



SLOVENSKI STANDARD
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Aluminium and aluminium alloys - Products for structural railway applications - Technical conditions for inspection and delivery - Part 3: Castings

Aluminium und Aluminiumlegierungen - Erzeugnisse für tragende Anwendungen im Schienenfahrzeugbau - Technische Lieferbedingungen - Teil 3: Gussstücke

Aluminium et alliages d'aluminium - Produits pour applications ferroviaires structurales - Conditions techniques de contrôle et de livraison - Partie 3 : Pieces moulées

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Contents

Page

Foreword.....	4
1 Scope	5
2 Normative references	5
3 Terms and definitions	6
4 Ordering information	6
5 Requirements	7
5.1 Production and manufacturing processes	7
5.2 Quality assurance	7
5.3 Chemical composition and tempers	7
5.4 Mechanical properties of castings	8
5.4.1 Mechanical properties of castings under static loading	8
5.4.2 Mechanical properties of castings under cyclic loading	8
5.5 Properties of welded joints	8
5.6 Internal defects	8
5.7 Surface imperfections	8
5.8 Finishing welding	8
5.9 Tolerances on dimensions and form	9
6 Qualification procedures	9
6.1 First-off article approval procedure	9
6.2 Additional qualification procedure	9
7 Sampling and test methods	10
7.1 General	10
7.2 Analysis of chemical composition	10
7.3 Tensile test	10
7.4 Preparation of test pieces for the testing of welded joints	11
7.5 Tensile testing on welded joints	11
7.6 Fatigue testing	11
7.7 Visual inspection	11
7.8 Dye penetrant testing	11
7.9 X-ray examination	11
7.10 Measurement of dimensions	11
8 Traceability	11
9 Marking of products	12
10 Inspection certificate	12
11 Record keeping	12
12 Packaging	13
13 Application and use	13
14 Complaints of non-conformity	13
Annex A (normative) Chemical composition and mechanical properties of EN AC-AIzn10Si8Mg	14
Annex B (informative) Guidelines for application and use	17
B.1 Selection of alloys	17
B.2 Fatigue Design	17
B.3 Welding	17

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SIST EN 13981-3:2006
<https://standards.iteh.ai/catalog/standards/sist/a5a19072-8ffa-47f8-86cb-9f15b01fa10/sist-en-13981-3-2006>

Bibliography..... 18

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SIST EN 13981-3:2006

<https://standards.iteh.ai/catalog/standards/sist/a5a19072-8f6a-47f8-86cb-9f15b01fca10/sist-en-13981-3-2006>

Foreword

This document (EN 13981-3:2006) 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 March 2007, and conflicting national standards shall be withdrawn at the latest by March 2007.

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 13981-3, *Aluminium and aluminium alloys – Products for structural railway applications — Technical conditions for inspection and delivery – Part 3 : Castings.*

"EN 13981 comprises the following parts under the general title "Aluminium and aluminium alloys – Products for structural railway applications – Technical conditions for inspection and delivery".

- *Part 1 : Extruded products*
- *Part 2 : Plates and sheets*
- *Part 3 : Castings*
- *Part 4 : Forgings*

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

1 Scope

This document specifies requirements for castings which contribute to the structural properties of the railcar bodyshell and other major structural components.

It specifies particular requirements regarding qualification, quality control, material properties and dimensional tolerances and gives guide-lines for application and use.

2 Normative references

The following referenced documents are indispensable for the application 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 444, *Non-destructive testing – General principles for radiographic examination of metallic materials by X- and gamma-rays*

EN 462-1, *Non-destructive testing – Image quality of radiographs – Part 1: Image quality indicators (wire type) – Determination of image quality value*

EN 473, *Non destructive testing – Qualification and certification of NDT personnel – General principles*

EN 571-1, *Non destructive testing – Penetrant testing – Part 1: General principles*

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

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

EN 1371-1, *Founding - Liquid penetrant inspection – Part 1: Sand, gravity die and low pressure die castings*

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

EN 1559-4, *Founding – Technical conditions of delivery – Part 4: Additional requirements for aluminium alloy castings*

EN 1706:1998, *Aluminium and aluminium alloys – Castings – Chemical compositions and mechanical properties*

EN 10204, *Metallic products – Types of inspection documents.*

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

EN 12681, *Founding – Radiographic examination*

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

EN ISO 10042, *Welding - Arc-welded joints in aluminium and its alloys – Quality levels for imperfections (ISO 10042:2005)*

EN 13981-3:2006 (E)

EN ISO 15614-4, *Specification and qualification of welding procedures for metallic materials – Welding procedure test – Part 4: Finishing welding of aluminium castings (ISO 15614-4:2005)*

ISO 5579, *Non-destructive testing – Radiographic examination of metallic materials by X- and gamma-rays – Basic rules*

ISO 8062, *Castings – System of dimensional tolerances and machining allowances*

ASTM-E 155 Standard, *Reference Radiographs for Inspection of Aluminium and Magnesium Castings*

3 Terms and definitions

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

3.1

cast

quantity of products of the same shape and cast from the same melt

3.2

inspection lot

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

3.3

structural property

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

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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 1706;
- b) drawing of casting including the following indications:
 - area for X-ray-testing and the relevant acceptance criteria according to ASTM-E 155;
 - acceptance criteria for surface imperfections according to EN 1371-1;
- c) reference to this European Standard (EN 13981-3);
- d) quantity:
 - total mass or number of pieces;
 - tolerances on quantity if required;
- e) any requirements for certificates of conformity, test and/or analysis reports or inspection certificates;
- f) 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 document, 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 manufacturer's discretion.

