SLOVENSKI STANDARD
oSIST prEN 286-1:2019

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Enostavne nekurjene tlačne posode, namenjene za zrak ali dušik - 1. del: Tlačne posode za splošne namene

Simple unfired pressure vessels designed to contain air or nitrogen - Part 1: Pressure vessels for general purposes

Einfache unbefeuerte Druckbehälter für Luft oder Stickstoff - Teil 1: Druckbehälter für allgemeine Zwecke

Récipients à pression simples, non soumis à la flamme, destines à contenir de l'air ou de l'azote - Partie 1 : Récipients pour usage général

Ta slovenski standard je istoveten z: **prEN 286-1**

ICS:

23.020.32	Tlačne posode	Pressure vessels

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EUROPEAN STANDARD

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This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 54.

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.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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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 (prEN 286-1:2019) has been prepared by Technical Committee CEN/TC 54 “Unfired pressure vessels”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 286-1:1998.

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 the EU Directive 2014/29/EU.

For relationship with EU Regulation 2014/29/EU, see the informative Annex ZA, which is an integral part of this document.

1 Scope

1.1 This document applies to the design and manufacture of welded, simple unfired pressure vessels manufactured in series, with a single or multiple compartment, here-in-after referred to as vessels.

It only applies to vessels that:

a) include fabrication by welding, but some designs can entail the use of bolts;

b) have a simple geometry enabling simple-to-use production procedures. This is achieved by either

   1) a cylindrical part of circular cross section closed by outwardly dished and/or flat ends which revolve around the same axis as the cylindrical part; or

   2) two outwardly dished ends revolving around the same axis.

1.2 It applies to vessels which are intended to contain air or nitrogen which are not intended to be fired and which operate within the following constraints:

a) subjected to an internal gauge pressure greater than 0,5 bar;

b) the parts and assemblies contributing to the strength of the vessel under pressure to be made either of non-alloy quality steel or of non-alloy aluminium or non-age hardening aluminium alloys;

NOTE In this document, the use of "aluminium" covers non-alloy aluminium and aluminium alloys.

c) the maximum working pressure is not greater than 30 bar. The product of the maximum working pressure and the capacity of the vessel ($PS \cdot V$) is greater than 50 bar · l but does not exceed 10 000 bar · l. Below 50 bar · l use of this document is considered to fulfil the requirements of sound engineering practice;

d) the minimum working temperature is not lower than −50 °C and maximum working temperature not higher than 300 °C for steel and 100 °C for aluminium or aluminium alloy vessels.

It does not apply to vessels specifically designed for nuclear use, to vessels specifically intended for installation in or the propulsion of ships and aircraft, or to fire extinguishers.

The document neither applies to transportation vessels nor to vessels which also contain substances other than air or nitrogen which could adversely affect their safety. For vessels to contain compressed air for braking systems of road vehicles and their trailers, see also EN 286-2. For vessels to contain compressed air for braking systems of rail mounted vehicles, see also EN 286-3 and EN 286-4.

1.3 It applies to the vessel proper, from the inlet connection to the outlet connection and to all other connections required for valves and fittings.

1.4 For the purposes of calculations required to be made in accordance with this document, dimensions are in millimetre, pressures are in bar (except otherwise specified), stresses are in newton per square millimetre and temperatures are in degree Celsius.

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 473:2008, *Non-destructive testing — Qualification and certification of NDT personnel*

EN 10002-1:2001, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

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

EN 10226-1:2004, *Pipe threads where pressure tight joints are made on the threads — Part 1: Taper external threads and parallel internal threads — Dimensions, tolerances and designation*

EN ISO 228-1:2003,[1] *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation (ISO 228-1:2000)*

EN ISO 2409:1994, *Paints and varnishes — Cross-cut test (ISO 2409:1992)*

EN ISO 5173:2010,[2] *Destructive tests on welds in metallic materials — Bend tests (ISO 5173:2009 + Amd 1:2011)*

EN ISO 5817:2014, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections (ISO 5817:2014)*

EN ISO 9016:2012, *Destructive tests on welds in metallic materials — Impact tests — Test specimen location, notch orientation and examination (ISO 9016:2012)*

EN ISO 9606-1:2017, *Qualification testing of welders — Fusion welding — Part 1: Steels (ISO 9606-1:2012 including Cor 1:2012 and Cor 2:2013)*

EN ISO 9606-2:2004, *Qualification test of welders — Fusion welding — Part 2: Aluminium and aluminium alloys (ISO 9606-2:2004)*

EN ISO 10042:2018, *Welding — Arc-welded joints in aluminium and its alloys — Quality levels for imperfections (ISO 10042:2018)*

EN ISO 14732:2013, *Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials (ISO 14732:2013)*

EN ISO 15607:2003, *Specification and qualification of welding procedures for metallic materials — General rules (ISO 15607:2003)*

EN ISO 15609-1:2004, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding (ISO 15609-1:2004)*

EN ISO 15614-1:2017, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys (ISO 15614-1:2017)*

EN ISO 15614-2:2005, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 2: Arc welding of aluminium and its alloys (ISO 15614-2:2005)*

EN ISO 17636-1:2013, *Non-destructive testing of welds — Radiographic testing — Part 1: X- and gamma-ray techniques with film (ISO 17636-1:2013)*

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[1] As impacted by EN ISO 228-1 Supplement 1.

