SLOVENSKI STANDARD
SIST EN 2004-7:2017

01-oktober-2017

Aeronavtika - Preskusne metode za proizvode iz aluminija in aluminijeve zlitine - 7. del: Primerjalne ploščice za umerjanje merilne opreme, ki se uporablja za ugotavljanje električne prevodnosti gnetenega aluminija in aluminijevih zlitin

Aerospace series - Test methods for aluminium and aluminium alloy products - Part 7: Reference blocks for the calibration of measuring equipment used in the determination of electrical conductivity of wrought aluminium and aluminium alloy

Luft- und Raumfahrt - Prüfverfahren für Erzeugnisse aus Aluminium und Aluminiumlegierungen - Teil 7: Referenzblöcke zur Eichung von Meßgeräten zur Bestimmung der elektrischen Leitfähigkeit von gekneteten Aluminium und Aluminium-Legierungen

Série aérospatiale - Méthodes d'essais applicables aux produits en aluminium et alliages d'aluminium - Partie 7 : Blocs de référence pour l'étalonnage pour la détermination de la conductivité électrique d'aluminium et d'alliages d'aluminium corroyés

Ta slovenski standard je istoveten z: **EN 2004-7:2017**

ICS:

49.025.20	Aluminij	Aluminium

SIST EN 2004-7:2017 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 2004-7

August 2017

ICS 49.025.20

English Version

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This European Standard was approved by CEN on 14 May 2017.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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European foreword

This document (EN 2004-7:2017) 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 European 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of an identical text or by endorsement, at the latest by February 2018, and conflicting national standards shall be withdrawn at the latest by February 2018.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN 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, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard defines different types of electrical conductivity reference blocks, to be used for the calibration of eddy current conductivity measuring equipment, their method of production and calibration.

It is to be used in conjunction with EN 2004-1.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 2004-1, *Aerospace series - Test methods for aluminium and aluminium alloy products - Part 1: Determination of electrical conductivity of wrought aluminium alloys*

ISO 10012-1, *Quality assurance requirements for measuring equipment - Part 1: Metrological confirmation system for measuring equipment*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
master reference standards
a set of electrical conductivity reference standards, held by a National Standards Laboratory or an Accredited Laboratory and traceable to electrical reference standards

Note 1 to entry: This set is maintained as the reference standard against which all the corresponding secondary reference blocks shall be calibrated.

3.2
secondary reference blocks
sets of electrical conductivity reference blocks calibrated by a National Standards Laboratory or an Accredited Laboratory against its master reference standards using eddy current conductivity measuring equipment. Individual companies or organisations may hold sets of secondary reference blocks

Note 1 to entry: These blocks are the means by which traceability to the master reference standards is maintained.

3.3
operating reference blocks
sets of electrical conductivity reference blocks prepared and calibrated by competent personnel against secondary reference blocks using eddy current conductivity measuring equipment

Note 1 to entry: The operating reference blocks are used for routine instrument calibration.

4 Production and calibration of master reference standards

4.1 The master reference standards shall be taken from wrought material of an appropriate electrical conductivity, in a stable metallurgical condition and whose electrical conductivity homogeneity at the surface and through the thickness has been verified (see 4.3). The surface roughness shall not exceed a value of R_a = 1,6 μm.

4.2 Calibration shall be carried out at a temperature of 20 °C ± 2 °C, using a method which ensures traceability to electrical standards. The result shall be normalized to a temperature of 20,00 °C.

4.3 All appropriate precautions shall be taken to ensure that variations of electrical conductivity (measured by an eddy current method) at the surface of any standard do not exceed 0,05 MS/m, and that variations associated with a frequency change over a range of 10 kHz to 100 kHz do not exceed 0,05 MS/m.

5 Production and calibration of secondary reference blocks

5.1 The secondary reference blocks shall be taken from wrought material of an appropriate electrical conductivity, in a stable metallurgical condition and whose homogeneity at the surface and through the thickness has been verified. They shall preferably be taken from the same material as that used to produce the master reference standards. The surface roughness shall not exceed a value of R_a = 1,6 μm.

5.2 The secondary reference blocks shall consist of square or circular samples with a thickness of at least 4 mm and sides or diameter of at least 30 mm. However, the dimensions shall be large enough compared with the probe area in order to avoid edge effects.

5.3 The secondary reference blocks shall be calibrated against master reference standards using properly calibrated eddy current conductivity measuring equipment. The calibration shall be performed at 20 °C ± 2 °C using the normalized conductivity value of the master reference standards for comparison. The values shall be normalized to a temperature of 20,00 °C.

The secondary reference blocks shall be calibrated at a frequency, within the calibrated range of the master reference standards, as required by the purchaser of these blocks (usually 60 kHz).

5.4 The secondary reference blocks shall be available as a set of at least four blocks of electrical conductivity values covering the whole range required for the calibration of operating reference blocks. Additional blocks may be required to ensure a finer coverage of some frequently used ranges.

