SLOVENSKI STANDARD
oSIST prEN 286-3:2019

01-november-2019

Enostavne neogrevane (nekurjene) tlačne posode, namenjene za zrak ali dušik - 3. del: Tlačne posode iz jekla za zračne zavore in pomožno pnevmatsko opremo na tirnih vozilih

Simple unfired pressure vessels designed to contain air or nitrogen - Part 3: Steel pressure vessels designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock

Einfache unbefeuerte Druckbehälter für Luft oder Stickstoff - Teil 3: Druckbehälter aus Stahl für Druckluftbremsanlagen und pneumatische Hilfseinrichtungen in Schienenfahrzeugen

Récipients à pression simples, non soumis à la flamme, destinés à contenir de l'air ou de l'azote - Partie 3 : Récipients à pression en acier, destinés aux équipements pneumatiques de freinage et aux équipements pneumatiques auxiliaires du matériel roulant ferroviaire

Ta slovenski standard je istoveten z: **prEN 286-3**

ICS:

23.020.32	Tlačne posode	Pressure vessels
45.040	Materiali in deli za železniško tehniko	Materials and components for railway engineering

oSIST prEN 286-3:2019 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

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ICS

Will supersede EN 286-3:1994

English Version

Simple unfired pressure vessels designed to contain air or nitrogen - Part 3: Steel pressure vessels designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock

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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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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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European foreword

This document (prEN 286-3:2019) 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 286-3:1994.

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 is applicable to simple unfired steel pressure vessels, referred to as "vessel" in this document, designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock (see Clause 13).

It defines three types of vessel A, B and C (see Table 1) corresponding to the current practice of European railway networks.

1.2 The vessels in this document are:

a) made from a single shell;

b) made from non-alloy steel;

c) fabricated by welding;

d) used at a maximum working pressure of 15 bar;

e) the product of the maximum working pressure (in bar) and the volume (in litre): 50 bar litres < PV ≤ 10 000 bar litres;

f) made of a cylindrical part of circular cross-section called the shell with two outwardly dished torispherical ends, that is two dished ends with the same axis of rotation. This document therefore does not apply to vessels with one or two flat ends or those made up of several compartments;

g) calculated with a design pressure P (see 5.1.4.1.2);

h) designed for a working temperature of between −40 °C and +100 °C;

i) fastened to vehicles:

   1) by straps for types A and B vessels,

   2) by welded brackets for types B and C vessels.

1.3 In normal service, a momentary overpressure of 10 % of PS, the maximum working pressure PS, is permitted.

1.4 This document applies to the vessel proper, from the inlet connection to the outlet connection and to all other connections and fittings belonging to the vessel.

1.5 This document gives the requirements to be met for the calculation, design, fabrication, inspection during fabrication and certification of the vessel, and fittings for assembly to the vehicle.

These requirements cannot be written in sufficient detail to ensure good workmanship or proper construction. Each manufacturer is therefore responsible for taking every necessary step to make sure that the quality of workmanship and construction is such as to ensure compliance with good engineering practice.

This document gives:

a) in Annex B, recommendations for assembly to the vehicles;

b) in Annex C, recommendations for the service surveillance of type A vessels;

c) in Annex D, recommendations for the service surveillance of types B and C vessels.

The requirements of this document apply to vessels designed to be fitted to rail vehicles.

