



**SLOVENSKI STANDARD**  
**oSIST prEN 12392:2024**  
**01-julij-2024**

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**Aluminij in aluminijeve zlitine - Gnetne in ulite zlitine - Posebne zahteve za aluminijeve izdelke za izdelavo tlačnih naprav**

Aluminium and aluminium alloys - Wrought products and cast products - Special requirements for products intended for the production of pressure equipment

Aluminium und Aluminium-Legierungen - Knet- und Gusserzeugnisse - Besondere Anforderungen an Erzeugnisse für die Fertigung von Druckgeräten

Aluminium et alliages d'aluminium - Produits corroyés et moulés - Exigences particulières pour les produits destinés à la fabrication des équipements sous pression

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## Aluminium and aluminium alloys - Wrought products and cast products - Special requirements for products intended for the production of pressure equipment

Aluminium et alliages d'aluminium - Produits corroyés et moulés - Exigences particulières pour les produits destinés à la fabrication des appareils à pression

Aluminium und Aluminium-Legierungen - Knet- und Gusserzeugnisse - Besondere Anforderungen an Erzeugnisse für die Fertigung von Druckgeräten

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EUROPEAN COMMITTEE FOR STANDARDIZATION  
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EUROPÄISCHES KOMITEE FÜR NORMUNG

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

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**prEN 12392:2024 (E)****European foreword**

This document (prEN 12392:2024) has been prepared by Technical Committee CEN/TC 132 “Aluminium and aluminium alloys”, the secretariat of which is held by AFNOR.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 12392:2016+A1:2022.

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

Details of significant technical changes between this document and its previous edition are provided at Annex D.

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## 1 Scope

This document specifies the material requirements and testing procedures applicable to wrought and cast aluminium and aluminium alloys intended for use in the production of pressure equipment.

This document covers:

- the products forms, grades and tempers of wrought and cast aluminium and aluminium alloys which can be used for such applications together with data for wrought and cast alloys over their permissible working temperature ranges;
- the technical conditions for inspection and delivery, mechanical property limits and tolerances on form and dimensions by reference to the appropriate European standards for the relevant wrought and cast aluminium and aluminium alloys;
- additional requirements which are specific to pressure equipment applications.

It applies to hot-rolled plate, cold-rolled sheet/ strip/ circles, extruded or extruded and cold drawn rod/bar, tube, extruded open / hollow profiles, forgings and castings. Considering this, this document is intended to be used in conjunction with EN 573 series, EN 485 series, EN 941, EN 754 series, EN 755 series, EN 586 series and EN 1706. The materials and application ranges covered by this document are those given in Annex A, Table A.1 for wrought alloys and Table A.2 for castings.

The objective of this document is to only cover the materials used for components of pressure equipment. Fabrication or fabrication methods for pressure equipment are excluded from this document and can be found in the relevant standards listed in the “Bibliography”.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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<https://standards.iteh.ai/catalog/standards/sist/811284dc-7911-42d5-95e8-6453a9970b32/osist-pren-12392-2024>

EN 485-2:2016+A1:2018, *Aluminium and aluminium alloys — Sheet, strip and plate — Part 2: Mechanical properties*

EN 485-3:2003, *Aluminium and aluminium alloys — Sheet, strip and plate — Part 3: Tolerances on dimensions and form for hot-rolled products*

EN 485-4:1993, *Aluminium and aluminium alloys — Sheet, strip and plate — Part 4: Tolerances on shape and dimensions for cold-rolled products*

EN 573-3:2019+A2:2023, *Aluminium and aluminium alloys — Chemical composition and form of wrought products — Part 3: Chemical composition and form of products*

EN 586-1:1997, *Aluminium and aluminium alloys — Forgings — Part 1: Technical conditions for inspection and delivery*

EN 586-3:2001, *Aluminium and aluminium alloys — Forgings — Part 3: Tolerances on dimensions and form*

