



QUALICOAT Specifications 2022

Specifications for a quality label for liquid and powder coatings on aluminium for architectural applications

Master version (V01)

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Chapter 1

General Information



1. General Information

Scope of the Specifications

These Specifications apply to the QUALICOAT quality label, which is a registered trademark. The regulations for use of the quality label are set out in [Appendix A1](#).

QUALICOAT does not allow commercial, financial or other pressures to compromise its impartiality. The Specifications may be amended when risks of impartiality have been identified or when they need to conform to new standards.

The aim of these Specifications is to establish minimum requirements that plant installations, organic coating materials, chemical conversion materials, processes and finished products shall meet.

These Specifications form the basis for granting and renewing the quality label. All requirements in these Specifications shall be met before a quality label can be granted. In case of ambiguities or uncertainties in any part of the Specifications, clarification shall be requested from QUALICOAT.

The Specifications for plant installations are the minimum requirements for producing good quality. Other methods may only be used if they have been previously approved by QUALICOAT.

These Specifications are designed to ensure high-quality of coated products for use in architectural applications, whatever kind of coating process is used. Any after-treatment not stipulated in these Specifications may affect the quality of an organic coated product and is the responsibility of whoever applies it.

The procedures for granting and renewing a licence for decoration are set out in a separate document (QUALIDECO Specifications - Appendix to the QUALICOAT Specifications) that can be downloaded from the [QUALICOAT Website](#).

These Specifications do not apply to coil coating.

Release and revision of the Specifications

The Specifications may be supplemented or amended with update sheets that set out and incorporate QUALICOAT's resolutions until a new edition is issued. These numbered sheets will state the subject of the resolution, the date when QUALICOAT passed the resolution, the effective date and the details of the resolution. The quality assurance representative in the company holding the label shall always have the latest version of the Specifications.

The Specifications and update sheets are published on the Internet (www.qualicoat.net). They shall also be communicated to all licensed coating applicators and to holders of an approval.

Aluminium alloy material

The aluminium or aluminium alloy material shall be suitable for the coating processes specified in this document. It shall be free from corrosion and shall not have any anodic or organic coating (except anodic pretreatment as described in these Specifications). It shall also be free from all contaminants, especially silicone lubricants. The edge radii shall be as large as possible.

**QUALICOAT 3.0**

To address the problems of corrosion and longevity of coating finishes, QUALICOAT has completed an extensive research programme called 'QUALICOAT 3.0'. The principles of this new quality assessment for the evaluation of the alloying elements, extrusion quality, microstructure, and corrosion potential of both primary and recycled aluminium, are described in a separate document (Appendix A13 – QUALICOAT 3.0).

Kommentiert [PB1]: SPEC 2021 – US12 – QUALICOAT 3.0

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Coating and pretreatment materials

Coating applicators holding the quality label shall treat all products intended for architectural applications in accordance with these Specifications and shall only use organic coating materials and chemical conversion materials approved by QUALICOAT for such products. For external architectural applications, other materials may be used only at the customer's written request and only if there are technical reasons for doing so. It is not permitted to use unapproved materials for commercial reasons.

Training

The licensees shall attend training programmes organised regularly by the General Licensee or QUALICOAT.

Language

The official version of these Specifications are derived from the English language version.

In the English language version, certain verbal forms have meanings which correspond to the requirements of the ISO/IEC Directives, Part 2, Clause 7.

The following verbal forms indicate strict requirements to be followed to comply with these Specifications and from which no deviation is permitted:

- Shall.
- Shall not.

The following verbal forms indicate that among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required. Additionally, in the negative form, a certain possibility or course of action is deprecated but not prohibited:

- Should.
- Should not.

The following verbal forms indicate a course of action permissible within the limits of these Specifications:

- May.
- Need not.

The following verbal forms are used for statements of possibility and capability—whether material, physical, or causal:

- Can.
- Cannot.

Kommentiert [PB2]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

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Terminology

Approval:	Confirmation that a specific material (coating or chemical conversion) meets the requirements of the QUALICOAT Specifications.
Coating applicator:	Company that has one or several plant installations.
Plant installation:	A production site with one or more coating lines used for coating aluminium for architectural applications.
Coating line:	A production line used for coating aluminium for architectural applications that includes a single pretreatment cycle (surface preparation, conversion coating and drying) and a coating cycle (one or more spraying booths and ovens).
Continuous line:	A production line where parts are pretreated, coated and cured without intermediate handling.
Curing index:	A numerical index of cure value that quantifies directly from the curing graph the total coating cure experienced against the coating supplier's paint cure schedule
Licence:	Permission to use the quality label in accordance with the QUALICOAT Specifications.
Licensee:	Holder of the licence.
General licence:	Permission to grant licences and approvals in a certain territory.
General Licensee (GL):	National or international association holding the QUALICOAT general licence for a defined territory.
Testing laboratories:	Independent quality testing and/or inspection bodies duly authorised by the General Licensee or QUALICOAT.



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Chapter 2

Test Methods and Requirements



2. Test Methods and Requirements

The test methods described below are used to test finished products, organic coating materials and chemical conversion materials for approval (see chapters [4](#) and [5](#)).

The test methods are based on international standards, where they exist, listed in [Appendix A9](#). The requirements are specified by QUALICOAT on the basis of practical experience and/or testing programs organized by QUALICOAT.

For the mechanical tests stipulated in § [2.6](#), [2.7](#) and [2.8](#), the test panels shall be made of the alloy AA 5005-H24 or -H14 (AlMg 1 - semihard) with a thickness of 0.8 or 1 mm, unless otherwise approved by QUALICOAT. These mechanical tests shall be carried out on the reverse side of the significant surface.

For the corrosion tests (§ [2.10](#) and [2.11](#)), the test samples shall be made of AA 6060 or AA 6063. If the main production in the plant is on sheets or alloys other than AA6060 or AA6063, the corrosion tests will be carried out on the material actually used.

2.1. Appearance

The appearance will be evaluated on the **significant surface**.

The significant surface shall be defined by the customer and is the part of the total surface which is essential to the appearance and serviceability of the item. Edges, deep recesses and secondary surfaces are not included in the significant surface. The organic coating on the significant surface shall not have any scratches through to the base metal. When the organic coating on the significant surface is viewed at an oblique angle of about 60° to the upper surface, none of the defects listed below shall be visible from a distance of 3 metres: excessive roughness, runs, blisters, inclusions, craters, dull spots, pinholes, pits, scratches or any other unacceptable flaws.

The organic coating shall be of even colour and gloss with good hiding power. When viewed on site, these criteria shall be fulfilled as follows:

- for parts used outside: viewed at a distance of 5 m
- for parts used inside: viewed at a distance of 3 m

Specific requirements for testing and approving coating materials (laboratories):

The colour of the organic coating shall be measured on the significant surface.

The colour deviation (ISO 11664-4) from the the certified RAL card shall not be greater than the limit prescribed in [Appendix A8](#).¹

2.2. Gloss

ISO 2813 - using incident light at 60° to the normal.

Note: if the significant surface is too small or the finish of the coating (structured finish type a², highly metallic finishes) unsuitable for the gloss to be measured with the glossmeter, the gloss shall be compared visually with the reference sample provided by the powder coating supplier (from the same viewing angle).

¹ List of colour tolerances before granting or renewing an approval (for QUALICOAT laboratories)

² See [Appendix A3](#)

Kommentiert [PB3]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

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**REQUIREMENTS:**

Gloss category	Gloss range			Acceptable variation*		
1 (matt)	0	-	30	+/-	5	units
2 (satin)	31	-	70	+/-	7	units
3 (gloss)	71	-	100	+/-	10	units

(* permissible variation from the nominal value specified by the coating supplier)

2.3. Coating thickness

ISO 2360

The thickness of the organic coating on each part to be tested shall be measured on the significant surface at not less than *five measuring areas* (appr.1 cm²).

REQUIREMENTS:Powder coating³:

Class 1	:	60 µm
Class 1.5	:	60 µm
Class 2	:	60 µm
Class 3	:	50 µm
Two-coat powder coating (classes 1 and 2)	:	110 µm
Two-coat PVDF powder coating	:	80 µm

Liquid coating

To be defined by the liquid coating supplier and documented within a technical data sheet with the approval of the Executive Committee.

Other organic coatings may require different thicknesses, but they **shall** only be applied with the approval of the Executive Committee.

Final assessment

None of the measured values **shall** be less than 80% of the specified minimum value otherwise the thickness test as a whole will be considered unsatisfactory.

The results shall be assessed as shown by **four typical examples** (minimum thickness for coatings of 60 µm):

Example 1:

Measured values in µm : 82, 68, 75, 93, 86 average: 81

Rating: This sample is satisfactory.

Example 2:

Measured values in µm : 75, 68, 63, 66, 56 average: 66

Rating: This sample is good because the average thickness is more than 60 µm and because no value measured is less than 48 µm (80% of 60 µm).

³ There are different classes of coating powders that meet different requirements. The particular class is stated in the approval.

Kommentiert [PB4]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

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Kommentiert [PB5]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

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Example 3:

Measured values in μm : 57, 60, 59, 62, 53 average: 58

Rating: This sample is unsatisfactory and comes under the heading "rejected samples" in table [5.1.5](#).

Example 4:

Measured values in μm : 85, 67, 71, 64, 44 average: 66

Rating: This sample is unsatisfactory although the average thickness is more than 60 μm . The inspection is unsatisfactory because the measured value of 44 μm is below the tolerance limit of 80% (48 μm).

2.4. Adhesion

2.4.1 Dry adhesion

ISO 2409

An adhesive tape with an adhesive strength between 6 N per 25 mm width and 10 N per 25 mm width shall be used. The tape shall be at least 25 mm wide.

The spacing of the cuts shall be 1 mm for organic coating thicknesses of up to 60 μm , 2 mm for thicknesses between 60 μm and 120 μm , and 3 mm for thicknesses over 120 μm .

REQUIREMENTS:

The result shall be 0.

2.4.2 Wet adhesion

Boiling water

Immerse a sample in boiling demineralised water using method 1 or 2 as described in § [2.16](#). Remove the sample and allow it to cool down to room temperature. Carry out the test as detailed in § 2.4.1. The cross-hatch shall be made after one hour but within two hours.

REQUIREMENTS:

On visual inspection, there shall be no sign of detachment or blistering. Colour change is acceptable.

2.5. Buchholz Indentation

ISO 2815

REQUIREMENTS:

Minimum 80 at the required thickness.

2.6. Cupping test (only for the approval of organic coatings)

All organic coatings except class 1.5, 2 and 3 powder coatings: **ISO 1520**

Class 1.5, 2 and 3 powder coatings:

ISO 1520 followed by a tape pull adhesion test as specified below:



Apply an adhesive tape (see § 2.4) to the significant surface of the test panel following the mechanical deformation. Cover the area by pressing down firmly against the coating to eliminate voids or air pockets. Pull the tape off sharply at right angles to the plane of the panel after 1 minute.

REQUIREMENTS:

Minimum 5 mm for powder coatings (classes 1, 1.5, 2 and 3)

Minimum 5 mm for liquid coatings except

- two-component liquid coatings: minimum 3 mm
- water-thinnable liquid coatings: minimum 3 mm

Minimum 5 mm for electrophoretic coatings

The test shall be performed on an organic coating with a thickness approximating the minimum required.

In case of a negative result, the test shall be repeated on a panel coated with a thickness of

- Classes 1, 1.5 and 2: 60 to 70 µm
- Class 3: 50 to 60 µm

Using normal corrected vision, the organic coating shall not show any sign of cracking or detachment, except for class 1.5, 2 and 3 powder coatings.

Class 1.5, 2 and 3 powders coatings:

Using normal corrected vision, the organic coating shall not show any sign of detachment following the tape pull adhesion test.

2.7. Bend test

All organic coatings except class 1.5, 2 and 3 powder coatings: **ISO 1519**

Class 1.5, 2 and 3 powder coatings:

ISO 1519 followed by a tape pull adhesion test as specified below:

Apply an adhesive tape (see § 2.4) to the significant surface of the test panel following the mechanical deformation. Cover the area by pressing down firmly against the coating to eliminate voids or air pockets. Pull the tape off sharply at right angles to the plane of the panel after 1 minute.

The test shall be performed on an organic coating with a thickness approximating the minimum required.

In case of a negative result, the test shall be repeated on a panel coated with a thickness of

- Classes 1, 1.5 and 2: 60 to 70 µm
- Class 3: 50 to 60 µm

REQUIREMENTS:

Bending around a 5 mm mandrel for all organic coatings except for two-component and water-thinnable liquid coatings. For these, use an 8 mm mandrel.

Using normal corrected vision, the coating shall not show any sign of cracking or detachment, except for class 1.5, 2 and 3 powders coatings.

Class 1.5, 2 and 3 powders coatings:

Using normal corrected vision, the organic coating shall not show any sign of detachment following the tape pull adhesion test.

2.8. Impact test

(for powder coatings only)

The impact shall be carried out on the reverse side, whereas the results shall be assessed on the coated side.

- Class 1 powder coatings (one- and two-coat), energy: 2.5 Nm: **ISO 6272-2 / ASTM D 2794** (indenter diameter: 15.9 mm)
- Two-coat PVDF powder coatings, energy: 1.5 Nm: **ISO 6272-1 or ISO 6272-2 / ASTM D 2794** (indenter diameter: 15.9 mm)
- Class 1.5, 2 and 3 powder coatings, energy: 2.5 Nm: **ISO 6272-1 or ISO 6272-2 / ASTM D 2794** (indenter diameter: 15.9 mm) followed by a tape pull adhesion test as specified below.

Apply an adhesive tape (see § 2.4) to the significant surface of the test panel following the mechanical deformation. Cover the area by pressing down firmly against the organic coating to eliminate voids or air pockets. Pull the tape off sharply at right angles to the plane of the panel after 1 minute.

The test shall be performed on an organic coating with a thickness approximating the minimum required.

In case of a negative result, the test shall be repeated on a panel coated with a thickness of

- Class 1, 1.5 and 2: 60 to 70 µm
- Class 3: 50 to 60 µm

REQUIREMENTS:

Using normal corrected vision, the organic coating shall not show any sign of cracking or detachment, except for class 1.5, 2 and 3 powder coatings.