Table 1 — Definition of types of vessel

Criterion	Type A	Type B	Type C	Reference clause in this document
Nominal design stress f	0,6 R_{eT} or 0,3 R_m	—	0,6 R_{eT} or 0,3 R_m	5.1.4.1
	—	0,3 R_m/1,4 with $R_m \leq 360$ N/mm^2	—	5.1.4.2
Radii of curvature of the end	$R > 0{,}8\ D_0$ $r > 0{,}1\ D_0$	—	$R > 0{,}8\ D_0$ $r > 0{,}1\ D_0$	5.1.3.1.2
	—	$R = D_0$ $r \geq 0{,}06\ D_0$	—	5.1.3.1.3
Shell ring/end assembly	Butt weld or swaged end. Full penetration weld	—	Butt weld or swaged end. Full penetration weld	5.1.5.2.1
	—	Inserted end	—	5.1.5.2.2
Weld of drainage boss	Full penetration weld of the vessel wall for penetrating boss	Full penetration weld of the vessel wall for penetrating boss Convex weld for surface mounted boss	Full penetration weld of the vessel wall for penetrating boss Convex weld for surface mounted boss	5.2.4.2
Method of fixing to the vehicle	Fixing by steel straps	Fixing by straps or welded brackets	Fixing by welded brackets	Annex B
Service surveillance	Annex C	Annex D	Annex D	—

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 10028-2:2017, *Flat products made of steels for pressure purposes - Part 2: Non-alloy and alloy steels with specified elevated temperature properties*

EN 10207:2017, *Steels for simple pressure vessels - Technical delivery requirements for plates, strips and bars*

EN ISO 148-1:2010,[1] *Metallic materials — Charpy pendulum impact test — Part 1: Test method (ISO 148-1:2009)*

EN ISO 228-1:2003,[2] Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation (ISO 228-1:2000)

EN ISO 5173:2010,[3] Destructive tests on welds in metallic materials — Bend tests (ISO 5173:2009)

EN ISO 6520-1:2007, *Welding and allied processes - Classification of geometric imperfections in metallic materials - Part 1: Fusion welding (ISO 6520-1:2007)*

EN ISO 6892-1:2016, *Metallic materials - Tensile testing - Part 1: Method of test at room temperature (ISO 6892-1:2016)*

EN ISO 9606-1:2017,[4] *Qualification testing of welders — Fusion welding — Part 1: Steels (ISO 9606-1:2012, including Cor 1:2012)*

EN ISO 14341:2011, *Welding consumables - Wire electrodes and weld deposits for gas shielded metal arc welding of non alloy and fine grain steels - Classification (ISO 14341:2010)*

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

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 7-1:1994,[5] *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

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

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[1] As impacted EN ISO 148-1 Supplement 1.

[2] As impacted by EN ISO 228-1 Supplement 1. German version EN ISO 228-1:2003.

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

[4] German version EN ISO 9606-1:2013

[5] As impacted by ISO 7-1:1994, Technical Corrigendum 1

3 Terms, definitions and symbols

3.1 Terms and definitions

No terms and definitions are listed in this document.

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

3.2 Symbols

A	Elongation at rupture	%
A_{fb}	Cross sectional area effective as compensation of the boss	mm^2
A_{fp}	Cross sectional area effective as compensation of the reinforcing plate	mm^2
A_{fs}	Cross sectional area effective as compensation of the shell	mm^2
A_p	Area of the pressurized zone	mm^2
c	Absolute value of the minus rolling tolerance for sheets as quoted in the standard	mm
D_0	Outside diameter of the shell of the vessel	mm
d_{ib}	Internal diameter of the boss	mm
d_{0b}	Outside diameter of the boss	mm
e	Nominal wall thickness	mm
e_c	Calculated thickness	mm
e_{ch}	Calculated thickness of the end	mm
e_{cs}	Calculated thickness of the shell	mm
e_h	Nominal thickness of the end	mm
e_{rb}	Wall thickness of the boss contributing to reinforcement	mm
e_{rp}	Wall thickness of the reinforcing plate contributing to reinforcement	mm
e_{rs}	Wall thickness of the shell contributing to reinforcement	mm
f	Nominal design stress at the design temperature	N/mm^2
f_b	Permitted stress of the boss	N/mm^2
g	Throat thickness of a weld	mm
h	External height of the dished part of an end (see Figure 4)	mm
h_1	Height of the cylindrical part of the end (see Figure 4)	mm
h_2	Internal height of a dished part of the end (see Figure 4)	mm
K_c	Design coefficient which is a function of the welding process	

