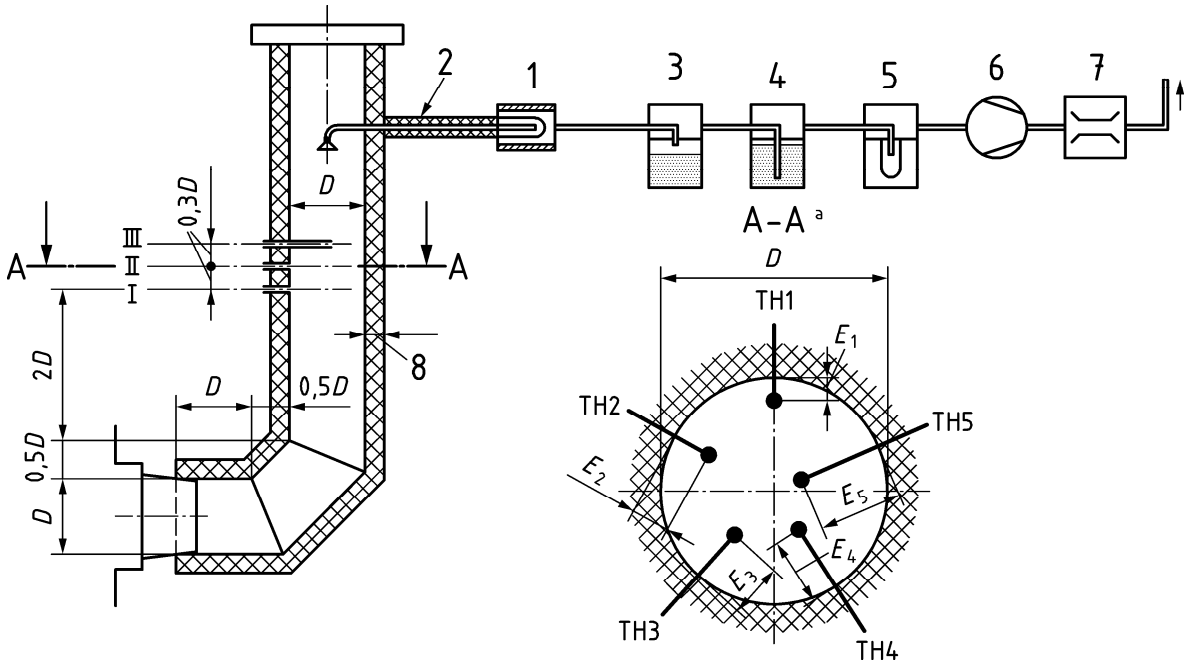
— drying temperature of filter prior to and following impingement;

— minimum drying period of filter prior to and following impingement.

The sample equipment (Figure A.1) shall be mechanically cleaned and rinsed prior to each test series.

Because of the low flue gas velocities of domestic heating appliances (< 2 m/s), the extraction velocity at the filter head shall remain in the interval of 70 % to 150 % (as a deviation to EN 13284-1 in which an isokinetic sampling rate in the interval of 95 % to 115 % is stated). It is assumed that the basics of the process are fulfilled if during sample time the isokinetic sampling rate does not exceed a value of 150 %.

The configuration of the extraction unit shall be done corresponding to EN 13284-1. In case of out-stack sampling, the extraction probe of the out-stack unit shall be kept as short as possible and the filter head shall be heated at the temperature of the measured flue gas or at (110 ± 5) °C.



Key

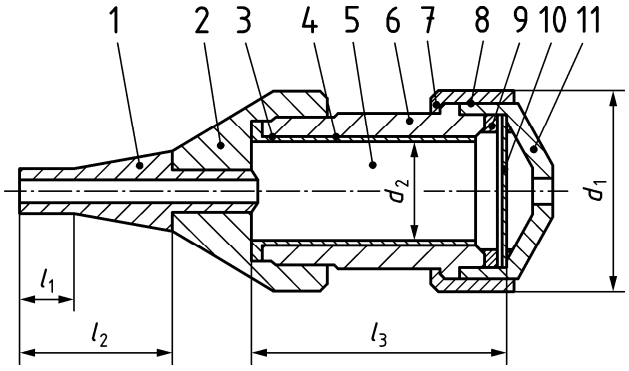
1 filter
2 gas sampling probe and line for particles measurement (heat-insulated)
3 water separator
4 silica gel filter
5 superfine filter
6 pump
7 gas flow meter
8 insulation t = 40 mm

I section for draught measuring
II section for temperature measuring
measuring device for flue gas analysis (sampling cross)
III section for measuring the smoke contents in the flue gas

immersion depth of the thermocouples:

$E_1 = 0{,}10 \cdot D$
$E_2 = 0{,}17 \cdot D$
$E_3 = 0{,}24 \cdot D$
$E_4 = 0{,}30 \cdot D$
$E_5 = 0{,}37 \cdot D$

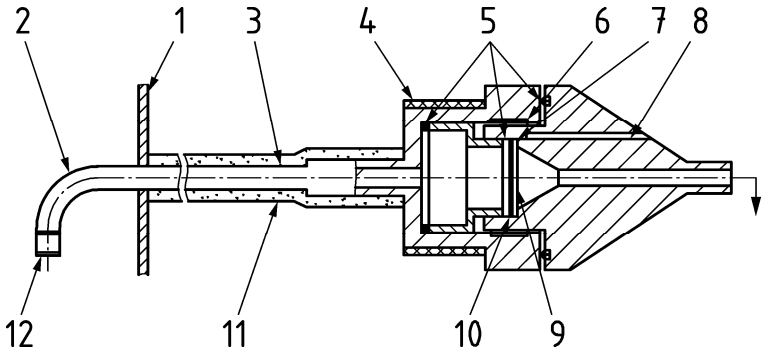
Figure A.1 — Scheme of the sampling equipment



