



**BSI Standards Publication**

## **Water-tube boilers and auxiliary installations**

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Part 10: Requirements for safety devices against excessive pressure

ICS 23.060.40; 27.040; 27.060.30

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**Water-tube boilers and auxiliary installations - Part 10:  
Requirements for safety devices against excessive  
pressure**

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Partie 10 : Exigences pour la protection vis-à-vis des  
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Anforderungen an Sicherheitseinrichtungen gegen  
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## European foreword

This document (EN 12952-10:2021) 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of an identical text or by endorsement, at the latest by June 2022, and conflicting national standards shall be withdrawn at the latest by June 2022.

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

This document supersedes EN 12952-10:2002.

EN 12952 series, *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 using liquefied pressurized ammonia and ammonia water solution;*
- *Part 15: Acceptance tests;*
- *Part 16: Requirements for grate and fluidized-bed firing systems for solid fuels for the boiler;*
- *CR 12952 Part 17: Guideline for the involvement of an inspection body independent of the manufacturer;*
- *Part 18: Operating instructions.*

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 document to be satisfactorily fulfilled.

NOTE A "Boiler Helpdesk" has been established in CEN/TC 269 which may be contacted for any questions regarding the application of EN 12952 series and EN 12953 series, see the following website: <http://www.boiler-helpdesk.din.de>

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

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

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## 1 Scope

This document specifies the requirements for safety devices against excessive pressure in water-tube boilers as defined in EN 12952-1:2015.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 4126-1:2013,<sup>1</sup> *Safety devices for protection against excessive pressure - Part 1: Safety valves (ISO 4126-1:2013)*

EN ISO 4126-4:2013, *Safety devices for protection against excessive pressure - Part 4: Pilot-operated safety valves (ISO 4126-4:2013)*

EN ISO 4126-5:2013,<sup>2</sup> *Safety devices for protection against excessive pressure - Part 5: Controlled safety pressure relief systems (CSPRS) (ISO 4126-5:2013)*

EN 764-7:2002,<sup>3</sup> *Pressure equipment - Part 7: Safety systems for unfired pressure equipment*

EN 12952-1:2015, *Water-tube boilers and auxiliary installations - Part 1: General*

EN 13480-3:2017, *Metallic industrial piping - Part 3: Design and calculation*

ISO 4126-9:2008, *Safety devices for protection against excessive pressure — Part 9: Application and installation of safety devices excluding stand-alone bursting disc safety devices*

## 3 Terms and definitions

For the purposes of this document the terms and definitions given in EN 12952-1:2015, EN ISO 4126-1:2013, EN ISO 4126-4:2013 and EN ISO 4126-5:2013 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <http://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

<sup>1</sup> Document impacted by EN ISO 4126-1:2013/A1:2016 and EN ISO 4126-1:2013/A2:2019.

<sup>2</sup> Document impacted by EN ISO 4126-5:2013/A1:2016.

<sup>3</sup> Document impacted by EN 764-7:2002/AC:2006.

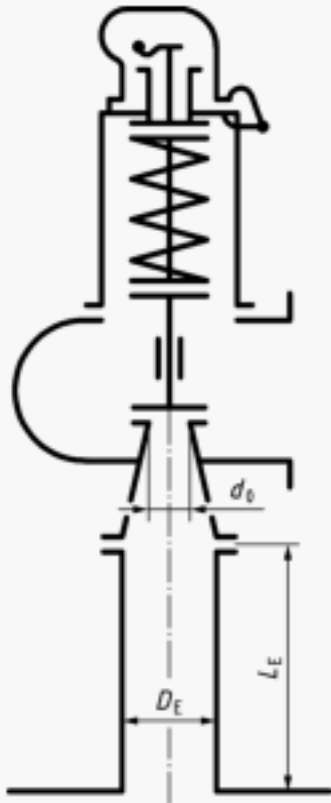


4 Symbols and abbreviations

For the purposes of this document, the symbols given in EN 12952-1:2015, Table 1 shall apply. Throughout this document, additional terminology and symbols have been included where necessary to meet the requirements of the specific text concerned (see Table 1 and Figure 1).

