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Nekurjene tlačne posode - 1. del: Splošno

Unfired pressure vessels - Part 1: General

Unbefeuerte Druckbehälter - Teil 1: Allgemeines

Récipients sous pression non soumis à la flamme - Partie 1: Généralités

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Unfired pressure vessels - Part 1: General

Récipients sous pression non soumis à la flamme - Partie 1: Généralités

Unbefeuerte Druckbehälter - Teil 1: Allgemeines

This European Standard was approved by CEN on 24 February 2021.

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This European Standard exists 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

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Contents

Page

European foreword

This document (EN 13445-1:2021) 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of an identical text or by endorsement, at the latest by November 2021, and conflicting national standards shall be withdrawn at the latest by November 2021.

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 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).

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

The 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.

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 http://www.unm.fr (en13445@unm.fr). 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.

This document supersedes EN 13445-1:2014. 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.

Amendments to this new edition may be issued from time to time and then used immediately as alternatives to rules contained herein. It is intended to deliver a new Issue of EN 13445:2021 each year, starting with the precedent as Issue 1, consolidating these Amendments and including other identified corrections.

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, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

EN 13445 specifies the requirements for design, construction, inspection and testing of unfired pressure vessels. It defines terms, definitions and symbols applicable to unfired pressure vessels.

NOTE In EN 13445 the term pressure vessel includes the welded attachments up to and including the nozzle flanges, screwed or welded connections, or the edge to be welded at the first circumferential weld at connecting piping or other elements. The term unfired excludes vessels that are subject to direct generated heat or flame impingement from a fired process. This does not exclude vessels subject to electrical heating or heated process streams.

In Parts 2 to 5 only pressure vessels manufactured from steels and steel castings as detailed in Part 2 of this standard are covered. Parts 6, 8, and 10 specifically deal with vessels of spheroidal graphite cast iron, aluminium, and nickel, respectively, where special considerations apply.

Part 1

This part contains general information on the scope of the standard as well as terms, definitions, quantities, symbols and units which are applied throughout the standard.

Part 2

This part deals with the general philosophy on materials, material grouping and low temperature behaviour. It is limited to steel with sufficient ductility and, for components operating in the creep range, sufficient creep ductility.

Part 2 also provides the general requirements for establishing technical delivery conditions and the requirements for marking of material.

Part 3

This part of the standard gives the rules to be used for design and calculation under internal and/or external pressure (as applicable), local loads and actions other than pressure. The rules provided are both design by formulae (DBF), design by analysis (DBA) and design by experiment (DBE).

The part also sets the requirements for when fatigue analysis must be performed and the rules to be followed when this is the case.

NOTE Collaborative work is in hand to harmonize flange design across European standards.

Part 4

This part of the standard specifies requirements for the manufacture of unfired pressure vessels and their connections to non-pressure parts. It specifies requirements for material traceability, manufacturing tolerances, welding requirements, requirements for permanent joints other than welding, production tests, forming requirements, heat treatment, repairs and finishing operations.

Part 5

This part covers all those inspection and testing activities associated with the verification of the pressure vessel for compliance with the standard, including design review by the manufacturer and supporting technical documentation, NDT and other inspection activities including document control, material traceability, joint preparation and welding.

The level of testing is driven by the selection of the vessel testing group. Basically, the testing group determines the level of NDT and the joint coefficient used in the design.

In terms of NDT, the overall philosophy has been the general adoption of EN ISO 5817:2014 quality level 'C' for predominantly non-cyclic loaded vessels and level 'B' for vessels subject to cyclic loadings.

Part 6

This part contains special rules for material, design, fabrication, inspection, and testing of pressure vessels made from spheroidal graphite cast iron. In general the rules in the relevant parts of parts 2–5 apply with additions and exceptions outlined in this part.

Part 7

This part gives guidance on how to use the conformity assessment procedures in the Pressure Equipment Directive 97/23/EC. This is a CEN Technical Report.

Part 8

This part contains special rules for material, design, fabrication, inspection, and testing of pressure vessels made from aluminium and aluminium alloys. In general the rules in the relevant parts of parts 2–5 apply with additions and exceptions outlined in this part.

Part 9

This part details the conformance of the whole EN 13445 series to ISO 16528-1 "Boilers and pressure vessels — Part 1: Performance requirements". This is a CEN Technical Report. The first edition is limited to vessels of steel construction, but will be amended later to include spheroidal graphite cast iron and aluminium.

