



**SLOVENSKI STANDARD**  
**SIST EN 2157-3:2001**

**01-januar-2001**

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**Aerospace series - Steel - Forging stock and forgings - Technical specification - Part 3: Pre-production and production forgings**

Aerospace series - Steel - Forging stock and forgings - Technical specification - Part 3: Pre-production and production forgings

Luft- und Raumfahrt - Stahl - Schmiedevormaterial und Schmiedestücke - Technische Lieferbedingungen - Teil 3: Ausfallmuster- und Serienmusterstücke

Série aérospatiale - Acier - Produits destinés à la forge - Pièces forgées et pièces matricées - Spécification technique - Partie 3: Pièces types et pièces de série

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**Ta slovenski standard je istoveten z: EN 2157-3:1993**

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**ICS:**

49.025.10      Jekla                                      Steels

**SIST EN 2157-3:2001**                                      **en**

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EUROPEAN STANDARD

EN 2157-3:1993

NORME EUROPÉENNE

EUROPÄISCHE NORM

August 1993

UDC 669.14-4:621.1:629.7

Descriptors: Aircraft industry, forgings, die forgings, steels, specifications

English version

**Aerospace series - Steel - Forging stock and  
forgings - Technical specification - Part 3:  
Pre-production and production forgings**

Série aérospatiale - Acier - Produits destinés  
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This European Standard was approved by CEN on 1993-08-19. 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 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

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#### 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 February 1994, and conflicting national standards shall be withdrawn at the latest by February 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

The present standard specifies the particular requirements for steel forgings produced from forging stock complying with EN 2157-2.

This standard shall be used in conjunction with EN 2157-1.

This standard also applies to pre-production forgings intended for the qualification of the method of manufacture and inspection.

## 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 <sup>1)</sup>
- EN 2002-7 Aerospace series - Test methods for metallic materials - Part 7 - Hardness test <sup>1)</sup>
- EN 2002-8 Aerospace series - Test methods for metallic materials - Part 8 - Micrographic determination of grain size <sup>1)</sup>
- EN 2002-16 Aerospace series - Test methods for metallic materials - Part 16 - Dye penetrant testing <sup>2)</sup>
- EN 2002-22 Aerospace series - Test methods for metallic materials - Part 22 - Plane strain fracture toughness test <sup>2)</sup>
- EN 2003-1 Aerospace series - Test methods for steel products - Part 1 - Charpy impact test (U notch) <sup>1)</sup>
- EN 2003-2 Test methods for steel products - Part 2 - Izod impact test - Aerospace series <sup>3)</sup>
- EN 2003-8 Aerospace series - Test methods for products in steel, titanium, titanium alloys and heat resisting alloys - Part 8 - Ultrasonic inspection for semi-finished products (rolled, drawn, extruded, forged) <sup>2)</sup>
- EN 2003-11 Aerospace series - Test methods for austenitic stainless steels - Part 11 - Determination of resistance to intergranular corrosion by the Huey method <sup>1)</sup>
- EN 2078 Aerospace series - Metallic materials - Manufacturing schedule - Inspection schedule - Inspection and test report - Description and rules for use
- EN 2157-1 Aerospace series - Steel - Forging stock and forgings - Technical specification - Part 1 - General requirements
- EN 2157-2 Aerospace series - Steel - Forging stock and forgings - Technical specification - Part 2 - Forging stock
- EN 2857 Aerospace series - Test methods for ferromagnetic materials - Magnetic particle testing <sup>2)</sup>

1) Published as AECMA Pre-standard at the date of publication of this standard

2) In preparation at the date of the publication of this standard

3) Published as AECMA Standard 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...);
- manufacturing schedule as defined in EN 2078, if necessary.

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

3.1.3 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 2078, 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 of pre-production forgings

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 the 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 product with more certainty.

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

4.2 When a manufacturing schedule has been agreed, no change in manufacturing method shall be made without the written approval of the purchaser.