Key

1 removable sampling probe
2 union nut
3 seal
4 filtering bush
5 quartz wool
6 filter housing
7 union nut
8 clamping ring
9 flat filter support
10 flat filter
11 end case

Figure A.2 — Example of a tubular filter device



Key

1	pipe wall	6	threaded coupling	9	ø 44 X 1.5 thick perforated support disc with 109 X ø 2.2 equi-spaced holes on triangular pitch	10	ø 47 X 0.4 thick perforated filter support disc with ø 0.55 equi-spaced holes on triangular pitch
2	stainless steel tubing (inner ø 9)	7	filter ø 47			11	Insulation
3	sampling probe	8	thermocouple pocket			12	M12 threaded end for nozzle attachment
4	heater band						
5	0-ring seals						

NOTE The sample nozzle, probe and filter housing material is stainless steel.

Figure A.3 — Suggested arrangement − Filter housing

Annex B
(normative)

Design criteria for solutions to prevent back burning

Table B.1 — Design criteria for solutions to prevent back burning

number	Prevention of thermal conductance	Prevention of back flow	Prevention of fire propagation	Independent on power supply	Accepted Solution	Detailed criteria to fulfil the requirements as common accepted solution
	4.3.3.2	4.3.3.3	4.3.3.4	4.3.3.1	**according to**	
1	YES	NO	YES	YES	Extinguishing device using the medium water	The extinguishing device shall provide an adequate distribution of the water across the cross section; the amount of available water shall be ≥ 0,1 litre per kW of nominal heat output and ≥ 5 litres; if the amount of water is less than two times the volume of the stoking device, a permanent connection to the water supply shall be provided; the extinguishing device shall react in combination with an STB according to EN 14597 (STW + non volatile lockout function) reacting at ≤ 95 °C; water is not accepted for coal fired boilers.

Table B.1 *(continued)*

number	Prevention of thermal conductance	Prevention of back flow	Prevention of fire propagation	Independent on power supply	Accepted Solution	Detailed criteria to fulfil the requirements as common accepted solution
	4.3.3.2	4.3.3.3	4.3.3.4	4.3.3.1	**according to**	
2	YES	NO	YES	NO	Emergency discharge device operating automatically.	Automatic discharge activated by STB according to EN 14597 (STW + non volatile lockout), reacting at a temperature ≤ 85 °C or an increase of Δt = 20 K compared to normal operation (maximum 95 °C) emptying the stoking device without over filling the boiler.
3	YES	NO	NO	NO	A stoking device which is cooled by a water circuit and the temperature of the water is limited by a cut out (e.g. water circuit is part of boiler circuit).	Maximum water temperature set at 95 °C, limited by a separate STB or the STB of the boiler in a closed water circuit.
4	YES	NO	YES	YES	An extinguishing device directly in the hopper e.g. water sprinkler system and a STB adjusted to a maximum of 95 °C.	The extinguishing device shall provide an adequate distribution of the water across the cross section; a permanent connection to the water supply shall be provided; the extinguishing device shall react in combination with a STB according to EN 14597 (STW + non volatile lockout function) reacting at ≤ 95 °C.
5	YES	NO	NO	YES	Sufficient insulation of the hopper from hot parts of the boiler.	Insulation shall be made of non-combustible material.

Table B.1 *(continued)*

number	Prevention of thermal conductance	Prevention of back flow	Prevention of fire propagation	Independent on power supply	Accepted Solution	Detailed criteria to fulfil the requirements as common accepted solution
	4.3.3.2	4.3.3.3	4.3.3.4	4.3.3.1	**according to**	
6	YES	NO	NO	YES	Naturally ventilated space between hopper and boiler body (separate casing).	Requirement shall be fulfilled in combination with test in 5.16.4 without mechanical support.
7	NO	YES	YES	YES	Safety device to maintain a continuous seal between the stoking device and the fuel line.	Safety device continuously operating, with a leakage of 1 % of the nominal flue gas flow rate (or 1 m^3/h up to 70 kW) at ambient temperature and a pressure difference of (5 Pa + any permissible positive pressure in the combustion chamber of the boiler); a free cross section and sufficient space to operate safety device without any disturbance by the fuel (normal operation, shut down, overload.
8	NO	YES	YES	YES	Safety device to maintain a seal between the stoking device and the fuel line not during the supply of fuel, but during all other states of operation.	Safety device (not continuously operating), with a leakage of 1 % of the nominal flue gas flow rate (or 1 m^3/h up to 70 kW) at ambient temperature and a pressure difference of 5 Pa in state of operation; only allowed for boilers designed for operation with negative pressure in the combustion chamber; sufficient space to operate the safety device without any disturbance of fuel (normal operation, shut down, overload).

Table B.1 *(continued)*

number	Prevention of thermal conductance	Prevention of back flow	Prevention of fire propagation	Independent on power supply	Accepted Solution	Detailed criteria to fulfil the requirements as common accepted solution
	4.3.3.2	4.3.3.3	4.3.3.4	4.3.3.1	**according to**	
9	NO	YES	YES	YES	Tight fuel hopper lid in combination with pressure equalization and interlock switch.	Tight fuel hopper lid in combination with pressure equalization that works during normal operation and in case of start up, shut down or power loss. Diffusion of hot gasses into the hopper shall be avoided by a connection for pressure equalization between the combustion air supply and the fuel hopper. The dimension of the connection shall only be sufficient to equalize pressure not to accelerate fire propagation. Hopper lid shall be fitted with an interlock switch (according to H27 of EN 60730-2-5) which stops combustion air supply in case of an open lid. The pressure equalization shall be reached without mechanical support (i.e. fan assistance).
10	NO	YES	YES	YES	Tight fuel hopper lid in combination with negative pressure operation of the boiler, inclined auger and an interlock switch.	Tight fuel hopper lid in combination with negative pressure operation of the boiler. Diffusion of hot gasses into hopper shall be avoided by natural draught (e.g. inclined auger). Hopper lid shall be fitted with an interlock switch (according to H27 of EN 60730-2-5) which stops combustion air supply in case of an open lid. Minimum inclination 30°, minimum height difference 20 cm.
11	NO	YES	YES	YES	Use of directed flow to create stable pressure conditions.	Use of directed flow to create stable pressure conditions, e.g. injector, safety device class B according to 4.3.1 to control fan rotation of supply fan or relevant pressure, which stops the fuel supply in case of failure. The closing of the fuel line shall be achieved by a inclined auger or tight sealing (technical conditions as described in solution number 7 or 8 or 12).