Part 10

This part 10 contains special rules for material, design, fabrication, inspection, and testing of pressure vessels made from nickel and nickel alloys. In general, the rules in the relevant parts of parts 2–5 apply with additions and exceptions outlined in this part.

1 Scope

This document defines the terms, definitions, quantities, symbols and units that are used throughout the EN 13445 series and gives general information on the design and manufacturing of vessels under this standard.

It also contains instructions on how to use the standard (Annex A) as well as an index which covers the whole standard (Annex B). This information is aimed to aid users of the EN 13445 series.

This document applies to unfired pressure vessels with a maximum allowable pressure greater than 0,5 bar gauge but may be used for vessels operating at lower pressures, including vacuum.

This document is not applicable to pressure vessels of the following types:

— vessels of riveted construction;

— vessels of lamellar cast iron or any other materials not included in Parts 2, 6, or 8 of the standard;

— multilayered, autofrettaged or pre-stressed vessels.

This document can be applied to the following pressure vessels, provided that account is taken of additional and/or alternative requirements resulting from the hazard analysis and from rules or instructions specific for:

— transportable vessels;

— items specifically designed for nuclear use;

— pressure vessels with a risk of overheating.

NOTE EN 14222 covers electrically fired boilers made from stainless steel and can be used as an example of additional requirements for such vessels.

Other European standards apply to industrial piping (EN 13480 series) and to water tube and shell boilers (EN 12952 series and EN 12953 series).

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 764-1:2015+A1:2016, *Pressure equipment — Part 1: Vocabulary*

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

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

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

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

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

EN 13445-6:2021, *Unfired pressure vessels — Part 6: Requirements for the design and fabrication of pressure vessels and pressure parts constructed from spheroidal graphite cast iron*

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

EN 13445-10:2021, *Unfired pressure vessels — Part 10 Additional requirements for pressure vessels of nickel and nickel alloys*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 764-1:2015+A1:2016, EN 764-2:2012 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 To aid the user, some of the most important terms and definitions from EN 764-1 have been repeated here.

3.1
assembly
several pieces of pressure equipment assembled by a manufacturer to constitute an integrated and functional whole

3.2
fluid
gas, liquid and vapour in their pure phase as well as mixtures thereof

Note 1 to entry: A fluid may contain a suspension of solids.

3.3
hazard
potential source of harm

3.4
hazard category
category of the pressure vessel taking into account the potential hazards

3.5
joint coefficient
reduction coefficient, which is applied to the nominal design stress

Note 1 to entry: E.g. used for a welded joint and related to the testing group.

3.6
main pressure bearing parts
parts which constitute the envelope under pressure, essential for the integrity of the equipment

3.7
manufacturer
individual or organization responsible for the design, fabrication, testing, installation where relevant, and compliance with the requirements of the relevant product standard, whether executed by him or a subcontractor

Note 1 to entry: The manufacturer can subcontract one or more of the above mentioned tasks under its responsibility.

3.8
material manufacturer
individual or organization that produces material in the basic product form used in the manufacture of pressure components

3.9
maximum allowable pressure
PS
maximum pressure for which the pressure vessel is designed as specified by the manufacturer

3.10
maximum allowable temperature
TS_{max}
maximum temperature for which the pressure vessel is designed as specified by the manufacturer

3.11
minimum allowable temperature
TS_{min}
minimum temperature for which the pressure vessel is designed as specified by the manufacturer

3.12
pipelines
piping or system of piping designed for the conveyance of any fluid or substance to or from an installation (onshore or offshore) starting from and including the first isolation device located within the installation and including all the annexed equipment designed specifically for pipelines

3.13
piping
tubing, fittings, expansion joints, hoses or other pressure-bearing components, intended for the transport of fluid, connected together and integrated into a pressure system

3.14
pressure vessel
housing and its direct attachments up to the coupling point connecting it to other equipment, designed and built to contain fluids under pressure

Note 1 to entry: A vessel may be composed of more than one chamber.

3.15
required thickness
thickness excluding corrosion or any other allowances specified in the EN 13445 series

Note 1 to entry: The minimum thickness that the component can have in service to fulfil the standard.

3.16
risk
combination of the probability of occurrence of harm and the severity of that harm

3.17
significant hazard
hazard which has been identified as associated with the pressure vessel and which requires specific action by the designer to eliminate or to reduce the risk according to the risk assessment

3.18
testing factor
reduction factor taking into account the amount of NDT testing in castings, applied on the nominal design stress to take account of possible manufacturing deficiencies

3.19
testing group
grouping which determines the appropriate level of non-destructive testing (NDT) on a welded joint

Note 1 to entry: The testing group of a vessel is not linked to the hazard category.

