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Organic coatings on aluminium and its alloys — Methods for specifying decorative and protective organic coatings on aluminium —

Part 1: Powder coatings

Couches organiques sur l'aluminium et ses alliages — Méthodes de spécification des revêtements décoratifs et protecteurs sur aluminium —

Partie 1: Revêtements par poudre

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 79, *Light metals and their alloys*, Subcommittee SC 2, *Organic and anodic oxidation coatings on aluminium*.

A list of all parts in the ISO 18768 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

There are three major surface treatments on aluminium and its alloys:

a) anodic oxidation coatings;

b) organic coatings;

c) combined coatings of anodic oxidation coatings and organic coatings.

This document and ISO 18768-2 provide the performance requirements and test methods for b) organic coatings.

Performance requirements and test methods for a) anodic oxidation coatings are given in ISO 7599 and for c) combined coatings of anodic oxidation coatings and organic coatings in ISO 28340.

It is assumed that users are familiar with other relevant international and regional standards. Those standards should be respected, and this document adopts optional systems in such cases.

Organic coatings on aluminium and its alloys — Methods for specifying decorative and protective organic coatings on aluminium —

Part 1: Powder coatings

1 Scope

This document specifies methods for specifying decorative and protective powder coatings on aluminium and its alloys. It defines the characteristic properties of powder coatings and provides testing methods with minimum performance requirements, with reference to the application and the aggressiveness of the environment in which the coated aluminium exists.

This document does not apply to coil coatings on aluminium.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1463, *Metallic and oxide coatings — Measurement of coating thickness — Microscopical method*

ISO 1519, *Paints and varnishes — Bend test (cylindrical mandrel)*

ISO 1520, *Paints and varnishes — Cupping test*

ISO 2360, *Non-conductive coatings on non-magnetic electrically conductive base metals — Measurement of coating thickness — Amplitude-sensitive eddy-current method*

ISO 2409, *Paints and varnishes — Cross-cut test*

ISO 2810, *Paints and varnishes — Natural weathering of coatings — Exposure and assessment*

ISO 2813, *Paints and varnishes — Determination of gloss value at 20°, 60° and 85°*

ISO 2815, *Paints and varnishes — Buchholz indentation test*

ISO 3892, *Conversion coatings on metallic materials — Determination of coating mass per unit area — Gravimetric methods*

ISO 4623-2, *Paints and varnishes — Determination of resistance to filiform corrosion — Part 2: Aluminium substrates*

ISO 4628-1, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 1: General introduction and designation system*

ISO 4628-2, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 2: Assessment of degree of blistering*

ISO 4628-10, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 10: Assessment of degree of filiform corrosion*

ISO 6270-1, *Paints and varnishes — Determination of resistance to humidity — Part 1: Condensation (single-sided exposure)*

ISO 6270-2, *Paints and varnishes — Determination of resistance to humidity — Part 2: Condensation (in-cabinet exposure with heated water reservoir)*

ISO 6270-3, *Paints and varnishes — Determination of resistance to humidity — Part 3: Condensation (in-cabinet exposure with heated, bubbling water reservoir)*

ISO 6272-1, *Paints and varnishes — Rapid-deformation (impact resistance) tests — Part 1: Falling-weight test, large-area indenter*

ISO 6272-2, *Paints and varnishes — Rapid-deformation (impact resistance) tests — Part 2: Falling-weight test, small-area indenter*

ISO 8251, *Anodizing of aluminium and its alloys — Measurement of abrasion resistance of anodic oxidation coatings*

ISO 8993, *Anodizing of aluminium and its alloys — Rating system for the evaluation of pitting corrosion — Chart method*

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 15184, *Paints and varnishes — Determination of film hardness by pencil test*

ISO 16474-2, *Paints and varnishes — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

ISO 16474-3, *Paints and varnishes — Methods of exposure to laboratory light sources — Part 3: Fluorescent UV lamps*

ISO 22479, *Corrosion of metals and alloys — Sulfur dioxide test in a humid atmosphere (fixed gas method)*

ISO 28340:2013, *Combined coatings on aluminium — General specifications for combined coatings of electrophoretic organic coatings and anodic oxidation coatings on aluminium*

ASTM C207, *Standard Specification for Hydrated Lime for Masonry Purposes*

ASTM D2794, *Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)*

ASTM D7869, *Standard Practice for Xenon Arc Exposure Test with Enhanced Light and Water Exposure for Transportation Coatings*

ASTM G85-19, *Standard Practice for Modified Salt Splay (Fog) Testing*

GSB International, GSB QR AL 631-7 ST 663-7, *International Quality Regulations For the Coating of Building Components*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
powder coating
continuous layer of coating powder applied to the aluminium or aluminium alloy substrate, which is protective and/or decorative

3.2
reference sample
reference specimen
sample which defines the criteria for acceptable properties

Note 1 to entry: This may be agreed between the customer and the surface processor.

