
**Aluminium and aluminium alloys - Products for structural railway applications -
Technical conditions for inspection and delivery - Part 1: Extruded products**

Aluminium and aluminium alloys - Products for structural railway applications - Technical conditions for inspection and delivery - Part 1: Extruded products

Aluminium und Aluminiumlegierungen - Erzeugnisse für tragende Anwendungen im Schienenfahrzeugbau - Technische Lieferbedingungen - Teil 1: Strangpresserzeugnisse

Aluminium et alliages aluminium - Produits pour applications ferroviaires structurales - Conditions techniques de contrôle et de livraison - Partie 1: Produits filés

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This European Standard was approved by CEN on 7 May 2003.

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 Management Centre or to any CEN member.

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 Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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EN 13981-1:2003 (E)**Foreword**

This document (EN 13981-1:2003) has been prepared by Technical Committee CEN/TC 132 "Aluminium and aluminium alloys", the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by February 2004, and conflicting national standards shall be withdrawn at the latest by February 2004.

Within its program of work, Technical Committee CEN/TC 132 entrusted CEN/TC 132/WG 21 "*Aluminium for railway applications*" to prepare the following standard :

EN 13981-1, *Aluminium and aluminium alloys - Products for structural railway applications - Technical conditions for inspection and delivery - Part 1: Extruded products.*

This standard is part of a set of four standards. The other standards deal with:

- *Part 2: Plates and sheets;*
- *Part 3: Castings;*
- *Part 4: Forgings.*

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Annexes A, B and C are normative, Annex D is for information only.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies requirements for extruded products (rod/bar, tube, profiles) which contribute to the structural properties of the railcar bodyshell and other major structural components.

The requirements on welded joints specified in this standard are not applicable to welded assemblies and sub-assemblies as they are specified for material qualification purposes only.

It specifies particular requirements regarding qualification, quality control, material properties and dimensional tolerances. Furthermore, guidelines for application and use are also given.

NOTE Some of the products listed in the present standard can be subject to patent or patent applications, and their listing herein does not in any way imply the granting of a licence under such patent right.

CEN/TC 132 affirms that it is its policy that in the case when a patentee refuses to grant licenses on standardised standard products under reasonable and not discriminatory conditions, then this product is removed from the corresponding standard.

2 Normative references

This European Standard incorporates by dated and 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 (including amendments).

EN 515, *Aluminium and aluminium alloys – Wrought products – Temper designations.*

EN 573-3, *Aluminium and aluminium alloys – Chemical composition and form of wrought products – Part 3: Chemical composition.*
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EN 755-1, *Aluminium and aluminium alloys – Extruded rod/bar, tube and profiles – Part 1: Technical conditions for inspection and delivery.*

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

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

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

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

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

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

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

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

EN 895, *Destructive tests on welds in metallic materials – Transverse tensile test.*

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EN 1011-4:2000, *Welding – Recommendations for welding of metallic materials – Part 4: Arc welding of aluminium and aluminium alloys.*

EN 12258-1:1998, *Aluminium and aluminium alloys – Terms and definitions – Part 1: General terms.*

EN 30042, *Arc-welded joints in aluminium and its weldable alloys – Guidance on quality levels for imperfections (ISO 10042:1992).*

EN 45014, *General criteria for supplier's declaration of conformity (ISO/IEC Guide 22:1996).*

EN ISO 4287, *Geometrical Product Specifications (GPS) – Surface texture: Profile method – Terms, definitions and surface texture parameters (ISO 4287:1997).*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 12258-1:1998 and the following apply:

**3.1
extrusion lot**

quantity of products of the same grade or alloy, form, temper, thickness or cross-section, subsequently extruded without die change

**3.2
extruded length**

length of a profile extruded in a single push

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NOTE An extruded length can be cut into several cut lengths.

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**3.3
snap ring**

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annular mark or blemish left on the surface of the extruded profile caused by any sudden die movement

**3.4
stop mark**

transverse peripheral ridge on an extruded product arising from a stoppage during extrusion

**3.5
structural property**

property having a direct effect on the static and dynamic load carrying capability of a component or assembly

4 Ordering information

The order shall define the product required for structural applications and shall contain the following information:

- a) designation of the aluminium alloy and temper according to EN 573-3 and EN 515; for extruded products ordered in T4 temper the purchaser shall specify whether extruded products are used afterwards in T6 temper;
- b) drawing of extruded product, if applicable;
- c) reference to this European Standard (EN 13981-1);
- d) Quantity:
 - total mass or number of pieces;
 - tolerances on quantity if required;

- e) length of the extruded product, if applicable;
- f) any requirements for certificates of conformity, test and/or analysis reports or inspection certificates;
- g) any additional requirements agreed between supplier and purchaser;

If special requirements are stated in the order agreed between supplier and purchaser which differ from requirements specified or referenced in this European Standard, then these special requirements shall apply.

5 Requirements

5.1 Production and manufacturing processes

Unless otherwise specified on the order, the production and manufacturing processes shall be left to the discretion of the manufacturer.

Unless it is explicitly stated on the order, no obligation shall be placed on the manufacturer to use the same processes for subsequent and similar orders.

Billet changes within one cut length of extruded product shall not be permitted. Unless otherwise agreed the manufacturer shall define the extent to which the transition zone between two extruded lengths has to be discarded.

5.2 Quality assurance iTeh STANDARD PREVIEW

The manufacturer shall establish and maintain a quality management system which should be at least equivalent to EN ISO 9001.

