



SLOVENSKI STANDARD

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Aeronavtika - Jeklo in zlitine, odporne proti vročini - Gneteni izdelki - Tehnična specifikacija - 006. del: Vzorci in izkovki za proizvodnjo

Aerospace series - Steel and heat resisting alloys - Wrought products - Technical specification - Part 006: Pre-production and production forgings

Luft- und Raumfahrt - Stahl und Hochwarmfesten Legierungen - Umgeformte Erzeugnisse - Technische Lieferbedingungen - Teil 006: Ausfallmuster und Serienschmiedestücke

Série aérospatiale - Aciers et alliages résistant à chaud - Produits corroyés - Spécification technique - Partie 006: Pièces types et pièces de série

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EUROPEAN STANDARD
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English Version

Aerospace series - Steel and heat resisting alloys - Wrought products - Technical specification - Part 006: Pre-production and production forgings

Série aérospatiale - Aciers et alliages résistant à chaud -
Produits corroyés - Spécification technique - Partie 006:
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Serienschmiedestücke

This European Standard was approved by CEN on 9 January 2010.

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 CEN 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 CEN Management Centre has the same status as the official versions.

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Foreword

This document (EN 4700-006:2010) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

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 2011, and conflicting national standards shall be withdrawn at the latest by March 2011.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, 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 the United Kingdom.

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Introduction

This European Standard is part of the series of EN metallic material standards for aerospace applications. The general organization of this series is described in EN 4258.

1 Scope

This European Standard defines the requirements for the ordering, manufacture, testing, inspection and delivery of pre-production and production forgings in steel and heat resisting alloys.

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 ISO 3651-1, *Determination of resistance to intergranular corrosion of stainless steels — Part 1: Austenitic and ferritic-austenitic (duplex) stainless steels — Corrosion test in nitric acid medium by measurement of loss in mass (Huey test)* (ISO 3651-1:1998)

EN ISO 3651-2, *Determination of resistance to intergranular corrosion of stainless steels — Part 2: Ferritic, austenitic and ferritic-austenitic (duplex) stainless steels — Corrosion test in media containing sulfuric acid* (ISO 3651-2:1998)

EN ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method* (ISO 6506-1:2005)

EN ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method* (ISO 6507-1:2005)

EN ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)* (ISO 6508-1:2005)

EN ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature* (ISO 6892-1:2009)

prEN ISO 6892-2, *Metallic materials — Tensile testing — Part 2: Method of test at elevated temperature* (ISO/DIS 6892-2:2009)

EN 2002-001, *Aerospace series — Metallic materials — Test methods — Part 001: Tensile testing at ambient temperature*

EN 2002-002, *Aerospace series — Metallic materials — Test methods — Part 002: Tensile testing at elevated temperature*

EN 2002-005, *Aerospace series — Test methods for metallic materials — Part 005: Uninterrupted creep and stress-rupture testing*

EN 2002-16, *Aerospace series — Metallic materials — Test methods — Part 16: Non-destructive testing — Penetrant testing*¹⁾

EN 2003-2, *Aerospace series — Steels — Test methods — Part 2: Izod impact test*¹⁾

1) Published as ASD-STAN Prestandard at the date of publication of this standard by Aerospace and Defence Industries Association of Europe-Standardization (ASD-STAN), (www.asd-stan.org).

EN 2032-1, *Aerospace series — Metallic materials — Part 1: Conventional designation*

EN 2032-2, *Aerospace series — Metallic materials — Part 2: Coding of metallurgical condition in delivery condition*

EN 2078, *Aerospace series — Metallic materials — Manufacturing schedule, inspection schedule, inspection and test report — Definition, general principles, preparation and approval*

EN 2950, *Aerospace series — Test method — Wrought heat resisting alloys — Semi-finished products and parts — Conditions for macrographic and micrographic examination — Atlas of structures and defects*

EN 2951, *Aerospace series — Metallic materials — Test method — Micrographic determination of content of non-metallic inclusions* ¹⁾

EN 3874, *Aerospace series — Test methods for metallic materials — Constant amplitude force-controlled low cycle fatigue testing* ¹⁾

EN 3987, *Aerospace series — Test method for metallic materials — Constant amplitude force-controlled high cycle fatigue testing* ¹⁾

EN 3988, *Aerospace series — Test methods for metallic materials — Constant amplitude strain-controlled low cycle fatigue testing* ¹⁾

EN 4050-1, *Aerospace series — Test method for metallic materials — Ultrasonic inspection of bars, plates, forging stock and forgings — Part 1: General requirements* ¹⁾