Class 1.5, 2 and 3 powder coatings:

Using normal corrected vision, the organic coating shall not show any sign of detachment following the tape pull adhesion test.

2.9. Resistance to humid atmospheres containing sulphur dioxide

ISO 22479 Method B (0,2 l SO₂ - 24 cycles). A cross-cut incision with a width of 1 mm shall be made to cut the organic coating down to the metal.

REQUIREMENTS:

No infiltration exceeding 1 mm on both sides of the scratch, and no change in colour⁴ or blisters in excess of 2 (S2) according to ISO 4628-2.

⁴ If there is any colour change, the samples shall be heated at 105°C for 30 minutes and a new assessment of the colour change shall be made.

Dark / brown spots shall be cleaned by polishing (e.g., pumice flour sludge with melamine pad) and a new assessment of the colour shall be made.



2.10. Acetic acid salt spray resistance

ISO 9227. A cross-cut incision with a width of 1 mm shall be made to cut the organic coating down to the metal. The test shall be carried out on three test pieces of AA 6060 or AA 6063.

For all organic coatings except class 3 powder coatings: testing time: 1000 hours

For class 3 powder coatings: testing time: 2000 hours

REQUIREMENTS:

No blistering in excess of 2 (S2) according to ISO 4628-2. An infiltration of maximum 16 mm² is allowed over a scratch length of 10 cm but the length of any single infiltration shall not exceed 4 mm.

The inspector takes three test pieces from different lots. The results are classified according to the scale below:

- A. 3 samples satisfactory = 0 sample unsatisfactory
- B. 2 samples satisfactory = 1 sample unsatisfactory
- C. 1 sample satisfactory = 2 samples unsatisfactory
- D. 0 sample satisfactory = 3 samples unsatisfactory

Final assessment of the AASS test:

RATING	CORRECTIVE ACTION	
	APPROVAL (GRANTING/RENEWAL)	LICENCE (GRANTING/RENEWAL)
A satisfactory	No action	No action
B satisfactory	No action	► Notification to the coater
C unsatisfactory	► Repetition of the acetic acid salt spray resistance test. ► If the result of this second test is C or D, all tests shall be repeated.	► Repetition of the AASS test. If the result of this second test is C or D, the inspection shall be repeated.
D unsatisfactory	► All laboratory tests shall be repeated.	► The inspection shall be repeated

2.11. Machu test

(Accelerated corrosion test, on extruded sections of AA 6060 or AA 6063 only)

Before immersion, a cross-cut incision with a width of 1 mm shall be made on the significant surface with a special tool to cut the coating down to the metal. If the dimensions of the sample are smaller than 70 x 70 mm, one scratch will be made lengthwise.

Test solution:

NaCl	:	50 ± 1 g/l
CH ₃ COOH (Glacial)	:	10 ± 1 ml/l
H ₂ O ₂ (30%)	:	5 ± 1 ml/l
Temperature	:	37 ± 1 °C



Testing time : 48 ± 0.5 hours

The pH of this solution is 3.0 - 3.3. After 24 hours, another 5 ml/l of hydrogen peroxide (H₂O₂ 30%) shall be added, and the pH adjusted with glacial acetic acid or caustic soda. A new solution shall be prepared for each test.

REQUIREMENTS:

No infiltration exceeding 0.5 mm on both sides of the scratch.

The inspector takes three test pieces from different lots. The results are classified according to the scale below:

- | | | | |
|----|------------------------|---|--------------------------|
| A. | 3 samples satisfactory | = | 0 sample unsatisfactory |
| B. | 2 samples satisfactory | = | 1 sample unsatisfactory |
| C. | 1 sample satisfactory | = | 2 samples unsatisfactory |
| D. | 0 sample satisfactory | = | 3 samples unsatisfactory |

Final assessment of the Machu test:

RATING	ASSESSMENT
A	satisfactory
B	satisfactory
C	unsatisfactory
D	unsatisfactory

2.12. Accelerated weathering test

2.12.1 Accelerated weathering test for classes 1, 1.5 and 2

ISO 16474-2 Method A (daylight filters) – Cycle 1 (102 min dry/18 min wet)

Classes 1, 1.5 and 2

For granting an approval, three panels shall be tested for every single colour in different areas of the climatic chamber.

For renewals, only one panel shall be tested, except for class 2 powder coatings and for banned colours which shall also be tested in triplicate.

The position of all panels shall be changed approximately every 250 hours.

After 1000 hours exposure the test panels shall be rinsed with demineralised water and checked for:

- Gloss variation: ISO 2813 - angle of incidence 60°
- Colour change: CIELAB ΔE^*_{ab} using the formula in ISO 11664-4, measurement including specular reflection.

Three colour measurements are to be made on the test panels before and after the accelerated weathering test.

**REQUIREMENTS:**Gloss retention⁵

The gloss retention shall be at least

- 50% for class 1
- 75% for class 1.5
- 90% for class 2

In case of an unsatisfactory result, an additional visual assessment shall be carried out for

- category 1 organic coatings;
- organic coatings with structured appearance in all gloss categories;
- organic coatings with a metallic or metallised effect (see [Appendix A4](#))
- organic coatings in light colours ($L > 70$)

Colour change:

The colour change ΔE shall not be greater than

- the limits prescribed in [Appendix A12](#) for class 1
- 75% of the limits prescribed in [Appendix A12](#) for class 1.5
- 50% of the limits prescribed in [Appendix A12](#) for class 2

Final assessment of the accelerated weathering test (in the case of triplicate testing)

The results of the instrumental measurements shall be evaluated according to the following criteria:

PANELS (individual values)	ASSESSMENT
3 panels OK	satisfactory
2 panels OK and 1 panel NOT OK	satisfactory
1 panel OK and 2 panels NOT OK	unsatisfactory
3 panels NOT OK	unsatisfactory

2.12.2 Accelerated weathering test for class 3

For class 3 the accelerated weathering test is replaced by a Florida exposure test of 3 years.

REQUIREMENTS:Gloss retention:

The gloss retention shall be at least 80% after 3 years

Colour change:

The colour change ΔE shall not be greater than 50% of the limits prescribed in [Appendix A12](#)

⁵

Gloss retention = $\frac{\text{gloss value measured after testing}}{\text{initial gloss value}} \times 100$



2.13. Natural weathering test

Exposure in Florida according to ISO 2810

The test ~~shall~~ start in April.⁶

Class 1 organic coatings

Samples shall be exposed facing 5° south for **1 year**.

4 test panels per colour shade are required (3 for weathering and 1 reference panel)

Class 1.5 organic coatings

Samples shall be exposed facing 5° south for **2 years with an annual evaluation**.

7 test panels per colour shade are required (3 per year for weathering and 1 reference panel).

Class 2 organic coatings

Samples shall be exposed facing 5° south for **3 years with an annual evaluation**.

10 test panels per colour shade are required (3 per year for weathering and 1 reference panel).

Class 3 organic coatings

Samples shall be exposed facing 45° south for **10 years**.

All the test panels shall be cleaned and measured annually by the laboratory in Florida.

After 3, and 7 years, three test panels will be sent back to the QUALICOAT laboratory in charge for evaluation. The remaining three test panels will finally be sent back to the laboratory in charge at the end of the 10-year exposure period.

For all organic coatings:

Dimensions of the test panels: approx. 100 x 305 x 0.8 - 1 mm

After exposure, the exposed panels shall be cleaned using the following method:

Immerse in demineralised water (maximum temperature of 25°C) with a 1% surface-active agent for 24 hours, and then clean by wiping with a soft sponge with tap water applying gentle pressure, or using any other method approved by the Technical Committee. This process shall not scratch the surface.

The gloss shall be measured according to ISO 2813, at an angle of 60°.

The average is taken from the colorimetric measurements. The conditions for measurement and colorimetric evaluation are:

- Colour variation: ΔE CIELAB formula according to ISO 11664/4, measurement including specular reflection.
- The colorimetric evaluation shall be made for the standard illuminant D65 and the ten-degree normal observer.

To determine the gloss and colour, three measurements will be made on the cleaned panels before and after the weathering test. These measurements shall be made at different points at least 50 mm apart.

Kommentiert [PB6]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

Ratified on 19.11.2021

Applicable from 1 January 2022

⁶ A complete procedure is available.

**REQUIREMENTS:****Gloss**

The gloss retention shall be at least 50% for class 1 organic coatings.

The following values apply to class 1.5 organic coatings:

- After 1 year in Florida : at least 65%
- After 2 years in Florida : at least 50%

The following values apply to class 2 organic coatings:

- After 1 year in Florida : at least 75%
- After 2 years in Florida : at least 60%
- After 3 years in Florida : at least 50%

The following values apply to class 3 organic coatings:

- After 3 years in Florida : at least 80%
- After 7 years in Florida : at least 55%
- After 10 years in Florida : at least 50%

In case of unsatisfactory result, an additional visual assessment shall be carried out for

- category 1 organic coatings
- organic coatings with structured appearance in all gloss categories
- organic coatings with a metallic or metalised effect (see [Appendix A4](#))
- organic coatings in light colours ($L > 70$)

Colour change

For class 1, 1.5 and 2 organic coatings the ΔE values shall not exceed the maximum values prescribed in the annexed tables (see [Appendix A12](#)).

The following values apply to class 3 organic coatings:

- After 3 years in Florida : max. 50% of the limits prescribed in [Appendix A12](#)
- After 10 years in Florida : within the limits prescribed in the table.

2.14. Polymerisation test

Prescribed solvent for liquid coatings: MEK or as specified by the liquid coating material's manufacturer and approved by the Technical Committee.

Prescribed solvent for powder coatings: xylene or as specified by the powder coating material's manufacturer and approved by the Technical Committee.

Saturate a swab of cotton wool with solvent. Within 30 seconds, rub it lightly back and forth 30 times in each direction over the part to be tested. Wait 30 minutes before making the assessment.

The polymerisation quality is assessed according to the following ratings:

1. The coating is very dull and quite soft.
2. The coating is very dull and can be scratched with a fingernail.
3. Slight loss of gloss (less than 5 units)
4. No perceptible change. Cannot be scratched with a fingernail.



REQUIREMENTS:

Ratings 3 and 4 are satisfactory.
Ratings 1 and 2 are unsatisfactory.

For powder coatings, this test is optional in in-house control; it is merely indicative and cannot alone cast doubt upon the quality of the coating.

2.15. Resistance to mortar

The test shall be performed according to the **EN 12206-1** (paragraph 5.9) standard.

REQUIREMENTS:

The mortar shall be easy to remove without leaving any residues. Any mechanical damage to the organic coating caused by grains of sand shall be disregarded.

Any change in the appearance/colour of organic coatings with metallic or metallised effect shall not exceed 1 on the reference scale (see [Appendix A4](#)). All other colours shall not show any change.

Kommentiert [PB7]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

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2.16. Resistance to boiling water

Method 1 with boiling water:

2 hours immersion in boiling demineralised water (maximum 10 µS at 20°C). Remove the test sample and allow it to cool down to room temperature. Apply an adhesive tape (see [§ 2.4](#)) to the surface, ensuring that no air is trapped. After one minute, remove the tape at an angle of 45° with a sharp even pull.

**Method 2 with a pressure cooker:
(to be used for powder and electrophoretic coatings only)**

Add demineralised water (maximum 10 µS at 20°C) to a pressure cooker with an internal diameter of about 200 mm to a depth of 25 mm and place a test panel measuring 50 mm in it.

Place the lid in position and heat the pressure cooker until steam escapes from the valve. The weighted needle valve shall be adjusted to produce an internal pressure of 100 +/- 10 kPa (1 bar). Continue heating for 1 hour, timing from the moment when steam first escapes from the valve. Cool the pressure cooker, remove the sample and allow it to cool down to room temperature.

Apply an adhesive tape (see [§ 2.4](#)) to the surface, ensuring that no air is trapped. After one minute, remove the tape at any angle of 45° with a sharp even pull.

REQUIREMENTS:

On visual inspection, there shall be no sign of detachment or blistering. Colour change is acceptable.

2.17. Constant climate condensation water test

ISO 6270-2

A cross-cut incision with a width of at least 1 mm shall be made to score the organic coating down to the metal.

The test duration is 1000 hours for all organic coatings except class 3 and 2000 hours for class 3 organic coatings.



REQUIREMENTS:

No blistering in excess of 2 (S2) according to ISO 4628-2; the maximum infiltration at the cross is 1 mm.

2.18. Sawing, milling and drilling

The good quality of the organic coating is tested using sharpened tools suitable for aluminium.

REQUIREMENTS:

The coating shall not crack or chip when sharp tools are used.

2.19. Filiform corrosion test

TEST METHOD

ISO 4623-2 with the following modification:

Size of samples: preferably 150 x 70 mm

The scratches shall be made as follows:

On each sample, make two scribe marks perpendicular to each other, each at least 30 mm long and at a distance of at least 10 mm from each other and from the edges.

The scribe marks shall be 1 mm in width with a rectangular shape.

If the samples have a small width (<50 mm), no horizontal scribe mark (perpendicular to the extrusion direction) shall be made.

Corrosion is produced by dripping hydrochloric acid (concentration 37%, density 1.18 g/cm³) along the scratches for 1 minute. Then the acid shall be removed by dabbing gently with a piece of cloth or laboratory paper and the sample shall be allowed to stand at laboratory conditions for 60 minutes.

The samples shall then be put into the test cabinet at 40 ±2°C and 82 ±5% relative humidity for 1000 hours in a horizontal position.

ASSESSMENT

Based on the ISO 4628-10 standard.

Using a ruler, determine the length of the longest filament L (mm) as described in the ISO 4628-10 standard, reporting the results for the two scribe marks separately.

The worst results of each test sample shall be reported for the final assessment.

In case of regular filiform corrosion, use **method 1**.

For irregular filiform corrosion, use **method 2**.