Table B.1 *(continued)*

Number	Prevention of thermal conductance	Prevention of back flow	Prevention of fire propagation	Independent on power supply	Accepted Solution	Detailed criteria to fulfil the requirements as common accepted solution
	4.3.3.2	4.3.3.3	4.3.3.4	4.3.3.1	**according to**	
12	NO	YES	YES	YES	Inclined auger in combination with a fuel transport slide into the combustion chamber.	Only for boilers ≤ 70 kW Inclination minimum 30° Minimum height fuel transport slide: 150 mm ≤ 15 kW 250 mm > 15 kW ≤ 70 kW
13	NO	NO	YES	YES	Drop chute without any safety device and minimum height.	Only for pellet boilers up to 300 kW minimum height 150 mm ≤ 15 kW 250 mm > 15 kW ≤ 70 kW 300 mm >70 kW ≤ 300 kW

Annex C
(informative)

A-deviations

C.1 General

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

This European Standard falls under Directive 2006/42/EC Machinery Directive.

NOTE Where standards fall under EU Directives, it is the view of the Commission of the European Union (OJ No C 59, 1982-03-09) that the effect of the decision of the Court of Justice in case 815/79 Cremonini/Vrankovich (European Court Reports 1980, p. 3583) is that compliance with A-deviations is no longer mandatory and that the free movement of products complying with such a standard should not be restricted except under the safeguard procedure provided for in the relevant Directive.

[SOURCE: CEN/CENELEC IR Part 2:2002, 2.17]

A-deviations in an EFTA-country are valid instead of the relevant provisions of the European Standard in that country until they have been removed.

C.2 Deviations from Austria:

C.2.1 General

Subclause 4.4.2

Figure 1: Boiler efficiency

Subclause 4.4.7

Table 6: Emission limits

EN 303-5 disagrees with the Austrian law (agreement according to Art 15a B-VG relating the placement of small burners on the market and the testing of firing systems and combined heating and power stations, October 2009). Small burners may only be put into circulation if the requirements of the following agreement are fulfilled.

Austria has stricter limits relating to boiler efficiency and emissions. For this reason, the following A-deviation is necessary:

C.2.2 Boiler efficiency for nominal heat output and minimum heat output

Table C.1 — Boilers

Boiler	Minimum efficiency in percent
Heating boilers for solid fuels	75

Table C.2 — Central heatings used for solid fossil and standardized biogenous fuels according to the nominal heat output

Boiler	Minimum efficiency %
a) manually loaded	
up to 10 kW	79
> 10 to 200 kW	(71,3 + 7,7 log P_n)
> 200 kW	89
b) automatically loaded	
up to 10 kW	80
> 10 to 200 kW	(72,3 + 7,7 log P_n)
> 200 kW	90
NOTE P_n is the nominal heat output (Q_N in this standard).	

C.2.3 Emission limits

Sub-clause 5.8

Observation of the emission limits for solid fuels at nominal load and at minimum partial load, as specified by the manufacturer, shall be verified.

These limits shall be proved at minimum partial load as specified by the manufacturer, not to exceed 50 % of nominal heat output for manually loaded small burners and 30 % of nominal heat output for automatically loaded small burners.

Exceptions: manually loaded small burners

a) For manually loaded small burners with a nominal heat output below 8 kW, the limit shall be proved only at nominal load.

b) If the verification cannot be proved at the lowest partial load as specified by the manufacturer, the installation of a buffer tank shall be declared on the type plate and in the technical documentation.

Exceptions: automatically loaded small burners

c) For automatically loaded central heatings with a nominal heat output below 10 kW combined with a buffer tank, the emission limits and the efficiencies shall be proved only at nominal load. This shall be declared by the manufacturer on the type plate and in the technical documents.

d) For room heaters and central heatings for wood pellets with a nominal heat output below 8 kW, the minimum partial load shall be proved at a heat output of 2,5 kW.

Table C.3 — Small burners used for solid fuels manually loaded

	Emission limits mg/MJ					
	Wooden fuels		Other standardised biogenous fuels		Fossil fuels	
Parameter	Room heaters	Central heaters	< 50 kW nominal heat output	> 50 kW nominal heat output	< 50 kW nominal heat output	> 50 kW nominal heat output
CO	1100	500	1100	500	1100	500
NO_x	150	150/100[a]	300	300	100	100
OGC	80/50[a]	50/30[a]	50	30	80	30
Dust	60/35[a]	50/30[a]	60/35[a]	60/35[a]	50/35[a]	50/35[a]

[a] Values applying as from 1.1. 2015.

Table C.4 — Small burners used for solid fuels automatically loaded

Parameter	Emission limits mg/MJ			
	Wood pellets Room heaters	Wood pellets Central heaters	Other wooden fuels	Other standardised biogenous fuels
CO	500[a]	250[a]	250[a]	500[a]
NO_x	150/100[b]	150/100[b]	150 / 100[b]	300
OGC	30	30/20[b]	30	30/20[b]
Dust	50/25[b]	40/20[b]	50 / 30[b]	60 / 35[b]

[a] The limit value can be exceeded by 50 % during partial load operation at 30 % of nominal output.
[b] Values applying as from 1.1. 2015.