3.3
significant surface
part of the article covered or to be covered by the coatings, and for which the coatings are essential for service and/or appearance

3.4
test specimen
single sample of the final product to be used for testing

4 Information to be supplied by the customer to the surface processor

In order to coat the product correctly and depending on the application, the following information should be supplied by the customer to the surface processor, if necessary, in consultation with the aluminium supplier and/or the surface processor.

A summary of the references to this information is given in Annex A.

a) a reference to this document, i.e. ISO 18768-1;

b) the intended service use of the article to be coated;

c) the environmental categories of the intended service (see Clause 6);

d) the specification of the aluminium (chemical composition and temper designations) to be coated;

e) an indication of the significant surface(s) of the product to be coated;

f) the preferred position and maximum size of contact marks;

g) details of any formal sampling plans required;

h) the type of pretreatment;

i) mass loss by etching;

j) thickness of the anodic oxidation coating or mass of the chemical conversion coating used for pretreatment;

k) the type of coating process to be used;

l) the quality of appearance required;

m) the acceptable limits of colour variation by agreed reference samples;

n) the colour difference of the coating between the test specimen and the reference samples using a colour difference meter;

o) the acceptable limits of gloss variation by agreed reference samples;

p) the value range of the gloss measured by equipment;

q) the thickness of coating;

r) the hardness of coating;

s) the dry adhesion of coating;

t) the wet adhesion of coatings (boiling water resistance);

u) the impact resistance (excluding anodic oxidation coating for pretreatment);

v) the abrasion resistance of coating;

w) the cupping resistance (excluding anodic oxidation coating for pretreatment);

x) the flexibility of coating (excluding anodic oxidation coating for pretreatment);

y) the processing resistance, such as cutting, milling or drilling;

z) the solvent resistance of coating;

aa) the humidity resistance;

bb) the type of chemical resistance to be used;

cc) the detergent resistance;

dd) the alkali resistance;

ee) the mortar resistance;

ff) the acid resistance;

gg) the corrosion resistance;

hh) the resistance to a humid atmosphere containing sulfur dioxide;

ii) the filiform corrosion resistance;

jj) the weathering resistance;

kk) the accelerated weathering resistance;

ll) the sealing compounds adhesion.

5 Metal preparation and pretreatment

5.1 Material (substrate)

Aluminium and its alloys are classified in accordance with ISO 209.

5.2 Pretreatment of the substrate

5.2.1 General

Before the application of the coating, a pretreatment coating should be applied. This pretreatment may be one of the following:

a) anodic oxidation coating;

b) chemical conversion coating with aqueous solutions containing either chromate ions or chromate and phosphate ions, without applying an electric current;

c) alternative pretreatment (e.g. chromium-free systems).

After the chemical conversion coating process, the substrate is normally rinsed with deionized water (preferably below 30 µS/cm at 20 °C) and dried.

There are also some coatings used mainly for decorative purposes, which do not need to be pretreated before coating.

If a non-rinsing pretreatment is applied, the last rinsing is carried out before the conversion coating process.

5.2.2 Degreasing, etching and rinsing

All surface contaminants such as greases, lubricants and residues shall be removed using alkaline or acidic solutions and/or solvents in appropriate combinations. Before the conversion stage, the substrate shall be thoroughly cleaned.

Mass loss before and after etching should be measured by the mass of a test specimen. It should be no less than 1 g/m^2, and preferably 2 g/m^2 or more.

5.2.3 Anodic oxidation coatings

The anodic oxidation coating for pretreatment should be chosen so as to produce an anodic oxidation coating with a thickness of 3 µm to 10 µm without chalking and surface flaws. It shall be measured using an eddy current meter in accordance with ISO 2360. After the pretreatment, rinse the test specimen with deionized water to remove the acid from the surface. The anodic oxidation coating should not be sealed.