REQUIREMENTS:

Acceptable limits within 10 cm on each side of the scratch:

L (longest filament) ≤ 4 mm

M (average length of filaments) ≤ 2 mm



The inspector takes three test pieces from different lots. The results are classified according to the scale below:

- A. 3 samples satisfactory = 0 sample unsatisfactory
- B. 2 samples satisfactory = 1 sample unsatisfactory
- C. 1 sample satisfactory = 2 samples unsatisfactory
- D. 0 sample satisfactory = 3 samples unsatisfactory

Final assessment of the FFC test:

RATING	GRANTING / RENEWAL OF	
	APPROVAL OF PRETREATMENT SYSTEMS	SEASIDE ENDORSEMENT
A	Satisfactory	Satisfactory
B	Satisfactory	Satisfactory with a comment to the coating applicator
C	Unsatisfactory ▶ Repetition of the filiform corrosion test. ▶ If the result of this second test is C or D, all tests shall be repeated.	Unsatisfactory ▶ Repetition of the filiform corrosion test ▶ If the result of this second test is C or D, the inspection shall be repeated.
D	Unsatisfactory ▶ All laboratory tests shall be repeated.	Unsatisfactory ▶ Another complete and unannounced inspection including SEASIDE shall be conducted.

2.20. Water spot test

TEST METHOD

The test shall be performed on one panel.

The demineralised water shall be heated up to 60°C in a beaker of the proper size and kept under stirring to uniform temperature.

The test panel shall be immersed for a half in water. Care must be taken not to put the panel in contact with the bottom of the beaker. The panel shall be immersed for 24 hours at $60 \pm 1^\circ\text{C}$. The glass shall be properly covered to avoid water evaporation.

At the end of the test, the panel shall be immediately cooled down in demineralised water at a temperature of $\leq 5^\circ\text{C}$. It shall then be dried with paper towels without rubbing.

Colour change: ΔE and ΔL CIELAB formula according to ISO 11664-4, measurement including specular reflection.

REQUIREMENTS:

Colour change

The ΔL value shall be less than 4.



2.21. Scratch and mar resistance test (Martindale)⁷

TEST METHOD - CEN/TS 16611

The test shall be performed on one panel.

Test panel dimensions: A5 or 150x150 mm. Any deformation of the test panels that could affect the results shall be avoided.

The thickness of the powder coating shall be between 60 µm and 90 µm.

The test panel shall be conditioned at 23 ± 2°C and 50 ± 5% RH for at least 16 hours.

The test surface shall be carefully wiped with a cleaning cloth before and after the test without scratching the surface, before taking gloss measurements.

The test panel shall be fixed on the table of the Martindale tester with a double-sided adhesive tape or other means, provided that the test surface remains substantially flat. The abrasive pad (3M Scotch Pad, CF-RL 7448, ultra-fine, grey) shall be fixed on the holder guide plate with a double-sided adhesive tape.

The holder for scrub material consists of a guide plate with an inner diameter of 90 ± 0,5 mm and a spindle (no additional ring weight) for a total of 155 ± 2 g.

The testing instrument shall be moved across the surface in a Lissajous figure of 1.5 martindales, i.e. 24 movements (1 martindale = a Lissajous figure with 16 movements).

The test shall be carried out at 23 ± 2°C and 50 ± 5%RH.

A new abrasion pad (3M Scotch Pad, CF-RL 7448, ultra-fine, grey) shall be used for each test and sample.

Five gloss measurements shall be made on the panels according to ISO 2813 at a 60° angle of incidence before and after the Martindale test.

REQUIREMENTS:

Gloss retention⁸

The gloss retention shall be at least

- 60% for organic coatings with a structured appearance in all classes
- 40% for class 1 and 1.5 smooth organic coatings
- 30% for class 2 and 3 smooth organic coatings

⁷ Implementation for data collection with real application by the laboratories from 2020 renewals (Florida exposure 2021–2022/3/4). No consequence on test results in case of failure until 2022 renewals.

⁸ Gloss retention = $\frac{\text{gloss value measured after testing}}{\text{initial gloss value}} \times 100$



QUALICOAT Specifications 2022

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Chapter 3

Work Specifications



3. Work Specifications

3.1. Storage of the products to be treated and layout of equipment

3.1.1 Storage

Aluminium

The products to be treated shall either be stored in a separate room or at least a good distance away from the processing baths. They shall also be protected against condensation and dirt.

Powder and liquid coating materials

Coating materials shall be stored in accordance with the specifications of the coating material's manufacturer.

Chemical products

Chemical products shall be stored in accordance with the specifications of the chemical material's manufacturer.

3.1.2 Layout of equipment

The layout of the equipment should be designed to avoid any form of contamination.

3.2. Surface preparation

The surfaces of the parts to be treated shall be clean and free of any oxidation, scale or soils, oil, grease, lubricants, hand sweat or any other contamination that may be detrimental to the final finish. The parts shall therefore be etched before conversion coating. Two preliminary pretreatments are defined: **standard** (compulsory) and **enhanced** (voluntary, for SEASIDE endorsement).

The products to be treated shall either be attached to the jig individually or placed in a basket as stipulated in [Appendix A7](#). Each product shall be treated fully in one pass, at each stage.

Cast accessories have special requirements (see [Appendix A5](#) – Special specifications for coatings on aluminium accessories for architectural applications under the QUALICOAT quality label).

3.2.1 Etching stage

All chemical pretreatments for powder and liquid organic coatings shall include an aluminium etching stage consisting of one or more steps.

The following types of etching are admissible:

- **Type A : acid etching**
 - Type A1: simple acid etching
 - Type A2: acid etching + acid etching
- **Type AA : dual etching**
 - Type AA1: alkaline etching and acid etching
 - Type AA2: acid etching + alkaline etching + acid etching.

The etching degree is measured by taking the weight of a test sample before and after etching. If a sample cannot be taken, the method used to measure the etching degree



shall be defined in agreement with the General Licensee or directly with QUALICOAT in countries without a General Licensee. Any new plant installation shall be designed to allow sampling after each stage of the chemical treatment.

The etching degree is measured on extruded sections of alloy AA6060 or AA6063. If the main production in the plants is on sheets or alloys other than AA6060 or AA6063 the inspector should also check the etching degree with the material actually used.

An etching degree is not specified for cast accessories. Etching is optional for such products.

Two preliminary pretreatments are defined:

a) Standard pretreatment (compulsory)

The total etching degree shall be at least 1.0 g/m².

b) Enhanced pretreatment (for SEASIDE endorsement)

This pretreatment includes degreasing either in an independent step or in a combined degreasing/etching step.

The total etching degree shall be at least 2.0 g/m².

For type AA (dual etching) the two final steps shall be at least 0.5 g/m².

Coating applicators who wish to have the endorsement SEASIDE on their licence certificate shall apply to their General Licensee or directly to QUALICOAT in countries without a General Licensee.

3.3. Chemical conversion coatings

After conversion coating pre-treated aluminium shall not be stored for more than 16 hours. As a rule, they should be coated immediately after pretreatment. The risk of insufficient adhesion increases the longer the products are stored.

Pre-treated aluminium shall never be stored in an atmosphere that is dusty and detrimental to them. Good atmospheric conditions shall always be maintained in the storage area. All workers handling pre-treated aluminium shall wear clean textile gloves to avoid contamination of the surface.

3.3.1 Chromate conversion coatings

This chemical chromate or chromate-phosphate conversion shall be carried out according to **ISO 10546**.

The conductivity of the final rinse preceding chemical chromate conversion's step shall comply with the manufacturer's specifications and be checked by the inspector.

Demineralised water shall be used for the final rinse after chemical chromate conversion before drying. The conductivity of the dripping water shall not exceed a maximum of 30 µS/cm at 20°C. The conductivity should only be measured for open sections and not for hollow sections.

The weight of the chromate conversion coating shall be between 0.6 and 1.2 g/m² for chemical chromate conversion (yellow coating) and between 0.6 and 1.5 g/m² for chemical chromate-phosphate conversion (green coating).



3.3.2 Chemical pretreatments

Chemical pretreatments other than the chromate conversion coatings described above may not be used until they have been approved by QUALICOAT, following a test programme set out in [Appendix A6](#).

The conductivity of the dripping water of all chemical pretreatment systems with a final rinse shall not exceed a maximum of 30 $\mu\text{S}/\text{cm}$ at 20°C. The conductivity should only be measured for open sections and not for hollow sections.

The weight of the conversion coating shall comply with the manufacturer's specified limits and be checked by the inspector.

The coating applicators shall use the products as described in the technical data sheet and in the instructions provided for the specific plant by the chemical manufacturer(s) concerning the methods for assessing the quality of the chrome VI-free conversion coating, the device prescribed for analytically determining the coating weight, and the in-house control frequencies. These specific instructions shall be accessible to the inspector.

Every two months a production sample shall be sent to the chemical manufacturer who shall carry out an acetic acid salt spray resistance test and a coating weight measurement. The test results and the measurements shall be communicated to the coater within a period of maximum four months.

The results and any corrective actions communicated by the chemical manufacturer shall be entered and retained along with the related shipping details in records readily accessible to the inspector. Unsatisfactory values shall have no influence on the result of a QUALICOAT inspection (see [Appendix A6, Section 9](#))

3.4. Anodic pretreatment (automatic SEASIDE endorsement)

The aluminium surface shall be treated to eliminate all impurities that could pose problems in the anodic pretreatment.

Etching

The aluminium parts (extrusions and sheet, not cast) shall be degreased and etched with a minimum etching rate of 2 g/m^2 . In the case of alkaline etching, desmutting shall be necessary.

Thickness of the pre-anodised layer

The anodic pretreatment shall be chosen so as to produce an anodic coating with a thickness of at least 4 μm (not more than 10 μm) without powdering and without surface flaws.

The anodic pretreatment parameters can be as follows:

- Acid concentration (sulphuric acid): 180-220 g/l
- Aluminium content: 5-15 g/l
- Temperature: 20-30°C ($\pm 1^\circ\text{C}$ of the temperature chosen by the coater)
- Current density: 0.8-2.0 A/dm^2
- Agitation of the electrolyte

Kommentiert [PB8]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

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Rinsing

After anodic pretreatment, the aluminium shall be rinsed for such a time and at such a temperature as is required to remove the acid from the pores and to fulfil the requirements of the wet adhesion test.

Enhancing rinsing with a hot sealing step or a passivation step with a QUALICOAT approved chemical pretreatment system is permitted. The conductivity of the dripping water of the last rinse shall not exceed a maximum of 30 µS/cm at 20°C. The conductivity shall only be measured for open sections and not for hollow sections.

Kommentiert [PB9]: SPEC 2021 – US09 – Wording clarifications in sections 3.4 and 3.5

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Storage conditions

Pre-anodised aluminium shall never be stored in an atmosphere that is dusty and detrimental to it. Good atmospheric conditions shall always be maintained in the storage area. All workers handling pre-anodised aluminium shall wear clean textile gloves to avoid contamination of the surface.

Storage time

Pre-anodised parts shall not be stored for more than 16 hours. However, the parts may be stored for up to 72 hours, provided that additional rinsing and drying has taken place prior to coating (no etching allowed). The risk of insufficient adhesion increases the longer the parts are stored.

Record of test results

Coating applicators using this type of anodic pretreatment shall perform and record the following additional tests:

- **Anodising bath**

- The acid concentration and aluminium content of the anodising bath shall be analysed once per day.
- The temperature of the anodising bath shall be checked every 8 hours.
- The etching rate shall be checked once per day.
- The thickness of the anodic coating shall be checked (every flight bar).

- **Testing of the coated finished products**

- Before application, each coating material (i.e., each colour shade, gloss category, and manufacturer) shall be tested for resistance to boiling water, followed by an adhesion test (see § 2.4).
- During application, resistance to boiling water shall be tested, followed by an adhesion test every 4 hours.

Coating applicators using anodic pretreatment, as specified above, shall ask their coating suppliers to confirm in writing the compatibility of their coating system with this type of pretreatment.

Kommentiert [PB10]: SPEC 2021 – US09 – Wording clarifications in sections 3.4 and 3.5

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Kommentiert [PB11]: SPEC 2021 – US09 – Wording clarifications in sections 3.4 and 3.5

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Kommentiert [PB12]: SPEC 2021 – US09 – Wording clarifications in sections 3.4 and 3.5

Ratified on 19.11.2021

Applicable from 1 January 2022

Kommentiert [PB13]: SPEC 2021 – US09 – Wording clarifications in sections 3.4 and 3.5

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Applicable from 1 January 2022

3.5. Electrophoretic coatings

All electrocoated products shall be cleaned by adapted chemical treatment in an alkaline or acid solution before the topcoat is applied. The cleaned surfaces shall be rinsed in demineralised water with a maximum conductivity of 30 µS/cm at 20°C prior to coating. The surfaces should be wettable with water.



The products shall be **top coated** immediately.

All workers handling pre-treated parts shall wear clean textile gloves to avoid contamination of the surface.

Kommentiert [PB14]: SPEC 2021 – US09 – Wording clarifications in sections 3.4 and 3.5

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3.6. Drying

After chemical pretreatment and before the application of organic coating, the products shall be dried thoroughly in an oven. For this purpose, a drying oven shall be installed in each plant.

For continuous treatment⁹ the maximum drying temperature allowed is 100°C.

For discontinuous treatment the products shall be dried at the following temperatures:

- chemical chromate conversion (yellow coating): maximum 65°C
- chemical chromate-phosphate conversion (green coating): maximum 85°C

The specified temperatures apply to the temperature of the metallic parts and not to the air temperature. The products shall be dried thoroughly before the coating is applied, irrespective of the production method (continuous/discontinuous).

For anodic pretreatment, the drying temperature **shall** be less than 80°C to prevent the anodic coating from being sealed.

Chemical pretreatment systems other than chromate conversion coatings **shall** be dried following the manufacturer's specifications.

Kommentiert [PB15]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

Ratified on 19.11.2021

Applicable from 1 January 2022

3.7. Coating and stoving

3.7.1 Coating

For architectural applications the coating plant installation shall use only organic coatings approved by QUALICOAT in accordance with [Chapter 4](#) "Approval of Organic Coatings".

Best before date expiry

At the coating applicator's request, permission to extend the use of expired powders may be given by the powder manufacturer. It is the powder manufacturer's responsibility to stipulate which additional tests need to be carried out either by themselves or by the coating applicator. Following satisfactory results, the powder manufacturer shall give written permission to the coater indicating the new "best before" date.

An extension of the best before date of banned or suspended colours shall not be permitted.

Kommentiert [PB16]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

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Applicable from 1 January 2022

3.7.2 Stoving

The coating line shall have an oven for drying and one for curing; in cases where the oven is combined (performing both functions), an efficient control system for temperature and time shall be in place to ensure that suppliers' recommended conditions can be followed.

