SLOVENSKI STANDARD
SIST EN 2545-3:2001

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Aerospace series - Titanium and titanium alloy remelting stock and castings - Technical specification - Part 3: Pre-production and production castings

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Luft- und Raumfahrt - Vormaterial und Gußstücke aus Titan und Titanlegierungen - Technische Lieferbedingungen - Teil 3: Ausfallmuster- und Seriengußstücke

Série aérospatiale - Produits pour refusion et pieces moulées en titane et alliages de titane - Spécification technique - Partie 3: Pieces types et pieces de série

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CEN

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

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Contents list

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 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of an identical text or by endorsement, at the latest by November 1995, and conflicting national standards shall be withdrawn at the latest by November 1995.

According to 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 and the United Kingdom.

1 Scope

This standard specifies the particular requirements for pre-production and production castings in titanium and titanium alloys.

This standard shall be used in conjunction with EN 2545-1. Where remelting stock is used it shall conform to EN 2545-2.

Unless otherwise required by the order, drawing or inspection schedule, the castings shall be supplied to quality level 2 (see table 3).

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 rupture testing [1]
EN 2002-16	Aerospace series - Test methods for metallic materials - Part 16 : Dye penetrant testing [2]
EN 2002-21	Aerospace series - Test methods for metallic materials - Part 21 : Radiographic testing on cast components [1]
EN 2003-10	Aerospace series - Test methods for products in steel, titanium, titanium alloys and heat resisting alloys - Part 10 : Sampling for determination of hydrogen content in titanium and titanium alloys [2]
EN 2078	Aerospace series - Manufacturing schedule - Inspection schedule - Inspection and test report - Description and rules for use
EN 2545-1	Aerospace series - Titanium and titanium alloy remelting stock and castings - Technical specification - Part 1 : General requirements
EN 2545-2	Aerospace series - Titanium and titanium alloy remelting stock and castings - Technical specification - Part 2 : Remelting stock
ASTM E 192-91	Standard reference diagraphs of investment steel castings of aerospace applications [3]

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) Published by: American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, PA 19 103

3 Recommendation for casting development

It is strongly recommended that a technical representative of the manufacturer is given the opportunity to examine the casting drawing at the initial stages of design and to advise on the optimum design which will facilitate consistent production of acceptable castings.

The dimensional tolerances of the castings shall be as agreed between the purchaser and the manufacturer and indicated on the drawing or inspection schedule.

4 Pre-production castings

4.1 General

4.1.1 The following requirements shall be specified on the order, drawing and/or inspection schedule in addition to those specified in EN 2545-1 :

- number of castings to be examined;

- who shall perform the examination;

- heat treatment condition;

- type and frequency of inspection and testing necessary to evaluate and qualify the manufacturing process (dimensions, mechanical and metallurgical properties, etc.).

4.1.2 The inspection and testing of pre-production castings shall be carried out and recorded to allow the definition of the optimum techniques to be used for production castings.

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

4.2 Inspection and test report

In addition to the information required by EN 2078, the inspection and test report on the pre-production castings shall provide all technical information to allow evaluation of the quality of these parts, e.g. radiographs, results of dimensional measurements.

4.3 Acceptance of pre-production castings

When all inspection and test results relative to pre-production castings have been reported and accepted as satisfactory, 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.

5 Manufacture of production castings

5.1 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, however minor, shall be recorded in the manufacturing schedule.

5.2 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 in the case of, for example :

a) alterations of pattern, mould material or position of runners and risers;

b) alterations of the casting process;

c) alterations of the heat treatment process;

the purchaser shall decide if new pre-production castings shall be manufactured and tested.

The manufacturing schedule and the inspection schedule shall be modified if necessary.

5.3 Any change in the form of the casting requiring a new or revised drawing may at the purchaser's or manufacturer's request result in :

- manufacturing of new pre-production castings, or

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

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

5.5 Manufacture

Castings shall be poured from a melt, made by one of the following methods :

5.5.1 VAR

Vacuum arc consumable electrode melting : Castings shall be manufactured from remelting stock conforming to EN 2545-2. No other material shall be introduced into the furnace during melting.

5.5.2 EBM

Electron beam melting : Charges shall consist only of remelting stock conforming to EN 2545-2, approved wrought or inhouse cast scrap and alloying elements (excluding titanium sponge). Light scrap or machining chips shall not be used. All scrap shall be grouped into identified batches.