EN 754-1:2016, *Aluminium and aluminium alloys — Cold drawn rod/bar and tube — Part 1: Technical conditions for inspection and delivery*

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EN 754-3:2008, *Aluminium and aluminium alloys — Cold drawn rod/bar and tube — Part 3: Round bars, tolerances on dimensions and form*

EN 754-4:2008, *Aluminium and aluminium alloys — Cold drawn rod/bar and tube — Part 4: Square bars, tolerances on dimensions and form*

EN 754-5:2008, *Aluminium and aluminium alloys — Cold drawn rod/bar and tube — Part 5: Rectangular bars, tolerances on dimensions and form*

EN 754-6:2008, *Aluminium and aluminium alloys — Cold drawn rod/bar and tube — Part 6: Hexagonal bars, tolerances on dimensions and form*

EN 754-7:2016, *Aluminium and aluminium alloys — Cold drawn rod/bar and tube — Part 7: Seamless tubes, tolerances on dimensions and form*

EN 754-8:2016, *Aluminium and aluminium alloys — Cold drawn rod/bar and tube — Part 8: Porthole tubes, tolerances on dimensions and form*

EN 755-1:2016, *Aluminium and aluminium alloys — Extruded rod/bar, tube and profiles — Part 1: Technical conditions for inspection and delivery*

EN 755-2:2016, *Aluminium and aluminium alloys — Extruded rod/bar, tube and profiles — Part 2: Mechanical properties*

EN 755-3:2008, *Aluminium and aluminium alloys — Extruded rod/bar, tube and profiles — Part 3: Round bars, tolerances on dimensions and form*

EN 755-4:2008, *Aluminium and aluminium alloys — Extruded rod/bar, tube and profiles — Part 4: Square bars, tolerances on dimensions and form*

EN 755-5:2008, *Aluminium and aluminium alloys — Extruded rod/bar, tube and profiles — Part 5: Rectangular bars, tolerances on dimensions and form*

EN 755-6:2008, *Aluminium and aluminium alloys — Extruded rod/bar, tube and profiles — Part 6: Hexagonal bars, tolerances on dimensions and form*

EN 755-7:2016, *Aluminium and aluminium alloys — Extruded rod/bar, tube and profiles — Part 7: Seamless tubes, tolerances on dimensions and form*

EN 755-8:2016, *Aluminium and aluminium alloys — Extruded rod/bar, tube and profiles — Part 8: Porthole tubes, tolerances on dimensions and form*

EN 755-9:2016, *Aluminium and aluminium alloys — Extruded rod/bar, tube and profiles — Part 9: Profiles, tolerances on dimensions and form*

EN 941:2022, *Aluminium and aluminium alloys — Circle and circle stock for the production of general applications — Specifications*

EN 1370:2011, *Founding — Examination of surface condition*



EN 1371-1:2011, *Founding — Liquid penetrant testing — Part 1: Sand, gravity die and low pressure die castings*

EN 1559-1:2011, *Founding — Technical conditions of delivery — Part 1: General*

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EN 1706:2020+A1:2021, *Aluminium and aluminium alloys — Castings — Chemical composition and mechanical properties*

EN 1779:1999, *Non-destructive testing — Leak testing — Criteria for method and technique selection*

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EN 2004-1:1993, *Aerospace series — Test methods for aluminium and aluminium alloy products — Part 1: Determination of electrical conductivity of wrought aluminium alloys*

EN 2101:1991, *Aerospace series — Chromic acid anodizing of aluminium and wrought aluminium alloys*

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

EN 12020-1:2022, *Aluminium and aluminium alloys — Extruded precision profiles in alloys EN AW-6060 and EN AW-6063 — Part 1: Technical conditions for inspection and delivery*

EN 12020-2:2022, *Aluminium and aluminium alloys — Extruded precision profiles in alloys EN AW-6060 and EN AW-6063 — Part 2: Tolerances on dimensions and form*