The conditions between the spray booth and the oven shall be absolutely free of dust and contamination.

⁹ See definition of a continuous line in Chapter 1 - Terminology



All organic coatings shall be stoved immediately after application. The oven shall bring the products to the required temperature and maintain them at that temperature for the whole length of the prescribed time.

The temperatures of the products and the stoving times shall match the values recommended in the manufacturer's technical specifications. If the coater uses a calculation of the curing index, the value shall meet the coating suppliers' recommendations.

It is recommended to keep the difference in metal temperature during polymerisation phase below 20°C.

It should be possible to measure the temperature over the whole length of the oven.

The oven shall be fitted with an alarm system which operates as soon as the temperature moves outside the prescribed temperature range.

3.8. Laboratory

The coating plant installation shall have laboratory facilities which are separate from the production facilities. The laboratory shall have the apparatus and chemicals necessary for testing and controlling the process solutions and finished products. The laboratory shall at least be equipped with the following apparatus and equipment:

- 1) Specular glossmeter suitable to measure in 60° incident light mode
- 2) 2 instruments for measuring coating thickness according to ISO 2360 (corresponding calibration standards <60 µm and >60 µm)
- 3) 1 analytical balance with precision 0.1 mg (2 calibrated weights for in-house adjustment)
- 4) Cutting tools and instruments necessary for performing the adhesion test
- 5) Impact tester
- 6) Recorder for stoving temperature and time with four different measuring points, three on the parts and one to measure the air temperature
- 7) Conductivity meter (calibration solution ≤ 100 µS/cm)
- 8) Apparatus for testing resistance to cracking on bending for bending radius 5 mm
- 9) Test solutions for the polymerisation test
- 10) pH-meter (calibration solution corresponding to the pH value of the coating line)
- 11) Device prescribed for the analytical coating weight determination (only for chemical pretreatment according to § 3.3.2)

Each piece of apparatus shall have a data sheet showing the apparatus identification number and calibration records.

The oven temperature recorder shall be checked, and the results shall be registered at least twice per year.

The laboratory conditions may differ from those prescribed by ISO standards for mechanical tests.

3.9. In-house control

Coating plant installations holding the quality label shall monitor their production processes and inspect their finished products in accordance with [Chapter 6](#).

Kommentiert [PB17]: SPEC 2021 – US06 – Requirements for the laboratory equipment at the coating applicator

Ratified on 19.11.2021

Applicable from 1 January 2022



3.10. Operating Instructions

For every test the coating plant installation shall have the relevant standards or operating instructions based on these standards. These standards or operating instructions shall be available to all operators carrying out the tests.

3.11. Registers

The coating plant installation shall maintain registers for:

- production of QUALICOAT products
- in-house control
- tests carried out by the chemical manufacturers (as defined in [Appendix A6](#))
- customers' complaints.



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Chapter 4

Approval of Organic Coatings



4. Approval of Organic Coatings

The organic coatings used in quality label coating shall be approved before they may be used. It is not permissible to apply a second coat for organic coating materials that are intended and approved for the application of a single coat.

When a two-coat organic coating material (primer and coloured topcoat) approved by QUALICOAT is used, the coating plant may apply either a class 1, 1.5 or class 2 topcoat on the approved primer provided that the powder supplier gives written authorisation for it. It is not necessary to have an approval for each combination. However the organic coating material (primer and coloured topcoat) used by the coating plant installation shall originate from the same manufacturer.

Any modification of the chemical properties of the binder (resin(s) and/or hardening agent(s)) is tantamount to a new product and absolutely requires a new QUALICOAT approval. Furthermore, if the physical appearance of the final coating is modified, a new specific QUALICOAT approval shall be required (see [Appendix A3](#)).

Special approvals or extensions of existing approvals may be granted for specific colours or applications such as decoration.

The concept of RAL families for class 2 and class 3 approvals is described in [Appendix A11](#).

4.1. Granting of an approval

Organic coating materials have a reference identifying a specific chemical formulation. Every organic coating material can have a variety of gloss levels (matt, satin or gloss) and appearances (see [Appendix A3](#)).

Approvals are granted for each organic coating material, gloss level and appearance.

Additionally, class 3 approvals are granted by lightness category¹⁰

Approvals are usually requested by the manufacturers themselves, but any third party interested may apply for approval of an organic coating material he wishes to sell under his own brand name provided that he clearly informs the General Licensee and QUALICOAT of the sources used.

An approval is granted for one single production site. If an approval holder changes his source, he shall advise the General Licensee and QUALICOAT and have such new organic coating materials approved.

In order for an approval to be granted, the following conditions shall be met:

4.1.1 Technical information

Technical Data Sheet

The manufacturer shall provide the coaters and the laboratory in charge with the relevant technical data sheet. It shall include at least the following information:

- QUALICOAT + P-No.
- Product description
- Curing conditions including a curing window with a minimum of 2 temperatures and minimum and maximum time for each temperature.

¹⁰ See [Appendix A11](#)

Kommentiert [PB18]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

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Eg.: - 12 min. to 30 min at 180°C
- 7 min. to 20 min at 190°C
- 5 min. to 15 min at 200°C

- Shelf life and maximum storage temperature (XX months <YY°C)
- Fire classification information, if available (e.g., EN 13501-1 – A2 s1d0).

Label

Labels shall include at least the following information:

- QUALICOAT + P-No.
- Colour description
- Product code
- Batch number
- Gloss value
- Curing conditions (min. and max. for time and temperatures)
- Best before date¹¹ at <YY°C)

Kommentiert [PB19]: SPEC 2021 – US05 – Requirements on fire combustibility

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Kommentiert [PB20]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

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4.1.2 Minimum laboratory equipment

- 1) Specular glossmeter
- 2) Instruments for measuring coating thickness
- 3) Apparatus for testing resistance to cracking on bending
- 4) Cutting tools and instruments necessary for performing the adhesion test
- 5) Instrument for measuring indentation hardness
- 6) Apparatus for cupping test
- 7) Impact tester
- 8) Apparatus for controlling stoving temperature and time
- 9) System for checking polymerisation
- 10) Spectrophotometer
- 11) Apparatus for accelerated weathering test¹²
- 12) Light cabinet
- 13) RAL GL cards

Each piece of apparatus shall have a data sheet showing the apparatus identification number and calibration checks.

4.1.3 Tests for granting an approval¹³

The following tests shall be made:

- Colour (2.1)
- Gloss (2.2)
- Coating thickness (2.3)
- Dry adhesion (2.4.1)
- Indentation (2.5)
- Cupping test (2.6)
- Bend test (2.7)

¹¹ See section 3.7.1

¹² The accelerated weathering test can be outsourced and carried out by a QUALICOAT approved laboratory or another laboratory accredited for this specific test according to ISO/IEC 17025.

¹³ A summary of tests and requirements for powder coatings is given in Appendix A10.



- Impact test ([2.8](#))
- Resistance to humid atmospheres ([2.9](#))
- Acetic acid salt spray resistance ([2.10](#))
- Accelerated weathering test ([2.12](#))
- Polymerisation test ([2.14](#))
- Resistance to mortar ([2.15](#))
- Wet adhesion ([2.4.2](#))
- Condensation water test ([2.17](#))
- Water spot test ([2.20](#))
- Scratch and mar resistance test Martindale ([2.21](#))
- Natural weathering (Florida) ([2.13](#))

These tests shall be made on three test panels (for mechanical tests) and on three test samples (for corrosion tests) coated by a laboratory approved by QUALICOAT.

Exceptions are the Martindale and water spot tests, which shall each be carried out on one panel, and the accelerated weathering test, which shall be carried out on the number of test panels specified in the corresponding section [2.12](#) according to the specific case.

4.1.4 Basic colours to be tested for standard approvals and metallic extension

4.1.4.1 Standards approvals

Classes 1, 1.5 and 2

The following colours shall be tested (independently of gloss category or appearance):

- white RAL 9010
- blue RAL 5010
- red RAL 3005

Class 3

The following RAL colours shall be tested:

- Lightness category LIGHT
 - RAL 1015
 - RAL 7035
 - RAL 9010
- Lightness category MEDIUM
 - RAL 1011
 - RAL 7040
 - RAL 8024
- Lightness category DARK
 - RAL 7016
 - RAL 8019
 - RAL 9005

4.1.4.2 Metallic extension

For all classes; if a manufacturer wishes to have an approval extended for metallic colours, tests shall be carried out on RAL 9006.



4.1.5 Basic colours to be tested for special approvals

4.1.5.1 Special approvals valid for single colours

If a coating material is produced for a single colour, tests shall be carried out only on the colour mentioned in the system name. The tests are the same as those specified in § 4.1.3.

No other colours shall be produced under the same approval number.

4.1.6 Sampling

The manufacturer shall send coating materials and coated samples to the laboratory in charge, together with the relevant technical data sheet for each colour. The data sheet shall include at least the following information: colour, gloss value and curing conditions (including range of times and temperatures).

The testing laboratory shall prepare the test samples on its premises using chromium VI-free chemical pretreatment and the coating materials supplied by the manufacturer. The test samples may also be coated elsewhere provided that the inspector is present during the whole time of treatment.

The testing laboratory shall always select the minimum stoving time and temperature specified by the manufacturer. After checking the colour and gloss, the laboratory shall perform the above-mentioned tests on the samples.

4.1.7 Assessment of test results

The testing laboratory shall submit the test report to the General Licensee or to QUALICOAT in countries where there is no General Licensee.

The inspection reports shall be assessed by the General Licensee. Under the supervision of QUALICOAT, the General Licensee shall decide whether or not to grant an approval or an extension.

- If the results of all tests (excluding the natural weathering test) meet the requirements for all basic colours an approval or extension shall be granted.
- If the results of all tests (excluding the natural weathering test) meet the requirements for the basic colours but not for the metallic one, an approval shall be granted for all colours excluding metallic ones.
- If the results of any of the tests (excluding the natural weathering test) on a basic colour do not meet the requirements, the manufacturer of the organic coating material tested shall be informed that no approval or extension can be granted for the time being, stating the details and reasons.
- If the results of all tests (excluding the natural weathering test) are satisfactory for the metallic colour but not for the basic colours, the manufacturer of the organic coating material tested shall be informed that no approval can be granted for the time being, stating the details and reasons.

The approval shall be confirmed if the results of the natural weathering test in Florida are satisfactory for all basic colours.

If the result is unsatisfactory for the metallic colour alone, the approval shall be maintained for all colours except metallic ones.

Kommentiert [PB21]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

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In all other cases, the approval shall be withdrawn at the end of the year, but the single failed basic colour shall already be banned by the end of September.

QUALICOAT shall publish the Florida test results including the deadlines on www.qualicoat.net at the end of August.

Within 30 working days after receiving the Florida test results from QUALICOAT, the General Licensee shall inform the powder manufacturer of the unsatisfactory result and of the resulting ban of the failed colour.

The table below shows the different deadlines until when the powder manufacturer may still produce and sell the different colours and until when a coating applicator may use them.

DEADLINES					
Production of QUALICOAT approved products		Sale of QUALICOAT approved products		Use of QUALICOAT approved products by coating applicator	
Single failed basic colour	Remaining colours	Single failed basic colour	Remaining colours	Single failed basic colour	Remaining colours
30.09.xx	31.12.xx	30.03.yy	30.03.yy	End of original shelf life	

xx = current year yy = following year

4.1.8 Inspection of coating manufacturer's plant

A visit shall be required for new applicants in order to check the laboratory equipment of the coating manufacturer's plant. The costs of such a visit will be paid by the applicant. If a visit is considered unsatisfactory, the General Licensee (or QUALICOAT) retains the right not to grant the approval.

4.2. Renewal of an approval

After an approval has been granted to a coating material, laboratory tests and Florida exposure shall be performed annually, and an inspection of the coating manufacturer's plant shall be carried out every three years.

4.2.1 Laboratory tests and Florida exposure

4.2.1.1 Renewal of class 1 and class 1.5 approvals

Consistent quality of approved organic coating materials is monitored with all the tests listed in § 4.1.3) being performed on two colours chosen from the three colours specified by QUALICOAT each year. One metallic colour specified by QUALICOAT (RAL 9006 and RAL 9007 alternately) shall also be tested every year if there is an extension for metallic colours.

4.2.1.2 Renewal of class 2 and class 3 approvals

Consistent quality of approved systems is monitored annually with all the tests listed in § 4.1.3) being performed on two colours chosen from the three colours of the same RAL family¹⁴ specified by QUALICOAT each year, excluding critical RAL colours¹⁵.

If a powder supplier himself considers a colour or a family specified by QUALICOAT to be critical, he shall inform QUALICOAT and this information will be mentioned on the

¹⁴ For a definition and list of RAL families, see [Appendix A11](#).

¹⁵ For a definition and list of critical colours, see [Appendix A11](#).



approval certificate and published on the QUALICOAT website. QUALICOAT will specify an alternative colour or family for the renewal.

One metallic colour specified by QUALICOAT (RAL 9006 and RAL 9007 alternately) shall also be tested every year if there is an extension for metallic colours.

4.2.1.3 Renewal of special approvals

For renewals of special approvals, the same colours as for granting an approval shall be tested in a laboratory and in Florida every year.

4.2.2 Sampling

There are three options for sampling systems to be tested for renewal of approvals:

- The inspector takes samples of the required colours during routine inspections at the coating plants.
- The inspector takes samples directly at the system manufacturer's premises.
- The powder manufacturer sends organic coating materials and coated panels to the laboratory in charge expeditiously, from January and not later than June of the current year, together with the relevant technical data sheet for each colour. The data sheet shall include at least the following information: colour, gloss value and curing conditions (including range of times and temperatures). In countries where there is neither a General Licensee nor a testing laboratory, the coating manufacturer sends the selected colours to a laboratory approved by QUALICOAT.

The coating material may be applied to the test panels in the testing laboratory, at a local licensed coater's plant or at the coating manufacturer's premises under the auspices of the inspector according to § 4.1.6.

