

Water-tube boilers and auxiliary installations —

Part 7: Requirements for equipment for the boiler

ICS 23.020.01; 27.040

National foreword

This British Standard is the UK implementation of EN 12952-7:2002. Together with BS EN 12952-1:2001, BS EN 12952-2:2001, BS EN 12952-3:2001, BS EN 12952-5:2001, BS EN 12952-6:2002, BS EN 12952-10:2002 and BS EN 12952-11:2007, it supersedes BS 1113:1999 which remains current and obsolescent.

The obsolescent status means that the standard will no longer be updated. This status is given to BS 1113:1999 on the basis that there are numerous boilers throughout the world with long expectations of life that will require use of this standard for service and repair, enabling justification of continued service of the boilers.

The UK participation in its preparation was entrusted to Technical Committee PVE/2, Water-tube and shell 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.

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

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7: Exigences pour l'équipement de la chaudière

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Anforderungen an die Ausrüstung für den Kessel

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

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Foreword

This document (EN 12952-1:2002) has been prepared by Technical Committee CEN/TC 269 "Shell and water-tube 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of an identical text or by endorsement, at the latest by November 2002, and conflicting national standards shall be withdrawn at the latest by November 2002.

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

This Part of this European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential safety requirements of the Pressure Equipment Directive (PED) [1]. For relationship with Pressure Equipment Directive see informative Annex ZA, which is an integral Part of this Standard.

The European Standard EN 12952 concerning water-tube boilers and auxiliary installations consists of the following Parts:

- Part 1: General.*
- Part 2: Materials for pressure parts of boilers and accessories.*
- Part 3: Design and calculation for pressure parts.*
- Part 4: In-service boiler life expectancy calculations.*
- Part 5: Workmanship and construction of pressure parts of the boiler.*
- Part 6: Inspection during construction; documentation and marking of pressure parts of the boiler.*
- Part 7: Requirements for equipment for the boiler.*
- Part 8: Requirements for firing systems for liquid and gaseous fuels for the boiler.*
- Part 9: Requirements for firing systems for pulverized solid fuels for the boiler.*
- Part 10: Requirements for safeguards against excessive pressure.*
- Part 11: Requirements for limiting devices of the boiler and accessories.*
- Part 12: Requirements for boiler feedwater and boiler water quality.*
- Part 13: Requirements for flue gas cleaning systems.*
- Part 14: Requirements for flue gas DENOX-systems.*
- Part 15: Acceptance tests.*
- Part 16: Requirements for grate and fluidized bed firing systems for solid fuels for the boiler.*

CR 12952-17: Guideline for the involvement of an inspection body independent of the manufacturer.

Although these Parts can be obtained separately, it should be recognized that the parts are inter-dependent. As such, the design and manufacture of water-tube boilers requires the application of more than one Part in order for the requirements of the standard to be satisfactorily fulfilled.

NOTE Parts 4 and 15 are not applicable during the design, construction and installation stages.

The Annex A is normative. The Annex B of this European Standard are informative.

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

1 Scope

This Part of this European Standard specifies the requirements for equipment for steam boilers and hot water generators as defined in EN 12952-1, wherein steam or hot water will be generated. Requirements for equipment for chemical recovery boilers are given in Annex A, and design examples for hot water generating systems are given in Annex B.

2 Normative references

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

EN 837-1, *Pressure gauges — Part 1: Bourdon tube pressure gauges — Dimensions, metrology, requirements and testing.*

EN 12952-1, *Water-tube boilers and auxiliary installations — Part 1: General.*

EN 12952-6, *Water-tube boilers and auxiliary installations — Part 6: Inspection during construction; documentation and marking of pressure parts of the boiler.*

EN 12952-8, *Water-tube boilers and auxiliary installations — Part 8: Requirements for firing systems for liquid and gaseous fuels for the boiler.*

prEN 12952-9, *Water-tube boilers and auxiliary installations — Part 9: Requirements for firing systems for pulverized solid fuels for the boiler.*

prEN 12952-10, *Water-tube boilers and auxiliary installations — Part 10: Requirements for safeguards against excessive pressure.*

prEN 12952-11, *Water-tube boilers and auxiliary installations — Part 11: Requirements for limiting devices of the boiler and accessories.*

prEN 12952-12, *Water-tube boilers and auxiliary installations — Part 12: Requirements for feedwater and boiler water quality.*

prEN 12952-13, *Water-tube boilers and auxiliary installations — Part 13: Requirements for flue gas cleaning systems.*

prEN 12952-14, *Water-tube boilers and auxiliary installations — Part 14: Requirements for flue gas DE-NOX-systems.*

prEN 12952-16, *Water-tube boilers and auxiliary installations — Part 16: Requirements for fluidized bed and grate firing systems for solid fuels for the boiler.*

prEN 50156-1, *Electrical equipment for furnaces and ancillary equipment — Part 1: Requirements for application design and installation.*