KV	Impact energy at break (V-notch test piece)	
L	Total length of the vessel	mm
L_1	Distance between the axis of a drainage opening and the end of the vessel	mm
l_{rb}	Length of the boss contributing to reinforcement	mm
l_{rbi}	Length of inward projecting boss contributing to reinforcement	mm
l_{rp}	Length of the reinforcing plate contributing to reinforcement, measured along the mid surface	mm
l_{rs}	Length of the shell contributing to reinforcement, measured along the mid surface	mm
P	Design pressure[6] which is a function of the maximum working pressure, the welding process and inspection used	bar
PS	Maximum working pressure[1]	bar
R	Internal radius of the spherical part of the end	mm
R_{eT}	Minimum yield point at the maximum working temperature	N/mm^2
R_i	Local internal radius at the location of the opening in question	mm
R_m	Minimum tensile strength specified by the manufacturer or by the standard defining the steel	N/mm^2
r	Internal radius of the torispherical part of the end	mm
S	Corrosion allowance	mm
T_{min}	Minimum working temperature	°C
T_{max}	Maximum working temperature	°C
T^*	Temperature at which the mean value of the energy absorbed at break (V-notch), $KV > 28$ J, is guaranteed longitudinally	°C
V	Volume of the vessel	Litre

4 Materials

4.1 Pressurized parts

4.1.1 Shell and ends

The shell and ends shall be made of steel sheet grade P 235 S, P 265 S or P 275 SL as specified in EN 10207:2017 and grade P 235 GH or P 265 GH as specified in EN 10028-2:2017.

These steels shall be accompanied by a test report drawn up by the material manufacturer.

The mean values of energy absorbed at break KV determined on three longitudinal test pieces shall be at least 28 J at the minimum working temperature T_{min}.

6) All pressures are gauge pressures.

This essential safety requirement may be met as follows:

a) For types A, B and C vessels

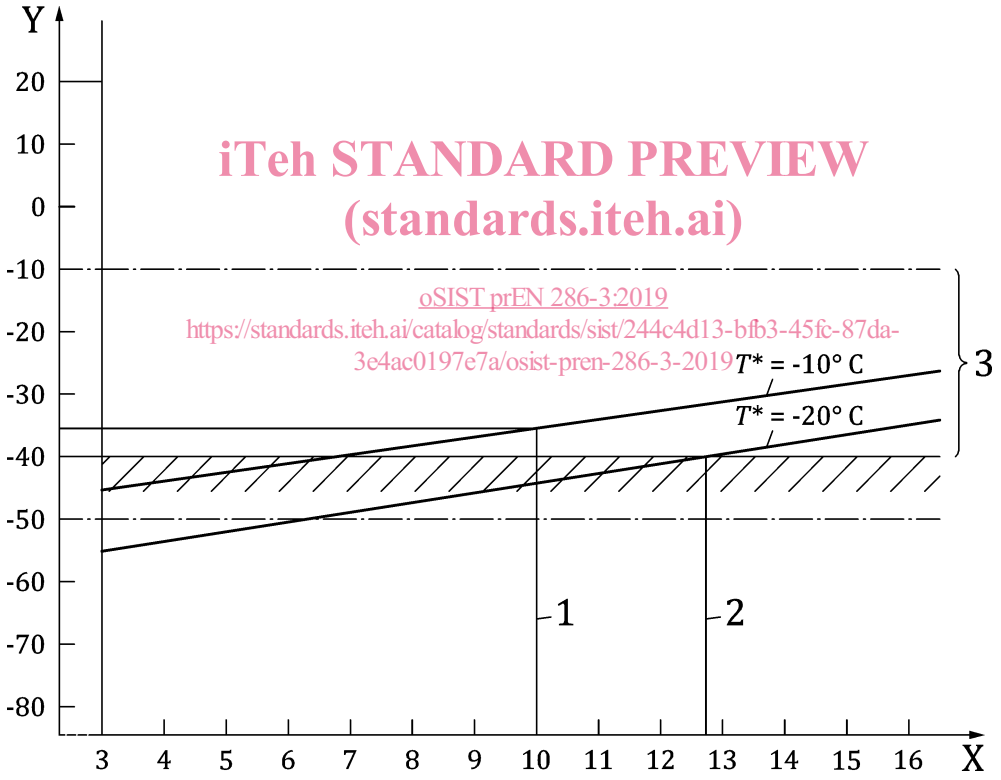
— by carrying out impact bending tests at the minimum temperature of −40 °C, at the responsibility of the material manufacturer;