4.2.3 Assessment of laboratory test results

The testing laboratory shall submit the test report via the web interface. QUALICOAT shall assess the results and decide whether to renew or withdraw the approval or to ban colours as follows:

- If the results of any of the laboratory test(s) do not meet the requirements for a colour, all the laboratory tests shall be repeated for this particular colour within one month, using new samples.
- If the results of this second series of tests are again unsatisfactory, the colour shall be banned.

Within 10 working days after receiving the laboratory test results from QUALICOAT, the General Licensee shall inform the powder manufacturer of all the results and their consequences (e.g. request for repetition or ban of a colour).

4.2.4 Assessment of the Florida test results

The Florida Working Group shall submit the test results to QUALICOAT.

For all classes

- The approval shall be renewed if the result of the natural weathering test in Florida is satisfactory.
- If the result is unsatisfactory for one colour, the colour shall be banned.

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Additional rules for classes 2 and 3

- If the colour change result is unsatisfactory for two colours of the same RAL family, the RAL family shall be banned.
- If the gloss retention result is unsatisfactory for two colours of the same RAL family, only those two colours shall be banned.

If a powder manufacturer has failed for any reason to submit the required colours to the laboratory on time and if no samples were sent to Florida as a result, two renewal colours specified by the Florida Working Group and one metallic colour (if there is an extension to metallic colours) shall be banned.

4.2.5 Banned colours

QUALICOAT shall publish on www.qualicoat.net the colours currently banned according to § 4.2.4, including colours suspended according to § 4.2.6, for every approved organic coating P-No. by the end of August.

Within 30 working days after receiving the Florida test results from QUALICOAT, the General Licensee shall inform the powder manufacturer of the unsatisfactory result and of the resulting ban of the failed colour.

The powder manufacturer shall have the banned colour tested again by sending organic materials and coated panels to the testing laboratory before the end of June of the following year. To have the Florida exposure started the following year, the powder manufacturer shall send the banned colours to the testing laboratory before the end of November of the current year.

Banned colours shall not be used under QUALICOAT's approval.

The tables below show the different deadlines until when the powder manufacturer may still produce and sell a single failed colour or a banned colour family and until when a coating applicator may use it.

For all classes

DEADLINES					
Production of QUALICOAT approved products		Sale of QUALICOAT approved products		Use of QUALICOAT approved products by coating applicator	
Single failed colour	Remaining colours	Single failed colour	Remaining colours	Single failed colour	Remaining colours
30.09.xx	----	30.03.yy	---	End of original shelf life	---

xx = current year yy = following year

For a class 2 or 3 banned colour family

DEADLINES					
Production of QUALICOAT approved products		Sale of QUALICOAT approved products		Use of QUALICOAT approved products by coating applicator	
Single failed colour	Remaining colours of the banned family	Single failed colour	Remaining colours of the banned family	Single failed colour	Remaining colours of the banned family
30.09.xx	31.12.xx	30.03.yy	30.03.yy	End of original shelf life	

xx = current year yy = following year

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Kommentiert [PB26]: SPEC 2021 – US10 – Clarifications for Chapter 4 -Approval of Organic Coatings

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4.2.6 Suspended colours

A colour shall have the status "suspended" in case of:

- an unsatisfactory accelerated weathering test, with samples sent to Florida for the natural weathering test;
- satisfactory results of the laboratory tests on a banned colour, with samples sent to Florida for the natural weathering test.

Like banned colours, suspended colours shall not be used under QUALICOAT's approval. However, they shall not be considered when counting colours for the withdrawal of an approval.

Suspended colours shall be indicated with an asterisk in the list of approved powder coatings published on www.qualicoat.net.

The number of suspended colours and the duration of the suspension shall be limited as follows:

	Number of suspended colours allowed by P-No.	Maximum duration of suspension
Class 1	Maximum 2	Two years
Class 1.5	Maximum 3	Three years
Class 2	Maximum 4	Four years

If these limits are exceeded, the colours concerned shall be banned.

Suspended colours that meet the requirements after the full natural weathering test period shall have their suspension lifted after the Florida Working Group's meeting.

Suspended colours that fail again in the Florida test shall be banned.

4.2.7 Withdrawal of an approval or extension

4.2.7.1 Withdrawal by QUALICOAT

Classes 1 and 1.5

The approval shall be withdrawn as soon as four non-metallic colours are banned. In applying this rule suspended colours will not be considered.

Classes 2 and 3

The approval shall be withdrawn as soon as one of the following conditions is met:

- two RAL families are banned; or
- four solid, i.e. non-metallic, colours belonging to at least two different RAL families are banned.

For all classes

- The extension for metallic colours shall be withdrawn as soon as both RAL 9006 and RAL 9007 are banned.
- A special approval valid for a single colour shall be withdrawn as soon as this single colour is banned.
- The approval shall be withdrawn at the end of the year, but a single failed colour shall already be banned by the end of September.

Kommentiert [PB27]: SPEC 2021 – US10 – Clarifications for Chapter 4 -Approval of Organic Coatings

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Kommentiert [PB28]: SPEC 2021 – US10 – Clarifications for Chapter 4 -Approval of Organic Coatings

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Applicable from 1 January 2022



- QUALICOAT shall publish the Florida test results including the deadlines on www.qualicoat.net at the end of August.

The table below shows the different deadlines until when the powder manufacturer may still produce and sell a single failed colour and until when a coating applicator may use it.

DEADLINES					
Production of QUALICOAT approved products		Sale of QUALICOAT approved products		Use of QUALICOAT approved products by coating applicator	
Single failed colour	Remaining colours	Single failed colour	Remaining colours	Single failed colour	Remaining colours
30.09.xx	31.12.xx	30.03.yy	30.03.yy	End of original shelf life	

4.2.7.2 Voluntary withdrawal

In case of voluntary withdrawal of approval by a powder manufacturer, the following administrative procedure will be followed:

Withdrawal request	ADMINISTRATION
January – March XX	• Date of cancellation: 31.03.XX • No approval fees will be charged for year XX • Any panels still remaining on the Florida exposure field will be removed.
April – December XX	• Date of cancellation: 31.12.XX • Full approval fees will have to be paid for year XX • Florida test results assessed by the Florida WG in the summer YY will be communicated to powder manufacturer.

The table below depicts the different deadlines that determine until when a powder manufacturer may still produce and sell a withdrawn product, and until when a coating applicator may use it:

Withdrawal request	Deadline for stopping production	Deadline for stopping sale	Use of product by coating applicator
January – December XX	Date of withdrawal request	30.03.YY	End of original shelf life

Kommentiert [PB29]: SPEC 2021 – US10 – Clarifications for Chapter 4 -Approval of Organic Coatings

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4.2.8 Procedure for unbanning colour families for class 2

If a family is banned, the two banned colours plus the third colour selected for that family in the relevant renewal period shall be tested.

- If all three colours are satisfactory, the family shall be unbanned.
- If two colours are satisfactory and one colour is unsatisfactory, the family shall be unbanned, but the unsatisfactory colour shall remain banned.
- If two or three colours are unsatisfactory, the family shall remain banned.



4.3. Powder manufacturer's right of appeal

The powder manufacturer shall receive a copy of each test and inspection report. If the results do not meet the requirements, full details and reasons shall be given.

The powder manufacturer shall be entitled to appeal to the General Licensee, or to QUALICOAT in countries where there is no General Licensee, within 10 working days after receiving notification of the Florida test results from the GL or from QUALICOAT in countries where there is no General Licensee.

4.4. Use of the logo by coating manufacturers

The use of the logo shall comply with the Regulations for use of the QUALICOAT quality label ([Appendix A1](#)).



QUALICOAT Specifications 2022

Master version (V01)

Chapter 5

Licensing of Coating Applicators



5. Licensing of Coating Applicators

This chapter specifies the procedure for granting a licence to a coater for one production site.

A preliminary inspection can be requested by the applicant but in this case the results cannot be used for granting the licence.

Training for staff of licensed coating plants is mandatory in all countries. This training shall be organised regularly by the General Licensees or QUALICOAT.

The procedures for granting and renewing a licence to coating applicators applying decoration are set out in a separate document available on the [QUALICOAT Website](#).

5.1. Granting of a licence (quality label)

Every coating line shall be checked in order for a QUALICOAT licence to be granted.

Two inspections shall be satisfactory before a licence is granted. These inspections will be made at the coating applicator's request. The first inspection will be conducted by appointment. The second will be unannounced and will only take place once all the results of the first inspection (including the acetic acid salt spray resistance test) have been found satisfactory.

The inspectors shall take along the following equipment:

- Thickness meter
- Conductivity meter
- Calibration tools for the other tests stipulated

The inspector shall check the following using the inspection form approved by QUALICOAT.

5.1.1 Inspection of materials

The inspector will check that for outside architectural applications the coating plant installation uses organic coating materials approved by QUALICOAT. If chemical materials other than the chromate conversion coating described in [3.3.1](#) are used, he shall also check that these chemical materials are approved by QUALICOAT.

5.1.2 Inspection of laboratory equipment

As specified in [§ 3.8](#) to ensure that the equipment is available, functional and properly used. The inspector will also verify whether there are relevant standards or written operating instructions according to [§ 3.10](#).

5.1.3 Inspection of production process and equipment

According to [§ 3.1](#), [3.6](#) and [3.7](#).

5.1.4 Inspection of chemical pretreatment

According to [§ 3.2](#), [3.3](#), [3.4](#) or [3.5](#)



5.1.5 Inspection of finished products

Only finished products which have been released by the coating applicator are to be tested (all parts ready for dispatch are deemed to have been released by the coating applicator).

The number of pieces on which film thickness measurements (see [§ 2.3](#)) shall be made is shown in the table below (subject to a minimum of 30 pieces).

Lot size (*)	Number of pieces (random selection)	Acceptance limit for rejected pieces
1 - 10	All	0
11 - 200	10	1
201 - 300	15	1
301 - 500	20	2
501 - 800	30	3
801 - 1'300	40	3
1'301 - 3'200	55	4
3'201 - 8'000	75	6
8'001 - 22'000	115	8
22'001 - 110'000	150	11

(*) Lot: 1 lot represents a customer's complete order in one colour or that part of the order which is in the coating plant installation.

The inspector shall perform the following tests on the finished products:

- Appearance (to test the uniformity of production) ([2.1](#))
- Thickness ([2.3](#))
- Dry adhesion ([2.4.1](#)) and wet adhesion ([2.4.2](#))
- Acetic acid salt spray ([2.10](#))
- Machu ([2.11](#))
- Polymerisation ([2.14](#))
- Sawing ([2.18](#))

During the first inspection, the Machu test is carried out prior to the acetic acid salt spray test. If the result of the Machu test is satisfactory, the acetic acid salt spray test will then be performed. However, if the result of the Machu test is unsatisfactory, the first inspection will be considered unsatisfactory and shall be repeated. The inspection is satisfactory when all tests are satisfactory including the acetic acid salt spray test.

In the second inspection, only the Machu test will be carried out. If the result of the Machu test is unsatisfactory, the second inspection shall be repeated.

5.1.6 Inspection of the test panels

The following tests shall be performed on test panels processed concurrently with a production lot:

- Gloss ([2.2](#))
- Thickness ([2.3](#))
- Dry adhesion ([2.4.1](#))
- Bend ([2.7](#))
- Impact ([2.8](#))

5.1.7 Review of in-house control and registers

The inspector will check that in-house control has been carried out in accordance with [§ 3.9](#) and that the coating plant installation maintains registers according to [§ 3.11](#).



In the in-house control register he will check that the results recorded in the register coincide with the results of the test panels. For this reason, all test panels shall be kept and held at the inspector's disposal for one year.

5.1.8 Final assessment for granting the licence

The inspector submits the inspection reports to the General Licensee for the evaluation. Under the supervision of QUALICOAT, the procedure below is to be followed by the General Licensee:

- If the results of both inspections meet the requirements, a licence to use the quality label shall be granted.
- If the results of one of the two inspections do not meet the requirements, the coating applicator will be informed that the licence to use the quality label cannot be granted for the time being, stating reasons. The coating applicator shall wait at least three months before making a new application for a licence.

5.1.9 "SEASIDE" endorsement

If the coating applicator has applied for the endorsement SEASIDE an inspection shall be carried out following the specifications as set out in § 3.2.1 or 3.4. and a filiform corrosion test shall be carried out on finished products (2.19).

If the results of the inspection meet the requirements, the "SEASIDE" endorsement shall be granted. A specific QUALICOAT SEASIDE certificate shall be issued¹⁶ stating that the coating plant installation is able to produce finished products that meet the SEASIDE requirements.

If the results of the inspection do not meet the requirements, the coating applicator shall wait at least three months before making a new application for a "SEASIDE" endorsement.

5.2. Routine inspections of licensees

After a coating applicator has been granted a licence to use the quality label, this licence shall be renewed if the results of at least two inspections per year meet the requirements. Every coating line shall be checked twice a year in order for a QUALICOAT licence to be renewed.

Samples for the acetic acid salt spray test and the filiform corrosion test (in the case of SEASIDE) shall be taken during the first inspection of the year.

Routine inspections shall be made without prior notice. Inspectors will only be authorised by the GL or QUALICOAT Secretariat to announce an inspection in the case of travel safety issues or visa problems.

The inspectors shall take along the following equipment:

- Thickness meter
- Conductivity
- Calibration tools for the other tests stipulated

The inspector shall check the following using the inspection form approved by QUALICOAT:

¹⁶ For the use of the QUALICOAT SEASIDE logo, see [Appendix A1](#), § 5 and § 6



- an inspection of materials according to § [5.1.1](#)
- an inspection of laboratory equipment according to § [5.1.2](#)
- an inspection of production process and equipment according to § [5.1.3](#)
- an inspection of chemical pretreatment according to § [5.1.4](#)
- an inspection of finished products and test panels according to § [5.1.5](#) and [5.1.6](#)
- an acetic acid salt spray test to be carried out on samples taken during the first inspection according to § [2.10](#)
- a review of the registers according to § [5.1.7](#)
- attendance in training

As the training is mandatory the inspector shall check that at least one in-house control employee and/or one responsible quality employee have attended regularly trainings organised at least once every two years by the General Licensees or by QUALICOAT in countries without GL.

In case of non-compliance with this requirement the inspector shall make a remark in the inspection report and, in case of repetition of this non-compliance after the next organised training has taken place, a non-conformity shall be issued.