EN 12258-1:2012, *Aluminium and aluminium alloys — Terms and definitions — Part 1: General terms*

EN 12681-1:2017, *Founding — Radiographic testing — Part 1: Film techniques*

EN 12681-2:2017, *Founding — Radiographic testing — Part 2: Techniques with digital detectors*

EN 13957:2008, *Aluminium and aluminium alloys — Extruded round, coiled tube for general applications — Specification*

EN 13958:2008, *Aluminium and aluminium alloys — Cold drawn, round, coiled tube for general applications — Specification*

EN 14242:2023, *Aluminium and aluminium alloys — Chemical analysis — Inductively coupled plasma optical emission spectral analysis*

EN 14361:2004, *Aluminium and aluminium alloys — Chemical analysis — Sampling from metal melts*

EN 14726:2019, *Aluminium and aluminium alloys — Determination of the chemical composition of aluminium and aluminium alloys by spark optical emission spectrometry*

EN ISO 148-1:2016, *Metallic materials — Charpy pendulum impact test — Part 1: Test method (ISO 148-1:2016)*

EN ISO 3452-1:2021, *Non-destructive testing — Penetrant testing — Part 1: General principles (ISO 3452-1:2021)*

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EN ISO 6506-1:2014, *Metallic materials — Brinell hardness test — Part 1: Test method (ISO 6506-1:2014)*

EN ISO 6892-1:2019, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature (ISO 6892-1:2019)*

EN ISO 8062-3:2023, *Geometrical product specifications (GPS) — Dimensional and geometrical tolerances for moulded parts — Part 3: General dimensional and geometrical tolerances and machining allowances for castings using  $\pm$  tolerances for indicated dimensions (ISO 8062-3:2023)*

EN ISO 8492:2013, *Metallic materials — Tube — Flattening test (ISO 8492:2013)*

EN ISO 8493:2004, *Metallic materials — Tube — Drift-expanding test (ISO 8493:1998)*

EN ISO 8495:2013, *Metallic materials — Tube — Ring-expanding test (ISO 8495:2013)*

EN ISO 8496:2013, *Metallic materials — Tube — Ring tensile test (ISO 8496:2013)*

ISO 9591:2004, *Corrosion of aluminium alloys — Determination of resistance to stress corrosion cracking*

ASTM B548:2003, *Standard Test Method for Ultrasonic Inspection of Aluminium-Alloy Plate for Pressure Vessels*

ASTM B594:2019, *Standard Practice for Ultrasonic Inspection of Aluminium-Alloy Wrought Products*

ASTM E112:2013, *Standard Test Methods for Determining Average Grain Size*

ASTM E215:2022, *Standard Practice for Standardizing Equipment for Electromagnetic Testing of Seamless Aluminum-Alloy Tube*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12258-1:2012 and the following apply.

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ISO and IEC maintain terminological databases for use in standardization at the following addresses: [12392-2024](https://standards.iteh.ai)

— IEC Electropedia: available at <https://www.electropedia.org/>

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

#### 3.1

##### **heat-treatment lot**

quantity of products of the same alloy or purity grade of alloy, form, thickness or cross-section and produced in the same way and heat-treated in one furnace load; or such products solution-treated and subsequently precipitation treated in one furnace load

Note 1 to entry: More than one solution-treatment batch can be included in one ageing furnace load.

Note 2 to entry: For heat treatment in a continuous furnace (vertical or horizontal), the products continuously heat-treated during a specified time (e.g. 8 h) can be considered as one heat treatment lot.

Note 3 to entry: For forgings, a heat-treatment lot may consist of a group of forgings of similar size and shape.

Source: EN 12258-1:2012, 4.1.15

### 3.2

#### **inspection lot**

consignment, or a part thereof, submitted for inspection, comprising products of the same grade or alloy, form, thickness or cross-section, and processed in the same manner

Note 1 to entry: For forgings, an inspection lot may consist of a group of forgings of similar size and shape.