3 Terms and definitions

For the purposes of this Part of this European Standard, the following terms and definitions apply in addition to those given in EN 12952-1, prEN 12952-8 and prEN 12952-9.

3.1

Types of steam boilers and hot water generators

3.1.1

natural circulation steam boilers and hot water generators

steam boilers and hot water generators in which the water to be evaporated/heated circulates due to the differences in density (see Figure B.3-1)

3.1.2

forced or assisted circulation steam boilers and hot water generators

steam boilers and hot water generators in which the water to be evaporated/heated is circulated by means of pumps (see Figure B.3-2)

3.1.3

once-through steam boilers and hot water generators

steam boilers, with or without separating vessels, where the water flow is determined by the feed pump, and the water is evaporated completely or in a major portion during one single passage

Hot water generators, where the water flow is effected by the circulating pump of the heating system and is heated during one single passage, e.g. once-through hot water generator where there is no contact between hot and cold water in the drum (two-way drum) see Figure B.3-3 once-through hot water generator with header distributing water from below, see Figures B.3-4 and B.4-9

3.1.4

waste heat steam boilers and hot water generators

generators utilizing heat recovered from outside sources, e.g. gas turbines, blast furnaces

3.2

limits of steam boilers and hot water generators

boundaries of the steam and water spaces located between the shut-off devices of the steam boilers and hot water generators in the inlet, outlet, pressure retaining, overflow, and drain lines. The bodies of the shut-off devices are considered to be within these limits

3.3

steam boilers and hot water generating plant

plant consists of the water-tube boiler and its equipment as defined in EN 12952-1

3.4

heat supply system

assembly of components in which the energy of the fuel (including electrical and waste-heat energy) is supplied to the steam boilers and hot water generator

3.5

Classification of pressure generation systems (Hot water generators)

3.5.1

internally pressurised systems

systems where the pressure is generated by the saturation pressure corresponding to the flow temperature (see Figures B.3-1, B.3-2, B.3-3, B.3-4, and Figure B.4-9)

3.5.2

externally pressurised systems

systems where the pressure is generated by such methods as gas cushion or pressure pumps (see Figures B.4-1 to B.4-8, B.4-10 to B.4-13)

3.6 **expansion system (vessel and tank)**

3.6.1 **Expansion vessels**

pressurized container to compensate temperature-dependent volume changes of the water

3.6.2 **Expansion tanks**

not pressurized container to compensate temperature-dependent volume changes of the water (see EN 12953-6).

3.7 **sinking time**

time during which the water level will sink from the lowest permissible water level (LWL) to the highest point of the heated surface (HHS) (see 4.5.2)

NOTE For hot water generators applicable only in the case of internal pressure generation; see Figures B.3-1, B.3-2, B.3-3, B.3-4, and B.3-9.

3.8 **maximum continuous rating (MCR)**

maximum continuous steam output that can be generated during continuous operation taking the specified steam condition into consideration (see EN 12953-6)

3.9 **allowable heat output**

maximum heat output (water mass flow times the difference between outlet and inlet enthalpy) that can be generated during continuous operation and at which hot water generators may be operated

3.10 **maximum allowable pressure**

maximum pressure for which equipment is designed, as specified by the manufacturer, and at a location specified by the manufacturer

NOTE This may be the location of connection of protective and/or limiting devices or the top of equipment or, if not applicable, any point specified.