— or by using steels for which the appropriate guarantee of energy absorbed at break at the minimum temperature of −40 °C is given by a particular standard;

— or at a temperature T^* equal to or less than that obtained by extrapolation using the graph from Figure 1.

b) For type B vessels only

by ensuring that brittle fracture does not occur at the minimum service temperature −40 °C, using the fracture mechanics theory through the use of a recognized standard or code and by applying knowledge of the physical and metallurgical properties at the temperature T of a steel defined in a specific standard, whilst taking into account the stresses (primary and secondary stresses) and the thickness of the materials of the vessel.



Key

1 example 1
2 example 2
3 scope of the diagramm for the prupose of this document
X thickness of the plate material [mm]
Y minimum working temperature [°C]

EXAMPLE 1 : if e = 10 mm and T* = −10 °C, Tmin = −35 °C;

EXAMPLE 2 : if T* = −20 °C and Tmin = −40 °C, emax = 12,7 mm.

Figure 1 — Extrapolation of the guaranteed energy absorbed at break at temperature T_{min}

4.1.2 Inspection bosses, pipe connection branches and drainage bosses

These accessories (pipes/tubes, bosses etc.) shall be manufactured from circular profiles or pipes/tubes made of steel grades, which are compatible with the materials used for the manufacture of pressurized parts. They shall have an elongation after rupture, A, on test pieces taken in the length of at least 14 % (see EN ISO 6892-1:2016):

4.2 Non-pressurized parts

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

To this end, for steel vessels, supports and accessories fitted by welding on, the shells and ends shall be made of non-alloy steel which meets the following requirements:

$C \leq 0{,}25$ %, $S \leq 0{,}05$ %, $P \leq 0{,}05$ % and

$R_{\mathrm{m\ max}} \leq 580\ \mathrm{N/mm^2}$

4.3 Welding consumables

The welding consumables used for welding onto the vessels or welding the vessels themselves shall be suitable and compatible with the parent materials.

They shall correspond to EN ISO 14341:2011.

5 Design

5.1 Shell and ends

5.1.1 General

The vessels are of simple geometrical form, composed of a cylindrical body of circular cross-section and two outwardly dished torispherical ends.

The design of the vessels shall take into account the installation and maintenance conditions. The installation and maintenance conditions shall be given by the manufacturer or the user.

NOTE Examples of installation and maintenance requirements are given in informative Annexes B, C and D.

5.1.2 Design of the shell

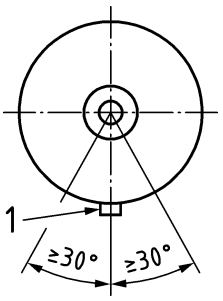
Shells are generally made from a single sheet. If the shell is made of several welded parts, the number of circular welds shall be kept to a minimum.

Longitudinal weld seams of parts of the shell shall:

— not be located on the lower part of the vessel defined by an angle of 30° on either side of the vertical axis (see Figure 2);

— be sufficiently far apart such as to form an angle greater than 40 ° (see example in Figure 3).

