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

Série aérospatiale - Méthodes d'essais applicables aux produits en aluminium et alliages d'aluminium - Partie 1: Détermination de la conductivité électrique des alliages d'aluminium corroyés

Luft- und Raumfahrt - Prüfverfahren für Erzeugnisse aus Aluminium und Aluminiumlegierungen - Teil 1: Bestimmung der elektrischen Leitfähigkeit von Aluminium-Knetlegierungen

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This European Standard was approved by CEN on 1993-07-23. 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.

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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of an identical text or by endorsement, at the latest by January 1994, and conflicting national standards shall be withdrawn at the latest by January 1994.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 a non destructive test method for the determination of electrical conductivity of wrought aluminium alloy. It is applicable when referenced.

## 2 Purpose of the test

The test is used to determine :

- the heat treatment condition of products ;
- the heat treatment uniformity of batches ;
- the heat treatment condition in which some alloys show the lowest susceptibility to stress corrosion attack ;
- the uniformity of cladding thickness.

## 3 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 2004-7 Aerospace series — Test methods for aluminium and aluminium alloy products — Part 7 — Calibration of electrical conductivity instrumentation <sup>1)</sup>  
<https://standards.iteh.ai/catalog/standards/sist/7f65cd23-6c45-48eb-a8fe-7ad4ca5b664f/sist-en-2004-1-2001>

## 4 Definitions and use of reference blocks

### 4.1 Master reference blocks

Blocks of sensibly uniform electrical conductivity the values of which have been determined and calibrated in a standardised bridge. They shall be used solely to calibrate and to act as standards for the preparation of other reference blocks.

If such blocks are not yet available, other blocks shall be used by agreement between the purchaser and the manufacturer.

### 4.2 Secondary reference blocks

Blocks of sensibly uniform electrical conductivity calibrated either against a standardised bridge or against master reference blocks such that they may be used for the calibration of operating reference blocks. They shall be used by material manufacturers and users for the calibration of apparatus for electrical conductivity measurement to the requirements of this standard.

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1) In preparation at the date of publication of this standard.

### 4.3 Operating reference blocks

Blocks necessary for operation and calibration of apparatus for electrical conductivity measurement. The operating reference blocks shall be calibrated at the operating frequency against secondary reference blocks.

## 5 Unit of conductivity

The unit of electrical conductivity is megasiemens per metre (MS/m).

Measuring instruments shall be calibrated in this unit. Where the instrument is scaled differently (e.g. % IACS), the instrument manufacturer shall supply to the purchaser the values for conversion to MS/m (see table 1).

Table 1 - Conversion IACS to MS/m

% IACS	25,9	27,6	29,3	31,0	32,8	34,5	36,2	37,9
MS/m	15	16	17	18	19	20	21	22
% IACS	39,7	41,4	43,1	44,8	46,6	48,3	50,0	51,7
MS/m	23	24	25	26	27	28	29	30

## 6 Principle

A comparator method by means of an instrument which requires to be calibrated against operating reference blocks of known electrical conductivity.

## 7 Limitations

### 7.1 Products of less than 1,2 mm thickness

They shall only be tested by agreement between the purchaser and the manufacturer. These parties shall jointly define the corrections and acceptance conditions to be applied during testing and acceptance of these products.

### 7.2 Coated products

They shall not be tested unless the coating is insulating and less than 0,01 mm thick.

## 8 Apparatus

8.1 The frequency of measuring instruments lies normally between 2 kHz and 800 kHz.

The choice of frequency lies with the purchaser of the instrument.

8.2 Should a multi-range instrument be used, each range shall be calibrated.

8.3 Every time when an instrument is to be used for determining uniformity of cladding thickness, it shall be calibrated at the operating frequency.

8.4 The reading or measuring instrument shall be so accurate that the indication can be read to an accuracy of at least 0,2 MS/m.

## 9 Calibration and checks on apparatus

9.1 The apparatus shall be calibrated to EN 2004-7.

9.2 Before measuring and at adequate intervals of more than 2 h during testing, the apparatus shall be calibrated against the operating reference blocks and any necessary correction factor or correction applied.

9.3 Where routine measurement is made over a limited range of conductivity (3,5 MS/m max.), the apparatus shall be regularly checked at the high and low limits of this range using the operating reference blocks with the same limits.

9.4 If the measuring instrument shows a greater deviation than  $\pm 0,3$  MS/m from the operating reference blocks, it shall be re-calibrated and all parts re-checked.

## 10 Procedure

### 10.1 Temperature

The apparatus and operating reference blocks shall be used in conditions of stable temperature and the product to be tested shall be as near as possible to this stable temperature.

All reference blocks used for measurements shall be placed in contact with the product under examination for a period of time sufficient to achieve a uniform temperature and where possible remain in contact during the whole test.

## 10.2 Frequency

A frequency of 60 kHz is the most widely used.

For sheet thickness  $1,2 \text{ mm} \leq a \leq 1,6 \text{ mm}$  the minimum frequency to be used shall be 60 kHz.

## 10.3 Measuring conditions

10.3.1 Unless otherwise stated in the technical specification or design documents, the measurement shall be made with the probe on a surface which is parallel to the longitudinal direction of the product.

10.3.2 During the tests the edges of the test coil or probe shall be at least 8 mm from an edge or a surface discontinuity. Tests shall not be made where an element can influence the reading.

10.3.3 Unless otherwise agreed between purchaser and manufacturer, measurements shall be made on surface having a concave radius of curvature  $> 500 \text{ mm}$  or a convex radius of curvature  $> 100 \text{ mm}$ .

10.3.4 The measurement shall be carried out on surfaces with roughness  $R_a \leq 10 \mu\text{m}$ .  
For products with surface roughness  $R_a > 10 \mu\text{m}$ :

- the operating reference blocks shall have the same roughness as the product,
- or
- the surface area to be tested shall be dressed to  $R_a \leq 10 \mu\text{m}$ .

## 10.3.5 Surface cleanliness

All surfaces to be tested shall be clean and free from loose contaminant.

## 10.3.6 Irregular readings

Where local irregular variations in reading are obtained, the presence of small surface flaws may be suspected. The surface may be slightly dressed to remove such flaws.

If the irregular readings are still displayed at this point, they shall be stated in the test report with the remark «after dressing».

## 11 Test report

The test report shall include the following :

- reference to this standard;
- results of electrical conductivity measurements in MS/m;
- measuring positions;
- type and reference number of the instrument used.