3.11 **allowable flow temperature**

maximum allowable temperature at which the hot water generator may be operated

3.12 **controls**

devices used for holding the variable to be controlled (e.g. water level, pressure, temperature) at a specified value (set point)

3.13 **limiters**

device that, on reaching a fixed value (e.g. pressure, temperature, flow, water level) is used to interrupt and lock out the energy supply, and requires manual unlocking before restart (see EN 12953-6)

3.14 **fail-safe**

functional unit is fail-safe if it possesses the capability of remaining in a safe condition in the event of certain faults occurring (e.g. internal faults)

3.15 **self-monitoring**

regular and automatic determination that all chosen components of a safety device are capable of functioning as required

3.16

redundancy

provision of more than one device or system so that in the event on a fault, the necessary facilities will still be provided

3.17

independent

ability to function as required without interference from other equipment

3.18

reliability

ability to perform a required function under specified conditions and for a given period of time without failing

3.19

lock-out

isolation of the energy supply which requires a manual intervention to reinstate

3.20

unit test

individual testing of any unit(s) of the safety device

3.21

functional test

testing of the safety device to ensure it performs its intended function (see EN 12953-6)

3.22

permanent supervision

supervision during which the boiler operator stays close to the boiler, boiler room, operating platform or control room so that he has sufficient time to intervene in any dangerous condition

4 General requirements for steam boilers and hot water generators

4.1 Safeguards against excessive pressure

Each steam boiler and hot water generator shall be equipped with safeguards against excessive pressure in accordance with prEN 12952-10.

4.2 Heat supply system

4.2.1 For the heat supply of steam boilers and hot water generators the following Parts of this European Standard shall apply:

EN 12952-8 for firing systems for liquid and gaseous fuels;

prEN 12952-9 or prEN 12952-16 for solid fuels.

4.2.2 The heat supply shall be adapted to the allowable heat output as well as to the intended mode of operation.

4.3 Ash removal plants

Ash removal plant shall be in accordance with prEN 12952-9 or prEN 12952-16.

4.4 Flue-gas cleaning plants

Flue-gas cleaning plants shall be in accordance with prEN 12952-13 and prEN 12952-14.

4.5 Requirements for limiting devices and safety circuits

4.5.1 All limiters and their installation shall be in accordance with prEN 12952-11. The electrical safety circuits shall correspond to prEN 50156-1 (see safety levels given in Table 4.6.1 and Annex B).

4.5.2 Functional testing of limiters shall be possible at any time for any operating condition, e.g. by simulation where appropriate. If any part of the functional test involves delaying the cut-off and lock-out of the heat supply, then the time delay shall not exceed a value specified by the manufacturer. For boilers fitted with water level limiter, the time delay shall not exceed the time for the water level to fall from the lowest controlled water level to LWL at MCR:

- a) for steam boilers in the case of complete loss of feedwater supply and at maximum steam output, i.e.

$$t = \frac{V}{Q_{St} \cdot v_{St}}$$

- b) for hot water generators in the case of interrupted feeding and recirculation and at the allowable heat output, i.e.

$$t = \frac{V}{Q_{HW} \cdot v_{HW}}$$

where

Q_{HW} is the equivalent steam generation calculated according to the allowable heat output, in kg/s;

Q_{St} is the maximum continuous rating, in kg/s;

t is the sinking time, in s;

V is the water volume between HHS and LWL, in m³;

v_{HW} is the specific water volume, m³/kg;

v_{St} is the specific water volume at saturated steam temperature, in m³/kg.

4.5.3 The result of each limiter check shall be clearly recognizable to the boiler operator, e.g. by the lighting of a signal.

4.6 Cleaning, access and inspection openings

4.6.1 Steam boilers and hot water generators shall be provided with openings to permit cleaning and inspection of the boiler interior. Sufficient space shall be provided to permit access to the steam and water spaces and the combustion chamber as well.

4.6.2 Water or steam-containing components with an inside diameter of more than 1 200 mm and components with a diameter of more than 800 mm and a length of 2 000 mm shall be so designed as to permit internal inspection. Internals shall be of such a design as not to obstruct inspection of the component walls, or it shall be possible to remove them.

4.6.3 Headers and similar components shall be provided with adequate access for inspection of their inner surface as follows:

for inside diameters in excess of 80 mm where mud deposits can accumulate;

for inside diameters in excess of 150 mm for any other cases.

Inspection access shall be designed as head, hand or inspection holes where manual inspection methods are to be used or, as inspection nozzles where inspection devices are used e.g. endoscopes.