[2] As impacted by EN ISO 5173:2010/A1:2011. German version EN ISO 5173:2010 + A1:2011.

EN ISO 17636-2:2013, *Non-destructive testing of welds — Radiographic testing — Part 2: X- and gamma-ray techniques with digital detectors (ISO 17636-2:2013)*

ISO 3057:1998, *Non-destructive testing — Metallographic replica techniques of surface examination*

ISO 7005-1:2011, *Pipe flanges — Part 1: Steel flanges for industrial and general service piping systems*

ISO 7253:1996, *Paints and varnishes — Determination of resistance to neutral salt Spray (fog)*

3 Terms and definitions, symbols and units

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1.1
automatic welding
welding in which all the welding parameters are automatically controlled, some of these parameters may be adjusted to a limited amount (manually or automatically by mechanical or electronic devices) during welding to maintain the specified welding conditions

3.1.2
non-automatic welding
all types of welding other than that defined in 3.1.1

3.1.3
batch
<of vessels> consists at most of 3 000 vessels of the same type

3.1.4
type of vessel
vessels are of the same type if the 4 following conditions are met:

— have similar geometrical form (i.e. shell rings and ends or only ends, in both cases ends of the same shape);

— have wall material and thickness within the limit of validity of the weld procedure, including those for branches, nozzles and inspection opening;

— have the same type of inspection openings, (sightholes, handholes, headholes and manholes are examples of different types of inspection openings);

— have the same design temperature limitations.

3.1.5
controlled product test
procedure carried out by a notified body during manufacture to ensure that the manufacturer duly fulfils the requirements of this document

3.1.6
design and manufacturing documents
prepared by the manufacturer to describe the construction, materials and fabrication including the certificates

3.1.7
design temperature

3.1.7.1
maximum design temperature
temperature that is used in the design calculations, and which is never less than the maximum working temperature

3.1.7.2
minimum design temperature
lowest temperature used in the selection of materials, and which is never greater than the minimum working temperature

3.1.8
minimum working temperature
T_{min}
lowest stabilized temperature in the wall of the vessel under normal conditions of use

3.1.9
maximum working temperature
T_{max}
highest stabilized temperature which the wall of the vessel can attain under normal conditions of use

3.1.10
design pressure
P
pressure used in design calculations, and which is never less than the maximum working pressure *PS*

3.1.11
maximum working pressure
PS
maximum gauge pressure which may be exerted under normal conditions of use (the set pressure of the pressure relief device is never greater than *PS*, but after pressure relief has commenced the pressure can exceed *PS* by 10 % maximum)

3.1.12
manufacturer's inspector
person(s) employed and authorized by the manufacturer, but independent from the production personnel, qualified and responsible for inspections, examinations and tests to be carried out by him on vessels

Note 1 to entry: Qualification means technical competency on the different inspections, examinations and tests to be carried out under the manufacturer's responsibility, as well as necessary experience. It is the responsibility of the manufacturer to ascertain that the inspector is competent.

3.1.13
report on the examinations and tests
report of the examinations and tests carried out by the manufacturer

3.1.14
material test report
document in which the material manufacturer certifies that the products supplied are in compliance with the requirements of the order and in which he supplies test results based on non-specific inspection and testing

Note 1 to entry: This corresponds to "inspection slip" defined in Directive 2014/29/EU.

[SOURCE: EN 10204:2004, 2.2 or 3.1 or 3.2]

3.1.15
series manufacture
more than one vessel of the same type manufactured during a given period by a continuous manufacturing process in accordance with a common design and using the same manufacturing process

3.1.16
main body
main shell and/or ends

3.2 General symbols and units

International System (S.I.) units are used in the standard as follows:

— dimensions (thickness, diameter, length, ...): mm

— areas: mm^2

— loads, forces: N

— moments: N · mm

— pressures: bar or N/mm^2 (see note)

— stresses, yield strength, tensile strength, ...: N/mm^2

NOTE Concerning the design pressure P, the unit N/mm^2 is used throughout 6.4 in order to have a coherent system of units for the formula. The unit bar is used throughout the other clauses in order to meet the terminology of Directive 2014/29/EU.