Table 1 — Symbols and units

| Symbol | Explanation                                | Unit |
|--------|--|------|
| $D_E$  | inlet pipe internal diameter               | mm   |
| $d_0$  | smallest flow diameter (minimum free bore) | mm   |
| $L_E$  | developed length of inlet pipe             | mm   |



Key

- $D_E$  inlet pipe internal diameter, in mm
- $d_0$  smallest flow diameter (minimum free bore), in mm
- $L_E$  developed length of inlet pipe, in mm

Figure 1 — Safety valves

## 5 Requirements

### 5.1 Steam boiler

**5.1.1** Each steam boiler and each isolatable heated compartment (e.g. reheater, superheater, economizer) shall be provided with at least one suitable safety device which shall ensure against excessive pressure. The total certified discharge capacity of all safety devices mounted on the boiler shall be at least equal to the maximum continuous rating (MCR) of the boiler. Pressure relieving devices shall be installed in accordance with relevant parts of EN 764-7:2002. The suitability of the safety device shall be demonstrated by a hot test on the assembled boiler.

The number and type of safety devices to be installed shall be specified by the manufacturer and shall meet the requirements of this clause.

At least one of the following safety devices shall be considered suitable:

- a) safety valves in accordance with EN ISO 4126-1:2013 or;
- b) pilot-operated safety valve (POSV) in accordance with EN ISO 4126-4:2013, consisting of a main valve, controlled by signals from 3 pilot valves;
- c) controlled safety pressure relief system (CSPRS) in accordance with EN ISO 4126-5:2013, consisting of a main valve, controlled by 3 redundant control paths.

In the case of safety devices in accordance with b) and c) the following shall apply:

- The safety device shall be capable of operating when the signal from only one pressure sensing line is available.
- The size and position of the pressure sensing lines shall ensure that the risk of loss of function is reduced to a minimum.

NOTE 1 The common size of sensing line is 15 mm internal diameter.

- The mechanical and electrical parts of the pilot and control unit which are used to actuate the main valves shall still be functionally fit even in the case of an assumed individual defect.
- It shall be possible to prove the reliability of the safety pressure relief device by functional testing on the plant.

It is permissible to operate more than one main valve from a single control unit.

Safety devices shall have a set pressure not exceeding the maximum allowable pressure (*PS*) of the equipment to be protected, except as permitted as follows.

The discharge capacity corresponding to the required relief capacity at maximum continuous rating of the applicable boiler parts shall be achieved without causing the pressure to be increased by more than 10 % of the maximum allowable pressure. The duration of the pressure increase up to 1,1 *PS* shall not exceed 1 h per event.

If the capacity is provided by more than one safety device, only one of the devices needs to be set at a pressure not exceeding *PS*. The other device(s) may be set at a pressure not more than 5 % in excess of *PS*. In these cases, it is necessary to use safety devices with certified overpressure lower than 10 %.

NOTE 2 More information can be found in EN 764-7:2002, Annex A.

The pressure at which a safety device is set to operate shall take into account the effect of static head, of superimposed back pressure and whether this is constant or variable.

**5.1.2** The minimum flow diameter of safety valves or main valves of POSV or CSPRS for boilers with a volume  $\leq 10$  litres shall be at least 6 mm and for volumes  $> 10$  litres shall be at least 15 mm.

**5.1.3** In the case of boilers without superheater(s) the safety valves or main valves of POSV or CSPRS shall be connected to the steam space.

If the total required discharge capacity is  $q_m$  and the steam space is simultaneously protected by  $n$  safety devices ( $n > 1$ ) the discharge capacity of each of them should be at least  $q_m/(n + 1)$ .

**5.1.4** In the case of once-through steam generators the safety valves or main valves of POSV or CSPRS shall be located at the steam outlet of the boiler.