EN 4050-4, *Aerospace series — Test method for metallic materials — Ultrasonic inspection of bars, plates, forging stock and forgings — Part 4: Acceptance criteria* ¹⁾

EN 4259, *Aerospace series — Metallic materials — Definition of general terms* ¹⁾
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EN 9100, *Quality Management Systems — Requirements for Aviation, Space and Defence Organizations*

EN 9133, *Aerospace series — Quality management systems — Qualification procedure for aerospace standard parts*

EN 10027-1, *Designation systems for steels — Part 1: Steel names*

EN 10045-1, *Metallic materials — Charpy impact test — Part 1: Test method*

EN 10079, *Definition of steel products*

TR 2410, *Aerospace series — Metallic materials — Relationship between dimensional standards and material standards* ²⁾

AMS 2315, *Determination of Delta Ferrite Content* ³⁾

AMS 2750, *Pyrometry* ³⁾

2) Published as ASD-STAN Technical Report at the date of publication of this standard by Aerospace and Defence Industries Association of Europe-Standardization (ASD-STAN), (www.asd-stan.org).

3) Published by: SAE National (US) Society of Automotive Engineers <http://www.sae.org/>

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ASTM E709, *Standard Guide for Magnetic Particle Testing* ⁴⁾

ASTM E1444, *Standard Practice for Magnetic Particle Testing* ⁴⁾

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 4259 apply. For definitions specific to steel, see EN 10079.

4 Wording of order

The order shall clearly indicate:

- quantities to be supplied;
- dates of delivery;
- material standard number;
- delivery condition and metallurgical code of products;
- dimensions and tolerances or reference to an appropriate dimensional standard;
- product designation, when required;
- forwarding address;
- nature and type of packing, if required;
- surface protection, if appropriate;
- definition and frequency of any special tests and their retest procedures, if required.

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5 Health and safety

Products in the delivery condition shall fulfil the health and safety laws of the area of the country when and where it is to be delivered.

A product safety data sheet shall be available.

6 Technical requirements**6.1 General**

The product shall satisfy the requirements of the order, drawing inspection schedule or material standard: see Table 2, line 5.

The order, drawing or inspection schedule shall specify the tests to be performed upon (i) pre-forgings for qualification and/or requalification (ii) serial production forgings for process control testing (Procedure X: see 6.4) and (iii) batch release when cut-up testing or forgings is required. Unless otherwise specified on the order, drawing or inspection schedule, acceptance criteria for the tests are stated in the material standard,

4) Published by: ASTM National (US) American Society for Testing and Materials <http://www.astm.org/>

the requirements for each line of which are detailed in Tables 2 and 3 of this technical specification. Table 2 related to lines 1 to 29 (inclusive) of the material standard and Table 3 relates to lines 30 onwards in which the subline format is also used. If a particular test is needed but not shown in a specific line in Tables 2 and 3, the requirement shall be specified on the order, drawing, inspection schedule or material standard.

6.2 Qualification requirements

See line 100 in Table 3 of this technical specification.

Qualification shall normally comprise assessment of pre-production forgings. See Table 2, section 4.2.

6.3 Re-qualification requirements

Re-qualification of serial production forgings may be required, in the following cases:

- modification of the drawing;
- use of forging stock from a different source;
- modifications to the forging stock form and/or manufacturer route;
- modifications to an existing die;
- use of a new (replacement) die;
- modifications to the forging manufacturing route;
- when a significant time interval (usually several years) had elapsed between forging campaigns for a specific part number;
- when required by the purchaser for any other reason.

Re-qualification testing requirements, especially location of test pieces, shall be identical to those used for the initial qualification of the pre-production forgings unless otherwise specified on the order, drawing or inspection schedule.

6.4 Release requirements

Release testing shall be the responsibility of the manufacturer. The sampling procedure for release testing shall be one of the following, as specified on the order, drawing or inspection schedule. Where no procedure is specified, procedure A shall be used:

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- Procedure A: Separate forged test samples shall be procedure produced from the same batch of forging stock as that used to make the serial production forgings. Procedure A may be used alone unless denoted AX on the drawing, order or inspection schedule in which case it shall be applied only in conjunction with procedure X (See 6.5).
- Procedure B: Separate forged heat treatment control test samples shall be prepared which conform to the same material standard as the production forgings, but from a different batch of forging stock. Procedure B shall only be used when full heat treatment of the serial production forgings is carried out by the manufacturer and only in conjunction with procedure X (See 6.5).
- Procedure C: Integral test samples shall be removed from each forgings. The order, drawing of inspection schedule shall specify how many test samples shall be tested per batch. Procedure C may be used alone unless denoted CX on the drawing, order or inspection schedule in which case it shall be applied only in conjunction with procedure X (See 6.5).
- Procedure D: Test samples shall be machined from forging(s) selected from each production batch and at locations specified on the order, drawing or inspection schedule.

