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Nekurjene tlačne posode - 3. del: Konstruiranje (vključno z dopolnilom A1)

Unfired pressure vessels - Part 3: Design

Unbefeuerte Druckbehälter - Teil 3: Konstruktion

Récipients sous pression non soumis à la flamme - Partie 3: Conception

Ta slovenski standard je istoveten z: **EN 13445-3:2021+A1:2026**

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Unfired pressure vessels - Part 3: Design

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This European Standard was approved by CEN on 24 February 2021 and includes Amendment 1 approved by CEN on 18 August 2025 and Amendment 1 approved by CEN on 4 February 2026.

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

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European foreword

This document (EN 13445-3:2021+A1:2026) has been prepared by Technical Committee CEN/TC 54 “Unfired pressure vessels”, the secretariat of which is held by BSI.

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of an identical text or by endorsement, at the latest by October 2026, and conflicting national standards shall be withdrawn at the latest by October 2026.

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 includes Amendment 1, approved by CEN on 18 August 2025.

This document supersedes EN 13445-3:2021.

This document has been prepared under a standardization request addressed to CEN by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

For relationship with EU Legislation, see informative Annex ZA, which is an integral part of this document.

This new edition incorporates the Amendments which have been approved previously by CEN members, and the corrected pages up to Issue 5 without any further technical change. Annex Y provides details of significant technical changes between this European Standard and the previous edition.

Corrections to the standard interpretations where several options seem possible are conducted through the Migration Help Desk (MHD). Information related to the Help Desk can be found at https://unm.fr/en/maintenance-agencies/maintenance-agency-en-13445/. A form for submitting questions can be downloaded from the link to the MHD website. After subject experts have agreed an answer, the answer will be communicated to the questioner. Corrected pages will be given specific issue number and issued by CEN according to CEN Rules. Interpretation sheets will be posted on the website of the MHD.

A list of all parts in the EN 13445 series can be found on the CEN website.

Although these Parts may be obtained separately, it should be recognised that the Parts are inter-dependant. As such the manufacture of unfired pressure vessels requires the application of all the relevant Parts in order for the requirements of the Standard to be satisfactorily fulfilled.

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, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

1 Scope

This Part of this document specifies requirements for the design of unfired pressure vessels covered by EN 13445-1:2021 and constructed of steels in accordance with EN 13445-2:2021+A1:2023.

EN 13445-5:2021, Annex C specifies requirements for the design of access and inspection openings, closing mechanisms and special locking elements.

NOTE This Part applies to design of vessels before putting into service. It may be used for in service calculation or analysis subject to appropriate adjustment.

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 286-2:1992, *Simple unfired pressure vessels designed to contain air or nitrogen — Part 2: Pressure vessels for air braking and auxiliary systems for motor vehicles and their trailers*

EN 764-1:2015+A1:2016, *Pressure equipment — Terminology — Part 1: Pressure, temperature, volume, nominal size*

EN 764-2:2012, *Pressure equipment — Part 2: Quantities, symbols and units*

EN 764-3:2002, *Pressure equipment — Part 3: Definition of parties involved*

EN 837-1:1996, *Pressure gauges — Part 1: Bourdon tube pressure gauges — Dimensions, metrology, requirements and testing*

EN 837-3:1996, *Pressure gauges — Part 3: Diaphragm and capsule pressure gauges — Dimensions, metrology, requirements and testing*

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

EN 1591-1:2013, *Flanges and their joints — Design rules for gasketed circular flange connections — Calculation method*

EN 1708-1:2010, *Welding — Basic weld joint details in steel — Part 1: Pressurized components*

EN 1990:2023, *Eurocode — Basis of structural and geotechnical design*

EN 1991-1-4:2005[1)], *Eurocode 1: Actions on structures — Part 1-4: General actions — Wind actions*

EN 1991-1-6:2005[2)], *Eurocode 1 — Actions on structures — Part 1-6: General actions — Actions during execution*

EN 1992-1-1:2023, *Eurocode 2 — Design of concrete structures — Part 1-1: General rules and rules for buildings, bridges and civil engineering structures*

[1)] EN 1991-1-4:2005 is impacted by the stand-alone amendment EN 1991-1-4:2005/A1:2010 and the corrigendum EN 1991-1-4:2005/AC:2010.