When such changes 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 in the form of the forging requiring a new or revised drawing may require, at the request of the manufacturer or purchaser :

- manufacture of new pre-production forgings, or
- modification of the manufacture 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 manufacturing 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 same conditions as applied to pre-production forgings.

### 5.1 Non destructive tests

#### 5.1.1 External defects

All surfaces of each forging shall be visually examined after abrasive blasting and/or etching. This operation shall be followed by either : [SIST EN 2157-3:2001](https://standards.iteh.ai/catalog/standards/sist/c6c9e67c-600e-4c44-85cb-)

<https://standards.iteh.ai/catalog/standards/sist/c6c9e67c-600e-4c44-85cb->

- a) magnetic particle examination in conformity with EN 2857, or
- b) dye penetrant testing in conformity with EN 2002-16. 1)

The test method shall be indicated in the order or inspection schedule, if not indicated in these documents, the test method used shall be:

- a) for magnetic steels;
- b) for non magnetic steels.

The surface of forgings shall be free from harmful defects, such as cracks, laps and single or discontinuous inclusion indications  $> 8$  mm in length, unless shorter lengths are specified on the drawing or inspection schedule.

Local dressing may be carried out by the manufacturer provided the dimensions of the product remain within the tolerance limits.

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

1) Dye penetrant testing alone will not guarantee the detection of inclusions.

## 5.1.2 Internal defects

When required by the drawing or the inspection schedule, the forgings shall be submitted to an 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 detailing the ultrasonic technique.

Unless otherwise stated by the purchaser, the acceptance criteria shall be class 2 of EN 2003-8.

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

The test frequency is given in table 2.

## 5.1.3 Batch uniformity

To ensure that the forgings have been properly heat treated and that the batch is uniform, hardness shall be measured, unless otherwise specified by the purchaser.

Hardness shall be measured at the location selected by the manufacturer unless otherwise specified on the drawing or inspection schedule.

Hardness shall be determined in accordance with EN 2002-7 and the results shall comply with the requirements of the material standard. Where no hardness value is indicated on the material standard, the method used to demonstrate batch uniformity shall be at the option of the manufacturer.

Hardness measurements on forgings in a batch and on test samples representing the batch shall be made by the same method and under the same conditions of loading.

The number of forgings to be tested for each batch shall be as indicated in table 1.

Table 1

Number of forgings per batch (N)	Hardened and tempered, solution and precipitation treated	Not heat treated annealed, normalized, solution treated
	Number of forgings to be tested	
≤ 20	Each forging	Each forging
> 20		$2\sqrt{N}$ <sup>1)</sup>

1) By agreement between the manufacturer and the purchaser, the number of forgings to be tested may be reduced by using statistical principles.



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

#### 5.2 Inclusion content

5.2.1 The inclusion content of forgings shall meet the requirements of the order or the inspection schedule.

5.2.2 The inclusion content shall be determined on the forging stock used for the manufacture of forgings in accordance with the requirements of EN 2157-2.

#### 5.3 Tensile test

The nature, the quantity and the locations of the test pieces shall conform with the drawing and/or the inspection schedule.

The test shall be conducted in conformance 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. The results shall conform to the material standard, drawing or inspection schedule.

The test frequency is given in table 2.

#### 5.4 Beam impact test

The nature, the quantity and the locations of the test pieces shall conform with the drawing and/or the inspection schedule.

Tests shall be carried out in accordance with EN 2003-1 or EN 2003-2 as required by the material standard.

The results shall conform with the material standard, drawing or inspection schedule.

The test frequency is given in table 2.

#### 5.5 Grain flow and grain size

If grain flow examination and grain size determination are required by the drawing or inspection schedule, macrographic and micrographic examination shall be carried out. The type and frequency shall conform with the drawing or inspection schedule.

Grain size determination shall be in accordance with EN 2002-8.

The test results shall conform to the results obtained on pre-production forgings and meet any specified requirements.

#### 5.6 Intergranular corrosion testing

If required, intergranular corrosion testing shall be carried out in accordance with EN 2003-11 and the frequency shall be indicated in table 2. The results shall conform with the material standard, drawing or inspection schedule.