



**SLOVENSKI STANDARD**  
**oSIST prEN 12952-3:2021**  
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**Vodocevni kotli in pomožne napeljave - 3. del: Konstruiranje in izračun tlačno obremenjenih delov kotla**

Water-tube boilers and auxiliary installations - Part 3: Design and calculation for pressure parts of the boiler

Wasserrohrkessel und Anlagenkomponenten - Teil 3: Konstruktion und Berechnung für drucktragende Kesselteile

Chaudières à tubes d'eau et installations auxiliaires - Partie 3 : Conception et calcul des parties sous pression

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## Water-tube boilers and auxiliary installations - Part 3: Design and calculation for pressure parts of the boiler

Chaudières à tubes d'eau et installations auxiliaires -  
Partie 3 : Conception et calcul des parties sous pression

Wasserrohrkessel und Anlagenkomponenten - Teil 3:  
Konstruktion und Berechnung für drucktragende  
Kesselteile

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 269.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN 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 CEN-CENELEC Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

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**prEN 12952-3:2021 (E)****European foreword**

This document (prEN 12952-3:2021) has been prepared by Technical Committee CEN/TC 269 “Shell and water-tube boilers”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 12952-3:2011.

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 2014/68/EU, see informative Annex ZA, which is an integral part of this document.

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

The European Standard series 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 of the boiler*
- *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 liquified 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 this European Standard 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 European Standards series EN 12952 and EN 12953, see the following website: <http://www.boiler-helpdesk.din.de>

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**prEN 12952-3:2021 (E)****1 Scope**

This document specifies the requirements for the design and calculation of water-tube boilers as defined in EN 12952-1.

The purpose of this document is to ensure that the hazards associated with water-tube boilers are reduced to a minimum by the proper application of the design according to this part of EN 12952.

**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 1092-1:2018, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1: Steel flanges*

EN 1759-1:2004, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, Class designated — Part 1: Steel flanges NPS 1/2 to 24*

EN 10028-1:2017, *Flat products made of steels for pressure purposes — Part 1: General requirements*

EN 10164:2018, *Steel products with improved deformation properties perpendicular to the surface of the product — Technical delivery conditions*

EN 10253-2:2007, *Butt-welding pipe fittings — Part 2: Non alloy and ferritic alloy steels with specific inspection requirements*

EN 10266:2003, *Steel tubes, fittings and structural hollow sections — Symbols and definitions of terms for use in product standards*

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

EN 12952-2,<sup>1</sup> *Water-tube boilers and auxiliary installations — Part 2: Materials for pressure parts of boilers and accessories*

EN 12952-5,<sup>2</sup> *Water-tube boilers and auxiliary installations — Part 5: Workmanship and construction of pressure parts of the boiler*

EN 12952-6,<sup>3</sup> *Water-tube boilers and auxiliary installations — Part 6: Inspection during construction; documentation and marking of pressure parts of the boiler*

EN 12952-7:2012, *Water-tube boilers and auxiliary installations — Part 7: Requirements for equipment for the boiler*

EN 12952-12:2003, *Water-tube boilers and auxiliary installations — Part 12: Requirements for boiler feedwater and boiler water quality*

EN 12953-3:2016, *Shell boilers — Part 3: Design and calculation for pressure parts*

EN 13445-3:2014,<sup>4</sup> *Unfired pressure vessels — Part 3: Design*

<sup>1</sup> Under preparation. Current stage: FprEN.

<sup>2</sup> Under preparation. Current stage: FprEN.

<sup>3</sup> Under preparation. Current stage: FrpEN.

EN 13480-3:2017,<sup>5</sup> *Metallic industrial piping — Part 3: Design and calculation*

### 3 Terms and definitions

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

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

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

### 4 Symbols and abbreviations

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

## 5 General

### 5.1 Purpose

Water-tube boiler pressure parts shall be designed in accordance with the requirements of this document. The resulting designs shall be reproduced in the form of approved drawings and specifications to ensure the proper application of the design requirements during the manufacturing and inspection stages.

### 5.2 Dimensions of pressure parts

The wall thickness and other dimensions of pressure parts sufficient to withstand the calculation pressure at calculation temperature for the design lifetime shall be determined in accordance with this European Standard using materials in accordance with EN 12952-2:-.

The design for loadings arising from the following situations shall also be determined in accordance with this European Standard:

- a) the bending of a drum or header as a beam under self weight and imposed loads;
- b) local support loads on drums;
- c) thermally induced forces and moments within or arising from systems of integral tubing;
- d) local loading of tubes by structural attachments;
- e) rapid and frequent changes of pressure and temperature.

Methods for calculating stresses caused by external loads applied to nozzles and to attachments shall be in accordance with EN 13445-3:2014<sup>4</sup>.

**NOTE** The purpose of this part is to give specific design rules for common forms of loadings to which boiler parts are normally subjected to and general rules on how other loadings are to be considered. It does not give specific design rules for loadings other than those described in a) to e).

