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Aerospace series - Cables, electrical, aircraft use - Test methods - Part 508: Plating thickness

Luft- und Raumfahrt - Elektrische Leitungen für Luftfahrtverwendung - Prüfverfahren - Teil 508: Schichtdicke des Uberzugs

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Foreword

This document (EN 3475-508:2007) 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 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of an identical text or by endorsement, at the latest by February 2008, and conflicting national standards shall be withdrawn at the latest by February 2008.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 3475-508:2002.

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, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This standard specifies the procedures for measuring the plating thickness and centricity of metallic coatings on single conductors.

It shall be used together with EN 3475-100.

2 Normative references

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

ISO 6955, *Analytical spectroscopic methods — Flame emission, atomic absorption, and atomic fluorescence — Vocabulary.*

EN 3475-100, *Aerospace series — Cables, electrical, aircraft use — Test methods — Part 100: General.*

3 Test methods

3.1 General

Five methods may be used. In the event of dispute, method 4 shall be the reference method for the measurement of plating thickness.

3.2 Test method 1

3.2.1 Principle

This method uses an analytical procedure for evidence of elements and determining concentration by means of measuring the atomic absorption of optical radiation. The average plating thickness is determined by converting the measured element concentration.

The determination of the centricity (distribution of the metal coating) is not possible with this method.

3.2.2 Method

A flame AAS (Atome Absorption Spectrometry) is sufficient to determine metal concentrations as defined in ISO 6955.

Other procedures, e.g. graphite tube, cold steam or hybrid technique, permit higher resolutions.

General instructions on the necessary equipment, such as gas fuels, oxidizers, light sources, etc., and the actual operation of the equipment can be found in the operating instructions for the relevant AAS equipment.

Typical detection limits for flame AAS: see Table 1.

Table 1

Element	mg/l
Ag	0,002
Ni	0,01
Sn	0,001

3.2.3 Calibration

In atomic absorption spectrometry calibration shall take place by the use of reference solutions (standard solutions).

Standard solutions are solutions which contain the element to be assessed (e.g. Ag, Ni, Sn) in a known concentration and, if required, the chemicals used in producing the sample solution and the components affecting the measurement in the same or a similar concentration to the samples for analysis.

The standard calibration method involves establishing the reference function with several reference solutions starting from extinction A = 0 up to the extinction of the highest anticipated concentration of the solution to be measured.

3.2.4 Preparation for measurement

Three samples of a single strand are dissolved in acid (e.g. nitric acid), diluted with H_2O and inserted in the (AAS) measuring equipment.

3.2.5 Determining the plating thickness

The average value of the plating thickness is determined by conversion of the measured concentration and the length and diameter of the sample which were determined prior to measurement.

3.3 Test method 2

3.3.1 Principle

This method uses a procedure for determining the plating thickness and centricity of metallic coatings on single conductors using a scanning electron microscope (SEM).

3.3.2 Method

The object to be examined is scanned with electron beams. Because of the short wavelength, this allows high resolution and magnification (up to 3×10^5). A further advantage is the great definition (three-dimensional image). The geometries of the samples can be directly measured and documented. In combination with X-ray analysis equipment rapid assessment of the elements in the sample is possible.

3.3.3 Preparation for measurement

a) A sample of the strand for analysis ($d < 0{,}5$ mm) of sufficient length (approximately 200 mm) is wound around the core of a sample holder (min. 4 turns) and cast in epoxy resin. Single strands with $d > 0{,}5$ mm shall be cast standing upright in epoxy resin.

b) The cast samples shall be left to harden for approximately 12 h (or in accordance with the manufacturer's instructions).

c) The sample shall be cut at right angles to the longitudinal axis of the strand with a suitable cutting device and rubbed down with SiC (silicon carbide) paper in gradations of up to 4 000 granulations.

d) The sample shall be polished with diamond paste or Al_2O_3 with 1 µm granulation.

e) The sample shall be etched (e.g. with ammonium chlorocuprate) for better differentiation of the metals.

f) The sample shall be gold-plated.

g) The sample shall be inserted in the apparatus.

