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Shell Boilers - Part 6: Requirements for equipment for the boiler

Großwasserraumkessel - Teil 6: Anforderungen an die Ausrüstung für den Kessel

Chaudières à tube de fumée - Partie 6: Exigences pour l'équipement de la chaudière

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EUROPEAN STANDARD
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Shell Boilers - Part 6: Requirements for equipment for the boiler

Chaudières à tube de fumée - Partie 6: Exigences pour
l'équipement de la chaudière

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Ausrüstung für den Kessel

This European Standard was approved by CEN on 1 January 2011.

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Foreword

This document (EN 12953-6:2011) 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of an identical text or by endorsement, at the latest by August 2011, and conflicting national standards shall be withdrawn at the latest by August 2011.

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 12953-6:2002.

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.

Annex F provides details of significant technical changes between this European Standard and the previous edition.

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The European Standard EN 12953 (concerning shell boilers) 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: Workmanship and construction of pressure parts of the boiler*
- *Part 5: Inspection during construction, documentation and marking of pressure parts of the boiler*
- *Part 6: Requirements for equipment for the boiler*
- *Part 7: Requirements for firing systems for liquid and gaseous fuels for the boiler*
- *Part 8: Requirements for safeguards against excessive pressure*
- *Part 9: Requirements for limiting devices of the boiler and accessories*
- *Part 10: Requirements for boiler feedwater and boiler water quality*
- *Part 11: Acceptance tests*
- *Part 12: Requirements for firing systems for solid fuels for the boiler*
- *Part 13: Operating instructions*

CR 12953-14: *Guidelines for the involvement of an inspection body independent of the manufacturer.*

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

For any questions arising when using these standards the Boiler Helpdesk of CEN/TC 269 may be contacted:

<http://www.boiler-helpdesk.din.de>

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

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1 Scope

This part of this European Standard specifies the minimum requirements for safety related equipment for shell boilers as defined in EN 12953-1, to ensure the boiler operates within the allowable limits (pressure, temperature, etc.) and if the limits are exceeded the energy supply shall be interrupted and locked out without manual (human) intervention at the boiler.

NOTE 1 The maximum time of operation without manual (human) intervention should be defined for each boiler system.

NOTE 2 Annex C (informative) gives recommendations of operation and testing of the boiler system with a maximum time of operation without manual (human) intervention of 72 hours.

2 Normative references

The following referenced documents are indispensable for the application of this European Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12953-1:2002, *Shell boilers — Part 1: General*

EN 12953-2:2002, *Shell boilers — Part 2: Materials for pressure parts of boilers and accessories*

EN 12953-7:2002, *Shell boilers — Part 7: Requirements for firing systems for liquid and gaseous fuels for the boilers*

EN 12953-8:2001, *Shell boilers — Part 8: Requirements for safeguards against excessive pressure*

EN 12953-9:2007, *Shell boilers — Part 9: Requirements for limiting devices of the boiler and accessories*

EN 12953-10:2003, *Shell boilers — Part 10: Requirements for feedwater and boiler water quality*

EN 12953-12:2003, *Shell boilers — Part 12: Requirements for grate firing systems for solid fuels for the boiler*

EN 50156-1:2004, *Electrical equipment for furnaces and ancillary equipment — Part 1: Requirements for application design and installation*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12953-1:2002 and the following apply.

3.1 controls

devices used for maintaining the variable to be controlled (pressure, temperature, etc.) at a specific value (set point)

3.2 limiter

limiting device that, on reaching a fixed value (pressure, temperature, etc.) is used to interrupt and lock-out the energy supply and requires manual unlocking before restart

limiting device requires:

— measuring or detection function, and

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— activation function for correction, or shutdown, or shutdown and lockout,

and which is used to carry out safety related functions as defined in the Pressure Equipment Directive "PED" 97/23/EC [1], either on its own or as part of a protective system (e.g. sensors, limiters, etc.) (see also Figure 1)

NOTE 1 If this is achieved by multi channel systems, then all items or limiters for safety purposes are included within the protective system.

NOTE 2 Manual resetting can be realised as a part of the limiter or as a part of the safety logic. This will be achieved by the responsible operator taking into account of the physical situation.

