SLOVENSKI STANDARD
SIST EN 2858-3:2001

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Aerospace series - Titanium and titanium alloys - Forging stock and forgings - Technical specification - Part 3: Pre-production and production forgings

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Luft- und Raumfahrt - Titan und Titanlegierungen - Schmiedevormaterial und Schmiedestücke - Technische Lieferbedingungen - Teil 3: Ausfallmuster- und Serienschmiedestücke

Série aérospatiale - Titane et alliages de titane - Produits destinés a la forge, pieces forgées et pieces matricées - Spécification technique - Partie 3: Pieces types et pieces de série

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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.

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

CEN

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

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

Contents

Foreword

This European Standard has been prepared by the European Association of Aerospace Manufacturers (AECMA).

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

This standard was submitted for Formal Vote, and the result was positive.

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of an identical text or by endorsement, at the latest by October 1994, and conflicting national standards shall be withdrawn at the latest by October 1994.

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

This standard specifies the particular requirements for titanium and titanium alloys forgings produced from forging stock complying with EN 2858-2.

It shall be used in conjunction with EN 2858-1.

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 2002-1 Aerospace series - Test methods for metallic materials - Part 1: Tensile testing at ambient temperature [1)]

EN 2002-2 Aerospace series - Test methods for metallic materials - Part 2: Tensile testing at elevated temperature [1)]

EN 2002-5 Aerospace series - Test methods for metallic materials - Part 5: Uninterrupted creep and creep rupture testing [1)]

EN 2002-16 Aerospace series - Test methods for metallic materials - Part 16: Dye penetrant testing [2)]

EN 2003-8 Aerospace series - Test methods for products in steel, titanium, titanium alloys, aluminium alloys and heat resisting alloys - Part 8: Ultrasonic inspection of billet, bars, plates and forgings [2)]

EN 2003-10 Aerospace series - Test methods for products in titanium and titanium alloys - Part 10: Sampling for determination of hydrogen content in titanium and titanium alloys [2)]

EN 2078 Aerospace series - Metallic materials - Manufacturing schedule - Inspection schedule - Inspection and test report - Description and rules for use

EN 2858-1 Aerospace series - Titanium and titanium alloys - Forging stock and forgings - Technical specification - Part 1: General requirements

EN 2858-2 Aerospace series - Titanium and titanium alloys - Forging stock and forgings - Technical specification - Part 2: - Forging stock

EN 2954-2 Aerospace series - Macrostructure of titanium alloy wrought products - Part 2: Macrostructure of bar, section, forging stock and forgings [2)]

EN 2957 Aerospace series - Method of preparation of forged samples [1)]

EN 3114 Aerospace series - Test methods for titanium α + ß - Micrographic examination [2)]

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1) Published as AECMA Prestandard at the date of publication of this standard
2) In preparation at the date of publication of this standard

3 Pre-production forgings

3.1 General

3.1.1. The following requirements shall be specified on the order, drawing and/or inspection schedule :

- number of forgings to be examined by the manufacturer and/or the purchaser;
- heat treatment condition;
- type and number of tests and inspections necessary to evaluate and qualify the manufacturing process (dimensions, mechanical and metallurgical properties, etc.);
- location and orientation of test samples;
- if required, manufacturing schedule as defined in EN 2078.

3.1.2 The inspection and test conditions shall be recorded to allow the definition of the optimum techniques to be used for production forgings, including, where appropriate, the ultrasonic test method (probe, frequency, angle of incidence, etc.).

3.1.3 Straightening operations shall be recorded. If these operations become necessary for production forgings, their condition shall be agreed between the manufacturer and purchaser, and stated in the manufacturing schedule.

3.1.4 The inspection and tests carried out on pre-production forgings shall include those which will be carried out on production forgings.

3.2 Inspection and test report

In addition to the information required by EN 2858-1, the inspection and test report on the pre-production forgings shall provide all technical information to allow the evaluation of the quality of these parts, e.g. photographs taken during macro- and micrographic examination, results of dimensional measurements, etc.

3.3 Acceptance

When all inspection and test results relative to pre-production forgings have been reported and accepted, the purchaser shall give his written agreement for series production. The inspection schedule and, if required, the manufacturing schedule, shall be agreed between the manufacturer and purchaser.

4 Manufacture of production forgings

4.1 At the start of production, the manufacturing schedule may be completed to allow the manufacturer to guarantee the reproducibility of the forging with more certainty.

All information, no matter how minor, shall be recorded in the manufacturing schedule.

4.2 When changes in the manufacturing method are necessary, the purchaser shall decide if new pre-production forgings shall be manufactured and tested.

The manufacturing schedule and the inspection schedule shall be modified accordingly.

4.3 Any change of the forging requiring a new or a revised drawing may require, at the request of the purchaser or manufacturer :

- manufacture of new pre-production forgings, or

- modification of the manufacturing schedule and/or the inspection schedule.

4.4 Manufacturing schedules and inspection schedules, which are modified during production shall be subjected to the same approval process as the original documents.

4.5 No straightening operations shall be permitted after final heat treatment unless previously agreed between the manufacturer and the purchaser and stated in the manufacturing schedule .