4.6.4 Sizes of openings in water and steam spaces shall be:

- a) Manholes shall not be smaller than 320 mm × 420 mm or have an inside diameter of at least 420 mm. The nozzle or ring height shall not exceed 300 mm, and 350 mm in the case of a tapered design. For structural or design reasons, the openings of manholes may be reduced to 300 mm × 400 mm clear width or to 400 mm inside diameter. In such cases, the nozzle or ring height shall not exceed 150 mm, or 175 mm in the case of a tapered design. For minimum number of openings see table 4.6-1;
- b) Head holes shall not be smaller than 220 mm × 320 mm or have an inside diameter of at least 320 mm. The nozzle or ring height shall not exceed 100 mm, or 120 mm in the case of a tapered design. For minimum number of openings see table 4.6-1;
- c) Hand holes shall not be smaller than 100 mm × 150 mm or have an inside diameter of at least 120 mm. The nozzle or ring height shall not exceed 65 mm, or 95 mm in the case of a tapered design. For minimum number of openings see table 4.6-1;
- d) Inspection holes shall have a diameter of 50 mm. However, they shall be provided only where a hand hole is not possible for design reasons. For minimum number of openings see Table 4.6-1;
- e) Inspection nozzles shall have an inside diameter of approximately 50 mm. They may be arranged in axial and/or radial direction as shown in Figure 4.6-1. Radial inspection nozzles may be omitted, if connecting tubes can be used in lieu of such nozzles.

Table 4.6-1 — Selection for type and minimum number of openings

Inside diameter, mm	length mm	Type and minimum number of openings required
300	—	By agreement as part of the design approval process
> 300 450	1 200	2 inspection holes at the front faces
	1 500	1 hand hole in the mid-third of cylindrical length or at one front face
	> 1 500	At least 2 hand holes, one each either near header ends or in front faces, in which case the distance between the hand holes shall not exceed 2 000 mm
> 450 800	1 500	1 hand hole in the mid-third of cylindrical length
	> 1 500 3 000	1 head hole in the mid-third of cylindrical length 2 hand holes, one each either near header ends or in front faces, in which case the distance between the hand holes shall not exceed 2 000 mm
	> 3 000	The number of the inspection holes shall be increased accordingly. In the cylinder, the greatest distance between head holes shall not exceed 3 000 mm and between hand holes shall not exceed 2 000 mm. One hand hole each shall be provided near the header ends or in the front faces.
> 800 1 200	2 000	1 head hole in the mid-third of cylindrical length or 2 hand holes near the header ends or in the front faces
	> 2 000	1 manhole
> 1 200	—	1 manhole