3.20
weldment
weld metal, heat affected zone and adjacent base material(s)

4 Interdependency of the parts of the series

Parts 2 to 6 and parts 8 and 10 of EN 13445, together with Part 1, form a consistent set of specifications which shall be followed for compliance to the standard.

NOTE Parts 7 and 9 of this series are published as a CEN Report and a CEN Technical Report respectively. They are not European Standards.

5 Quantities, symbols and units

Quantities, symbols and units to be used for pressure equipment shall be in accordance with Tables 5-1 and 5-2 and EN 764-2:2012

NOTE 1 Other symbols used in specific parts of this document are tabulated in the relevant part.

NOTE 2 The choice of the appropriate multiple (decimal multiple or sub-multiple) of a unit is governed by convenience, the multiple chosen for a particular application being one which should lead to numerical values within a practical range. Therefore when indicating quantities it is recommended that decimal multiple or sub-multiple quantities be chosen such that the resulting values are easy to handle, e.g. between 0,1 and 1 000. The non-SI units, bar for pressure and L for volume should be used on the nameplate.

Table 5-1 — Quantities for space and time

Quantity	Symbol	Unit
Time	t	s, min, h
Frequency	f	Hz
Dimension	any Latin letter [a]	mm
Length	l	mm
Thickness	e	mm
Corrosion allowance	c	mm
Diameter	d, D	mm
Radius	r, R	mm
Area	A, S	mm^2
Volume, capacity	V	mm^3 [b c]
Weight	W	N, kN
Density	ρ	kg/mm^3 [d]
Second moment of area	I	mm^4
Section modulus	Z	mm^3
Acceleration	γ	m/s^2
Plane angle	any Greek letter [a]	rad, °

[a] Symbols may use any lower-case letter, except for those defined elsewhere in this table.
[b] volume may also be given in m^3 or L.
[c] litre "L" is a non-SI unit which may be used with SI units and their multiples.
[d] Density may also be given in kg/m^3.

Table 5-2 — Mechanical quantities

Quantity [a]	Symbol [b]	Unit
Force	F	N
Moment	M	N·mm
Pressure	p, P	bar [c], MPa
Temperature	T	°C
Linear expansion coefficient	α	µm/m°C
Normal stress	σ	MPa
Shear stress	τ	MPa
Nominal design stress	f	MPa
Tensile strength	R_m	MPa
Yield strength	R_e	MPa
1 % proof strength	$R_{p1.0}$	MPa
Proof strength at temperature T	$R_{p/T}$	MPa
Upper yield strength	R_{eH}	MPa
0,2 % proof strength	$R_{p0,2}$	MPa
0,2 % proof strength at temperature T	$R_{p0,2/T}$	MPa
Ultimate tensile strength at temperature T	$R_{m/T}$	MPa
Modulus of elasticity	E	MPa
Shear modulus	G	MPa
Poisson's ratio	υ	-
Strain	ε	%
Elongation after rupture/fracture	A	%
Impact energy	KV	J
Hardness	HB,HV	-
Joint coefficient	z	-
Safety factor	S	-

[a] Quantities without a temperature index normally refer to room temperature.

[b] Some of these symbols, such as R, f, are not part of ISO 31.

[c] "bar" is a non-SI unit which may be used with SI units and their multiples. .The unit bar shall be used on nameplates, certificates, drawings, pressure gauges and instrumentation and is always used as a gauge pressure. This is in line with the requirements of the Pressure Equipment Directive **2014/68/EU**.

NOTE The use of symbols for temperature may be different from the PED.

6 Risk assessment and handling

6.1 Hazards

Pressure vessels according to this document shall be designed, constructed, installed and equipped under consideration of all significant hazards and risks that may arise when the vessel is erected, tested and operated in accordance with the manufacturer's instructions or else are reasonably foreseeable.

Such hazards shall be analysed by the manufacturer prior to designing the vessel. Apart from normal hazards connected to the operation of the vessel (see EN 13445-3:2021, 5.3), the following hazards shall be considered (as applicable):

— corrosion and chemical attack;

— wear;

— external fire;

— reasonably foreseeable misuse of the vessel.

6.2 Hazard removal and risk reduction

6.2.1 General

As far as practically feasible, the vessel shall be designed as to remove or reduce the respective risk. If removal of a certain hazard is not feasible, the vessel shall be designed and equipped to protect against the respective risk or (as a final measure) information be given on the hazard and what measures are to be taken to reduce the risks from the hazard. Such information shall be given through warning signs and in the operating instructions.