Machu test

During the first inspection of the year, the Machu test is carried out prior to the acetic acid salt spray test. If the result of the Machu test is satisfactory, the acetic acid salt spray test will then be performed. However, if the result of the Machu test is unsatisfactory, the first inspection will be considered unsatisfactory and shall be repeated. The inspection is satisfactory when all tests are satisfactory including the acetic acid salt spray test.

In the second inspection of the year, only the Machu test will be carried out. If the result of the Machu test is unsatisfactory, the second inspection shall be repeated.

The inspector submits the inspection reports to the General Licensee for the evaluation.

Final assessment for renewing the licence

Under the supervision of QUALICOAT, the procedure below is to be followed by the General Licensee:

- If the results of the inspection meet the requirements, authorisation to use the quality label will continue.
- If the results of the inspection do not meet the requirements another inspection shall be made within one month (allowing for holiday periods) after the coater has received notification of an unsatisfactory inspection from the General Licensee and/or QUALICOAT. In the meantime, the licensee should rectify non-conformities and inform the General Licensee or QUALICOAT immediately.

If the second inspection again produces unsatisfactory results, the licence to use the quality label will be withdrawn immediately. The coating applicator shall wait at least three months before making a new application for a licence to use the quality label.

Licences with the endorsement «SEASIDE»

Routine SEASIDE inspections are carried out as set out in § [3.2.1](#) or § [3.4](#) during QUALICOAT inspections and a filiform corrosion test is performed on finished products ([2.19](#)) during the first inspection of the year. At least one SEASIDE inspection shall be possible and satisfactory during the year. If no SEASIDE inspection is possible during QUALICOAT visits, an additional announced inspection shall be carried out.



If the results of the inspection meet the requirements, the "SEASIDE" endorsement shall be confirmed.

If the result of the FFC test is D, another complete and unannounced inspection including SEASIDE shall be conducted.

If the second inspection again produces unsatisfactory results, the "SEASIDE" endorsement shall be withdrawn immediately. The coating applicator shall wait at least three months before making a new application for a "SEASIDE" endorsement.

Suspension of an inspection

In case of political unrest or unforeseen circumstances and after consultation with the testing laboratory responsible the inspection can be suspended for a maximum period of 12 months by the General Licensee or by QUALICOAT. After this period, the licence will be cancelled.

5.3. Coating applicator's right of appeal

The coating plant shall receive a copy of each inspection report. If the results do not meet the requirements, full details and reasons shall be given. The plant shall be entitled to appeal within 10 days.

5.4. Confidentiality of information

All information concerning the inspection results and their assessment shall be confidential.

5.5. Deadlines for submission of inspection reports

All inspection reports (including test results) shall reach QUALICOAT's Secretariat within three months of the dates of the inspections.

If a plant inspection was unsatisfactory, the General Licensees shall send the report to QUALICOAT's Secretariat within one month after the inspection.

5.6. Use of the logo by coating applicators

The use of the logo shall comply with the Regulations for use of the QUALICOAT quality label ([Appendix A1](#)).



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Chapter 6

Specifications for In-House Control



6. Specifications for In-House Control

The aim of in-house control is to give the coating plant a tool to keep control over its own production process. The number of shifts worked, the requirements, the results of the analyses and corrective actions shall be entered in charts or some other records/registration systems readily accessible to the inspector.

The staff responsible for managing in-house control shall follow the training programme stipulated by QUALICOAT.

6.1. Controlling the production process parameters

6.1.1 Chemical pretreatment baths

The chemical parameters defined by the manufacturer of the chemical pretreatment materials shall be analysed at least once per bath in every working shift, or according to the chemical supplier's advice, that shall be at least once per day (24 hours).

6.1.2 Water quality

The conductivity of the final rinsing preceding chromate bath and of the demineralised rinsing water shall be measured at least once per bath in every working shift, or according to the chemical supplier's advice, that shall be at least once per day (24 hours).

6.1.3 Measuring the temperature of chemical pretreatment and rinsing baths

The temperature of the pretreatment baths and the final rinse, if a hot water rinse, shall be measured at least once per bath in every working shift, or according to the chemical supplier's advice, that shall be at least once per day (24 hours).

6.1.4 Recording and measuring the drying temperature

The drying temperature displayed shall be recorded at least once in every working shift.

The temperature shall be measured on parts at least once a week using a recording instrument or some other means such as thermochromic pencils or tablets.

6.1.5 Measuring the stoving conditions

The stoving conditions according to § 3.7 shall be tested as follows:

- The displayed temperature shall be recorded at least once in every working shift.
- A stoving curve shall be made on profiles at least twice a week.

6.2. Quality control of the chemical pretreatment

6.2.1 Testing the etching degree

The degree of aluminium removal shall be measured at least once in every working shift, or according to the chemical supplier's advice, that shall be at least once per day (24 hours). using the method described in § 3.2.1.

If a licence has the SEASIDE endorsement, the coating applicator shall check the etching degree at least once in every working shift during SEASIDE production.

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6.2.2 Testing the weight of the conversion coating

The weight of chromate conversion coating shall be tested in accordance with **ISO 10546** at least once in every working shift, or according to the chemical supplier's advice, that shall be at least once per day (24 hours).

6.3. Quality control of the finished products

6.3.1 Gloss test (ISO 2813)

The gloss of the organic coating on finished products shall be tested at least once in every working shift for each colour shade and each manufacturer.

6.3.2 Coating thickness test (ISO 2360)

The coating thickness shall be measured on pieces as specified below:

Lot size (°)	Number of pieces (random selection)	Acceptance limit for rejected pieces
1 - 10	All	0
11 - 200	10	1
201 - 300	15	1
301 - 500	20	2
501 - 800	30	3
801 - 1'300	40	3
1'301 - 3'200	55	4
3'201 - 8'000	75	6
8'001 - 22'000	115	8
22'001 - 110'000	150	11

* lot : a customer's complete order in one colour or the part of the order that has already been coated.

6.3.3 Appearance test

The appearance shall be controlled on pieces as specified below:

Lot size (°)	Number of pieces (random selection)	Acceptance limit for rejected pieces
1 - 10	All	0
11 - 200	10	0
201 - 300	15	0
301 - 500	20	0
501 - 800	30	0
801 - 1'300	40	0
1'301 - 3'200	55	0
3'201 - 8'000	75	0
8'001 - 22'000	115	0
22'001 - 110'000	150	0

* lot : a customer's complete order in one colour or the part of the order that has already been coated



6.3.4 Adhesion test

6.3.4.1 Dry adhesion (ISO 2409)

The dry adhesion test shall be carried out at least on one panel for every two production hours¹⁷.

6.3.4.2 Wet adhesion

The wet adhesion test shall be carried out on finished products at least once in every working shift. All samples from one working day may be tested together.

6.3.5 Polymerisation test

This test is used to check that the organic coating polymerisation is good. In in-house control, this test is **optional for powder coatings**.

The polymerisation test shall be carried out on test panels at least once in every working shift for each colour shade and gloss category and for each manufacturer.

6.3.6 Bend test (ISO 1519)

The resistance to cracking on bending shall be tested at least on one panel for every two production hours¹⁷.

6.3.7 Impact test (ISO 6272 / ASTM D 2794)

The impact test shall be carried out on test panels at least on one panel for every two production hours¹⁷.

6.4. Quality control registers

6.4.1 Control register for the production process

This control register is either a bound register with numbered pages, or a computer listing.

It shall show the following information:

- the temperature of the baths,
- the chemical parameters specified by the manufacturers,
- the results of the etching degree test,
- the results of the tests of the conversion coating weight,
- the results of the water conductivity tests,
- the results of the tests of the drying and stoving conditions.
- the drying and stoving temperature curves

6.4.2 Control register for test panels

This control register is either a bound register (not a spiral binding) with numbered pages, or a computer listing.

It shall show the following information:

- the production date

¹⁷ The same panel to be chosen for dry adhesion test, bend test and impact test.



- the references of the organic coating material used: RAL or some other reference for identification, lot number, manufacturer's name
- the following results:
 - dry adhesion test
 - polymerisation test (optional for powder coatings)
 - bend test
 - impact test

6.4.3 Control register for finished products

It is either a bound register (not a spiral binding) with numbered pages, or a computer listing.

It shall show the following information

- the customer's name and the order or lot identification data
- the production date
- the reference of the organic coating material used
- the following results:
 - coating thickness test (minimum and maximum values)
 - inspection of the colour shade and its gloss
 - appearance
 - wet adhesion test

6.4.4 Control register for tests carried out by the chemical manufacturer

This is either a bound register (not a spiral binding) with numbered pages, or a computer listing.

It shall show the following information

- sample reference
- date of sampling and dispatch/collect
- chemical manufacturer's test report
- test results (see Appendix A6)
- remarks and/or corrective action.



6.5. Table summarising the specifications for In-House Control

CONTROL	OBJECT TESTED		FREQUENCY
Process (6.1)	Chemical pretreatment baths, degreasing, pickling, chromating, rinsing	Chemical Parameters	Once per bath in every working shift, or according to the chemical supplier's advice, that shall be at least once per day (24 hours).
	Conductivity of the water		Once per bath in every working shift, or according to the chemical supplier's advice, that shall be at least once per day (24 hours).
	Temperature of chemical pretreatment		Once per bath in every working shift, or according to the chemical supplier's advice, that shall be at least once per day (24 hours).
	Drying temperature		- Once in every working shift: record the displayed temperature - Once a week: make one recording of the temperature using strips or some other means
	Stoving conditions		- Once in every working shift: record the displayed temperature - Twice a week: make 1 stoving curve on profiles
Conversion coating (6.2)	Etching degree		Once in every working shift, or according to the chemical supplier's advice, that shall be at least once per day (24 hours).
	Weight of the conversion coating (chromate conversion)		Once in every working shift, or according to the chemical supplier's advice, that shall be at least once per day (24 hours).
	Weight of the conversion coating (chromium-free)		Once in every working shift, or according to the chemical supplier's advice, that shall be at least once per day (24 hours).
Finished products (6.3)	Gloss		Once in every working shift for each shade and manufacturer
	Coating thickness		According to the order lot size
	Appearance		According to the order lot size
	Wet adhesion		Once in every working shift <i>All samples from one day may be tested together.</i>
Panels (6.3)	Dry adhesion		Minimum of 1 x sample* for every two production hours.
	Polymerisation (optional for powder coatings)		Once in every working shift for each colour shade and gloss category and for each manufacturer
	Bend test		Minimum of 1 x sample* for every two production hours.
	Impact test		Minimum of 1 x sample* for every two production hours.

* The same panel to be chosen for dry adhesion test; bend test and impact test



QUALICOAT Specifications 2022

Master version (V01)

Appendices



Appendices

A1 – Regulations for use of the QUALICOAT quality label for liquid and powder organic coatings on aluminium for architectural applications

1. Definitions

For the purposes of these regulations, the QUALICOAT "Quality Label" denotes the trademark registered by the Association for Quality Control in the Lacquering, Painting and Coating Industry (QUALICOAT), Zurich, with the Federal Patent and Trademark Office on 8 May 1987 under trademark no. 352 316 and in the International Trademark Register on 14 August 1987 under no. 513 227 and published in the Swiss Official Gazette of Commerce on 5 May 1987.

"QUALICOAT" means the Association for Quality Control in the Lacquering, Painting and Coating Industry, Zurich.

"GL" means a General Licensee i.e. a national or an international association holding the QUALICOAT general licence for a defined territory.

"Licence" is a statement issued by or on behalf of the Association authorising the holder to use the Quality Label in accordance with these regulations.

"Approval" is a confirmation that a specific material (coating or chemical conversion) meets the requirements of the Specifications.

"Specifications" are the "Specifications for a Quality Label for liquid and powder organic coatings on Aluminium for Architectural Applications".

"Holder" is the company authorised to use the Quality label.

2. Ownership of the Quality Label

The Quality Label is owned by QUALICOAT and shall not be used by anyone unless authorised to do so by QUALICOAT.

QUALICOAT has granted to the GL a general licence in respect of the Quality Label for (country) with powers to authorise the use of the Quality Label in accordance with these regulations.

3. Qualifications of applicant

Authorisation to use the Quality Label may be granted on condition that the applicant operates in accordance with the Specifications. This authorisation is governed by a contract.

The granting of a licence or approval entitles the Holder to use the Quality Label for the products specified. The licence or approval shall not be transferred.

Kommentiert [PB31]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

Ratified on 19.11.2021

Applicable from 1 January 2022

Kommentiert [PB32]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

Ratified on 19.11.2021

Applicable from 1 January 2022



4. Register of holders

QUALICOAT shall keep a register showing (in addition to other details which may be resolved upon now or later) the name, address and trade description of each Holder, the date on which the licence or approval was granted to the Holder, the number assigned to each Holder, the date of withdrawal of the licence or approval and any other details which QUALICOAT may deem necessary.

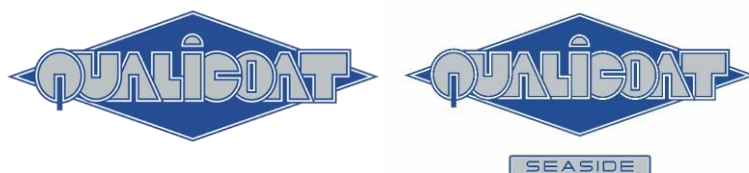
The Holder shall notify the GL forthwith of any changes in name or address and the GL shall in turn inform QUALICOAT in order for the change to be recorded in the register.

5. Use of the logo by coating applicators and manufacturers

5.1 Use in general

The logo exists in black and white, in white and blue (PANTONE Reflex Blue CV; RGB: 14-27-141; CMYK: 100-72-0-6) and in blue and silver (PANTONE Silver 877u; RGB: 205-211-215; CMYK: 8-3-3-9).

The words "Quality Label for Architectural Coating on Aluminium" (or a text appropriate to national legal requirements) may be added in the space to the right.



The Holder shall not make any alteration or addition to the logo when using it. In the event that the Holder's own brands or trademarks are used separately on or in connection with his products, these regulations shall not be infringed in any manner whatsoever. Holders of an approval or licence shall at any time provide the GL with all information required as to the use of the logo.

Improper use of the logo may lead to the sanctions stipulated in § 9.