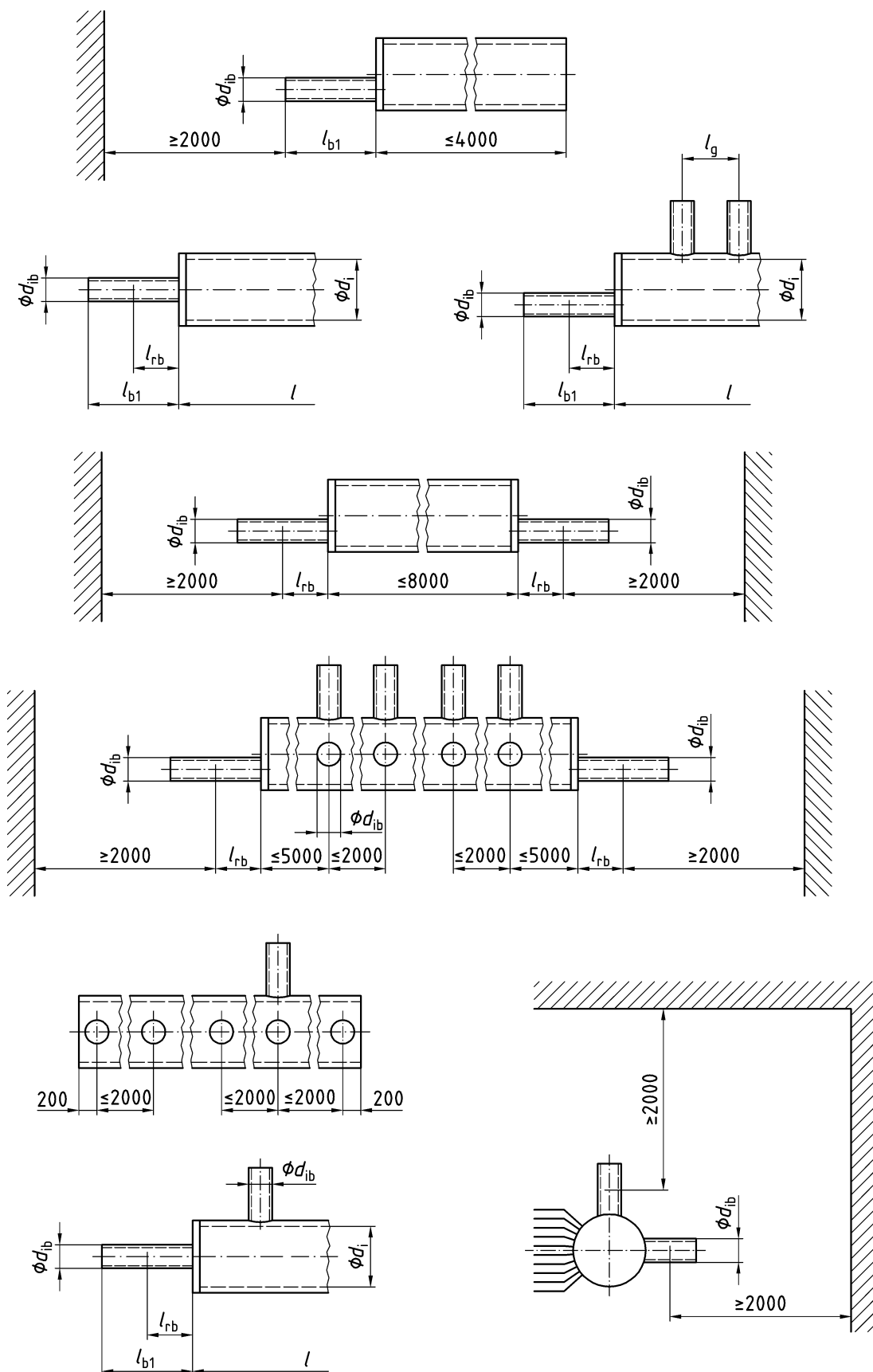


Figure 4.6-1 — Examples of arrangements of inspection nozzles

4.6.5 The following shall apply with regard to the size of openings on boiler plant spaces which are to be inspected and contain neither water nor steam:

- a) Access openings for inspection by personnel using auxiliary or personal protective equipment shall have an inside diameter of at least 600 mm. For design reasons the minimum size of access openings may be reduced to an inside diameter of 500 mm in which case the nozzle or ring height shall not exceed 250 mm;
- b) Access openings for inspection without use of auxiliary or personal protective equipment shall have a clear width of at least 320 mm 420 mm. For design reasons the minimum size of access openings may be reduced to a clear width of 300 mm 400 mm in which case the nozzle or ring height shall not exceed 150 mm, and 175 mm in the case of a tapered design;
- c) Inspection openings shall have a width of 100 mm 150 mm or an inside diameter of 120 mm.

4.6.6 Access and inspection doors of the type in which the internal pressure forces the door against a flat gasket shall have a minimum gasket bearing width of 15 mm for manholes and headholes. For handholes the gasket bearing width may be reduced to 10 mm. The total clearance between the door frame and the spigot or recess of such doors shall not exceed 3 mm, i.e. 1,5 mm all round, and the spigot depth shall be sufficient to trap the gasket.

The selection of the gasket material combined with the design of such doors shall be adequate to provide an effective and safe sealing assembly.

4.7 Feed lines and protection against feedwater backflow

4.7.1 Each feed line leading to the steam boiler or hot water generator shall be equipped with a protection device against backflow and a shut-off device. If the shut-off device and the protection device against backflow are not installed in direct connection to each other, pressure relieving shall be possible for the intermediate piping section.

A single once-through steam boiler in which the heat supply is cut off automatically in the case of feedwater failure, requires neither a shut-off device nor protection device against backflow if the feed pump is of the positive displacement type where it can be ensured that no dangerous backflow can occur.

4.7.2 Except for once-through boilers, the feed line shall be connected to the steam boiler or hot water generator in such a way that, in the case of leakage of the protection device against backflow, the steam boiler cannot be drained to below the highest point of the downcomers.

4.7.3 Feed pumps shall be capable of isolation from common suction or pressure lines.

4.7.4 If there is a possibility of backflow through a feed pump, the suction line between the valve and the pump shall be designed for full pressure or appropriate devices shall be installed to exclude the danger from closing the isolating valve in the suction line.