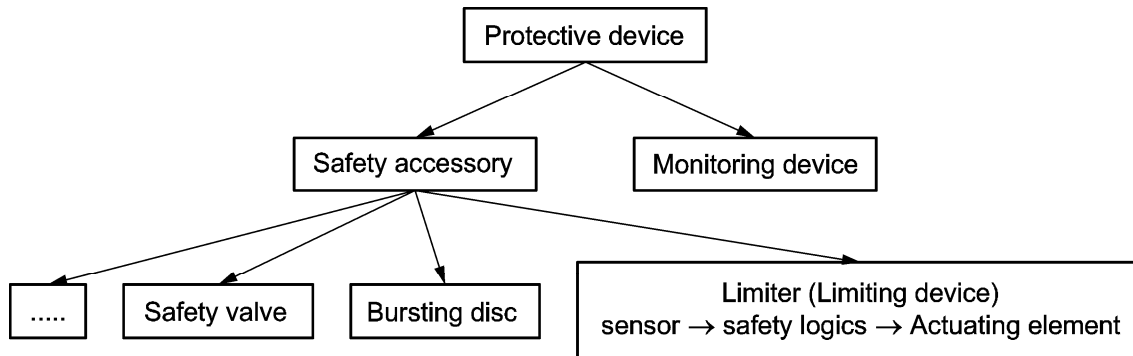


Figure 1 — Protective devices and safety accessories according to PED 97/23/EC

3.3 independent

ability to function as required without dependence upon other equipment

3.4 lock-out

safety shut-down condition of the protective system, such that a restart can only be accomplished by a manual reset of the limiter or by a manual reset of the safety logic and by no other means

3.5 functional check

testing of the safety device to ensure it performs its intended function

3.6 electrically heated steam boilers

steam boilers in which water is heated by an electric current flowing between electrodes or by immersion heaters

3.7 electrically heated hot water boilers

hot water boilers in which water is heated by an electric current flowing between electrodes or by immersion heaters

3.8 expansion vessels

containers to compensate for temperature dependent changes in water volume

— closed expansion vessels are pressurised

— open expansion vessels are vented to atmospheric pressure and are not pressurised

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 boilers can be operated

3.10**allowable flow temperature**

highest temperature, measured at the outlet branch at which the hot water boiler can be operated (see 6.5.2.3)

3.11**maximum continuous rating (MCR)**

maximum continuous steam output that can be generated during continuous operation taking the specified steam condition into consideration

3.12**internal steam cushion**

steam filled space located within the steam boiler to accommodate changes in volume

3.13**external steam cushion**

steam filled space located outside the steam boiler to accommodate changes in volume

3.14**gas cushion**

gas-filled space to accommodate changes in volume

3.15**effective heat transfer****3.15.1**

for a hot water boiler, the heat supply is on and flow of water is greater than or equal to a specified minimum value

3.15.2

for a steam boiler, the heat supply is on, the start-up or steam valve is open and the temperature is greater than the saturation temperature at ambient pressure

3.16**normal operation**

automatic operation, with all regulating circuits and controls (open loops/closed loops) in automatic mode and with the set points and parameters valid for normal operation

NOTE Normal operation also includes the automatic switching on and off of the assigned actuators (e.g. burner).

3.17**normal shut down**

controlled switch off of the boiler either operated manually or automatically

3.18**make-up water**

water which compensates for losses of water and steam from the system

3.19**feedwater**

mixture of returned condensate and/or make up water supplied to the boiler inlet

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EN 12953-6:2011 (E)**3.20****pressurization equipment**

external system for keeping the hot water system pressure within the required pressure limits

NOTE In order to prevent corrosion caused by oxygen infiltration, systems that prevent the system water being in direct contact with air should be preferred.

3.21**boiler attendant**

boiler operator

skilled person appointed for operating the boiler plant

4 General requirements for steam boilers and hot water boilers**4.1 Safeguards (safety valves) against excessive pressure**

Each steam boiler and hot water boiler, except open vented hot water boiler, shall be equipped with safeguards (safety valves) against excessive pressure in accordance with EN 12953-8.

Superheaters and economizers shall be protected in accordance with EN 12953-8. Where a superheater or an economizer can be isolated a pressure gauge connection shall be provided.

4.2 Materials for valves, fittings, flanges and bolting

The conditions and requirements to select the material shall be in accordance with EN 12953-2.