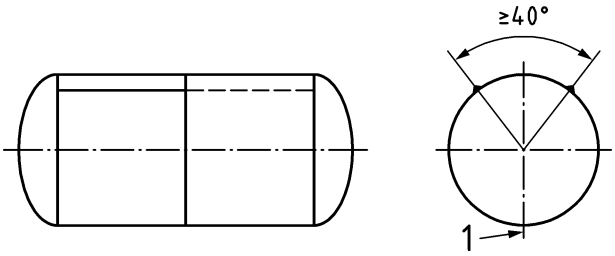
All welds, even of a temporary nature, located outside the designed seams are prohibited.



Key

1 Drainage opening

Figure 2 — Position of longitudinal welds on the bottom of the shell



Key

1 Drainage point or reference mark on the lower part

Figure 3 — Position of longitudinal welds on the shell

5.1.3 Design of the ends

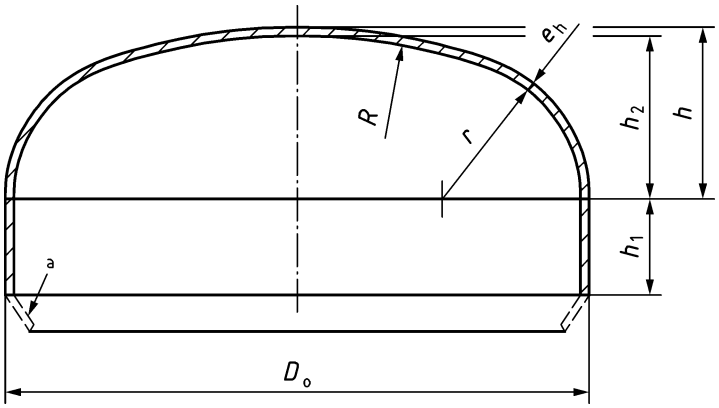
5.1.3.1 Shape and dimensions of the ends

5.1.3.1.1 General

The torispherical ends shall be made from a single sheet.

Dishing and flanging shall be carried out by a mechanical forming procedure, for example by pressing or spinning. Hand forming is not permitted.

The torispherical end (see Figure 4) shall meet the requirements of 5.1.3.1.2 or 5.1.3.1.3, respectively.



Key

a see Figure 9 and 10

Figure 4 — Torisperical end

5.1.3.1.2 Types A and C vessels

R (nominal) ≥ 0,8 D_0

r (nominal) ≥ 0,1 D_0

$h_{1\min} \geq 3 \times e_h$

5.1.3.1.3 Type B vessels

R (nominal) = D_0

r (nominal) ≥ 0,06 D_0

$26 \leq h_1 \leq 40$ mm (see 5.1.5.2.2)

5.1.3.2 Heat treatment of ends after forming

Steel ends obtained by cold forming:

c) the nominal sheet thicknesses of which are equal to or less than 6 mm, can be used without postforming heat treatment;

a) the nominal sheet thicknesses of which are greater than 6 mm and not more than 8 mm, shall undergo postforming heat treatment if the minimum temperature of the impact bending test (V-notch) required is less than −10 °C;

b) the nominal sheet thicknesses of which are greater than 8 mm, shall not be used without postforming heat treatment.

Where a heat treatment is required (see a), b) and c)), it is a normalizing treatment after cold forming, i.e. heating beyond the range of critical temperatures followed by air cooling.

The heating temperature shall be greater than the upper limit of the critical range (usually called point A3) but as close to it as possible.

For the steels specified in Clause 4, the heat treatment temperature is between 890 °C and 950 °C. If this range does not feature in the standard, the actual normalizing temperature should be stand by the steel producer.

5.1.4 Calculation of shell and end thickness

5.1.4.1 Type A vessels

5.1.4.1.1 General

The nominal thicknesses "e" of the shells and ends shall be such that:

$e \geq e_c + c + S$

The value of "e_c" shall in no case be less than 2 mm.

The corrosion allowance "S" is taken as equal to 1 mm.

The manufacturer shall apply a correction to allow for thinning resulting from the manufacturing process.