[2)] EN 1991-1-6:2005 is impacted by the corrigendum EN 1991-1-6:2005/AC:2013.

EN 1998-1:2004[3)], *Design of structures for earthquake resistance — Part 1: General rules, seismic actions and rules for buildings*

EN 10204:2004, *Metallic products — Type of inspection documents*

EN 10222-1:2017, *Steel forgings for pressure purposes — Part 1: General requirements for open die forgings*

EN 12195-1:2010[4)], *Load restraining on road vehicles — Safety — Part 1: Calculation of securing forces*

EN 12952-3:2022, *Water-tube boilers and auxiliary installations — Part 3: Design and calculation for pressure parts of the boiler*

EN 13445-1:2021, *Unfired pressure vessels — Part 1: General*

EN 13445-2:2021+A1:2023, *Unfired pressure vessels — Part 2: Materials*

EN 13445-4:2021+A1:2023, *Unfired pressure vessels — Part 4: Fabrication*

EN 13445-5:2021, *Unfired pressure vessels — Part 5: Inspection and testing*

EN 13445-8:2021, *Unfired pressure vessels — Part 8: Additional requirements for pressure vessels of aluminium and aluminium alloys*

EN 13555:2021, *Flanges and their joints — Gasket parameters and test procedures relevant to the design rules for gasketed circular flange connections*

EN ISO 4014:2022, *Fasteners — Hexagon head bolts — Product grades A and B (ISO 4014:2022)*

EN ISO 4016:2022, *Fasteners — Hexagon head bolts — Product grade C (ISO 4016:2022)*

EN ISO 15613:2004, *Specification and qualification of welding procedures for metallic materials — Qualification based on pre-production welding test (ISO 15613:2004)*

ISO 261:1998, *ISO general purpose metric threads — General plan*

3 Terms and definitions

For the purposes of this Part of this document, the terms and definitions given in EN 13445-1:2021, EN 13445-2:2021+A1:2023 and the following 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 http://www.iso.org/obp

NOTE EN 13445-1:2021 and EN 13445-2:2021+A1:2023 have adopted terminology, symbols and definitions of EN 764-1:2015+A1:2016, EN 764-2:2012 and EN 764-3:2002.

3) EN 1998-1:2004 is impacted by the stand-alone amendment EN 1998-1:2004/A1:2013

4) EN 12195-1:2010 is impacted by the corrigendum EN 12195-1:2010/AC:2014

3.1
action
imposed thermo-mechanical influence which causes stress and/or strain in a structure, e.g. an imposed pressure, force, temperature

3.2
analysis thickness
effective thickness available to resist the loading depending on the load case, see 5.3.2

3.3
assumed thickness
thickness assumed by the designer between the minimum required shell thickness e and the shell analysis thickness e_a

3.4
calculation pressure
differential pressure used for the purpose of the design calculations for a component

[SOURCE: EN 764-1:2015+A1:2016]

3.5
calculation temperature
temperature used for the purpose of the design calculations for a component

[SOURCE: EN 764-1:2015+A1:2016]

3.6
chamber
fluid space within a unit of pressure equipment

[SOURCE: EN 764-1:2015+A1:2016]

3.7
component
part of pressure equipment which can be considered as an individual item for the calculation

[SOURCE: EN 764-1:2015+A1:2016]

3.8
creep range
temperature range in which material characteristics used in design are time dependent

Note 1 to entry: See also 5.1.

3.9
cryogenic applications
applications involving liquefied gases at low temperature

3.10

design pressure

pressure at the top of each chamber of the pressure equipment chosen for the derivation of the calculation pressure of each component

[SOURCE: EN 764-1:2015+A1:2016]

Note 1 to entry: Any other location may be specified.