The subsequent procedure may be gathered from the instructions of the equipment manufacturer.

3.3.4 Determining the plating thickness and the centricity of the coating

The thickness of the metallic coating shall be measured in the places where it appears to be at its smallest and largest.

The centricity (< 1) of the coating is achieved by dividing the smallest value measured by the largest.

3.4 Test method 3

3.4.1 Principle

This method uses a procedure for determining the plating thickness and centricity of metallic coatings on single strands using an optical microscope with a maximum magnification of 800 times.

3.4.2 Method

The sample prepared in accordance with 3.4.3 shall be measured in an optical microscope. The method can be used starting from a coating thickness of > 2 µm.

3.4.3 Preparation for measurement

a) A sample of the strand for analysis (d < 0,5 mm) of sufficient length (approximately 200 mm) is wound around the core of a sample holder (min. 4 turns) and cast in epoxy resin. Single strand with d > 0,5 mm shall be cast standing upright in epoxy resin.

b) The cast samples shall be left to harden for approximately 12 h (or in accordance with the manufacturer's instructions).

c) The sample shall be cut at right angles to the longitudinal axis of the strand with a suitable cutting device and rubbed down with SiC (silicon carbide) paper in gradations of up to 4 000 granulations.

d) The sample shall be polished with diamond paste or Al_2O_3 with 1 µm granulation.

e) The sample shall be etched (e.g. with ammonium chlorocuprate) for better differentiation of the metals.

3.4.4 Determining the plating thickness and the centricity of the coating

The thickness of the metallic coating shall be measured in the places where it appears to be at its smallest and largest.

The centricity (< 1) of the coating is achieved by dividing the smallest value measured by the largest.

3.5 Test method 4

3.5.1 Principle

This method uses a procedure for determining the plating thickness of metallic coatings on single strand by galvanic removal (coulometric method).

Assessment of centricity is not possible.

3.5.2 Method

The use of the method assumes that the coating and base material [1)] of the sample are known (nickel, silver, pure tin).

In conventional measuring apparatus the reading for the amount of coating is reduced to a time reading by metering with direct current. The voltage in the element changes significantly if the coating to be measured is completely removed. This voltage impulse is amplified and acts to terminate the measurement procedure.

With due regard to all physical factors, the time for the removal of the metallic coating is a direct measurement for average plating thickness.

3.5.3 Preparation for measurement

a) The surfaces of the samples (3) shall be free of grease or oxide which can prevent the flow of current and falsify the measurement.

b) The test solution recommended by the equipment manufacturer shall be chosen depending on the known plating and base materials.

c) The measurement procedure (galvanic removal of the plating) is completed when the metallic coating has been completely removed and the equipment has switched off.

3.5.4 Determining the plating thickness of the coating

The average plating thickness can be directly read with an accuracy of ± 5 % by using conventional apparatus.

3.6 Test method 5

3.6.1 Principle

This method uses a procedure for determining the plating thickness of metallic coatings on single strand by chemical removal of the plating.

This method is particularly suitable to obtain the average of the thickness when the plating is not regular.

Assessment of centricity and minimum thickness in one point are not possible.

3.6.2 Method

The use of the method assumes that the coating and base material [1)] of the sample are known (nickel, silver, pure tin coating on copper or aluminium base material).

Unlike method 4, this method does not require a timed voltage reading. Instead, it requires enough time to completely remove or deplate all of the coating material. The weight of the specimen before and after chemical removal is used along with the diameter of the plated strand to calculate the average coating thickness. Caution should be used in selecting the solution that will remove only the coating material without affecting the base material.

To improve accuracy, the specimen shall be 50 cm in length and the chemical shall be changed after each test.

For large size diameter or thick coating thickness, time to completely remove or deplate all of the coating material can be increase. This increase shall be mentioned in the test report.

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1) In all instances the base material is taken to be the material beneath the coating to be measured. If several different platings are applied, various metals could appear one after the other as the base material.