SLOVENSKI STANDARD
SIST EN 286-4:1998

01-oktober-1998

Enostavne, neogrevane tlačne posode, namenjene za zrak ali dušik - 4. del: Tlačne posode iz aluminijevih zlitin za zračne zavore in pomožno pnevmatsko opremo na tirnih vozilih

Simple unfired pressure vessels designed to contain air or nitrogen - Part 4: Aluminium alloy pressure vessels designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock

Einfache unbefeuerte Druckbehälter für Luft oder Stickstoff - Teil 4: Druckbehälter aus Aluminiumlegierungen für Druckbremsanlagen und pneumatische Hilfseinrichtungen in Schienenfahrzeugen

Récipients a pression simples, non soumis a la flamme, destinés a contenir de l'air ou de l'azote - Partie 4: Récipients a pression en alliages d'aluminium destinés aux équipements pneumatiques de freinage et aux équipements pneumatiques auxiliaires du matériel roulant ferroviaire

Ta slovenski standard je istoveten z: **EN 286-4:1994**

ICS:

23.020.30	Tlačne posode, plinske jeklenke	Pressure vessels, gas cylinders
77.150.10	Aluminijski izdelki	Aluminium products

SIST EN 286-4:1998 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

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EN 286-4

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Descriptors: Railway rolling stock, brakes, pneumatic equipment, pressure vessels, tanks containers, aluminium alloys, design, computation, production control, weld defects, acceptability, assembling, certification, marking

English version

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This European Standard was approved by CEN on 1994-09-09. 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.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

The European Standards exist 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 Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart,36 B-1050 Brussels

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Foreword

This European Standard was prepared by the Technical Committe CEN/TC 54 "Unfires pressure vessels" of which the secretariat is held by BSI.

CEN/TC 54 has decided to submit the final draft for formal vote by its resolution. The result was positive.

This Part is one of a series of four. The other parts are:

Part 1: Design, manufacture and testing.

Part 2: Pressure vessels for air braking and auxiliary systems for motor vehicles and their trailers.

Part 3: Steel pressure vessels designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock.

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 March 1995, and conflicting national standards shall be withdrawn at the latest by March 1995.

According to the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

1 Scope

1.1 This Part of this European Standard is applicable to simple unfired aluminium alloy pressure vessels, referred to as "vessel" in this standard, designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock (see 1.6).

1.2 The vessels to this standard are:

a) made from a single shell;

b) made from aluminium alloy;

c) fabricated by welding;

d) used at a maximum working pressure of 10 bar;

e) the product of the maximum working pressure (in bar) and the volume (in litre):

$$50 \text{ bar litres} < PV \leq 10\,000 \text{ bar litres};$$

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 standard 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 5.1.4.2);

h) designed for a working temperature of between -50 °C and +100 °C [+ 65 °C for certain grades of aluminium alloy (see 4.1.1)];

j) fastened to the vehicles by straps;

1.3 In normal service, a momentary overpressure of 1 bar of the maximum working pressure is permitted (10 % of PS).

1.4 This Part of this European Standard 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 Part of this European Standard 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 Part of this standard gives:

a) in annex F, recommendations for assembly to the vehicles;

b) in annex G, recommendations for the service surveillance of vessels.

1.6 The requirements of this Part of this European Standard apply to vessels designed to be fitted to rail vehicles used on the main national networks, urban networks, underground railways, trams, private networks (regional railways, company railways, ...).