4.6 Where a manufaturing schedule is not required, any major change in the manufacturing process which could influence the quality of the forgings shall be reported to the purchaser.

5 Inspection and testing of production forgings

Inspection and testing shall be carried out on production forgings under the conditions defined during the examination of pre-production forgings.

5.1 Non-destructive tests

Inspections shall be carried out after a suitable chemical and/or mechanical surface preparation.

If HNO_3-HF is used on forgings where the thickness of metal to be removed by machining is locally $< 0{,}5$ mm, the concentration ratio HNO_3/HF shall be maintained $> 10 : 1$.

5.1.1 External defects

Two visual examinations shall be carried out on all surfaces of each forging :

- the first after macrographic etching in accordance with EN 2954-2 and the second after etching and penetrant flaw detection in accordance with EN 2002-16.

The surface of forgings shall be free from harmful defects (such as cracks, laps, α-case, segregations, inclusions etc.). The presence of a surface segregation or inclusions shall require further investigation by a method agreed between the manufacturer and purchaser.

Local dressing of defects may be carried out by the manufacturer provided the dimensions of the product remains within the tolerance limits. Local dressing shall not affect the sensitivity of any ultrasonic test which may be required.

The dressed area shall be re-inspected to verify that defects have been removed.

5.1.2 Internal defects

When required by the drawing or the inspection schedule, each forging shall be submitted to ultrasonic inspection. The areas to be inspected shall be defined by these documents. Inspection shall be conducted in conformity with the requirements of EN 2003-8 and the method defined during evaluation of the pre-production forgings. The inspection schedule shall include a sheet providing full details of the ultrasonic test procedure.

Unless otherwise stated by the purchaser, the criteria shall be class 3 as defined by EN 2003-8.

When the shape of the part does not permit inspection at the final stage of fabrication, it may be carried out at an earlier stage by agreement between manufacturer and purchaser.

The test frequency is given in table 1.

5.1.3 Batch uniformity

Evidence of the batch uniformity of the forgings (identification of the alloy and heat treatment condition) shall be demonstrated by the manufacturer.

Unless otherwise specified, the method used shall be at the discretion of the manufacturer and shall be communicated to the purchaser.

The frequency of examination adopted by the manufacturer shall be sufficient to permit him to certify compliance with the requirements.

5.1.4 Dimensions and tolerances

The dimensions and tolerances shall conform to the drawing or the inspection schedule.

The dimensions specially indicated shall be checked on each forging. For other dimensions, "capability clause" shall apply.

5.2 Tensile test

The nature :

- test samples cut from forging stock or forgings;
- test samples forged integrally with the forgings;
- test samples from forging stock, forged separately, in accordance with EN 2957;

quantity and locations of the test samples shall conform to the drawing and/or the inspection schedule.

5.2.1 At room temperature

Testing shall be carried out in accordance with EN 2002-1.

Tests on forgings thicker than 10 mm shall be performed on proportional round test pieces of the form and one of the sizes indicated in EN 2002-1. Where the use of such test pieces is not possible, the form and the size of the test pieces to be employed shall be agreed between the manufacturer and the purchaser and stated on the inspection schedule.

The results shall meet the requirements of the material standard, drawing or inspection schedule.

Unless otherwise specified on the drawing or inspection schedule the test frequency shall be as given in table 1.

5.2.2 At elevated temperature

Testing shall be carried out in accordance with EN 2002-2.

Tests on forgings thicker than 10 mm shall be performed on proportional round test pieces of the form and one of the sizes indicated in EN 2002-2. Where the use of such test pieces is not possible, the form and the size of the test pieces to be employed shall agreed between the manufacturer and the purchaser and shall be stated on the inspection schedule.

The results shall meet the requirements of the material standard, drawing or inspection schedule.

Unless otherwise specified on the drawing or inspection schedule, the test frequency shall be as given in table 1.

5.3 Uninterrupted creep and creep rupture testing

Tests shall performed on proportional round test pieces, in accordance with EN 2002-5.

Where the use of such test pieces is not possible, the form and the size of the test pieces to be employed shall be agreed between the manufacturer and the purchaser and shall be stated on the inspection schedule.

The results shall meet the requirements of the material standard, drawing or inspection schedule.

Unless otherwise specified on the drawing or inspection schedule the test frequency shall be as given in table 1.

5.4 Grain flow

The grain flow examination shall be carried out after surface preparation in accordance with EN 2954-2.

The grain flow of forgings shall meet the requirements of the drawing or inspection schedule and shall conform to the results obtained on pre-production forging.

The test frequency shall be defined in the inspection schedule.

5.5 Grain size and structure

Grain size and structure shall be checked as required by the drawing or inspection schedule.

α + ß alloys structure shall be assessed in accordance with EN 3114.

5.6 Hydrogen content

The hydrogen content shall be determined in accordance with EN 2003-10 on a representative sample taken from a forging in the delivery condition.

The results shall comply with the requirements of the material standard, drawing or inspection schedule.

The "capability clause" shall be applied.

5.7 Special tests

Special tests and inspections may be required by the purchaser. In each case, after agreement between the purchaser and manufacturer, the nature of the test, methods, frequency of testing and acceptance criteria shall be specified on the order or in the inspection schedule.