5.2 Use of the logo by coating applicators

By applying the logo to a product, the coating applicator guarantees that the quality of the finished product supplied meets all the requirements of the Specifications.

For applicators that have more than one production site, the quality label shall only be used for the coating plant installation for which the applicator is holding the licence.

The logo may be used on the products themselves, business stationery, quotations or invoices, price lists, cards, display boxes and on all company literature and brochures or in catalogues and newspaper advertisements.

Whenever a coating applicator makes mention or reference to QUALICOAT, it shall systematically indicate its licence number. This shall apply both to the use of the logo and in texts.



Licence n° xxxx

Kommentiert [PB33]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

Ratified on 19.11.2021

Applicable from 1 January 2022

Kommentiert [PB34]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

Ratified on 19.11.2021

Applicable from 1 January 2022



5.3 Use of the logo by manufacturers (coating manufacturers and manufacturers of pretreatment systems)

The QUALICOAT logo shall not appear on packaging or labels.

In their business literature and documents, the coating manufacturers shall only use the logo for products approved by QUALICOAT, stating: «Product approved by QUALICOAT». Wherever the logo is used, the phrase «QUALICOAT is a quality label for licensed coaters» should also appear in the document.

For any other use of the logo, the coating manufacturers are required to submit all new documents mentioning QUALICOAT to their national association. In countries without a General Licensee, these documents shall be submitted directly to the QUALICOAT Secretariat before publication.

Kommentiert [PB35]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

Ratified on 19.11.2021

Applicable from 1 January 2022

6. Other conditions for use of the logo

6.1 Use of the logo by General Licensees (national or international associations)

General Licensees are authorised to use the logo in the stipulated colours but always together with their respective logos or the legal designation of the national or international associations. The logo may also be used in conjunction with a national flag and by adding the name of the country. When the QUALICOAT logo or name is used on licensees' stationery or in correspondence, the national association's name shall always be predominant to avoid any confusion between the licensee and QUALICOAT. Wherever the logo is used, the phrase «X¹⁸ is the QUALICOAT General Licensee for Y¹⁹» should also appear in the document. The size of the logo may be altered provided that the geometrical proportions are maintained.

Kommentiert [PB36]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

Ratified on 19.11.2021

Applicable from 1 January 2022

Kommentiert [PB37]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

Ratified on 19.11.2021

Applicable from 1 January 2022

6.2 Use of the logo by the QUALICOAT Secretariat

Only the Secretariat is authorised to use the logo without any further designation. The logo should be used in black/white for internal communications, such as circular letters, notices of meetings and minutes. For external use, the stipulated colours are to be used. The logo shall always be placed on the first page of the respective documents, but not necessarily on the following pages. The logo shall be included in the letterhead.

6.3 Use of the logo by QUALICOAT officers

The President of QUALICOAT and the Chairman of the Technical Committee are also authorised to use the logo on business cards prepared by QUALICOAT if such cards are needed for representation purposes. Other members of the Committees (Executive and Technical Committees, Working Groups) are neither allowed to use the logo nor to make any reference to QUALICOAT unless authorised to do so by the Executive Committee.

6.4 Use of the logo by interested third parties

Some businesses using QUALICOAT coated products may wish to use the logo on the products they manufacture or in their business literature.

They shall request written authorisation which may be granted on condition that they:

18 X = name of the national association

19 Y = country



- undertake to use solely aluminium products coated by licensed coating plants;
- undertake to submit all documents that refer to QUALICOAT to the GL for approval or directly to QUALICOAT in countries where there is no GL;
- undertake to undergo inspections and controls by the GL or QUALICOAT.
- Such authorisation may require payment of an annual fee.

7. Conditions for granting and renewing approvals and licences

As stipulated in [chapter 4](#) for coating manufacturers.

As stipulated in [chapter 5](#) for coating plant installation.

As stipulated in [Appendix A6](#) for manufacturers of chemical pretreatment materials

The granting of an approval or licence shall require payment of an annual fee.

8. Withdrawal of approvals and licences

8.1 Failure to comply with the Regulations

The GL shall withdraw the approval or licence if the Holder ceases to comply with these regulations and in particular if the Holder is guilty of any improper use of the Quality Label or has failed to pay the annual fee.

In the event of withdrawal of an approval or licence, the Holder shall be given notice in writing by the GL and such notice shall be effective immediately. In such event, all tags, labels, bands, stencils, stamps, wrappers, containers, price lists, business notices, business cards and any other objects in or upon which the Quality Label is affixed shall either be delivered to the GL or, upon the GL's instructions, kept at the disposal of the GL until a new approval or licence is granted.

8.2 Significant changes in a company

In the case of any significant event (change in shareholders or key personnel, new lines), the company shall notify the GL immediately. The GL shall be authorised to make a supplementary visit in order to ensure that the Holder continues to satisfy all the conditions stipulated in the Specifications.

If the Holder ceases to trade, all tags, labels, bands, stencils, stamps, wrappers, containers, price lists, business notices, business cards and any other objects in or upon which the Quality Label is affixed shall either be delivered to the GL or, upon the GL's instructions, kept at the disposal of the GL until a new approval or licence is granted.

8.3 Voluntary withdrawal

In the event of voluntary withdrawal of an approval or licence, all tags, labels, bands, stencils, stamps, wrappers, containers, price lists, business notices, business cards and any other objects in or upon which the Quality Label is affixed shall either be delivered to the GL or, upon the GL's instructions, kept at the disposal of the GL until a new approval or licence is granted.



9. Sanctions

In the event of improper use of the Quality Label or of any behaviour or action which could impair the image of the Quality Label, the following sanctions may be imposed either by the GL or by QUALICOAT in countries without a GL:

- official statement
- reprimand
- withdrawal of the label

The party concerned shall have the right to appeal first at the GL's level and finally at the QUALICOAT Executive Committee's level whose decision is final.

10. Amendments to the Regulations

These Regulations may be amended if and when necessary. However, the Holder of the label shall be allowed 4 months from the date of publication in which to comply with any such amendment.

11. Notices

Any notice required to be given to or by the Holder under these regulations shall be effective if sent by correctly stamped and addressed letter.



A2 – List of currently approved procedures²⁰

CODE	PROCEDURE	INTENDED FOR
P-EVA	Procedure for evaluating inspection results List of failures to be considered nonconformities	General Licensees
P-FFC	Procedure for the filiform corrosion test	Testing laboratories
P-TAC	Procedure for testing and approving coating materials	Testing laboratories
P-RLT	Procedure for the repetition of laboratory tests	Testing laboratories
P-SAMP	Procedure for sampling (coating plant inspections and laboratory tests) - including classification of tests	Testing laboratories

²⁰ All current procedures are available on request.



A3 – Compulsory declaration of changes in formulation for organic coating materials approved by QUALICOAT

Organic coating materials essentially consist of 4 kinds of components:

- binder
- pigments
- extenders
- additives

These are the organic coating material's components that determine the organic coating's characteristics.

1. BINDER

The binder consists of resin(s) + hardening agent together; it imparts the principal characteristics to the organic coating material (reactivity, application properties, mechanical properties etc.). The main types of resins used in Europe are:

- saturated carboxylated polyester
- saturated hydroxylated polyester
- epoxy
- acrylic

These different types of resins can be used with several different kinds of hardeners.

It is quite obvious that variations in the chemical composition of the different resins or changes in the chemical molecular structure of the hardening agent can bring about modifications in the properties or characteristics of the organic coating and require a new QUALICOAT approval.

2. PIGMENTS

Pigments can be organic, inorganic or metallic; they impart colour, appearance and opacity to the organic coating.

3. EXTENDERS

Extenders improve the rheological or chemical properties of the organic coating.

4. ADDITIVES

These are substances added to the organic coating material in small quantities to improve certain characteristics of the organic coating (vapour relief, gloss etc.).

These other components (pigments, extenders or additives) of organic coating material can also have some influence on the film properties and characteristics controlled within the QUALICOAT label. Nevertheless, as these constituents can be numerous and varied, it is up to the organic coating manufacturers to control their formulations so that they comply with the QUALICOAT label.

5. APPEARANCE OF THE FINAL ORGANIC COATING

Like all other coatings, organic coating materials – after curing – can give the final organic coating different appearances, for example a smooth appearance or a structured appearance.

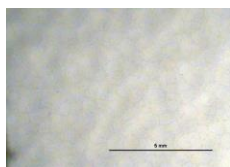


A structured appearance cannot be treated like a smooth appearance. Even if the change in formulation is based on special additives, an organic coating imparting an uneven appearance, which does not involve colour gloss or metallic effect, needs a special QUALICOAT approval in a different category from the approvals granted for smooth organic coatings.

Definition criteria for structured finishes

These finishes can be split into the following three types. An approval is necessary for each type (QUALICOAT designation a, b, c).

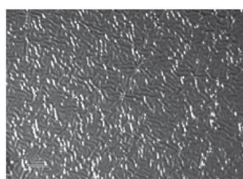
a) Leathered or orange-peel appearance (waves)



b) Textured or sandpaper appearance (sharp edges)



c) Wrinkled or vein appearance (heterogeneous)





A4 – Metallic organic coating

1. DEFINITION

Metallic organic coating materials are organic coatings with a metallic or metallised effect. A metallic organic coating is a "normal" organic coating, the difference is the pigmentation. Manufacturers achieve this special effect by incorporating metal (for example: leafing or non-leafing aluminium) or other materials (for example: mica) in the formulation of the organic coating.

We can separate metallic organic coatings into two categories:

- One-coat systems with a metallised appearance (no clear coat is needed for good outdoor durability and resistance). **The current approvals are sufficient.**
- Two-coat systems: metallic powder coatings that need a clear coat in order to have acceptable weathering resistance. **These specific two-coat systems shall be approved separately by QUALICOAT.**

The manufacturers are responsible for advising their customers whether they need to use a two-coat system or not.

2. REFERENCE SCALE

Some metallic colours, especially those based on aluminium, may show variations in colour during tests that affect the surface of the coating. In this case, QUALICOAT accepts a slight variation in colour. In the case of metallic colours, the colour variations may differ depending on the angle of observation. This makes it difficult to perform a reliable measurement using any of the apparatus defined in the standard mentioned in [§ 2.12](#) of the Specifications.

For this reason, a reference scale for the laboratories has been defined using panels coated in an aluminium-based metallic colour (RAL 9006). The stains are obtained by applying an alkaline solution to the surface for different lengths of time. These different panels produced by an approved laboratory are approved and distributed by QUALICOAT. Each approved laboratory shall have these reference panels.

For information, the following photographs show values 1 and 2 on the reference scale.



REFERENCE FOR EVALUATING MORTAR TEST RESULTS
(FOR INFORMATION)

 Acceptable value 1	 Acceptable value 1
 Unacceptable value 2	 Unacceptable value 2



A5 – Special specifications for coatings on aluminium accessories for architectural applications under the QUALICOAT quality label

1. Introduction

Cast accessories may be made of different alloys whose chemical composition is specified in the **EN 1706** standard.

The nature of the alloy and the production method determine the final quality of the coated accessory. Some alloys – especially those based on silicone and copper – are the cause of unsatisfactory resistance to corrosion.

The chemical pretreatment cycle shall be tailored to the alloy and the quality of the castings. For outdoor architectural applications, it is necessary to use special alloys which have good resistance to corrosion as indicated in EN 1706.

It is the responsibility of the customer to define the alloy.

2. Work Specifications

All the requirements set out in Chapter 3 of the Specifications are applicable to the treatment of accessories, **with the exception of the etching degree** which is not specified for castings (see Specifications, [§ 3.2.1](#)).

3. Testing

3.1 Inspection of finished products

Certain tests may be carried out on the finished products themselves but the full range of tests shall be performed on test panels processed concurrently with a production lot.

The inspector shall perform the following tests on the coated accessories:

- Appearance (Specifications [§ 2.1](#))
- Polymerisation (Specifications [§ 2.14](#))

and if the geometry of the parts permits:

- Coating thickness (Specifications [§ 2.3](#))
- Adhesion (Specifications [§ 2.4](#))

The following test shall be performed on extruded sections only:

- Acetic acid salt spray test (Specifications [§ 2.10](#))
- Machu test (Specifications [§ 2.11](#))



3.2 Inspection of test panels

The full range of tests shall be performed on test panels processed concurrently with a production lot.

- Gloss (Specifications § [2.2](#))
- Coating thickness (Specifications § [2.3](#))
- Adhesion (Specifications § [2.4](#))
- Bend test (Specifications § [2.7](#))
- Impact test (Specifications § [2.8](#))

Apart from the restrictions above, please refer to the QUALICOAT Specifications.



A6 – Approval of chemical pretreatments

1. INTRODUCTION

This Appendix specifies the procedure for granting and renewing an approval for pretreatment processes, with the exception of chromate conversion coatings (as specified in § 3.3.1 of the QUALICOAT Specifications). It also describes the testing programme to be followed by the laboratories involved and the requirements for every test.

2. FORMAL APPLICATION PRIOR TO TESTING

Chemical manufacturers who plan to submit a chemical pretreatment system for testing shall send a formal request to the General Licensee or to QUALICOAT in countries without a national association using the application form available on the [QUALICOAT website](#).

If the pretreatment system is manufactured at several production plants, the applicant shall name the main production site and/or technical service centre and indicate all other production sites.

The Technical Data Sheet (TDS), a safety data sheet and detailed instructions on treatment cycles shall be submitted to an approved QUALICOAT laboratory selected in agreement with the General Licensee and/or QUALICOAT in countries without a national association.

On the application form and in the TDS, the applicant shall specify whether the product is a rinse or a no-rinse system, or whether it is suitable for dual use depending on the coating applicator's pretreatment line set-up. Products intended for dual use shall be tested both ways.

The following minimum technical information shall also be provided to the QUALICOAT laboratory in charge on a separate sheet (General Technical Information):

APPLICATION METHOD (1) (2)	
PROCESS CYCLE (2)	
FINAL RINSE (YES/NO/DUAL USE)	
ANALYTICAL METHODS FOR BATH	
FILM WEIGHT (3)	
OTHER ANALYSES	
OTHER RECOMMENDATIONS (EQUIPMENT, HANDLING, STORAGE ETC.) (4)	
COLOURLESS CONVERSION COATING?	
DRYING CONDITIONS	
(1) Spraying and/or immersion. (2) The manufacturer is responsible for ensuring that the cycle used by the coating applicator is suitable for obtaining a coated product conforming to the QUALICOAT Specifications. What are the limits for demineralised water before conversion coating? (3) Method for in-house control and laboratory tests (limits and frequency). (4) The technical specifications shall make it clear which items are compulsory, for instance does "recommended" mean compulsory or not?	