The following general symbols are used (specific symbols are defined in the relevant clauses):

A	elongation after rupture
D_i	inside diameter of main body
D_o	outside diameter of main body
d	diameter of openings
d_{ib}	internal diameter of branch
d_{ob}	external diameter of branch
d_{ip}	internal diameter of pad
d_{op}	external diameter of pad

d_{is} internal diameter of shell

e nominal thickness of wall

e_s nominal thickness of shell

e_b nominal thickness of branch

e_p nominal thickness of compensating plate or of pad

e_c calculated thickness

e_a actual thickness

e_{as} actual thickness of shell

e_{ab} actual thickness of branch

e_{am} actual thickness of main body

e_{ap} actual thickness of compensating plate or of pad

f nominal design stress at design temperature

K_c calculation coefficient, which depends on the welding process (see 5.4.2)

K_s shell coefficient, which depends on the extent of testing (see 5.4.2)

KCV impact energy

l_b effective length of branch contributing to reinforcement

l_{bi} effective length for inside part of set-through branch

l_m effective length of main body, contributing to reinforcement

l_p width of compensating plate,

l_{rp} width of pad minus corrosion allowance and tolerances

P design pressure (never less than *PS*), in bar or in newton per square millimetre (see note at the beginning of 3.2)

PS maximum working pressure

R_{eT} value at the maximum working temperature T_{max}

— of the upper yield point R_{eH}, for a material with both a lower and upper yield point;

— of the proof stress $R_{p0,2}$;

— or of the proof stress $R_{p1,0}$ in the case of non-alloy aluminium

R_m minimum value of tensile strength at room temperature specified in the material standard

4 Materials

4.1 Main pressurized parts (see also 5.2)

4.1.1 General

The materials shall be delivered with at least a test report (type 2.2 in accordance with EN 10204:2004). Inspection certificates of types 3.1 or 3.2 are also acceptable.

4.1.2 Steel vessels

The following materials should be used:

a) plate, strip and bar: steel grades P 235 S, P 265 S, and P 275 SL in accordance with EN 10207; steel grades P 235 GH and P 265 GH in accordance with EN 10028-2;

b) tubes: steel grades P 235 TR 2, P 265 TR 2 in accordance with EN 10216-1 and P 195 GH, P 235 GH and P 265 GH in accordance with EN 10217-2;

c) forgings: steel grade P 285 QH in accordance with EN 10222-4.

4.1.3 Aluminium vessels

The materials stated in Table 1, in accordance with EN 573-4, should be used:

a) plates in accordance with EN 485-2;

b) bars in accordance with EN 755-2.

Table 1 — Aluminium materials in accordance with EN 573-4

Material designation		Maximum working temperature
Numerical	Chemical symbol	
EN AW-1080A	EN AW-Al 99,8(A)	100 °C
EN AW-1070A	EN AW-Al 99,7	100 °C
EN AW-1050A	EN AW-Al 99,5	100 °C
EN AW-5005	EN AW-Al Mg1(B)	100 °C
EN AW-5251	EN AW-Al Mg2	100 °C
EN AW-5049	EN AW-Al Mg2Mn0,8	100 °C
EN AW-5052	EN AW-Al Mg2,5	100 °C
EN AW-5754	EN AW-Al Mg3	100 °C
EN AW-5454	EN AW-Al Mg3Mn	100 °C
EN AW-5154A	EN AW-Al Mg3,5(A)	100 °C
EN AW-5086	EN AW-Al Mg4	65 °C
EN AW-5083	EN AW-Al Mg4,5Mn0,7	65 °C
EN AW-3103	EN AW-Al Mn1	100 °C
EN AW-3105	EN AW-Al Mn0,5Mg0,5	100 °C

4.1.4 Other standard materials

Any material not included in subclauses 4.1.2 and 4.1.3, which is manufactured in accordance with a National or International Standard for quality steels, aluminium or aluminium alloy, will be acceptable if in compliance with 4.1.1 and Directive SPVD, Annex I.

4.2 Accessories contributing towards the strength of vessels

These accessories (bolts, nuts, pipes, tubes, bosses, flanges, internal structures etc.) shall be made from steel, aluminium or aluminium alloy, which is compatible with materials used for the manufacture of the main pressurized parts. They shall have an elongation after rupture, A, on longitudinally oriented test pieces of at least 14 % (see EN 10002-1:2001).

4.3 Non-pressurized parts

All non-pressurized parts of welded vessels shall be of materials that are compatible with that of the components to which they are welded.

Aluminium and aluminium alloys shall be as given in 4.1.3.

4.4 Welding consumables

The welding consumables used to manufacture the welds on or of the vessel shall be appropriate to and compatible with the materials to be welded and shall comply with available European standards.