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 287-2 Approval testing of welders - fusion welding - Part 2: Aluminium and aluminium alloys

EN 288-1 Specification and approval of welding procedures for metallic materials - Part 1: General rules for fusion welding

EN 288-2 Specification and approval of welding procedures for metallic materials - Part 2: Welding procedure specification for arc welding

EN 288-4 Specification and approval of welding procedures for metallic materials - Part 4: Welding procedure tests for the arc welding of aluminium and its alloy

EN 10025 Hot rolled products of non-alloy structural steels - Technical delivery conditions

EN 26520 Classification of imperfections in metallic fusion welds, with explanations

ISO 209-1 Wrought aluminium and aluminium alloys - Chemical composition and forms of product - Part 1: Chemical composition

ISO 209-2 Wrought aluminium and aluminium alloys - Chemical composition and forms of product - Part 2: Forms of products

ISO 228-1	Pipe threads where pressure-tight joints are not made on the threads - Part 1: Designation, dimensions and tolerances
ISO 261	ISO general purpose metric screw threads - General plan
ISO 1101	Technical drawings - Geometrical tolerancing - Tolerancing of form, orientation, location and run-out - Generalities, definitions, symbols, indications on drawings
ISO 2081	Metallic coatings - Electroplated coating of zinc on iron or steel
ISO 2107	Aluminium, magnesium and their alloys - Temper designations
ISO 2437	Recommendation practice for the X-ray inspection of fusion welded butt joints for aluminium and its alloys and magnesium and its alloys 5 to 50 mm thick
ISO 4520	Chromate conversion coatings on electroplates zinc and cadmium coatings
ISO 6361-2	Wrought aluminium and aluminium alloy sheet, strip and plates Part 2: Mechanical properties
ISO 6362-2	Wrought aluminium and alloy extruded rods/bars, tubes and profiles Part 2: Mechanical properties

3 Symbols

For the purpose of this standard, the following symbols apply:

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_o	Outside diameter of the shell of the vessel	mm
d_{ib}	Internal diameter of the boss	mm

d_{ob}	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 3)	mm
h_1	Height of the cylindrical part of the end (see figure 3)	mm
h_2	Internal height of a dished part of the end (see figure 3)	mm
K_c	Design coefficient which is a function of the welding process	-
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[1] 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_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 material .....N/mm^2
$R_{p0,2}$	Minimum proof stress .....N/mm^2
r	Internal radius of the torispherical part of the end .....mm
T_{min}	Minimum working temperature .....°C
T_{max}	Maximum working temperature .....°C
V	Volume of the vessel .....litre

1) All pressures are gauge pressures.

4 Materials

4.1 Pressurized parts

The aluminium alloys used in the fabrication of the pressurized parts of the vessels shall fulfil the following conditions:

a) $R_m \leq 350$ N/mm²

b) elongation after rupture A shall be:

- if the test piece is taken parallel to the direction of rolling ≥ 16 %;

- if the test piece is taken perpendicular to the direction of rolling ≥ 14 %.

4.1.1 *Shell and ends*

The shell and ends shall be made of aluminium alloy sheet or strip of one of the grades given in table 1.

4.1.2 *Inspection bosses, pipes connection branches and drainage bosses*

The bosses shall be made of 5083, 5086, 5454 or 5754 aluminium alloy bars or tubes in condition M in accordance with ISO 6362: Part 2.

Table 1: Aluminium alloy materials

ISO designation[1)]	International registration record[1)]	Temper designation[2)]	Maximum temperature	Temperature °C			Design temperature[3)] °C			
				20	50	100	20	50	65	100
			°C	Minimum proof stress N/mm²			Minimum design stress N/mm²			
AlMg2Mn0,8	5049	0	100	80	80	70	48	48	46[5)]	42
AlMg3	5754	0	100	80	80	70	48	48	46[5)]	42
AlMg3Mn	5454	0	100	90	90	90	54	54	54[5)]	54
AlMg4	5086	0	65	100	100	90[4)]	60	60	58[5)]	54[4)]
AlMg4,5Mn0,7	5083	0	65	125	125	120[4)]	75	75	74[5)]	72[4)]

1) ISO designation and International registration record see ISO 209: Parts 1 and 2.

2) Temper designation, see ISO 2107.

3) For intermediate design temperatures linear interpolation may be used.

4) For interpolation purposes only as temperature limit of 65 °C.

5) Interpolated value.