3.11

design temperature

temperature chosen for the derivation of the calculation temperature of each component

[SOURCE: EN 764-1:2015+A1:2016]

3.12

differential pressure

pressure which algebraic value is equal to the pressure difference on either side of a separation wall

[SOURCE: EN 764-1:2015+A1:2016]

3.13

governing weld joint

main full penetration butt joint the design of which, as a result of membrane stresses, governs the thickness of the component

3.14

load case

combination of coincident actions

3.15

main joint

weld joint assembling main pressure bearing parts

3.16

maximum permissible pressure

maximum pressure obtained from the design by formulae or relevant procedures of EN 13445-3:2021 for a given component in a given load case, or for the whole pressure vessel the minimum of these maximum permissible pressures of all components

Note 1 to entry: The differences of the nominal design stress f, the analysis thickness e_a and the joint coefficient z for the calculation of the maximum permissible pressure in different load cases are specified in 5.3.2.

Note 2 to entry: If no explicit formula is given for the maximum permissible pressure P_{max} then P_{max} may be calculated as pressure which gives the required thickness equal to the analysis thickness.

Note 3 to entry: The maximum permissible pressure P_{max} used for the simplified assessment of fatigue life in Clause 17 and for the calculation of the equivalent full pressure in 5.4.2 is calculated for normal operating load cases.

3.17

minimum possible fabrication thickness

minimum possible thickness after fabrication

3.18
nominal design stress
stress value to be used in the formulae for the calculation of pressure components

3.19
nominal thickness
thickness as specified on the drawings

3.20
test pressure
pressure to which the equipment is subjected for test purposes

[SOURCE: EN 764-1:2015+A1:2016]

3.21
test temperature
temperature at which the pressure test of the pressure equipment is carried out

[SOURCE: EN 764-1:2015+A1:2016]

3.22
volume
internal volume of a chamber, including the volume of nozzles to the first connection (flange, coupling, weld) and excluding the volume of internal permanent parts (e.g. baffles, agitators)

[SOURCE: EN 764-1:2015+A1:2016]

3.23
weld throat thickness of a fillet weld
height of the inscribed isosceles triangle measured from the theoretical root point

4 Symbols and abbreviations

For the purposes of this Part of this document, the general symbols and abbreviations shall be in accordance with EN 13445-1:2021, EN 13445-2:2021+A1:2023 and Table 4-1:

Table 4-1 — Symbols, quantities and units [c]

Symbol	Quantity	Unit
a	weld throat thickness	mm
e	required thickness	mm
e_n	nominal thickness	mm
e_{min}	minimum possible fabrication thickness	mm
e_a	analysis thickness	mm
c	corrosion allowance	mm

Table 4-1 — Symbols, quantities and units [c] *(continued)*

Symbol	Quantity	Unit
f	nominal design stress	MPa
f_d	maximum value of the nominal design stress for normal operating load cases	MPa
f_{exp}	maximum value of the nominal design stress for exceptional load cases	MPa
f_{test}	maximum value of the nominal design stress for testing load cases	MPa
n_{eq}	number of equivalent full pressure cycles (see 5.4.2)	—
P	calculation pressure	MPa [a]
P_d	design pressure	MPa [a]
P_{max}	maximum permissible pressure	MPa [a]
PS, P_s	maximum allowable pressure	MPa [a]
P_{test}	test pressure	MPa [a]
R_{eH}	upper yield strength	MPa
R_m	tensile strength	MPa
$R_{m/T}$	tensile strength at temperature T	MPa
$R_{p0,2}$	0,2 % proof strength	MPa
$R_{p0,2/T}$	0,2 % proof strength at temperature T	MPa
$R_{p1,0}$	1,0 % proof strength	MPa
$R_{p1,0/T}$	1,0 % proof strength at temperature T	MPa
T	calculation temperature	°C
T_d	design temperature	°C
T_{test}	test temperature	°C
TS_{max}, TS_{min}	maximum/minimum allowable temperatures	°C
V	volume	mm^3 [b]
z	joint coefficient	—
ν	Poisson's ratio	—

[a] MPa for calculation purpose only, otherwise the unit may be bar (1 MPa = 10 bar).

[b] mm^3 for calculation purpose only, otherwise the unit should be litre.

[c] Formulae used in this standard are dimensional.