5 Design

5.1 General

The manufacturer shall, when designing the vessel, define the use to which it will be put and select:

— the minimum working temperature, T_{min};

— the maximum working temperature, T_{max};

— the maximum working pressure, PS.

When the intended use of the vessel implies additional loads or fatigue, this shall be taken into account in the design. Requirements related to roofing (out-of-roundness due to offset of (welded) connections or local shape deviations of the vessel) are given in Annex A.

5.2 Weld joint design

5.2.1 Welds of partial penetration type are not permitted, except in cases of branches, flat ends and flanges which are fixed to the main shell by means of two welds of adequate thickness, see 5.2.5. The type of edge preparation is dependent on the welding procedures used.

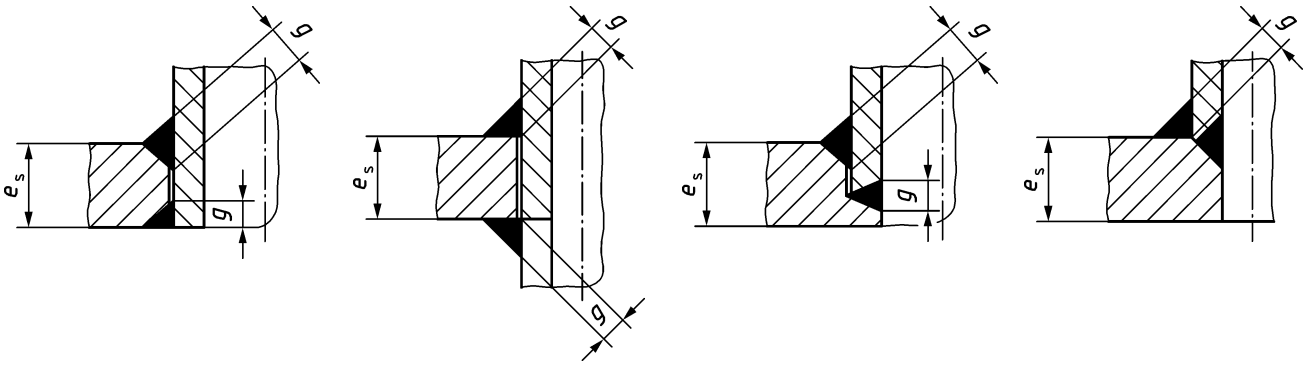
Where full penetration welds are not used for branches, welds shall be as shown in Figures 1a) to 1d) with each weld having a throat thickness, g, of at least 0,7 times the thickness of the thinnest part.

Branches may be considered as reinforcement of the main body if the weld joints are made as shown in Figures 1a) to 1d), 2a) and 2b).

5.2.2 A single partial penetration weld is permitted in the case of branch pipes and sockets whose outside diameter does not exceed 65 mm. The throat thickness, g, of the weld shall be at least 1,5 times the thickness of the thinnest part (see Figures 1e), 1f), 1g) and 1h)).Where the diameter of the hole in the wall is greater than 75 mm, a reinforcement calculation is necessary in accordance with the method described in 5.4.6.3.

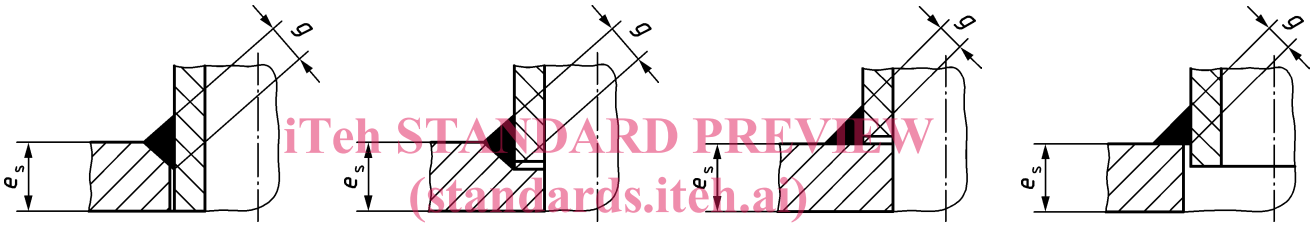
5.2.3 If a shell is manufactured from more than one ring, the alignment between the centrelines of the longitudinal welds shall be as far apart as possible but not less than 50 mm.

For horizontally mounted vessels longitudinal welds shall not be closer than 30° to the lowest line along the surface of the vessel parallel to its centre line (see Figure 3).



a) b) c) d)

NOTE *g* is at least 0,7 of the thinnest part.



e) f) g) h)

NOTE *g* is at least 1,5 of the thinnest part.

Figure 1 — Alternative welds for tubes, branches, pipes and sockets

a) b)

Figure 2 — Full penetration welds for tubes, branches, pipes and sockets