Source: EN 12258-1:2012, 4.1.2

### 3.3

#### **melt**

quantity of molten metal that has simultaneously undergone the same preparatory treatment in the furnace before the casting operation

Source: EN 12258-1:2012, 4.1.3

### 3.4

#### **cast**

quantity of products cast simultaneously from the same melt

Source: EN 12258-1:2012, 4.1.4

### 3.5

#### **casting**

product at or near finished shape, formed by solidification of the metal in a mould or a die

Note 1 to entry: Casting is also the process in which molten metal is poured into a mould and solidified

Note 2 to entry: Pressure die-cast products are excluded from the scope of the present standard.

Note 3 to entry: The mould of concern can be a single use mould (sand) or a permanent mould (e.g. cast iron or steel).

Source: EN 12258-1:2012, 2.5.1

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### 3.6

#### **forging**

wrought product formed by hammering or pressing, typically when hot, such as open die forging, drop or closed die forging or seamless rolled ring forging

Source: EN 12258-1:2012, 2.10.1

### 3.7

#### **tube**

hollow, wrought product with a uniform cross-section, with only one enclosed void and with a uniform wall thickness, supplied in straight lengths or in coiled form

Note 1 to entry: Cross-sections are in the shape of circles, ovals, squares, rectangles, equilateral triangles or regular polygons and can have rounded corners, provided the inner and outer cross-sections are concentric and have the same form and orientation.

Source: EN 12258-1:2012, 2.8.12, modification to Note 1 to entry: cross-sections can be round, oval, square, rectangular, an equilateral triangle or a regular polygon may have rounded corners, provided the inner and outer cross-sections are concentric and have the same form and orientation.

**prEN 12392:2024 (E)****3.8****longitudinal extrusion seam**

extrusion seam in a hollow profile or a tube, parallel to the extrusion direction, which has been formed after creating two or more streams of metal and rejoining them around the mandrel of a porthole or bridge die

Note 1 to entry: Extrusion seams are naturally occurring in porthole/bridge dies.

Source: EN 12258-1:2012, 3.4.13, modification: Note 2 to entry of 3.4.13 is not applicable

**3.9**

transverse extrusion seam

extrusion seam which is formed when two successive billets are welded together in the extrusion die

Note 1 to entry: This concept is sometimes termed "Charge Weld".

Source: EN 12258-1:2012, 3.4.14, modifications:

- word "subsequent" replaced here by "successive"
- Note 2 to entry of 3.4.13 is applicable, the note will be transferred in a future revision of EN 12258-1:2012 from 3.4.13 to 3.4.14.

**3.10****vessel**

housing designed and built to contain fluids under pressure including its direct attachments up to the coupling point connecting it to other equipment; a vessel may be composed of more than one chamber

Source: Directive 2014/68/EU

**3.11****pipng**

pipng components intended for the transport of fluids, when connected together for integration into a pressure system; pipng includes in particular a pipe or system of pipes, tubing, fittings, expansion joints, hoses, or other pressure-bearing components as appropriate; heat exchangers consisting of pipes for the purpose of cooling or heating air shall be considered as pipng

Source: Directive 2014/68/EU

**3.12****fluids**

gases, liquids and vapours in pure phase as well as mixtures thereof; fluids may contain a suspension of solids

Source: Directive 2014/68/EU

Note 1 to entry: If the fluid has a vapour pressure at the maximum allowable temperature of the equipment of greater than 0,5 bar above normal atmospheric pressure it is treated as a gas, otherwise as a liquid.