When required, the manufactured shall inform the purchaser of the planned dates for extraction of samples and release testing in order that these operations may be witnessed.

6.5 Process control testing (Procedure X)

Procedure X is process control procedure consisting of periodic “cut-up” testing to ensure that the serial production forgings continued to conform to the specified requirements.

If procedure X is invoked by the order, drawing or inspection/manufacturing schedule and/or if procedures B, AX or CX are used for release tests (see 6.4), forgings shall be selected from series production at the frequency stated therein. It is recommended that the maximum number of forgings manufactured between repeat “cut-up” testing conforming to procedure X shall be as stated in the following Table 1:

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Table 1

Mass of forging (kg)	Number of forgings
≤ 1	$\leq 2\ 000$
$1 < \text{mass} \leq 2$	$\leq 1\ 000$
$2 < \text{mass} \leq 5$	≤ 400
$5 < \text{mass} \leq 25$	≤ 200
> 25	As stated on the order, drawing, inspection schedule

The testing requirements, including the location, type and size of test pieces shall be identical to those used for qualification of the pre-production.

6.6 Retests

Retests shall be required if the specified acceptance criteria are not fully met during qualification testing on pre-production forgings, process control testing (procedure X) or batch release testing.

If the test product or test piece preparation is faulty, testing shall be re-applied at the original frequency after rectification of the original cause of failure. At least one of the retests shall be from forgings from which the unsatisfactory result was obtained (unless already rejected by the manufacturer after suitable identification of the cause of failure). If insufficient material remains, the purchaser shall advise as to how to proceed.

If all retest results fulfil the specified acceptance criteria, the pre-production forging qualification/process control test (procedure X) shall be deemed satisfactory or the batch shall be accepted, as appropriate.

If one or more retest results fail to fulfil the specified acceptance criteria, the following actions shall be taken:

- a) For qualification testing of pre-production forgings, advice shall be sought from the purchaser as to whether the retest results are acceptable for that part of the forging. If so, this shall be denoted by a note on the drawing, together with values which are acceptable for that location. Alternatively, if it is essential that the specified acceptance criteria are achieved at all locations, the purchaser may request modifications to be made to the manufacturer route.
- b) For process control testing (procedure X), the tests shall be repeated on a second forging taken as close as possible to the above in the production sequence and/or and extensive review shall be made of the manufacturing records of forgings made since the previous control tests. Serial production of the forging in question (and others if appropriate/deemed necessary) shall not continue until the cause of the unsatisfactory values has been ascertained and rectified).
- c) For batch release testing, the batch shall be either:
 - rejected, or
 - partially or fully re-heat treated if it is believed that re-heat treatment can rectify the cause of the failure and then test as a completely new batch from which the conforming products shall be accepted. The re-heat treatment shall be stated on the test and inspection report. No products or test sample shall be re-heat treated more than once.

6.7 Special tests

Special tests and/or inspections may be required by the purchaser. In such cases, the nature of the test, method, frequency and technical requirements shall be specified on the order, drawing or inspection schedule and shall be mutually agreed by the manufacturer and purchaser.

6.8 Capability clause

The capability clause normally applies only to forgings of suitable size and configuration during process control testing (procedure X) and/or batch release testing when invoking procedure D. The number of batches after which sufficient statistical evidence is deemed to justify cessation of testing for a particular property (or reduced frequency of testing) shall be mutually agreed between the manufacturer and purchaser. However, this in no way reduces, the obligations of the manufacturer to fulfil the requirements. If subsequent testing indicates that the product does not comply with the requirements, the batch shall be rejected.

6.9 Statistical process control

Reduction in the extent of release testing, other than that defined in 6.7 above may be negotiated with the purchaser on the basis of appropriate statistical process control and/or statistical data.

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EN 4700-006:2010 (E)**6.10 Inspection and test report**

The manufacturer shall furnish, with each delivery, a report conforming to the requirements of EN 2078 stating the following:

- manufacturer's name and address;
- order number;
- drawing and/or part number;
- material standard number;
- delivery condition and metallurgical code of the product;
- quantity of forgings;
- cast and batch number;
- batch and/or test samples heat treatment, if appropriate;
- results of all tests, retests and chemical analysis.

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