4.8 Connection of steam boilers or hot water generators

Where a steam boiler or hot water generating plant has several steam boilers or hot water generators connected by common lines and the shut-off devices in the steam or hot water and feed lines remain permanently connected with these lines during inspection of the steam boilers or hot water generators, two shut-off devices with intermediate venting shall be installed in each line which shall be lockable in the closed position and be protected against undue actuation.

5 Special requirements for steam boilers

5.1 Requirements for pumps

5.1.1 Number of feedwater pumps

5.1.1.1 One feed pump shall suffice if the following requirements are met:

- a) In the case of failure of the feed pump power source the heat supply shall be cut off automatically;
- b) The steam boiler shall be equipped with an oil or gas firing system or the design of the heat supply system shall ensure that, upon cut-off of the heat supply, no unacceptable evaporation of the water stored in the steam boiler occurs due to the heat accumulated in the furnace and in the boiler passes. This requirement shall be deemed to have been met, if it is proved that, after cut-off of the firing system from full-load steady-state condition, the flue-gas temperature at the highest point of the heating surface (HHS) falls to a value below 400 °C before the water level has sunk from the lowest permissible water level (LWL) to 50 mm above the highest point of the heating surface (HHS).

5.1.1.2 Steam boiler that do not meet the requirements of 5.1.1.1 shall be equipped with at least two feed pumps.

5.1.2 Capacity of feedwater pumps

5.1.2.1 The feed pump capacity shall correspond at least to 1,25 times the allowable steam output of all steam boilers. For safety reasons 1,15 times of maximum continuous rating is enough. For availability and difference in service conditions a greater margin can be necessary.

For once-through steam boilers a feed pump capacity of at least equal to 1,0 times the maximum continuous rating can suffice.

Where boiler water is constantly blown down in volumes exceeding 5 % of the allowable steam output, the feed pump capacity shall be increased by the corresponding percentage, e.g., if the blow down is 8 % of the allowable steam output, the feed pump capacity shall be increased by 8 %.

5.1.2.2 The feed pumps shall be capable of supplying to the steam boiler both the feedwater quantities at maximum allowable pressure as specified in 5.1.2.1 and the feedwater quantity corresponding to the allowable steam output at 1,1 times the allowable working pressure.

If it is proved that the pressure relief devices are capable of discharging the steam generated in the case of excess of the allowable working pressure by less than 10 %, a correspondingly lower factor than 1,1 can be used in the calculation.

5.1.2.3 If at least two feed pumps are required according to 5.1.1.2, the following shall apply:

- a) In the case of failure of the feed pump with the highest capacity, the remaining feed pumps shall meet the requirements of 5.1.2.1 and 5.1.2.2;
- b) Two independent power sources shall be available. By exception, steam operation of all feed pumps from only one steam main shall be permissible. The feed pumps shall be connected to the power sources in such a way that in the case of failure of one power source the remaining feed pumps shall meet the requirements of 5.1.2.1 and 5.1.2.2. Where the pumps are electrically driven one line per feed pump drive can suffice if the line can be switched over to the bus bars;
- c) In the case of steam boiler plant of a unitized arrangement, it shall be permitted to rate the second feed pump for 0,5 times the allowable steam output if it is ensured that in the case of failure of the feed pumps rated for the allowable steam output, the heat supply system is, at the same time, automatically adjusted to the reduced steam output. If water is blown down, the quantity of blow down water shall be fully considered when rating the second feed pump;

- d) For natural and assisted circulation steam boilers, the stand-by pump shall have been put into operation within the sinking time if the operating pump fails, or if the water level has sunk below the lowest water level (see 4.5.2);
- e) In the case of once-through steam generators, the stand-by pump shall have been put into operation, within a time interval to be specified by the manufacturer, if the operating pump fails, or if the flow through the steam boiler has fallen to below the minimum flow required, thus ensuring that an inadmissible excess of the temperature is avoided.

5.1.2.4 No specific margins need to be met by feed pumps regarding the volume flow and the pump head if two water level limiters cut off and lock out the heat supply in the event of the water level falling below the predetermined lowest permissible water level, and upon cut-off of heat supply, the heat accumulated in the furnace and in the boiler passes does not lead to an unacceptable evaporation of the water contained in the steam boiler.

5.1.3 Circulating pumps

5.1.3.1 For forced circulation steam boilers one circulating pump shall suffice if:

- a) in the case of failure of the power source for the circulating pump, the heat supply is cut off and the requirements of 5.1.1.1 b) are met;
- b) the steam boiler is only heated with gases not exceeding a temperature of 400 °C or if it is proved that higher temperatures can be withstood without danger.