For systems with a nominal heat output above 50 kW that are subject to trade law, the requirements of the regulation for firing systems shall be fulfilled.

C.3 Deviations from CROATIA

Clause 4.4.7
Table 6: Emission limits

The emission limits are regulated in Chapter VII., Article 107, 108, 109, and 111 of Croatian Regulation About Maximum Emission Values of Pollution Components from Stationary Sources, (GVE - NN 21/2007).

Boilers operated with solid fuels shall be put into operation if they fulfil the following specifications of the Regulation: Emission limits for Croatia.

Table C.5 — Maximum heat losses by combustion products

Nominal heat output, kW	Heat losses, %
100 - 1000	17

Table C.6 — Emission limits for solid fuels[a]

Nominal heat output, kW	CO mg/m3 at 7% O_2 for coal 11 % O_2 for wood and biomass
100 - 1000	1000
[a] Emissions are referred to dry exit flue gas, 0 °C, 1013,3 mbar.	

Limits for flue gas darkness: No. 1 according to the Ringelmann scale.

C.4 Deviations from DENMARK

C.4.1 Sub-clause 4.4.2 Boiler Efficiency

According to the Danish Construction Code BR08, Clause 8.5.1.4, Sub-clause 7, boilers for coal, coke, bio fuel or biomass shall have an efficiency equivalent to Class 3 in EN 303-5.

η = 67 + 6 log Q_N

For boilers above 300 kW, the requirement corresponding to 300 kW shall be used.

C.4.2 Sub-clause 4.4.7 Emission Limits

According to the Danish EPA Statutory Order no. 1432 of 11/12/2007, only Class 3 (or higher) is acceptable for Denmark.

Table C.7 — Emission limits for Denmark

Stoking	Fuel	Nominal heat output	Emission limits[a]		
			CO	OGC	Dust
			mg/m^3 at 10 % O_2		
			class	class	class
		kW	3	3	3
manual	biogenic	≤ 50	5 000	150	150
		> 50 to 150	2 500	100	150
		> 150 to 300	1 200	100	150
	fossil	≤ 50	5 000	150	125
		> 50 to 150	2 500	100	125
		> 150 to 300	1 200	100	125
automatic	biogenic	≤ 50	3 000	100	150
		> 50 to 150	2 500	80	150
		> 150 to 300	1 200	80	150
	fossil	≤ 50	3 000	100	125
		> 50 to 150	2 500	80	125
		> 150 to 300	1 200	80	125
[a] Refering to dry exit flue gas, 0 °C, 1 013 mbar.					

C.4.3 Sub-clause 5.1 Test Base

According to the Danish EPA Statutory Order no. 1432 of 11/12/2007, the type test shall be carried out by a laboratory which is accredited under the European cooperation for Accreditation (EA).

C.4.4 Clause 8 Technical documentation, supplied with boiler

According to the Danish EPA Statutory Order no. 1432 of 11/12/2007, a test certificate shall accompany the boiler and a copy shall be signed by the local chimney sweeper.

C.5 Deviations from Germany

C.5.1 Clause 4.4.7 Emission limits

Table 7 Emission limits

The emission limits are regulated in Chapter 2, paragraphs 4, 5 and Annex 2 of the German Immission Control Ordinance "Erste Verordnung zur Durchführung des Bundes-Immissionsschutzgesetzes (Verordnung über kleine und mittlere Feuerungsanlagen - 1. BImSchV)".

Boilers operated with solid fuels shall only be installed, possess the quality and be put into operation if they fulfil the following specifications of the 1. BImSchV:

Table C.8 — Emissions for boilers operated with solid fuels shall not exceed the following limits from the given dates on:

	Fuel acc §3 article 1	**Nominal output range** kW	**Dust** g/m³	**CO** g/m³
Stage 1: appliances, which will be installed after the 22.03.2010	Number 1 to 3a	≥ 4 ≤ 500	0,09	1,0
		> 500	0,09	0,5
	Number 4 to 5	≥ 4 ≤ 500	0,10	1,0
		> 500	0,10	0,5
	Number 5a	≥ 4 ≤ 500	0,06	0,5
		> 500	0,06	0,5
	Number 6 to 7	≥ 30 ≤ 100	0,10	0,8
		> 100 ≤ 500	0,10	0,5
		> 500	0,10	0,3
Stage 2: appliances, which will be installed after the 31.12.2014	Number 1 to 5a	≥ 4	0,02	0,4
	Number 6 to 7	≥ 30 ≤ 500	0,02	0,4
		> 500	0,02	0,3
	Number 8 to 13	≥ 4 < 100	0,02	0,4
NOTE Differing from sentence 1 for firing systems (appliances) which will exclusively be fired by fuels according §3 article 1 Number 4 in the form of split logs, the limits according Stage 2 apply for firing systems (appliances) when they will be installed after the 31.12.2016.				