The time between anodic oxidation pretreatment and powder coating should be less than 72 h. If the time between the anodic oxidation pretreatment and powder coating is more than 24 h, the anodic oxidation pretreatment should be tested by a dye spot test in accordance with ISO 2143. The intensity of the stain should be level 5.

5.2.4 Chemical conversion coatings

A chemical conversion coating shall be produced by application of the appropriate solution.

Chromate conversion coatings vary in colour from iridescent yellow to golden tan. The coatings are characterized by the presence of chromium and the absence of phosphate.

Phosphate conversion coatings vary in colour from iridescent to various shades of green. The coatings are characterized by the presence of both chromate and phosphate.

The surface density of conversion coatings shall be agreed between the customer and the surface processor. In the absence of such an agreement, the mass of the chromate coatings should be between 0,4 g/m^2 and 1,0 g/m^2 for chromate conversion coatings and between 0,4 g/m^2 and 1,2 g/m^2 for chromate-phosphate conversion coatings. They shall be measured in accordance with ISO 3892.

If the coating is applied with delay or interruption after pretreatment (within 16 h), the maximum temperature on the metal surface of drying should be as follows:

— 65 °C for chromate coatings;

— 85 °C for chromate-phosphate coatings.

5.2.5 Alternative pretreatment

Alternative pretreatments, e.g. chromium-free system, or other processes may be specified but shall be agreed between the customer and the surface processor taking into consideration the recommendations from the chemical supplier.

6 Categories

Typical applications of the powder coating are shown in Table B.1.

There are two typical environmental categories: corrosivity and UV radiation.

The corrosion protection and the adhesion of the coating on the aluminium is mainly determined by the surface pretreatment before coating. For this reason, the surface pretreatment should be selected according to the corrosivity category. It is recommended that the corrosivity category is defined in the specification.

The permanent colour stability of a coating and the decorative appearance of the coated surface depends on the UV resistance of the coating material. For this reason, the coating material should be selected based on the UV category. It is recommended that the UV category is defined in the specification.

Examples of typical applications of powder coatings for architectural application are shown in Tables C.1 and C.2.

The corrosivity category defined by the corrosion effects given in ISO 9223 are shown in Table 1. The UV categories are shown in Table 2.

Table 1 — Description of typical atmospheric environments related to the estimation of corrosivity categories

Corrosivity category[a]	Corrosivity	Typical environments — Examples[b]	
		Indoor	Outdoor
C1	Very low	Heated spaces with low relative humidity and insignificant pollution, e.g. offices, schools, museums.	Dry or cold zone, atmospheric environment with very low pollution and time of wetness, e.g. certain deserts, Central Arctic/Antarctica.
C2	Low	Unheated spaces with varying temperature and relative humidity. Low frequency of condensation and low pollution, e.g. storage, sport halls.	Temperate zone, atmospheric environment with low pollution (SO_2 < 5 µg/m^3), e.g. rural areas, small towns. Dry or cold zone, atmospheric environment with short time of wetness, e.g. deserts, subarctic areas.
C3	Medium	Spaces with moderate frequency of condensation and moderate pollution from production process, e.g. food-processing plants, laundries, breweries, dairies.	Temperate zone, atmospheric environment with medium pollution (SO_2: 5 µg/m^3 to 30 µg/m^3) or some effect of chlorides, e.g. urban areas, coastal areas with low deposition of chlorides. Subtropical and tropical zone, atmosphere with low pollution.
C4	High	Spaces with high frequency of condensation and high pollution from production process, e.g. industrial processing plants, swimming pools.	Temperate zone, atmospheric environment with high pollution (SO_2: 30 µg/m^3 to 90 µg/m^3) or substantial effect of chlorides, e.g. polluted urban areas, industrial areas, coastal areas without spray of salt water or, exposure to strong effect of de-icing salts. Subtropical and tropical zone, atmosphere with medium pollution.
C5	Very high	Spaces with very high frequency of condensation and/or with high pollution from production process, e.g. mines, caverns for industrial purposes, unventilated sheds in subtropical and tropical zones.	Temperate and subtropical zone, atmospheric environment with very high pollution (SO_2: 90 µg/m^3 to 250 µg/m^3) and/or significant effect of chlorides, e.g. industrial areas, coastal areas, sheltered positions on coastline.