<sup>4</sup> As impacted by EN 13445-3:2014/A1:2015, EN 13445-3:2014/A2:2016, EN 13445-3:2014/A3:2017, EN 13445-3:2014/A4:2018, EN 13445-3:2014/A5:2018, EN 13445-3:2014/A6:2019, EN 13445-3:2014/A7:2019 and EN 13445-3:2014/A8:2019.

<sup>5</sup> As impacted by EN 13480-3:2017/A1:2021, EN 13480-3:2017/A2:2020 and EN 13480-3:2017/A3:2020.

**prEN 12952-3:2021 (E)**

These design rules are adequate for boilers of established construction, installed and operated in accordance with the manufacturer's instructions.

Determination of the dimensions of pressure parts shall be given special consideration not included in this European Standard, when abnormal conditions are present, such as:

- abnormally high corrosive products of combustion;
- highly pressurized products of combustion;
- poor feedwater.

Deviations from the requirements of this document by the use of alternative design methods shall be permitted, provided it can be shown that the adoption of such methods does not impair the safety of the component. A record of all deviations shall be recorded in the manufacturer's dossier. See also EN 12952-1:2015, Clause 7.

**5.3 Strength of pressure parts**

The strengths of the pressure parts shall be such as to withstand the following loads:

- a) internal pressure;
- b) the weight of all pressure parts and their contents, the weight of components suspended from them and any superimposed slag, fuel, ash or dust;
- c) loads caused by gas pressure differentials over the boiler furnace and flue gas passes;
- d) loads arising at connections between the boiler system and other parts.

If applicable, the pressure parts shall be adequate to withstand wind and earthquake loads. The conditions applicable for such loads shall be determined by the customer. These determinations shall be considered by the manufacturer under his responsibility.

**5.4 Design by analysis**

It shall be permissible to design by analysis provided the safety and functional requirements of the components are not impaired.

The results of any stress calculations carried out for loadings not explicitly covered by formulae in this Clause 5 shall be determined by using the criteria given in EN 13445-3:2014<sup>4</sup>.

**5.5 Cyclic loading**

Boiler components are deemed to be exposed to cyclic loading if the boiler is designed for more than 500 cold start-ups. Where cylindrical or spherical pressure parts with openings are subject to cyclic loading, the following calculation for the allowable temperature change rate  $v_t$  shall be carried out:

$$v_t = \left( X - p_o \left( \frac{(\alpha_m \times d_m)}{(n_s \times e_{ms})} - 0,5 \right) \right) \frac{Z}{e_{ms}^2} \quad (1)$$

where

- $v_t$  is the allowable rate of temperature change in K/s;
- $p_0$  is the maximum operating pressure;
- $d_m$  is the mean diameter of the shell;
- $e_{ms}$  is the minimum wall thickness;
- $n_s = 2$  for cylindrical shells, or
- $n_s = 4$  for spherical shells;
- $\alpha_m = 4$  or if there is any doubt that this value is conservative, the exact value  $\alpha_m$  for cylindrical shells taken from Figure 60 or  $\alpha_{sp}$  for spherical shells, taken from Figure 62 shall be used;
- $X = 550 \text{ N/mm}^2$ ;
- $Z = 2 \text{ K mm}^4 / (Ns)$  for ferritic steels, or
- $Z = 1 \text{ K mm}^4 / (Ns)$  for austenitic and martensitic steels, or

$$Z = - \frac{0,5D_{th}}{\gamma_{cyl/sp} \alpha_t \beta_t E / (1 - \nu)} \quad (2)$$

where exact values  $D_{th}$ ,  $\beta_t$ ,  $E$ ,  $\nu$  may be taken from Annex D,  $\gamma_{cyl/sp}$  from Figure 61 or Figure 64 and  $\alpha_t$  from Figure 63.

If the result of this calculation is smaller than the required temperature transient at start-up, or if it is negative, then 13.4 shall apply.

For designs subject to cyclic loading, careful attention shall be paid to the design configuration in order to avoid stress raising features and to ensure good stress distribution. Stamping of materials shall not be done in critical areas.

In considering operating conditions, the design shall make adequate allowance for corrosion and fatigue.

The level of non-destructive testing adopted shall meet the acceptance criteria for main drum welds in EN 12952-6:-.

## 5.6 Other design requirements

### 5.6.1 General

In particular, cognizance shall be taken of the following requirements in EN 12952-5:- and EN 12952-6:-

- a) the design shall be such that manufacturing and welding in accordance with EN 12952-5:- and inspection in accordance with EN 12952-6:- shall be possible;
- b) where partial penetration welds are to be used, the depth of the required weld preparation groove shall be specified on the drawing;
- c) the welds attaching branches, nozzles, stubs and supports to drums and headers shall not involve any combination of austenitic and ferritic steel;