The fuels mentioned in column 2 are described in §3 of the 1.BImSchV:

a) In firing systems (appliances) according to §1, only the usage of the following fuels is allowed:

1. anthracite, not tar bonded anthracite briquette, anthracite coke;

2. lignite, lignite briquettes, lignite coke;

3. peat, peat pellets;

3a. barbeque charcoal, barbeque charcoal briquettes (according to DIN EN 1860, version September 2005);

4. natural finished lumpy wood (including adhered bark), in particular in the form of split logs and wood chips, as well as brush-wood and cones;

5. natural finished non-lumpy wood, in particular in the form of saw dust, shavings and abrasive dust, as well as bark;

5a. pellets from natural finished wood in form of wood briquettes according to DIN 51731 version October 1996, or in form of wood pellets according to the requirements for the fuels under the DINplus certification program DIN 51731-HP 5 "wood pellets for the usage in small firing installations according to DIN 51731-HP 5", version August 2007, as well as other wood pellets out of natural finished wood of the same quality;

6. coated, varnished or laminated wood as well as the remains, as far as no wood preservative has been applied or is contained due of a treatment and the laminates do not contain halogens in organic bonding or heavy metals;

7. plywood, chipboards, fibreboards or otherwise glued wood as well as the remains, as far as no wood preservative has been applied or is contained due to a treatment and the laminates do not contain halogens in organic bonding or heavy metals;

8. straw and similar herbal substances, corn not used for foodstuffs such as grain and bevelled grain punches, total grain plants, grain strip waste, husk and corn stalk remains, as well as pellets out of the aforementioned fuels;

9. heating oil, extra light (Heizöl EL) according to DIN 51603-1, version August 2008, as well methanol, ethanol, natural finished vegetable oil or rapeseed methyl ester;

10. gases of the public gas supply, natural finished gas or petroleum gas with comparable contents of sulphur as well as liquefied gas of hydrogen;

11. sewer gas with a volumetric content of sulphur compounds up to 1 per mill, stated as sulphur, or biogas out of agriculture use;

12. coke oven gas, mine damp, steel gas, blast furnace gas, refinery gas and synthetic gas with a volumetric content of sulphur compounds up to 1 per mill stated as sulphur; or

13. other renewables, as far as these fulfil the requirements of paragraph 5.

b) The mass content of sulphur of the named fuels in paragraph 1 numbers 1 and 2 shall not exceed one percent of the raw substance. For anthracite briquettes or lignite briquettes this requirement is fulfilled if, by a special pre-treatment, an equal limitation of the emissions of sulphur dioxide in the combustion components is assured.

C.5.2 Clause 5.9

Determination of the emission values: Annex 2 of the 1. BImSchV is valid.

C.6 Deviations from Switzerland

Clause 4.4.7, Table 7

The emission limits are regulated in Annex 4 of the Swiss Ordinance on Air Pollution Control ([OAPC] SR 814.318.142.1) of 1985-12-16 (as at 2010-07-15).

Boilers operated with woody biomass shall only be put on the market if they fulfil the following specifications of the OAPC:

— declarations of conformity (Figure 20 OAPC);

— Figures 1, 212, 23 Annex 4 OAPC;

— Figures 31, 32 Annex 5 OAPC.

Emissions for boilers operated with coal or wood fuels shall not exceed the following limits:

Table C.9 — Emission limits (from Annex 4 Figure 212 OAPC)

Type of installation	According to the norm	Particular requirements (emission limits)[a] for carbon monoxide (CO) and particulate matter (Dust)
Boilers for log wood and boilers for coal, manual stoking	EN 303-5 or EN 12809	CO: 800 mg/m^3 dust: 50 mg/m^3
Boilers for chipped wood and boilers for coal, automatic stoking	EN 303-5 or EN 12809	CO: 400 mg/m^3 dust: 60 mg/m^3
Boilers for wood pellets, automatic stoking	EN 303-5 or EN 12809	CO: 300 mg/m^3 dust: 40 mg/m^3
[a] Referred to oxygen basis: – for boilers for natural state wood 13 % volume; – for boilers for coal 7 % volume.		

The sulphur content of coal, coal briquettes and coke shall not exceed 3 %.

Boilers operated with non-woody biomass shall comply with the following specifications of the OAPC:

— Figures 741, 742, 743 Annex 2 OAPC;

— Figures 81, 82 Annex 3 OAPC.

According to Figure 743, Annex 2 OPAC, non-woody biomass, such as biogenic waste and products from agriculture, may only be burnt in boilers with a heat input of at least 70 kW. Such units need an approval and shall meet stronger emission limits according to Figure 742, Annex 2 OAPC.

C.7 Deviations from United Kingdom

Clause 4.4.7 and Table 6 in revision of EN 303-5

The Clean Air Act 1993 lays down legislative requirements regarding emissions from solid fuels and solid fuel fired appliances in Great Britain; similar legislation (the Clean Air Order 1981) covers Northern Ireland. The requirements of these instruments are more stringent than those in EN 303-5. The UK Government at this time does not envisage a change to its current legislation or to a lowering of its standards in this respect. The UK therefore requires an A-deviation for Clause 4.4.7 and Table 7 of this standard.

The emission requirements stated in EN 303-5 conflict with UK law in that Section 1 (1) of the UK 1993 Clean Air Act states "Dark smoke shall not be emitted from a chimney of any building, and if, on any day, dark smoke is so emitted, the occupier of the building shall be guilty of an offence." In applying this general regulation to domestic dwellings, the Clean Air Act 1993 gives local authorities the power to designate Smoke Control Areas within which it is an offence to emit smoke. The 1993 Act in Section 20(4) (prohibition of smoke emissions in smoke control area) states "... it shall be a defence to prove that the alleged emission of smoke was not caused by the use of any fuel other than an authorised fuel."

In assessing an Authorised Fuel, the Minister has stated that one of the conditions to be satisfied is that the fuel when tested in an Open fire in accordance with BS 3841 shall not emit more than 5 g/h of solid particle matter. Once authorised by The Secretary of State, the fuel may then be burned in any domestic heating appliance without further assessment of its use on a specified appliance.

Additionally, Section 21 of the 1993 Act states "The Secretary of State may by order exempt any class of fireplace, upon such conditions as he may specify in the order, from the provisions of Section 20 (prohibition of smoke emissions in smoke control area), if he is satisfied that such fireplaces can be used for burning fuel other than authorised fuels without producing any smoke or a substantial quantity of smoke".