4.2 Non-pressurized parts

The accessories to be welded to the vessel, but which do not contribute to its strength, shall be made of aluminium alloy compatible with the aluminium alloy from which the pressurized parts of the vessel are made. The product analysis of the aluminium alloy shall meet the following requirements:

- $R_m \leq 350$ N/mm²;
- Cu ≤ 0,5 % and Zn ≤ 0,25 %.

4.3 Welding materials

The filler material and gas fluxes shall be suitable for the parent metals.

The recommended grades of filler material to be used are 5183 and 5356. These grades are suitable for welding the grades listed in 4.1 and 4.2.

Aluminium-silicon grades shall not be used.

The suitability of the welding products used is verified during the qualification of the procedures described in clause 9.

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 (see clause 13).

NOTE: Examples of installation and maintenance requirements are given in informative annexes F and G.

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 1);

- be sufficiently far apart such as to form an angle greater than 40 ° (see example in figure 2).

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

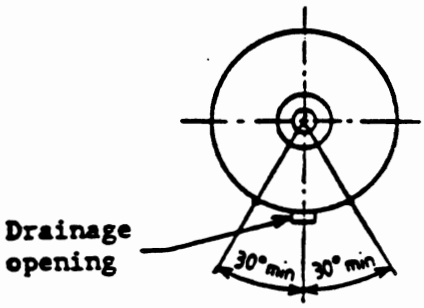


Figure 1: Position of longitudinal welds on the bottom of the shell

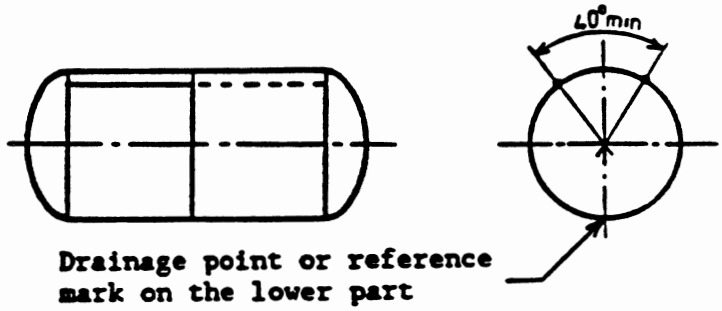


Figure 2: Position of longitudinal welds on the shell

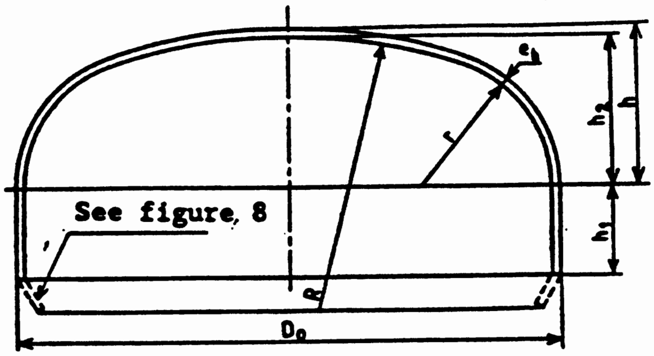
5.1.3 *Design of the ends*

5.1.3.1 *Shape and dimensions of the ends*

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 shall meet the requirements of figure 3 and table 2.



R (nominal) = D_o

0,1 D_o ≤ r (nominal) ≤ 0,15 D_o

Figure 3: Torispherical end

Table 2: Height of the cylindrical portion of ends

Dimensions in millimetres

e_h	3	4	5	6	8	10
h_{1min}	12	16	20	24	32	40
h_{1max}	25		40		50	

5.1.3.2 *Heat treatment after forming*

The parameters of the heat treatment to which ends are subjected after forming cannot be specified in this standard as they vary according to the following criteria:

- the grade of aluminium alloy;
- the type of oven (other than direct radiation, convection, etc);
- the forming process (hot or cold drawing).

The heat treatment shall not affect the values of $R_{p0,2}$ and R_m used in calculating the thickness.