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

Part 2: Liquid coatings

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

Partie 2: Revêtements liquides

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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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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.

ISO 18768-1 and this document 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 2: Liquid coatings

1 Scope

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

This document is applicable to aluminium products with liquid coatings for general applications, and liquid coatings mainly processed by electrostatic liquid spraying, air spraying or airless spraying.

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 2106, *Anodizing of aluminium and its alloys — Determination of mass per unit area (surface density) of anodic oxidation coatings — Gravimetric method*

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 2812-2, *Paints and varnishes — Determination of resistance to liquids — Part 2: Water immersion method*

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

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

ISO 4211-2, *Furniture — Tests for surface finishes — Part 2: Assessment of resistance to wet heat*

ISO 4211-3, *Furniture — Tests for surface finishes — Part 3: Assessment of resistance to dry heat*

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

ISO 4624, *Paints and varnishes — Pull-off test for adhesion*

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

ISO 7784-1, *Paints and varnishes — Determination of resistance to abrasion — Part 1: Method with abrasive-paper covered wheels and rotating test specimen*

ISO 7784-2, *Paints and varnishes — Determination of resistance to abrasion — Part 2: Method with abrasive rubber wheels and rotating test specimen*

ISO 8295, *Plastics — Film and sheeting — Determination of the coefficients of friction*

ISO 8296, *Plastics — Film and sheeting — Determination of wetting tension*

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

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

ISO 17132:2007, *Paints and varnishes — T-bend test*

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

ISO 21227-2, *Paints and varnishes — Evaluation of defects on coated surfaces using optical imaging — Part 2: Evaluation procedure for multi-impact stone-chipping test*

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 D968, *Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive*

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

QUALICOAT Specifications 2022, *Specifications for a quality label for liquid and powder organic coatings on aluminium for architectural applications*

GSB QR AL 631-7 ST 663-7, *Measuring and Testing Methods*

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
liquid coating
dry coating with a certain thickness that has effects of decorative and protective for a product, coating is formed by liquid lacquer excluding the coating whose based layer is formed by anodizing, combined coating or powder coating

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 18768-2;

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 thickness of the coating;

o) the hardness of the coating;

p) the dry adhesion of the coating;

q) the wet adhesion of the coating;

r) the value range of gloss measured by equipment;

s) the distinctness of the image;

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

u) the multi-impact stone chipping resistance;

v) the abrasion resistance of the coating;

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

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

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

z) the permeating depths of ink into the coating;

aa) the solvent resistance;

bb) the humidity resistance;

cc) the water resistance;

dd) the temperature resistance;

ee) the surface tension of the coating;

ff) the hydrophilicity of the coating;

gg) the thermal viscosity of the coating;

hh) the resistivity;

ii) the acid resistance;

jj) the alkali resistance;

kk) the detergent resistance;

ll) the mortar resistance;

mm) the contamination resistance;

nn) the oil resistance;

oo) the corrosion resistance;

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

qq) the filiform corrosion resistance;

rr) the weathering resistance of the coating;

ss) the accelerated weathering resistance;

tt) the colour difference between test specimens and reference samples using a colour difference meter;

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

vv) the sealing compounds adhesion.

5 Metal preparation and pretreatment

5.1 Material (substrate)

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

5.2 Pretreatment of the substrate

5.2.1 General

Before 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) an 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 more than 2 g/m^2.

5.2.3 Anodic oxidation coating

The anodic oxidation 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 in accordance with ISO 2360. After the pretreatment, rinse the 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 liquid coating should be less than 72 h. If the time between the anodic oxidation pretreatment and liquid 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. Generally, chromate and phosphate are used.

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 coating should be between 0,4 g/m^2 and 1,0 g/m^2 for chromate conversion coating and between 0,4 g/m^2 and 1,2 g/m^2 for chromate-phosphate conversion coating. It shall be measured in accordance with surface density (see 7.6.2.3).

The drying temperature should not exceed 65 °C for chromate conversion coating and 85 °C for chromate-phosphate conversion coating.

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

Symbols, typical properties and applications of the more common coating materials are shown in Table B.1. Symbols of the more common coating materials are for information only.

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 liquid 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.

Table 1 *(continued)*

Corrosivity category[a]	Corrosivity	Typical environments — Examples[b]	
		Indoor	**Outdoor**
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.
CX	Extreme	Spaces with almost permanent condensation or extensive periods of exposure to extreme humidity effects and/or with high pollution from production process, e.g. unventilated sheds in humid tropical zones with penetration of outdoor pollution including airborne chlorides and corrosion-stimulating particulate matter.	Subtropical and tropical zone (very high time of wetness), atmospheric environment with very high SO_2 pollution (higher than 250 µg/m^3) including accompanying and production factors and/or strong effect of chlorides, e.g. extreme industrial areas, coastal and offshore areas, occasional contact with salt spray.

NOTE 1 Deposition of chlorides in coastal areas is strongly dependent on the variables influencing the transport inland of sea salt, such as wind direction, wind velocity, local topography, wind sheltering islands outside the coast, distance of the site from the sea, etc.

NOTE 2 Extreme effect by chlorides, which is typical of marine splash or heavy salt spray, is outside of the scope of this document.

NOTE 3 Corrosivity classification of specific service atmospheres, e.g. in chemical industries, is outside of the scope of this document.

NOTE 4 Surfaces that are sheltered and not rain-washed in marine atmospheric environments where chlorides are deposited and cumulated can experience a higher corrosivity category due to the presence of hygroscopic salts.

NOTE 5 A detailed description of types of indoor environments within corrosivity categories C1 and C2 is given in ISO 11844-1. Indoor corrosivity categories IC1 to IC5 are defined and classified.

NOTE 6 Source: ISO 9223:2012, Table C.1.

[a] In environments with expected "CX category", it is recommended that the atmospheric corrosivity classification from one-year corrosion losses be determined.

[b] The concentration of sulfur dioxide (SO_2) should be determined during at least one year and is expressed as the annual average.