In assessing a domestic fireplace (i.e. stove, room heater or boiler etc.) for exemption to allow use in smoke control areas, the tests and emission guidelines of BS PD 6434 (covering domestic appliances of up to 45 kW nominal output) are employed. The tests and guidelines cover the measurement and evaluation of the desirable limits of emissions of solid particles at high, intermediate and low output and under conditions of misuse to ensure compliance under all possible continuously operating conditions and outputs.

When assessing commercial and industrial appliances (generally having nominal outputs greater than about 250kW), the smoke requirements stated in Schedule 1 of The Clean Air Act (Emissions of Grit and Dust from Furnaces) Regulations 1971 is employed to show compliance with the 1993 Act. In addition, where commercial and industrial appliances are installed in smoke control areas, the principles of BS PD 6434 are applied with testing at rated, low output and, where appropriate, misuse testing. Emission criteria applied include extrapolation of BS PD 6434 limits, plume visibility and an emission concentration limit under a range of operating conditions for the fuels to be burnt in them.

Section 4(2) of the 1993 Act also states "No furnace shall be installed in a building or in any fixed boiler or industrial plant unless the furnace is, so far as is practicable, capable of being operated continuously without emitting smoke when burning fuel of a type for which the furnace was designed.

The limits applied in the UK are detailed in Table C.10 below. The BS PD 6434 emission limit requirements are expressed in g/h based on heat output in accordance with the following formula: [5 + ((heat output in kW)/3)] (see also Table C.10), and the smoke emission is measured using an electrostatic precipitator arrangement which is shown diagrammatically in Figures C.1 and C.2. Therefore the class limits given in Table 6 of this European Standard are not applicable to the UK Legislation.

Table C.10 — Summary of UK Clean Air Act 1993 emission controls for solid fuel appliances

Location and appliance type	Limit	Reference
In Smoke Control Area		
Domestic, < 45 kW output	(5+ ((Output in kW)/3)) (in g/h)	5 tests at rated output, low output and, if appropriate, intermediate output. Also misuse tests. PD 6434
Non-domestic	(5+ ((Output in kW)/3)) (in g/h)	BS PD 6434 (extrapolated)
	Ringelmann Shade 1	BS 2742
	150 mg/m^3 for a dry gas at 0ºC, 101,3 kPa at stack O_2	Criterion developed based on custom and practise
Outside Smoke Control Area		
Non-domestic	As specified in Schedules 1 and 2 of Regulations for solid fuel and oil-fired furnaces. Applies to furnaces larger than about 240 kW (schedule 1) and 360 kW (schedule 2)	Grit and Dust Regulations 1971. Tests at normal loading or maximum regular loading.
	Ringelmann Shade 2	Clean Air Act 1993 (except as modified by the Dark Smoke (Permitted Periods) regulations 1958, the Dark Smoke (Permitted Periods) (Vessels) regulations 1958 and the Clean Air (Emission of Dark Smoke) (Exemption) Regulations 1969.

Clause 4.4.7 and Table 6 of EN 303-5 does not require testing or lay down particulate/smoke measurements with maximum limits for an appliance at low and intermediate output or under misuse conditions and therefore compliance with UK legislation in respect of all possible continuously operating conditions and outputs cannot be guaranteed for either domestic or commercial/industrial boilers.

The inclusion of appliances up to 500 kW output will bring some EN 303-5 appliances under other UK legislation. Appliances >400 kW rated thermal input which the manufacturer claims, in addition to the fuels covered by the scope of EN 303-5, can also burn for example other solid fuels such as biomass waste from furniture, timber processing or joinery activities[1)] are regulated in the UK. The emission limits are specified in the Secretary of State's Process Guidance Note PG1/12. The emission limits are summarised in Table C.11 below.

For these facilities, compliance with emission limits is demonstrated by continuous and/or annual compliance emission monitoring. The specified test procedure for particulate is ISO 9096.

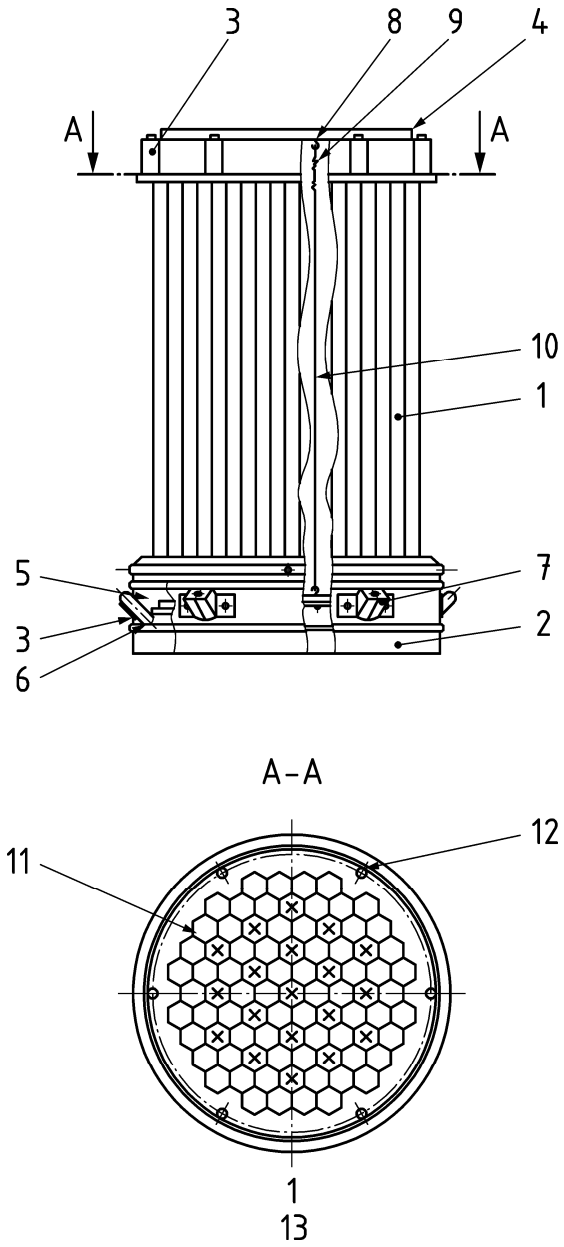
1) Process Guidance Note PG1/12 (12) : Secretary of State's Guidance for Combustion of Waste Wood February 2012, UK. Published by Defra and the Devolved Administrations and available here (accessed 20 March 2012): http://www.defra.gov.uk/environment/quality/pollution/ppc/localauth/pubs/guidance/notes/pgnotes/documents/pg1-12.pdf . Note that these are installations burning wastes which are exempt from the provisions of the EC Directive 2000/76/EC on incineration of waste.