The charges used for the manufacture of castings shall be constituted in accordance with one of the following methods :

- defined and constant percentage of each allowed constituent (except alloying additions);

- proportions of each allowed constituent at the option of the manufacturer. Unless otherwise specified on the order or manufacturing schedule this method shall be applied.

Alloying elements may be added during melting to compensate for losses due to evaporation.

5.5.3 Other melting processes

Requirements shall be agreed between the manufacturer and the purchaser.

5.6 Hot isostatic pressing (H.I.P.)

Unless otherwise specified on the order, drawing or inspection schedule, all castings shall be subjected to hot isostatic pressing.

The parameters of this operation shall be stated on the manufacturing schedule.

Mechanical test samples shall accompany the castings throughout this cycle.

5.7 Heat treatment

Unless otherwise agreed, castings and their representative test samples shall be heat treated under vacuum or in inert gas.

5.8 Correction of distortion

Correction of distortion shall be carried out only after agreement between the manufacturer and the purchaser. The manufacturer shall specify the conditions under which such correction is to be carried out, subject to any provisions made by the purchaser. The method agreed shall be incorporated in the manufacturing schedule.

6 Inspection and testing of production castings

Except for chemical analyses all inspection and testing shall be performed after completion of H.I.P., heat treatment and, if appropriate, repair operations and correction of distortion.

Inspection and testing shall be carried out on production castings under the same conditions as applied to pre-production castings.

6.1 Dimensions and tolerances

They shall conform to the drawing or inspection schedule.

The dimensions specially indicated by the purchaser shall be checked on every casting. For other dimensions the frequency of examination adopted by the manufacturer shall be sufficient to permit him to certify compliance with the requirements.

6.2 Chemical composition

In addition to EN 2545-1, chemical composition shall be determined on samples cast integrally with or gated to castings and cut from solidified material at a frequency of one per batch.

6.3 External defects

6.3.1 Castings shall be suitably fettled, dressed, cleaned and etched, to enable inspection to be carried out in a satisfactory manner.

6.3.2 Each casting shall be examined for surface defects by visual inspection and penetrant flaw detection to EN 2002-16.

6.3.3 Surface defects may be removed by local dressing provided the castings remain within the dimensional tolerances. Dressing shall be followed by penetrant flaw detection (see table 1).

Table 1 - Acceptance criteria for external defects

		Grade A	Grade B	Grade C
Cracks, cracklike indications,laps, cold shuts, perforation		Rejected		
Local protuberances		Accepted if the height ≤ 0,5 mm and distance between two protuberances ≥ 25 mm		
Residual feeder height		Accepted if the height ≤ 0,25 mm		
Excess of metal at parting line		Accepted if the height ≤ 0,75 mm and if sharp edges are removed by dressing		
Isolated cavities (visual only)		Accepted if depth ≤ 15 % of the wall thickness and ≤ 0,5 mm max., and		
		Ø ≤ 0,5 mm [1] max. density Two per area of 25 mm x 25 mm	Ø ≤ 0,8 mm [1] max. density Four per area of 25 mm x 25 mm	Ø ≤ 1,2 mm [1] max. density Six per area of 25 mm x 25 mm
Penetrant indications round [2]	Cluster	None	C 1	C 2
	Isolated	max. density Five per area of 60 mm x 60 mm	I 1	I 2
	Nest	None	N 1	N 2
	Aligned	None	A 1	A 2
Penetrant indications linear.		Rejected		

1) Indications with Ø ≤ 0,3 mm shall not be considered. Ø is the minimum diameter of the circle containing the indication.

2) See annex A.

6.4 Internal defects

Castings shall be radiographically examined in accordance with EN 2002-21.

Unless otherwise specified on the drawing or inspection schedule, the technique and frequency to be used shall be as indicated in table 3, quality level 2.

The inspection schedule shall include a specific instruction sheet detailing the radiographic technique.

6.4.1 Unless otherwise specified or agreed between the purchaser and manufacturer to use Annex B, acceptance criteria for radiographic examination of castings with the thicknes ≤ 25 mm are given in table 2. The normal standard of acceptance shall conform to grade B of table 2, unless alternative general or localised levels are agreed and defined on the drawing or in the inspection schedule.

6.4.2 The acceptance criteria for castings with wall thicknesses greater than 25 mm shall be agreed between the manufacturer and the purchaser and stated on the order, drawing or inspection schedule.