**5.1.5** In the case of natural and forced circulation boilers with superheaters which cannot be isolated the following shall apply:

- a) Safety devices in accordance with 5.1.1 located at the superheater outlet shall be of sufficient capacity to prevent the allowable wall temperature of the superheater from being exceeded. The safety device at the superheater outlet shall be so arranged, that it is always open when the safety device on the saturated steam space opens, or alternatively, the heat source is immediately cut-out with no residual heat release allowed.
- b) Safety devices in accordance with 5.1.1 a) rated for at least 75 % or in accordance with 5.1.1 b) or c) rated for at least 25 % of the required discharge capacity shall be located at the saturated steam space of the boiler. No safety devices need to be installed at the saturated steam space if the capacity of the safety device in accordance with 5.1.1 b) or c) located at the superheater outlet corresponds to the total steam quantity to be discharged. At least one pressure signal shall be transmitted to the control unit from the saturated steam space and at least one pressure signal shall be taken from the superheater outlet.
- c) The superheater safety device shall be so set as to respond before the safety device on the saturated steam space.

**5.1.6** A superheater that can be isolated shall be equipped with at least one safety valve or main valve of POSV or CSPRS at the superheater outlet. The safety valve or main valve of POSV or CSPRS shall be rated for at least 20 % of the required discharge capacity of the boiler. The safety valve or main valve of POSV or CSPRS located on the saturated steam space of the steam generator shall in this case be rated for the maximum continuous rating. If the superheater can be isolated precautions shall be taken to prevent overheating. Superheaters that can be isolated from the saturated steam space are not allowed for boilers firing fuels with considerable residual heat release.

**5.1.7** Every reheater shall have at least one safety valve or main valve of POSV or CSPRS with a total discharge capacity of not less than the maximum steam flow for which the reheater is designed.

**5.1.8** There shall be no shut off devices between the boiler and its protective safety devices or between the safety devices and their points of discharge.

**5.1.9** Direct-loaded safety valves shall be installed in the vertical position.

Safety devices shall be safeguarded against damaging external influences, e.g. the weather, which can impair the functional capability of the safety device. The transfer of vibrations onto the safety device shall be avoided.

Safety devices where leaking fluid, e.g. due to open bonnet, can directly or indirectly endanger persons or the environment, shall be provided with suitable protective devices.

**5.1.10** The cross-section of the line leading to the safety valve or main valve of POSV or CSPRS (inlet pipe) shall not be less than the safety valve or main valve of POSV or CSPRS inlet cross-section.

The line leading to the safety valve (inlet pipe) shall be as short and straight as possible and should not be located opposite to other nozzles.

The pressure loss in the inlet pipe shall not exceed 3 % of the set pressure at the highest discharged mass flow. A blow down of the installed safety valve (difference between set and reseating pressure) of least 5 % is a prerequisite to undisturbed functioning at this pressure loss.

At a blowdown of less than 5 % the difference between the blowdown and the pressure loss in the inlet pipe shall be at least 2 % of the set pressure

For controlled safety pressure relief systems the requirements for pressure loss in the inlet pipe shall only apply if these valves operate as direct-loaded valves in the event of releasing the operating force.

For calculation of pressure losses see ISO 4126-9:2008, Annex C.

**5.1.11** The outlet pipe cross-section shall not be less than the safety valve or main valve of POSV or CSPRS outlet cross-section.

The pressure relief system shall be properly designed and installed to ensure that the required discharge capacity of the safety device is not impaired.

Outlet piping shall be designed in accordance with EN 13480-3:2017.

Safety device outlet pipes shall discharge the effluent safely. The discharge shall not be released openly inside the boiler house and shall be disposed of safely and be prevented from unintentional flowing into other equipment creating a hazard (e.g. into equipment out of service or undergoing maintenance or close to air intakes or into accessible areas).

No liquid shall be allowed to accumulate in the outlet system. Where the pipe is endangered by freezing, it shall be protected accordingly. Taking into account the local operating conditions, the pipes shall be designed to withstand the static, dynamic (reaction forces) and thermal loadings. The valve or the outlet system shall be fitted with an adequate drain and the drainage shall be led to a safe place.

The diameter and length of outlet pipes, bends, silencers etc. will determine the build-up of back pressure. These parts shall be designed so that the allowable back pressure indicated by the valve manufacturer shall not be exceeded.

Back pressures on the outlet side affecting the set pressure (gauge) and the opening forces or the mass flow shall be taken into consideration.

If the back pressure exceeds 10 % of the set pressure, or the superimposed pressure is variable, the valve manufacturer should be informed so that a suitable device can be supplied.