NOTE The procedure to follow is outlined in Figure 6.2–1.

6.2.2 Design considerations

If it is envisaged that safety accessories will have to be fitted to the vessel, the vessel shall be equipped with the necessary connections for such accessories.

NOTE The selection, application and installation of safety related accessories intended to protect pressure vessels during operation are covered in EN 764-7:2002.

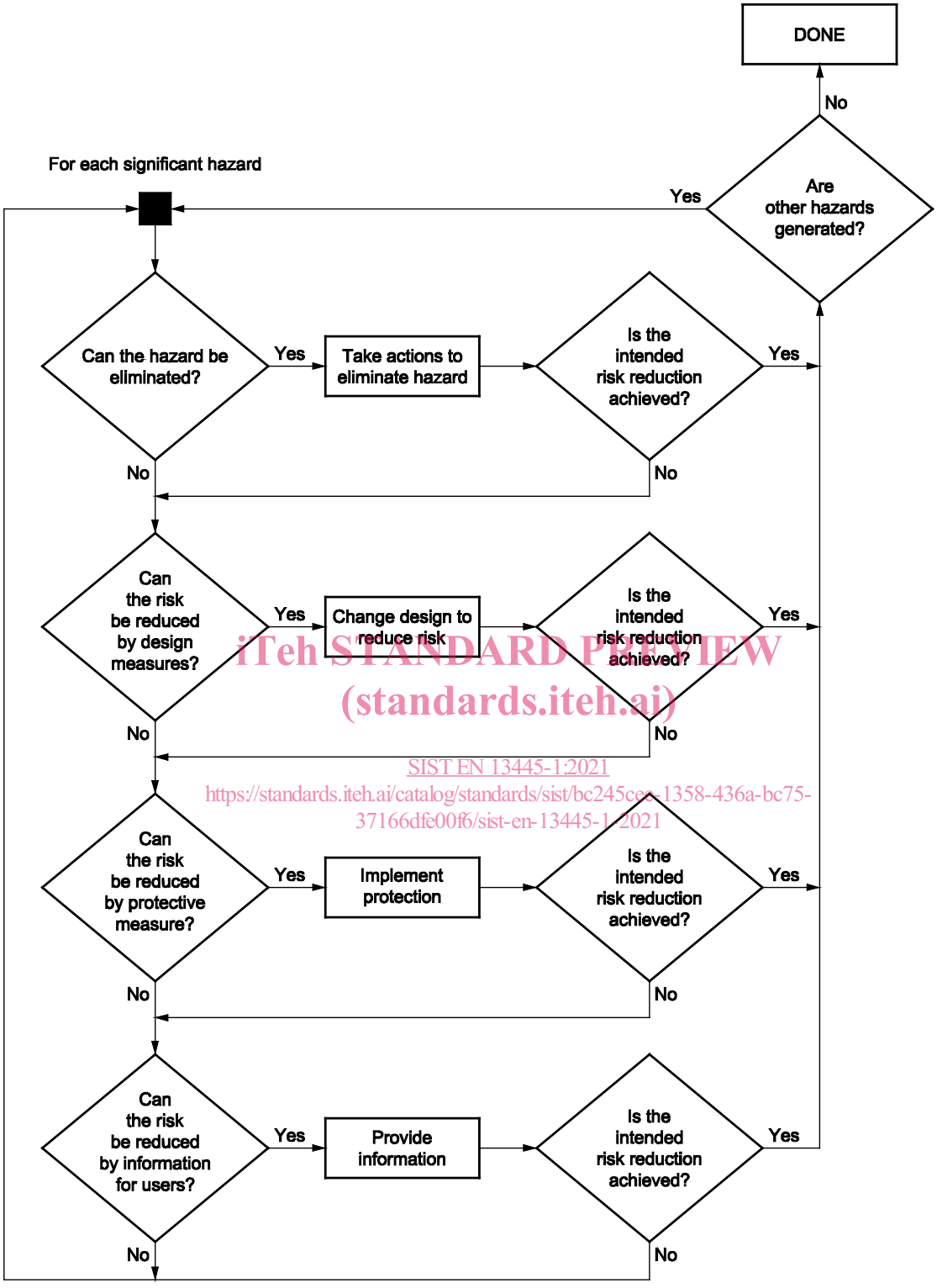

Figure 6.2-1 — Hazard consideration