5.1.3.2 Forced circulation steam boilers not corresponding to 5.1.3.1 shall be equipped with at least two circulating pumps. A common standby circulating pump can suffice for several forced circulation steam boilers of one steam boiler plant, if it can be connected to each steam boiler.

5.1.3.3 An alarm system shall become effective in the case of failure of one circulating pump and whenever the flow rate in the circulation system has fallen to a specified minimum value.

5.1.3.4 For the power sources of the circulating pumps 5.1.2.3 b) shall apply.

5.2 Isolating and drain devices

5.2.1 Each steam boiler shall be provided with sufficient devices by which it can be positively isolated from the system. Except in the case of unitized arrangements such devices shall be located as close as possible to the steam boiler.

Where duplicate isolating devices are installed in series, but not adjacent to each other, the intervening tubework shall be provided with means for venting and condensate removal.

5.2.2 Steam boilers shall be equipped with drains. Such drains and the nozzles thereof shall be protected against the effects of combustion gases. Self-closing blowdown devices shall be capable of being locked manually in the closed position unless a further shut-off device is installed in the line.

5.2.3 Automatic devices by which the water level may be lowered to below LWL (see 5.3) shall only be used if the following requirements are met.

The steam boiler shall be equipped with oil or gas firing system or the design of the heat supply system shall ensure that no unacceptable evaporation of the water inside the steam boiler occurs due to the heat accumulated in the boiler passes upon cut-off of the heat supply.

5.3 Lowest permissible water level (LWL)

5.3.1 For all steam boilers except once-through steam boilers, the lowest permissible water level (LWL) shall be determined and shall be permanently marked on the boiler.

5.3.2 The lowest permissible water level (LWL) shall be at least 150 mm above:

the uppermost heated point of the drum and;

the highest connection of the downcomers (top edge) to the boiler drums.

In the case of two-drum boilers with an evaporator tube bundle between them, the outer tubes shall not be considered as downcomers.

5.3.3 If 5.1.1.1b) applies the water level indicating device shall be so arranged as to make the value "50 mm above HHS" visible.

5.4 Water level and flow indicators

5.4.1 All steam boilers, except once-through steam boilers, shall be provided with at least two devices (e.g. glass water gauge) which make the water level to be maintained during operation clearly visible from the boiler control room. One glass water gauge may be replaced by:

- a) either two remote water level indicators;
- b) or a water level controller or limiter indicating the water level at least indirectly. An indication of the limit values for safety-relevant water level is sufficient.

A glass water gauge located at the water level controller or limiter shall be considered a direct-reading water level indicator.

In case a) the glass water gauge need not be in the field of vision of the boiler operator responsible for the feedwater.

5.4.2 The connecting tubes between the steam boiler and the local water level indicators shall have an inside diameter of at least 20 mm. If the water level indicators are connected by means of common connecting lines or if the water-side connecting tubes are longer than 750 mm, the latter shall have an inside diameter of at least 40 mm. Connecting tubes on the steam side shall be designed so that condensate does not accumulate. Water-side connecting tubes shall always be arranged horizontally to the water level indicators.

However, when reverse measuring method is used, impulse tubes to transmitters on the steam and water side shall be full of condensate and the transmitters shall be below the water level. Impulse tubes to transmitters can have a smaller inside diameter.

5.4.3 Water level indicators shall permit isolation from the steam boiler for blowdown. Where cocks are used, the open position shall be indicated.

5.4.4 During operation the water level shall always be visible. The lower limit of the indicating range of a glass gauge shall be at least 30 mm below the lowest permissible water level (LWL) (also see 5.1.1.1 b)).

5.4.5 On each glass gauge the lowest permissible water level (LWL) shall be permanently and clearly marked by the letters LWL at the height of the level mark in accordance with to 5.3.1.

5.4.6 All glass gauges shall be provided with an internal self-closing safety device. Cylindrical glass gauges shall be provided with a safety device for protection against damage by bursting glass.

5.4.7 Blowdown systems on water level indicators, controllers and limiters shall be so installed as to prevent accidents. Any blowdown operation shall be detectable.

5.4.8 Once-through steam boilers shall be equipped with at least one low-flow indicator device which will indicate water shortage to the coil. Indirect measuring methods may be used.

5.4.9 Forced circulation steam boilers shall be equipped with at least one low-flow indicator device in the circulating line.