For calculation of pressure losses see ISO 4126-9:2008, Annex D.

Where the outlet pipe of a safety valve or main valve for POSV or CSPRS leads into a downstream system, the safety valve or main valve for POSV or CSPRS shall be so set and dimensioned so that it is capable of discharging the required mass flow at the highest possible back pressure  $p_{ao}$ , which is the sum of built up and superimposed back pressure.

**5.1.12** Safety devices shall be accessible for functional testing and maintenance.

**5.1.13** The installation instructions of the safety device manufacturer shall be taken into consideration.



## 5.2 Hot water generator

**5.2.1** Each hot water generator shall be provided with at least one suitable safety device against excessive pressure. Pressure relieving devices shall be installed in accordance with relevant parts of EN 764-7:2002.

The discharge capacity corresponding to the required relief capacity at maximum continuous rating of the applicable boiler parts shall be achieved without causing the pressure to be increased by more than 10 % of the maximum allowable pressure. The duration of the pressure increase up to 1,1 PS shall not exceed 1 h per event.

After reclosing of all safety devices, the pressure shall be less than or equal to PS.

In the case of staggered set pressure, at least one safety device shall respond if the maximum allowable pressure is reached, but all valves shall have reached their required capacity within a pressure surge of 10 % above PS.

The suitability of the safety devices shall be demonstrated by a type test.

At least one of the following safety devices shall be considered suitable, taking into account that safety devices in the water space of hot water generators shall have proportional lift characteristics:

- a) safety valves in accordance with EN ISO 4126-1:2013 or;
- b) pilot-operated safety valve (POSV) in accordance with EN ISO 4126-4:2013, consisting of a main valve, controlled by signals from 3 pilot valves;
- c) controlled safety pressure relief system (CSPRS) in accordance with EN ISO 4126-5:2013, consisting of a main valve, controlled by 3 redundant control paths.

In the case of safety devices in accordance with b) and c) the following shall apply:

- The safety device shall be capable of operating when the signal from only one pressure sensing line is available.
- The size and position of the pressure sensing lines shall ensure that the risk of loss of function is reduced to a minimum.

NOTE The common size of sensing line is 15 mm internal diameter.

- The mechanical and electrical parts of the pilot and control unit which are used to actuate the main valves shall still be functionally fit even in the case of an assumed individual defect.
- It shall be possible to prove the reliability of the safety pressure relief device by functional testing on the plant.

It is permissible to operate more than one main valve from a single control unit.

**5.2.2** There shall be no shut off devices between the boiler and its protective safety devices or between the safety devices and their points of discharge.

**5.2.3** The minimum flow diameter of safety valves or main valves of POSV or CSPRS for hot water generators shall be at least 15 mm.

**5.2.4** The safety device shall be installed at the highest point or in vicinity thereof, or on the flow line in direct vicinity of the hot water generator.

On hot water generator with internal expansion vessel the safety release valve shall be placed at the steam space of the vessel.

**5.2.5** In the case of once-through hot water generators the safety devices shall be installed on the hot water outlet nozzle.

**5.2.6** Direct-loaded safety valves shall be installed in the vertical position.

Safety devices shall be safeguarded against damaging external influences, e.g. the weather, which can impair the functional capability of the safety device. The transfer of vibrations onto the safety device shall be avoided.

Safety devices where leaking fluid, e.g. due to open bonnet, can directly or indirectly endanger persons or the environment, shall be provided with suitable protective devices.

**5.2.7** When rating safety devices, steam discharge shall be assumed to occur at the saturated steam condition corresponding to the safety device setting also for valves set under hydraulic pressure during operation. The safety devices shall be so designed that the steam flow corresponding to the allowable heat output can be discharged, without the maximum allowable pressure of the hot water generator being exceeded by more than 10 %.

The discharge capacity of safety valves or main valves of POSV or CSPRS fitted to hot water generators may need to consider the effects of two phase flow.

**5.2.8** Each overhead expansion vessel operated with a steam space shall be additionally equipped with a safety device being so set as to discharge earlier than the pressure relief device of the hot water generators.