Furthermore, the ordering rail transport enterprise may require a formal approval of the manufacturer according to a specified procedure.

The manufacturer shall establish and maintain inspection plans defining all inspections and tests to be performed on the product to fulfil the requirements of this standard and any other requirement agreed according to 4. g), the frequency of the inspections and tests and the type of record to be established. The inspection plan shall specify for each inspection or test whether it is to be performed per cast, per extrusion lot, per heat treatment batch, per inspection lot or per any other lot of importance. The inspection plan shall conform as a minimum to the test procedures and test requirements stipulated in this standard (see table 4). The inspection plan shall include additional schemes for appropriate process control. If required the inspection plan shall be submitted to the purchaser for approval before start of production.

The manufacturer shall be responsible for carrying out all inspections and tests required by this standard, prior to the shipment of the product. If the purchaser wishes to inspect the product at the manufacturer's works, he shall stipulate this at the time of placing the order.

The extent of inspections shall be in accordance with Table 4. Unless explicitly stated quality controls and inspections shall be performed on inspection lots. Products included in one inspection lot shall be manufactured in the same production unit.

If additional bend testing according to Annex A or any other testing is required by the purchaser, this shall be specified on the order.

5.3 Alloys, chemical composition and tempers

Alloys shall be selected from the following:

EN AW-5754; EN AW-5083; EN AW-6005; EN AW-6005A; EN AW-6106; EN AW-6008; EN AW-6060; EN AW-6061; EN AW-6063; EN AW-6082.

Any other alloy shall be qualified according to the procedure given in 6.2.

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The chemical compositions of these alloys are specified in EN 573-3. In addition, the lead (Pb) content of all alloys shall be limited to max. 0,01 %. The tempers shall be selected from those specified in EN 755-2 unless otherwise agreed upon between supplier and purchaser. Tempers are defined in EN 515.

5.4 Mechanical properties of extruded products**5.4.1 Mechanical properties of extruded products under static loading**

Tensile strength, yield strength and elongation of extruded products shall conform to the requirements of EN 755-2 unless otherwise agreed upon between purchaser and supplier and stated on the order.

The mechanical properties of alloy EN AW-6008 shall conform to Annex B.

5.4.2 Mechanical properties of extruded products under cyclic loading

The minimum values for the maximum stress specified in Table 1 shall be met for all alloys and wall thicknesses under the following conditions:

Percentage of non-failure: 97,5 %

Number of cycles: 10^7

The test pieces shall be tested according to 7.6.

Table 1 — Fatigue properties of extruded products (not applicable for design purposes, see D.2)

Stress ratio $R = \sigma_{\min} / \sigma_{\max}$	1	0,1	0,5
Maximum stress ^{a, b} σ_{\max}	65	110	180
^a Meeting these values is a necessary condition for the use of design codes mentioned under D.2. ^b If σ_{\max} exceeds the yield strength as specified in 5.4.1, σ_{\max} is equal to $R_{p0,2}$.			

5.5 Mechanical properties of welded joints**5.5.1 General**

Products shall be capable of providing the properties specified under 5.5.2 and 5.5.3 in the welded condition.

Values specified under 5.5.2 and 5.5.3 shall be used for qualification only, and not for design purposes.

5.5.2 Mechanical properties of welded joints under static loading

The requirements on tensile strength and yield strength of welded joints between extruded products are specified in Table 2. Test pieces shall be prepared according to 7.4 and tested according to 7.5.

Table 2 — Mechanical properties of welded butt joints, EN 30042 class C, MIG welded

Alloy	Temper of parent material	thickness ≤ 15mm		thickness > 15mm	
		R_m MPa	$R_{p0,2}$ MPa	R_m MPa	$R_{p0,2}$ MPa
EN AW-5754	H112	180	80	-	-
EN AW-5083	H112	270	125	270	125
EN AW-6060	T66	110	65	85	55
EN AW-6063	T6	110	65	85	55
EN AW-6063	T66	130	75	-	-
EN AW-6106	T6	160	95	-	-
EN AW-6005	T6	160	90	-	-
EN AW-6005A	T6	165	115	-	-
EN AW-6008	T6	165	115	-	-
EN AW-6061	T6	175	115	165	115 ^a
EN AW-6082	T6	185	125	165	115 ^a

^a above 20 mm wall thickness $R_{p0,2}$ is equal to 95 MPa.

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5.5.3 Mechanical properties of welded joints under cyclic loading

The minimum values for the maximum stress specified in Table 3 shall be met for all alloys and wall thicknesses under the following conditions:

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Percentage of non-failure: 97,5 % <https://standards.iteh.ai/catalog/standards/sist/989260c5-7d1e-47ce-afac-cbf69ecb9f45/sist-en-13981-1-2004>

Number of cycles: 10^7

Welded test pieces shall be prepared according to 7.4 and tested according to 7.6.

Table 3 — Fatigue properties of MIG welded butt welds (not applicable for design purposes, see D.2)

Stress ratio $R = \sigma_{\min} / \sigma_{\max}$	-1	0,1	0,5
Maximum stress ^{a, b} σ_{\max}	30	55	80

^a Meeting these values is a necessary condition for the use of design codes mentioned under D.2.

^b If σ_{\max} exceeds the yield strength as specified in 5.5.2, σ_{\max} is equal to $R_{p0,2}$