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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

Chaudière à tubes d'eau et installations auxiliaires - Partie 3 : Conception et calcul des parties sous pression de la chaudière

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Partie 3 : Conception et calcul des parties sous pression
de la chaudière

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

This European Standard was approved by CEN on 26 September 2022.

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EN 12952-3:2022 (E)**European foreword**

This document (EN 12952-3:2022) 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of an identical text or by endorsement, at the latest by May 2023, and conflicting national standards shall be withdrawn at the latest by May 2023.

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 12952-3:2011.

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

The EN 12952 series, 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 safety devices 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 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 European Standards series EN 12952 and EN 12953, 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.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

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

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EN 12952-3:2022 (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 joint - 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 10253-2:2021, *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 12952-2:2021, *Water-tube boilers and auxiliary installations - Part 2: Materials for pressure parts of boilers and accessories*

<https://standards.iteh.ai/catalog/standards/sist/dd16fc67-7eb1-4c58-8b6f-4eb36f26a23b/sist-en-12952-3-2023>
EN 12952-5:2021, *Water-tube boilers and auxiliary installations - Part 5: Workmanship and construction of pressure parts of the boiler*

EN 12952-6:2021, *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 13445-3:2021, *Unfired pressure vessels — Part 3: Design*

EN 13480-3:2017,¹ *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 document, 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 document using materials in accordance with EN 12952-2:2021.

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

- 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 13445-3:2021.

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).

¹ As impacted by EN 13480-3:2017/A1:2021, EN 13480-3:2017/A2:2020, EN 13480-3:2017/A3:2020 and EN 13480-3:2017/A4:2021.

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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 document, 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 13445-3:2021.

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:

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