5.5 When the secondary reference blocks are anodised for protection (anodised layer between 10 μm and 15 μm on aluminium alloy blocks) the corresponding lift-off effect shall be taken into account and appropriate means devised to compensate for it when calibrating against the master reference standards.

5.6 The secondary reference blocks shall be supplied together with a certificate of measurement issued by a National Standards Laboratory or an Accredited Laboratory stating the electrical conductivity values registered in MS/m, the test frequency used and the temperature at which the values have been normalized. The maximum overall uncertainty (at 95 % confidence limit) of the stated electrical conductivity values shall not exceed ± 0,7 %.

6 Production and calibration of operating reference blocks

6.1 To avoid undue wear on secondary reference blocks, it is recommended that sets of operating reference blocks be used for the routine calibration of conductivity measuring equipments. The surface roughness shall not exceed a value of R_a = 1,6 μm.

6.2 The operating reference blocks shall normally be taken from wrought material of an appropriate electrical conductivity, in a stable metallurgical condition and whose uniformity of electrical conductivity over the surface has been verified.

The material chosen shall exhibit no permanent change in electrical conductivity values as a result of storage or operating conditions.

They shall be of such shape, size and finish that inaccuracies due to edge-effect and lift-off are avoided with the particular instrument to be calibrated. Their thickness shall be appropriate for the intended test frequency (see EN 2004-1).

6.3 The calibration of operating reference blocks shall be carried out by comparison against a set of secondary reference blocks. The calibration shall be carried out at the same frequency as that intended for routine testing (usually at a frequency of 60 kHz).

6.4 The calibration of the operating reference blocks shall be carried out using the following method:

— measurements shall be carried in a temperature-controlled environment at 20 °C ± 2 °C; the actual temperature variation during this calibration shall be within ± 0,5 °C.

— an eddy current, comparison type conductivity meter operating at the required frequency shall be used (see 6.3),

— sufficient time shall be allowed for the operating and secondary reference blocks, the eddy current conductivity meter and the probe to reach ambient temperature (unnecessary handling of the blocks shall be avoided),

— using the eddy current electrical conductivity meter, record the indicated values for a set of secondary reference blocks. The meter reading shall indicate the certified value ± 0,2 MS/m or ± 0,3 % IACS (International Annealed Copper Standard). If this is not the case then the eddy current electrical conductivity meter shall not be used for calibration of operating reference blocks [1)].

— read and record the conductivity of each applicable operating reference block. Conductivity readings shall be considered valid if they fall within a range of ± 2 MS/m or ± 3,5 % IACS from the electrical conductivity of the applicable secondary reference block. When electrical conductivity readings fall outside the range of ± 2 MS/m or ± 3,5 % IACS then the electrical conductivity values to be used shall be determined by linear interpolation i.e. using the formula:

$$C_0 = C_1 + \frac{C_2 - C_1}{S_2 - S_1}\,(S_0 - S_1)$$

where

C_0 is the calibrated conductivity of the operating reference block;

C_1 is the calibrated conductivity of the next lower secondary reference block;

C_2 is the calibrated conductivity of the next higher secondary reference block;

S_0 is the electrical conductivity meter scale reading for the operating reference block (mean value of five measurements);

S_1 is the electrical conductivity meter scale reading for the next lower secondary reference block (mean value of five measurements);

S_2 is the electrical conductivity meter scale reading for the next higher secondary reference block (mean value of five measurements).

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1) Non linear interpolation techniques may be used to compensate for a non linear response of the instrument.

6.5 The uncertainity of the reference block calibration shall be evaluated using an appropriate method according to ISO 10012-1.

7 Calibration schedule

7.1 Secondary reference blocks shall be calibrated at intervals not exceeding four years. The interval shall be shorter if there is any reason for it (see 7.3). The National Standards Laboratory or the Accredited Laboratory shall provide a calibration service for secondary reference blocks.

7.2 Operating reference blocks shall be calibrated at intervals not exceeding 13 months by the method defined in 6.4.

7.3 Any reference block which has been exposed to excessive heat, mechanical damage, wear or is suspect for any reason shall be re-calibrated before further use.

8 Identification

All reference blocks shall be identified with a unique indelible identification number or mark. Conductivity values and next calibration date shall be indicated on the sets.

9 Records

Calibration records shall be kept for each reference block in accordance with appropriate Quality Procedures, and shall include the following:

— identification of reference block,

— nominal conductivity value,

— uncertainity on this conductivity value,

— type of block (e.g. secondary),

— date of calibration,

— identification of apparatus and reference blocks used during calibration,

— temperature of calibration,

— frequency of calibration,

— results,

— normalized calibration values (where appropriate).

10 Availability

The list of Accredited Laboratories from which sets of secondary reference blocks may be purchased is given in Annex A.