4.3 Protective systems

4.3.1 All limiters and their installation shall be designed in accordance with EN 12953-9. The protective systems shall be in accordance with EN 50156-1.

4.3.2 The application design and installation of the electrical safety circuit as well as the electrical and control equipment for the heat supply and its auxiliary equipment shall be in accordance with EN 50156-1.

A hazard analysis shall be carried out for each limiting device function and appropriate levels of functional safety implemented.

NOTE 1 Typical Safety Integrity Level (SIL) requirements for boiler protective systems are not less than 2.

NOTE 2 It should be possible to stop the boiler by additional devices outside the boiler such as shut-off valve, emergency shut-off, fire detectors, etc.

4.3.3 Functional check of all limiters shall be possible at any time during operation e.g. by simulation where appropriate in accordance with manufacturer's operating instructions (see Clause 7).

4.3.4 When a limiter activates, information shall be given to indicate which limiter has activated.

4.3.5 After lock out, the steam boiler/hot water boiler shall be physically checked by the boiler attendant (operator), before start-up (see 4.4.2).

4.4 Heat supply**4.4.1 General**

The requirements for heat supply to steam boilers and hot water boilers shall be in accordance with either EN 12953-7 or EN 12953-12 depending on fuel type.

The combustion process shall be completed within the furnace.

The heat supply shall be automatically controlled and in all operating stages rapidly adapted to the variation of the heat demand. Steam pressure influences heat demand of steam boilers and hot water boilers with internal steam cushion (see Figures A.3 and A.4). For other hot water boilers, heat demand is influenced by flow temperature (see Figures A.1 and A.2).

In the event of normal shutdown or lock out, residual heat accumulated in the furnace and flue-gas passes shall not cause unacceptable metal temperatures (e.g. by evaporation of the water) in the steam boiler/hot water boiler.

This requirement is fulfilled if it is proved that, after interruption of the heat supply from the full load steady state condition, the flue-gas temperature at the highest point of the heating surface (HHS) falls to 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).

For solid fuels it may be necessary that an additional automatic emergency cooling system shall be provided to ensure adequate cooling of the heating surfaces in case of a sudden loss of essential operational parameters (energy supply, feed water supply, combustion air or similar). The function of the emergency cooling system shall ensure that no adverse side effects can occur.

4.4.2 Start up

When a boiler is started-up after normal shutdown or lockout, the boiler attendant/operator shall be present and remain with the boiler until it is operating correctly under normal operation.

When designing the controls for the start up sequence, the manufacturer shall take account of effective heat transfer to avoid unacceptable local over heating or thermal stresses or other stresses of any pressurised parts of the boiler or parts connected to the boiler, with particular regard to the heating up sequence and flow rates. These controls may be in the form of installed control systems and/or software and/or operating instructions.

The start-up sequence shall consider as a minimum the following points which are to be defined by the manufacturer:

- lock out by i.e. limiters;
- minimum flow of water for hot water boilers to avoid over heating and to reach effective heat transfer;
- minimum temperature of water for hot water boilers to avoid corrosion;
- minimum temperature of critical parts of boilers to avoid unacceptable thermal stresses;
- steam output as a function of pressure of steam boilers to improve internal mixing (flow) and to avoid thermal stresses (effective heat transfer);
- sequence shall contain times (or pressures) and burner loads for a gentle start-up to avoid thermal stresses;
- additional heat supply requirements like i.e. maximum permitted low loads, minimum number of burner steps for stepped burner or minimum burner adjustment time between low and high load for infinitely variable burners.

4.4.3 Normal shut down

The control sequence designed for normal shutdown shall involve the low load position of heat supply before switching off the boiler.

EN 12953-6:2011 (E)**4.5 Flue-gas heated economizers**

Economizers shall be fitted with a temperature indicating device on the water outlet.

4.6 Drain and blowdown devices

4.6.1 Drain and blowdown equipment shall be installed to prevent accidents (see also Annex D).

4.6.2 Each steam boiler shall be fitted with drain lines placed at, or as near as practicable to, the lowest point of the steam boiler.

NOTE On some steam boilers, drain valves can be used for blowdown purposes.