When rating this device, it will be sufficient to take the output of the largest of all hot water generators connected provided the expansion vessel is designed for that pressure which will be generated in this hot water generator at the allowable flow temperature.

Auxiliary heating systems and auxiliary steam supply shall be taken into consideration for rating.

**5.2.9** Each closed expansion vessel shall be equipped with at least one safety device, which shall be so rated that the maximum allowable pressure will not be exceeded under any operating condition. All quantities flowing into the tanks as well as auxiliary heating systems and auxiliary steam supply, if any, shall be taken into account for rating.

**5.2.10** The outlet pipe cross-section shall not be less than the safety valve or main valve of POSV or CSPRS outlet cross-section.

The pressure relief system shall be properly designed and installed to ensure that the required discharge capacity of the safety device is not impaired.

Outlet piping shall be designed in accordance with EN 13480-3:2017.

Safety device outlet pipes shall discharge the effluent safely. The discharge shall not be released openly into the area of installation and shall be disposed of safely and be prevented from unintentional flowing into other equipment creating a hazard (e.g. into equipment out of service or undergoing maintenance or close to air intakes or into accessible areas).

No liquid shall be allowed to accumulate in the outlet system. Where the pipe is endangered by freezing, it shall be protected accordingly. Taking into account the local operating conditions, the pipes shall be designed to withstand the static, dynamic (reaction forces) and thermal loadings. The valve or the outlet system shall be fitted with an adequate drain and the drainage shall be led to a safe place.

The diameter and length of outlet pipes, bends, silencers etc. will determine the build-up of back pressure. These parts shall be designed so that the allowable back pressure indicated by the valve manufacturer shall not be exceeded.

Back pressures on the outlet side affecting the set pressure (gauge) and the opening forces or the mass flow shall be taken into consideration.

If the back pressure exceeds 10 % of the set pressure, or the superimposed pressure is variable, the valve manufacturer should be informed so that a suitable device can be supplied.

For calculation of pressure losses see ISO 4126-9:2008, Annex D.

Where the outlet pipe of a safety valve or main valve for POSV or CSPRS leads into a downstream system, the safety valve or main valve for POSV or CSPRS shall be so set and dimensioned so that it is capable of discharging the required mass flow at the highest possible back pressure  $p_{so}$ , which is the sum of built up and superimposed back pressure.

### 5.3 Safety shut-off valves

Where CSPRS are installed to protect the downstream system by preventing further fluid input, the closing function of the main valves of the safety shut-off devices shall be safeguarded instead of the opening function. For the closing function the requirements for CSPRS as defined in EN ISO 4126-5:2013 shall apply accordingly. Upstream of the main valves a strainer shall be installed. The system to be safeguarded downstream of the safety shut-off device shall be additionally provided with a safety valve with a capacity based on the leakage rate of the main valve of the safety shut-off device.

**Annex A**  
(informative)

**Significant technical changes between this document and the previous edition**

| Clause/Paragraph/Table/Figure   | Change  |
|---|---|
| 2/Normative References  | Normative references updated  |
| 5.1.11/Steam generator  | Reference to EN 13480 series for steam generator safety valve outlet piping.    |
| 5.1.1/Steam generator,<br>5.2.1/Hot water generator   | Addition of a specific time duration for limiting the admissible pressure surge |
| NOTE The technical changes referred include the significant technical changes from the EN revised but is not an exhaustive list of all modifications from the previous version. |   |



**Annex ZA**  
(informative)

**Relationship between this European Standard and the essential requirements of Directive 2014/68/EU aimed to be covered**

This European Standard has been prepared under a Commission's standardization request M/071 to provide one voluntary means of conforming to essential requirements of New Approach Directive 2014/68/EU.

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZA.1 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.

**Table ZA.1 — Correspondence between this European Standard and Directive 2014/68/EU**

| Essential Safety Requirements (ESRs) of Directive 2014/68/EU, Annex I | Clause(s)/subclause(s) of this EN | Remarks/Notes  |
|---|-----------------------------------|--|
| 2.10  | 5                                 | Protection against exceeding the allowable limits – excessive pressure |
| 2.11.1, 2.11.2  | 5                                 |  |
| 7.3–1st para  | 5                                 |  |

**WARNING 1** — Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

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