Table C.11 — Process Guidance Note 1/12 (12) – Statutory Guidance for Combustion of Waste Wood

Substance	Limit	Comment
Total Particulate Matter	60 mg/m^3 (new plant)	66 mg/m^3 at 10 % O_2. Continuous monitoring and annual compliance test
Organic compounds	50 mg/m^3	55 mg/m^3 at 10 % O_2. Annual compliance test
Carbon monoxide	250 mg/m^3 (new plant, <1MW)	275 mg/m^3 at 10 % O_2. Continuous monitoring and annual compliance test
Oxides of nitrogen	400 mg/m^3 (new plant)	440 mg/m^3 at 10 % O_2. On commissioning
Smoke	Ringelmann shade 1	
Odour	No offensive odour beyond the site boundary	
Oxygen	Not applicable	Continuous monitoring

NOTE All limits are at 0 ºC, 101,3 kPa and 11 % O_2 unless indicated otherwise.

Clause 4.4.7 of EN 303-5 does not require continuous monitoring or lay down frequency of particulate measurements or specify the test method (ISO 9096) and therefore compliance with UK legislation cannot be guaranteed for those boilers which fall within the scope of PG1/12.



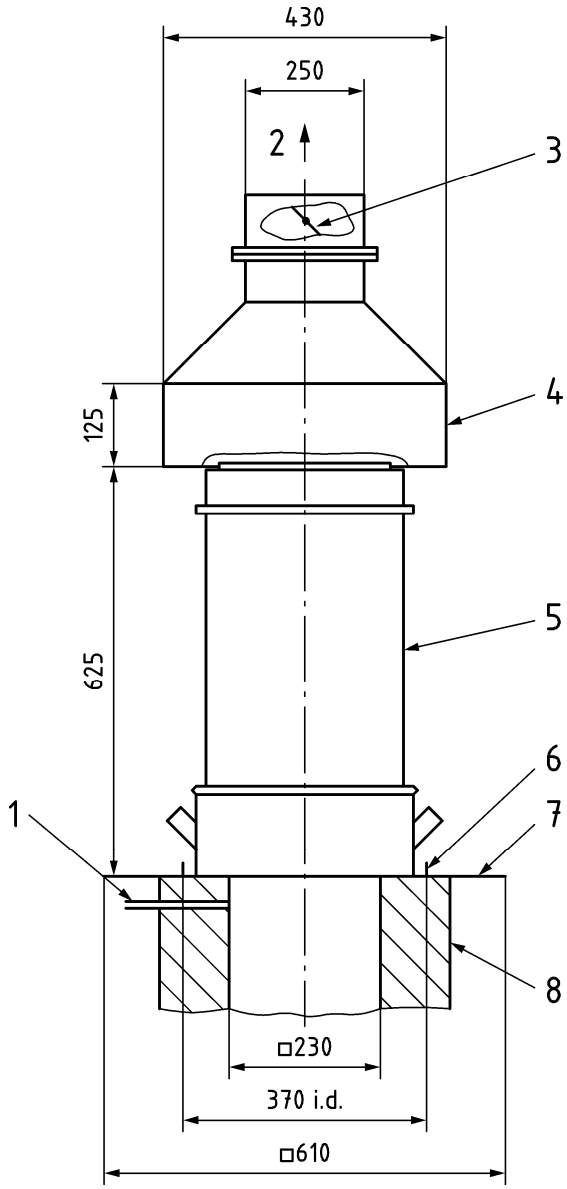
Key

1 collecting electrodes
2 skirt
3 insulators
4 upper end frame
5 lower end frame
6 inner mounting bracket
7 outer mounting bracket
8 suspension hook
9 tension spring
10 charged electrodes
11 main frame made from aluminium alloy hexagonal tubes welded at the ends to the dished and pieces
12 elevation

NOTE Tubes are omitted from positions marked x in section A-A.

Figure C.1 — General arrangement of electrostatic precipitator

Dimensions in millimetres



Key
1 pressure measuring point
2 to fan and outside air
3 drought control damper
4 hood
5 electrostatic precipitator
6 locating ring
7 base plate for safety cage
8 chimney

Figure C.2 — Electrostatic precipitator positioned for smoke collection

C.8 Deviations for Italy

Sub-clause 4.4.6

Table 6 Emission limits

EN 303-5 differs from the Italian law: Decreto legislativo n. 152 del 3 aprile 2006 "Norme in materia ambientale" (G.U. Serie generale n. 88 – 14/4/2006) (Legislative Decree n. 152 -3 April 2006 - “Regulation on environmental matter” - G.U. General n. 88 – 14/4/2006).

Therefore the following A-Deviation shall be taken into account.