4.6.3 Where lines from two or more steam boilers are connected to a common discharge, two valves shall be fitted to each drain line, one being of a non-return type to prevent the contents of one steam boiler passing to another.

4.6.4 The drain line between the steam boiler and the drain valve shall, if exposed to furnace heat, be protected by brickwork or other insulating material so arranged that the pipe may be inspected and is not constrained against expansion.

4.6.5 Taper-plug valves where fitted, shall be of the bolted cover type with separately packed glands and shall not be used with design pressures over 13 bar.

4.6.6 Where drain or the steam boiler blowdown valves are not self closing or capable of being locked in the closed position, a further shut-off device shall be installed in the line.

4.7 Water quality

4.7.1 The water quality shall be in accordance with EN 12953-10 and manufacturer's operating instructions.

4.7.2 It shall be possible at any time during operation to safely take reliable samples of the boiler water, feed-water, make-up water and if relevant the condensate and/or the recirculation water. Depending on the temperature of the media the samples shall be taken through one or more sample coolers.

4.8 Water quality protection**4.8.1 Steam boiler water**

The boiler water conductivity shall be continuously monitored to ensure the water quality remains within the allowable limits prescribed by the manufacturer's operating instructions and EN 12953-10.

If the limit values prescribed by the manufacturer can be exceeded, an adequate suitable device shall automatically cut off and lock out the heat supply.

NOTE The device should comply with the general requirements for limiting devices in EN 12953-9:2007, Clause 4. In addition, the suitability of the device should be verified by type testing.

4.8.2 Condensate in steam boiler plants

A hazard analysis shall be carried out to identify if there is a risk that harmful matter (e.g. oil, grease, organic material, acid, lye, seawater, hardness etc.) can enter with the condensate into the feed water system and/or into the boiler that will compromise the safety of the boiler or the operation of the limiters within the period of operation without manual intervention.

NOTE If the intermediate circuit of a double circuit system is filled with softened water, it is not considered that there is a hazard that harmful matter may enter the system.

If it is assessed in the hazard analysis that harmful matter can enter the condensate return to the feed water system, adequate monitoring shall be installed which is able to detect the contamination. If the maximum concentrations of the harmful matter as set out by the hazard analysis can be exceeded, a suitable protection method shall be used. If the method of protection is a device, which automatically interrupts the supply of, or diverts, the contaminated water from the system, or ultimately cuts off and locks-out the heat supply to the boiler, then the device shall comply with the general requirements for limiting devices in EN 12953-9:2007, Clause 4.

The monitoring shall be continuous unless justified by hazard analysis.

4.8.3 Water circulating system in hot water boiler plants

A hazard analysis shall be carried out to identify if there is a risk that harmful matter (e.g. oil, grease, organic material, acid, lye, seawater, hardness etc.) can enter the water circulating system that will compromise the safety of the boiler or the operation of the limiters within the period of operation without manual intervention.

NOTE If the intermediate circuit of a double circuit system is filled with softened water, it is not considered that there is a hazard of harmful matter entering the system.

If it is assessed in the hazard analysis that harmful matter can enter the water circulating system, adequate monitoring shall be installed which is able to detect the contamination. If the maximum concentrations of the harmful matter as set out by the hazard analysis can be exceeded, a suitable protection method shall be used. If the method of protection is a device, which automatically interrupts the supply of, or diverts, the contaminated water from the system, or ultimately cuts off and locks-out the heat supply to the boiler, then the device shall comply with the general requirements for limiting devices in EN 12953-9:2007, Clause 4.

The monitoring shall be continuous unless justified by hazard analysis.

4.8.4 Make-up water

4.8.4.1 If it is assessed that a significant change of the total hardness value in the make-up water downstream of the make-up water treatment plant or storage tanks can occur, the total hardness value of the make-up water shall be monitored automatically. In the case of demineralised make-up water the conductivity value can be monitored instead of the total hardness. If the limit values prescribed by the manufacturer are exceeded, an adequate suitable device shall automatically interrupts the supply of, or diverts, the make-up water downstream, or ultimately cuts off and locks-out the heat supply.

NOTE A significant change of the total hardness value are not necessarily the same as the limit value as stated in EN 12953-10 (total hardness < 0,01 mmol/l alt. 0,05 mmol/l).

The monitoring shall be continuous unless justified by hazard analysis.