Any modification of the production process qualified by the first-off procedure (see 6.1), which can affect the quality of the product shall be reported to and approved by the purchaser. In specific cases, a new first-off approval can be necessary.

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.

5.2 Quality assurance

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

Furthermore, the ordering railway company 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, 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 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. 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 the 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 or she shall stipulate this at the time of order.

The extent of inspections shall be in accordance with Table 1. Unless explicitly stated, quality controls and inspections shall be performed on cast and/or heat treatment lots.

5.3 Chemical composition and tempers

Alloys shall be selected from the following :

EN AC-21000 (EN AC-AlCu4TiMg), EN AC-21100 (EN AC-Al Cu4Ti), EN AC-42100 (EN AC-Al Si7Mg0,3), EN AC-42200 (EN AC-Al Si7Mg0,6), EN AC-43000 (EN AC-Al Si10Mg), EN AC-43300 (EN AC-Al Si9Mg), EN AC-44200 (EN AC-Al Si12), EN AC-51300 (EN AC-Al Mg5), (EN AC-Al Zn105i8Mg).

NOTE Alloys EN AC-21000 and EN AC-21100 are very prone to high stress corrosion in the under-aged condition T64 or even T6. If alloys EN AC-21000 or EN AC-21100 are subject to stress corrosion in use, it is recommended to have them in the T4 condition (suitable for EN AC-21000 only) or in the T7 condition (suitable for both alloys). T4 condition shows good stress corrosion resistance only if the part is used at temperatures below 100 °C, otherwise, the part will naturally evolve towards under-aged condition which is particularly prone to stress corrosion.

Any other alloy shall be qualified according to a mutually agreed procedure, which shall consider the intended joining technique and the intended use.

EN 13981-3:2006 (E)

The chemical compositions of these alloys are specified in EN 1706. The chemical composition of EN AC-AlZn10Si8Mg is specified in Annex A. In addition, the lead (Pb) content of all alloys shall be limited to a maximum of 0,05 %.

The casting processes and the tempers shall be selected from those specified in EN 1706 unless otherwise agreed upon between supplier and purchaser.

5.4 Mechanical properties of castings

5.4.1 Mechanical properties of castings under static loading

Tensile strength, yield strength and elongation of castings shall conform to the requirements of EN 1706 unless otherwise agreed upon between supplier and purchaser and stated on the order. Tensile strength, yield strength and elongation of EN AC-AlZn10Si8Mg is specified in Annex A.

The reduction according to EN 1706:1998 clause 6.3.3.2 of yield strength and tensile strength to 70 % and elongation to 50 % of the specified values is not allowed.

Any area of the casting with required mechanical properties different from those specified in EN 1706 shall be designated and stated on the drawing.

5.4.2 Mechanical properties of castings under cyclic loading

Guidance on fatigue properties of cast alloys is given in EN 1706, or for EN AC-AlZn10Si8Mg in Annex B.

5.5 Properties of welded joints

Properties of welded joints may be agreed between supplier and purchaser.

NOTE The mechanical properties of welded joints between castings and other cast or wrought products depend on the alloy, the temper, the cast process, the welding conditions, wall thicknesses and other parameters. Under certain conditions the following minimum values can be obtained:

- Yield strength $R_{p0,2}$: 90 MPa;
- Elongation A : 3,5 %.

5.6 Internal defects

The limits of internal defects shall be agreed upon between supplier and purchaser based on ASTM-E 155.

5.7 Surface imperfections

The limits of surface imperfections shall be agreed upon between supplier and purchaser based on EN 1371-1.

5.8 Finishing welding

Finishing welding is allowed under the following conditions, unless otherwise indicated on the drawing:

- manufacturer shall be approved by a welding standard accepted by the ordering railway company;
- welder shall be approved according to EN ISO 9606-2 for aluminium castings;
- welding procedure shall be qualified according to EN ISO 15614-4;
- welding consumable shall be the same type of alloy like the welded casting.

The defects shall be removed completely by grinding.

If the defect depth exceeds 40 % of the wall thickness, removal of the defect shall be supervised by an expert accepted by the purchaser.

After finishing welding and if required by the specified temper, the casting shall be heat treated and dye penetrant tested.

In addition, if the defect depth exceeds 40 % of the wall thickness, the welding area shall be tested by x-ray.

Finishing welding, heat treatment, dye penetrant and x-ray test shall be documented.

5.9 Tolerances on dimensions and form

The tolerances on dimensions and form are specified in ISO 8062. If other tolerances are required, this shall be indicated in the drawing.

6 Qualification procedures

6.1 First-off article approval procedure

Any casting of a given alloy produced for the first time in the foundry shall be qualified by tests to be performed on a representative production lot. The test methods, sampling and minimum test frequency and the acceptance criteria are laid down in Table 1.

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All test results from the "first-off" approval procedure shall be recorded and included in a first-off test report. The test report shall be approved by the purchaser.

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6.2 Additional qualification procedure

Qualification tests shall be performed by the manufacturer when setting up the production of any alloy for the first time.

The test methods, sampling, minimum test frequency and acceptance criteria shall be as specified in Table 1.

If the purchaser requests further qualification tests he shall specify this when asking for a quotation. The qualification procedure shall be agreed between supplier and purchaser.