Italian DLgs 152/2006, Annex IX, Part 3, Section 2 states as following:

Excerpt

Biomass heating plants shall respect the following emission limits, with regard to 1 hour running period under most required conditions:

Table C.12

Plant nominal thermal output (MW)	**>0,035 ÷ <0,15**	**> 0,15 ÷ <1**
Total Particulate Matter	200 mg/Nm^3	100 mg/Nm^3
Total Organic Carbon (COT) Carbon Monoxide (CO)		- 350 mg/Nm^3
Nitrogen Dioxide (expressed as NO_2)		500 mg/Nm^3
Sulphur Dioxide (expressed as SO_2)		200 mg/Nm^3

NOTE Emissions refer to an 11% O_2 concentration.

Concerning biomass for energy purposes, the decree allows only the use of (excerpt):

a) Vegetable material from forestry activity, forest maintenance and pruning (mainly compiles to class 1.1 in EN 14961-1:2010);

b) Vegetable material produced by exclusively mechanical processes on: untreated wood made by bark, sawdust, chips, ….(omission) not contaminated by pollutants (mainly compiles to class 1.2.1 in EN 14961-1:2010.

Moreover, Italian DLgs 152/2006, Annex IX, Part 3, Section 1 states the following limits:

Table C.13 — Italian emission limits for heating plants fuelled with non-biomass solid fuels

	6% O_2
Nominal thermal output (MW)	> 0,35
Total Particulate Matter	50 mg/Nm^3

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC Machinery Directive

This European Standard has been prepared under a mandate to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 2006/42/EC Machinery Directive.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member given State, compliance with the clauses referred to in this standard confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Table ZA.1 — Correspondence between this European Standard and Directive 2006/42/EC

Clause	Hazards	Hazardous situations or hazards events	References
1	**GENERAL PRINCIPLES** risk assessment		4.3; 5.16; Annex B
2	conditions foreseen	• normal operating conditions • foreseeable abnormal situations	4
1	**ESSENTIAL HEALTH AND SAFETY REQUIREMENTS**		4.2.4; 4.3; 5.12; 5.13; 5.14; 5.15; 5.16
1.1.2	Principles of safety integration		4.2.3; 4.3; 5.13; 5.14; 5.15; 5.16
1.1.3	Materials and products		4.1; 4.2.2; 4.2.3; 5.5.2
1.1.5	Design of machinery to facilitate its handling		4.2.3
1.1.6	Ergonomics		not relevant
1.2	**CONTROL SYSTEMS**		4.3.8; 5.13
1.2.1	Safety and reliability of control systems		4.3.8; 4.3.9; 5.13; 5.14
1.2.2	Control devices		4.3.8; 4.3.9; 5.13; 5.14
1.2.3	Starting		5.7.4
1.2.4	Stopping		not relevant
1.2.4.1	Normal stop		not relevant
1.2.4.2	Operational stop		not relevant
1.2.4.3	Emergency stop		not relevant

Table ZA.1 *(continued)*

Clause	Hazards	Hazardous situations or hazards events	References
1.2.4.4	Assembly of machinery		8.2
1.2.6	Failure of the power supply		4.3; 5.14; 5.16
1.3	Protection against mechanical hazards		4; 5
1.3.4	surfaces, edges or angles	Burning, cuts; injuries	4.2
1.3.5	combined machinery	Wrong connection	not relevant
1.3.6	variations in operating conditions	Overheating, fire, high pressure	4; 5
1.3.7	moving parts	Bruise, detach e.g. fingers	4; 5
1.4	**REQUIRED CHARACTERISTICS OF GUARDS AND PROTECTIVE DEVICES**		4
1.5.1	Electrical supply	The safety objectives set out in EN 60335-2-102 shall apply	4.3.9.2
1.5.3	Energy supply other than electricity		4.3
1.5.4	Errors of fitting	Bruise, detach e.g. fingers,	4; 5
1.5.5	Extreme temperatures	Surface temperature, temperature of control and safety devices	4.3, 5.2, 5.12; 5.7.2
1.5.6	Fire		4; 5
1.5.7	Explosion		4.3
1.5.8	Noise		4.1; 8.2
1.5.10	Radiation		not relevant
1.5.11	External radiation		not relevant
1.5.16	Lighting		not relevant
1.6	**MAINTENANCE**		4.2; 8.3
1.6.1	Machinery maintenance		4.2; 8.3
1.6.2	Access to operating positions and servicing points		4.2; 5.16
1.6.3	Isolation of energy sources		not relevant
1.6.5	Cleaning of internal parts		8.3
1.7	Information		7
1.7.1	Information and warnings on the machinery		7
1.7.2	Warning of residual risks		not relevant
1.7.3	Marking of machinery		7
1.7.4	Instructions		8

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[1] EN 12619, *Stationary source emissions — Determination of the mass concentration of total gaseous organic carbon at low concentrations in flue gases — Continuous flame ionisation detector method*

[2] EN 13526, *Stationary source emissions — Determination of the mass concentration of total gaseous organic carbon in flue gases from solvent using processes — Continuous flame ionisation detector method*

[3] EN 14789, *Stationary source emissions — Determination of volume concentration of oxygen (O_2) — Reference method — Paramagnetism*

[4] EN 14792, *Stationary source emissions — Determination of mass concentration of nitrogen oxides (NO_x) — Reference method: Chemiluminescence*

[5] EN 15036-1, *Heating boilers — Test regulations for airborne noise emissions from heat generators — Part 1: Airborne noise emissions from heat generators*

[6] EN 15058, *Stationary source emissions — Determination of the mass concentration of carbon monoxide (CO) — Reference method: Non-dispersive infrared spectrometry*

[7] EN 22553, *Welded, brazed and soldered joints — Symbolic representation on drawings (ISO 2553)*

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

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

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

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