4.8.4.2 If it is assessed that there is a risk that other harmful matter (e.g. oil, grease, organic material, acid, lye, seawater etc.) can enter the make-up water that will compromise the safety of the boiler or the operation of the limiters within the period of operation without manual intervention then a suitable monitoring system shall be installed. If the limit values prescribed by the manufacturer are exceeded, an adequate suitable device shall automatically interrupt the supply of, or diverts, the make-up water downstream, or ultimately cuts off and locks-out the heat supply.

The monitoring shall be continuous unless justified by hazard analysis.

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5 Special requirements for steam boilers

5.1 Water level indication

5.1.1 Each steam boiler shall have at least one means of indicating the water level, which shall be a gauge with an indicating column made of transparent material (the gauge glass).

5.1.2 The gauge(s) shall be mounted so that the lowest water level (LWL) and the maximum water level is visible in the gauge glass. The lowest permissible water level (LWL) shall be additionally marked on the gauge glass. The maximum water level shall be specified by the boiler manufacturer but need not be marked on the gauge glass. The water level indicating device shall be so arranged that the value "50 mm above HHS" is visible if there is a risk from accumulated heat in the furnace or in the flue gas passes.

5.1.3 The (LWL) of the steam boiler (see Figure 2), which shall be permanently and legibly marked on the steam boiler, visible at all times, and identified by the letters "LWL", shall be the greater of:

- a) 100 mm above the highest point of the heated surface "HHS"; or
- b) if the flue gas temperature exceeds 400 °C, and the steam boiler has slow acting combustion (e.g. combustion of wood or other solid fuels), a height above "HHS" shall be fixed to allow for a sinking time of not less than 7 min.

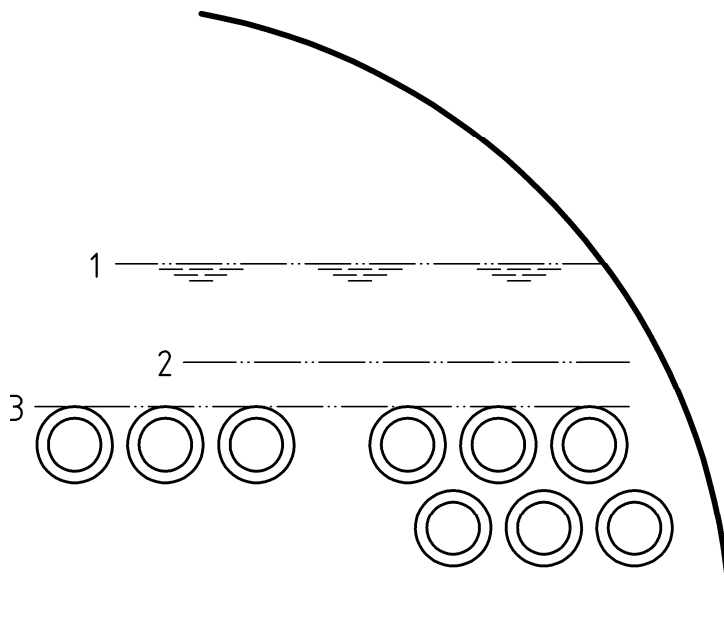
The sinking time t is the time taken for the water level to sink from the lowest permissible water level to the highest point of the heated surface in the case of complete loss of feedwater supply and at maximum continuous rating, i.e.

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$$t = V/(Q_{st} v) \quad (1)$$

where

- Q_{st} is the maximum continuous rating, in kg/min; <https://standards.iteh.ai/standards/sist/cb18217d-e02f-44c4-b6fb-508ded1db308/sist-en-12953-6-2011>
- V is the water volume of the steam boiler between LWL and HHS, in m³;
- v is the specific volume of water, in m³/kg.

**Key**

- 1 controlled water level
- 2 LWL
- 3 HHS

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Figure 2. — Water level indication
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5.1.4 All tubes and fittings connecting a water level gauge directly to a steam boiler or via an external chamber shall be as short as possible and constructed so that no undrained pocket is formed between the steam boiler and the gauge. There shall be no other outlet from this connection except for regulators, steam pressure gauges and drains or other similar apparatus which does not permit the escape of a significant amount of steam (see Figure 3).