**3.13****maximum allowable pressure PS**

the maximum pressure for which the equipment is designed, as specified by the manufacturer, and defined at a location specified by him, being either the connection of protective and/or limiting devices, or the top of equipment or, if not appropriate, any point specified

Source: Directive 2014/68/EU

### 3.14

#### **nominal size (DN)**

a numerical designation of size which is common to all components in a piping system other than components indicated by outside diameters or by thread size; it is a convenient round number for reference purposes and is only loosely related to manufacturing dimensions; the nominal size is designated by DN followed by a number

Source: Directive 2014/68/EU

### 3.15

#### **volume (V)**

the internal volume of a chamber, including the volume of nozzles to the first connection or weld and excluding the volume of permanent internal parts

Source: Directive 2014/68/EU

### 3.16

#### **operating temperature range**

temperature range at which the material is exposed during its use

### 3.17

#### **proof strength - yield strength**

stress necessary to produce a defined small plastic deformation in a material under uniaxial tensile or compressive load

Note 1 to entry: If the plastic deformation under tensile load is defined as 0,2 %, then the term "proof strength  $R_{p0,2}$ " or "yield strength 0,2 %" is used.

Note 2 to entry: The term "proof strength" is used in European and ISO standards, whereas the term "yield strength" is used in North American documents.

Source: EN 12258-1:2012, 4.3.4

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### 3.18

#### **elongation (to fracture)**

percentage increase in distance between two marks on a test piece, termed "gauge marks", that results from straining the test piece in tension to fracture between these gauge marks

Note 1 to entry: The elongation depends on the distance between the gauge marks.

Note 2 to entry: The elongation depends on the cross-sectional dimensions of the test piece. For example, the values obtained from sheet specimens will be lower for thin sheet than for thicker sheet. The same is true for extrusions.

Note 3 to entry: Elongation is the simplest and most common representation of the ductility of the material.

Source: EN 12258-1:2012, 4.3.5

### 3.19

#### **elongation**

#### **A<sub>50mm</sub>**

percentage elongation after fracture related to an original gauge length of 50 mm and a constant original width of the test piece between the gauge marks

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Note 1 to entry: Existing standards specify the original width of the test piece between the gauge marks as 12,5 mm.

Note 2 to entry: In the USA, the gauge length is often 2 inches, i.e. 50,8 mm.

Source: EN 12258-1:2012, 4.3.7

### **3.20 elongation**

#### **A**

percentage elongation after fracture related to a gauge length of  $5,65 \cdot \sqrt{S_0}$ , where  $S_0$  is the initial cross-sectional area of the test-piece

Note 1 to entry: The earlier designation  $A_5$  should be avoided.

Note 2 to entry: For round cross-sections the gauge length is calculated as  $5 \times d$ , where  $d$  is the diameter of the test-piece between the gauge marks.

Note 3 to entry: In some USA documents the gauge length is also specified as  $4 \times d$ .

Source: EN 12258-1:2012, 4.3.8

## **4 Symbols**

The symbols used in this document and corresponding designations are given in Table 1.

## **5 Materials**

### **5.1 General**

The materials covered by this document are to be used in a wide range of pressure equipment operating over diverse range of both pressure and temperature. The range of applications extends from relatively low-pressure automotive equipment such as heat exchangers to heavy duty applications including unfired pressure vessels and piping used in pressure equipment.

Materials (alloys and tempers), which can be used in compliance with the present standard are listed in Tables 2, 3, A.1 and A.2, together with their welding characteristics, main field of application and operating temperature ranges.

If the pressure equipment is operating above room temperature for times exceeding 100 h, then the long-time behaviour of the material according to Annex B, Tables B.1 to B.4 will need to be taken into consideration.

Materials to be used for welded components shall be produced with a hydrogen level no greater than 0,2 ml per 100 g aluminium, or an equivalent value/level determined by an alternative defined method stated on the order (see 6.3.3).

### **5.2 Wrought products**

Applicable alloys for wrought products which can be used for pressure applications are given in Table 2. Their chemical composition shall be in accordance with EN 573-3:2019+A2:2023.

All grades of wrought aluminium and aluminium alloys shall have a lead (Pb) and tin (Sn) content not exceeding 0,015 0 % (150 ppm) by mass, per each element.