3. PRELIMINARY CONDITIONS (minimum equipment)

THE CHEMICAL MANUFACTURER SHALL HAVE THE FOLLOWING MINIMUM EQUIPMENT AVAILABLE AT LEAST AT ONE LOCATION (main production site and/or technical service centre):

- analytical instruments for testing the quality of the conversion coating;
- cutting tools and instruments necessary for performing the adhesion test;
- apparatus for testing dry and wet adhesion and elasticity (cupping test);
- impact tester (ISO 6272);
- apparatus for testing resistance to cracking on bending;
- analytical balance for determining weight loss (precision 0.1 mg)
- apparatus to carry out the following corrosion tests:
 - constant climate condensation water
 - resistance to humid atmospheres containing sulphur dioxide
 - acetic acid salt spray resistance
 - pressure cooker test
 - filiform corrosion test²¹

AT ALL OTHER LOCATIONS (NOT BEING THE MAIN PRODUCTION SITE AND/OR TECHNICAL SERVICE CENTRE), THE FOLLOWING REQUIREMENTS SHALL BE MET:

- A method for testing the quality of the conversion coating shall be available.
- Tests that cannot be carried out on-site shall be performed by the laboratory at the main production site and/or technical service centre or outsourced to any QUALICOAT approved laboratory.

4. QUALICOAT TESTING LABORATORIES

Before an approval is granted for a new pretreatment system, the laboratory in charge shall carry out the testing programme specified in the following section. Corrosion tests shall also be performed by a second laboratory under the responsibility of the laboratory in charge.

For renewal of an approval, the full testing programme shall be carried out only by the laboratory in charge.

5. TESTING PROGRAMME

Approval is based on the following testing programme to ensure conformity with the requirements prescribed by QUALICOAT.

a) PANEL PREPARATION

For every corrosion test, six extruded samples shall be evaluated (three samples in each of the two laboratories involved). Special attention shall be paid to the preparation of samples. The final results of corrosion and exposure tests depend not only on the treatment but also on the

²¹ This test may be outsourced and carried out by a QUALICOAT approved laboratory or another laboratory accredited for this specific test according to ISO 17025.



aluminium composition and the reaction between the aluminium surface and chemical products.

The chemical manufacturers shall indicate the complete pretreatment cycle to be used (degreasing etc.), and the laboratory responsible for preparing the samples shall strictly follow these instructions.

Products intended for dual use need to be tested both ways. This implies that all tests must be done in duplicate, namely once with and once without the rinse pretreatment step.

The samples may be prepared:

- either in the QUALICOAT approved laboratory under the supervision of a representative of the applicant company;
- or in the laboratory of the chemical manufacturer under the supervision of a representative of the laboratory in charge.

Samples

The following alloys shall be used:

- panels for mechanical tests (thickness of 0.8 or 1 mm): **AA 5005-H24 or -H14** (AlMg 1 - semihard);
- extruded samples for corrosion tests and outdoor exposure: **AA 6060 or 6063**.

The chemical composition of the samples has an influence on the final results, especially in corrosion tests. For this reason, all laboratories shall use an alloy from the same batch to prepare the samples.

QUALICOAT shall provide every laboratory with enough test samples having a chemical composition specified by the Technical Committee.

The laboratory's final report shall always indicate the chemical composition.

Pretreatment

The laboratory in charge of preparing the samples shall take into account the following parameters:

- **Etching degree**
The **total** etching degree shall be between 1.0 g/m² and 2.0 g/m² on samples for all tests.
- **Weight of the conversion coating**
 - close to the system's lower limit for corrosion test samples;
 - close to the upper limit for mechanical test samples, especially for the adhesion test.

Anodic pretreatment

If a pretreatment system is proposed to be used in combination with pre-anodised substrates, the necessary test samples shall be prepared according to the requirements specified by QUALICOAT in [section 3.4](#). After this, the proposed pretreatment shall be applied to the pre-anodised panels as specified by the chemical supplier of the pretreatment system.

A specific numbering system shall be applied to these anodic pretreatment processes.

Coating material to be applied

The coating system material shall have a QUALICOAT approval. Each system shall be tested with the following organic coating materials:



- class 1 powder, metallic colour (RAL 9006 or RAL 9007)
- class 2 powder, category 1, RAL 9010
- class 3 powder (when requested by the supplier).
- liquid coating (when requested by the supplier)

b) LABORATORY TESTS

The following tests shall be performed

- Dry adhesion ([2.4.1](#))
- Cupping ([2.6](#))
- Bend ([2.7](#))
- Impact ([2.8](#))
- Resistance to humid atmospheres ([2.9](#))
- Acetic acid salt spray ([2.10](#))
- Wet adhesion ([2.4.2](#))
- Condensation water ([2.17](#))
- Filiform corrosion ([2.19](#))

The acceptable limits are the same as those prescribed in the QUALICOAT Specifications.

Evaluation of laboratory test results

The final evaluation shall be as follows:

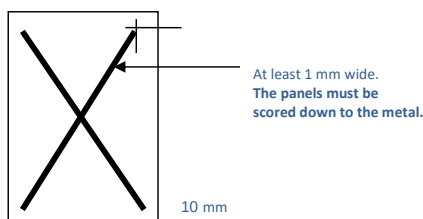
- **Result of one laboratory**
 - POSITIVE 0 or 1 unsatisfactory panel
 - NEGATIVE 2 or more unsatisfactory panels.
- **Results of two laboratories**
 - If the results in both laboratories are positive, the system is satisfactory.
 - If the results in both laboratories are negative, the system is unsatisfactory.
 - If the results are positive in one laboratory and negative in the other, the tests shall be repeated in a third laboratory.

c) OUTDOOR EXPOSURE

- **Exposure site**
2 years in Genoa starting in September.
- **Number of panels**
All tests shall be made in triplicate.

**Fig. 1 Scratches for outdoor exposure**

(panel dimensions: length 200 mm, width 70 – 100 mm)

**Evaluation of exposure test results**

After 2 years of exposure, a final evaluation shall be made, applying the following criteria:

POSITIVE	0 or 1 unsatisfactory panel
NEGATIVE	2 or more unsatisfactory panels

6. CONFORMITY ASSESSMENT

The testing laboratory shall submit the test report and the basic documentation (TDS, safety data sheet and detailed instructions on treatment cycles) to the General Licensee or to QUALICOAT in countries where there is no General Licensee.

Under the supervision of QUALICOAT, the General Licensee shall decide whether or not to grant or renew an approval.

The results shall be communicated to the chemical manufacturers in writing.

If the results do not meet the requirements, full details and reasons shall be given. The chemical manufacturer shall be entitled to appeal within 10 days to the General Licensee or to QUALICOAT in countries where there is no General Licensee.

7. GRANTING OF AN APPROVAL

If all the results meet the requirements, QUALICOAT shall issue a certificate which will be automatically reissued every year for a validity period of three years.

After the exposure tests, the working group shall evaluate the results and take a decision on confirmation of the approval. The manufacturer shall be informed of the results and decisions.

8. RENEWAL OF PRETREATMENT SYSTEM APPROVALS**a) Renewing pretreatment system approvals**

Approvals shall be renewed every three years, with the full testing programme including outdoor exposure (see § 5 of this Appendix) carried out by one laboratory. Once a system has been approved for six consecutive years, the renewal interval shall be extended to five years.

If an approved system identified by a single approval number is manufactured at different production sites of the same company, the full testing programme (including the exposure test) shall be carried out for the main production site and/or technical service centre. At the other production sites indicated by the chemical manufacturer, the approved pretreatment system shall be checked only with corrosion tests, specifically by sending coated samples that have been treated with the products



manufactured at all other production sites to the same laboratory that is also responsible for the main production site. The respective provenance shall be clearly stated.

An approval shall be renewed if the results of the laboratory and exposure tests conform to the Specifications. The certificate shall be issued every year.

b) Repetition of unsatisfactory laboratory tests

If the laboratory test results are unsatisfactory, all corrosion tests shall be repeated in two laboratories. Renewal shall be confirmed if the results are satisfactory in both laboratories. If the results are unsatisfactory in one of the two laboratories, the approval shall be cancelled. If the result of outdoor exposure is unsatisfactory, the approval shall then be cancelled.

c) '10+2' rule

10% of failures in the AASS test and at least two C+D values classified as unsatisfactory shall lead to an unsatisfactory assessment. If only one C+D AASS test result is obtained, the pretreatment system shall be considered satisfactory.

Evaluation

The QUALICOAT Secretariat shall determine all the chemical pretreatment systems falling under the '10+2 rule' by evaluating the previous year's AASS test results from samples taken during the annual inspections at the licensed coating applicators.

Information

By the end of June, at the latest, the chemical manufacturers concerned shall be informed by the General Licensee (or directly by QUALICOAT in countries without a General Licensee) that their chemical pretreatment system is being placed 'under observation' for exceeding the '10+2 rule'.

All licensed coating applicators using the chemical pretreatment system placed 'under observation' shall be informed by the General Licensee (or directly by QUALICOAT in countries without a General Licensee) by the end of July. They shall be made aware that they must continue to fully comply with the requirements of the QUALICOAT Specifications.

Observation period

The one-year observation period of the chemical pretreatment system shall start with the written notification of the chemical manufacturer by the end of June. If the chemical pretreatment system does not fall under the '10+2 rule' again in the subsequent calendar year, the status shall be reset, and the chemical manufacturer shall be informed by the General Licensee (or directly by QUALICOAT in countries without a General Licensee).

Withdrawal

If a system fails over two consecutive calendar years, it shall be cancelled by 30 June of the second year and the chemical manufacturer shall be notified by the General Licensee (or directly by QUALICOAT in countries without a General Licensee) that the chemical pretreatment system will be cancelled within 30 days from the notification date.

d) Deadline for the coating applicator to use the product

All licensed coating applicators using the chemical pretreatment system cancelled due to the '10+2 rule', may continue to use it until end of the year of cancellation. They shall be made aware that they must continue to fully comply with the requirements of the QUALICOAT Specifications.

Kommentiert [PB38]: SPEC 2021 – US07 – '10+2' rule for the chemical pretreatment system assessment

Ratified on 19.11.2021

Applicable from 1 January 2022



9. RESPONSIBILITY AND COOPERATION WITH THE COATING APPLICATOR

Manufacturers and coating applicators shall cooperate closely (see Chapter 3, [§ 3.2.2](#)).

For all systems, there shall be technical data sheets, also giving information about other products with which a system may or may not be used.

To take into account the particular conditions in each plant, specific instructions to be followed by the persons in charge shall be provided to the coating applicator and shall specify that the conductivity of the dripping water of all chemical pretreatment systems with a final rinse shall not exceed a maximum of 30 µS/cm at 20°C (the conductivity only being measured on open sections and not on hollow sections). The instructions for the specific plant shall also specify whether the product is to be used as a rinse or no-rinse system, or whether it is suitable for dual use, depending on the coating applicator's pretreatment line set-up.

The methods for assessing the conversion coating may differ from one system to the next since there is not a pertinent standard. . The manufacturer indicates how the coating applicator has to monitor the quality of the chrome VI-free conversion coating during in-house control. A device to check the coating weight analytically shall be prescribed. QUALICOAT recommends the coating weight to be measured in every working shift, or according to the chemical manufacturer's advice, which shall be at least once per day (see table in section [6.5](#)).

The following tests shall be carried out on the production sample received every two months from the

- acetic acid salt spray resistance test
- coating weight measurement

Receipt of the samples shall be confirmed to the coating applicator immediately. Detailed results and any corrective actions shall be entered and retained along with the related shipping details in records readily accessible to the inspector and communicated to the coating applicator within a period of maximum four months.

If the chemical manufacturer fails to cooperate with the coating applicator within the specified deadlines, the following sanction procedure shall be followed:

A written notification (warning letter) shall be sent to the chemical manufacturer by the General Licensee or QUALICOAT in countries without a General Licensee, giving it four weeks to respond:

- 1) The chemical manufacturer shall immediately acknowledge receipt of the notification;
- 2) The chemical manufacturer shall respond with a justification letter within four weeks;
- 3) The justification shall be assessed by the General Licensee or QUALICOAT (possibly involving the Board of Governors if the decision is not obvious), which could lead to a withdrawal of the approval;
- 4) If no justification letter is submitted within four weeks, the approval shall be withdrawn. The chemical manufacturer shall need to wait at least three months before sending a new application for approval.

10. COMPULSORY DECLARATION OF CHANGES IN FORMULATION OF PRETREATMENTS

In principle, if the chemical composition of the conversion coating remains the same, it shall not be necessary to apply for a new approval. In practice, this means accepting all the variations specified on the technical data sheet to adjust the system to a specific application line in order to achieve the specified coating weight. The chemical product may be supplied as a two-component or single-

Kommentiert [PB39]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

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Kommentiert [PB40]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

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component system. The chemical manufacturers shall guarantee that the chemical composition of the working solution is essentially the same as that approved by QUALICOAT.

Any change in formula that can result in significant changes in the composition of the conversion coating represents a new product and requires a new QUALICOAT approval.

To give a few examples of such changes, we would like to mention some clear-cut cases:

- Any change in the metal content of the coating through substitution, addition, removal, etc. of the approved metal system when the products are based on transition metals replacing chrome.
- Any change in the polymer composition and, by extension, in the organic components through substitution, addition, removal etc. when they are present in the approved formula.
- Any change in the typical appearance of the conversion coating, for example from colourless to colour.



A7 – Specifications for batch treatment

1. Introduction

For batch treatment, the products to be treated are arranged in organised loads in baskets used for immersion.

2. Specifications

The material used for separators and hooping shall be compatible with the chemistry used as recommended by the chemical manufacturer.

The number of separators shall be chosen to minimise contacts. The products shall be arranged with sufficient space between them to allow the liquid to pass freely through the load.

The maximum contact width between the sections shall be 2 mm

The distance between the sections shall be at least 1 cm.

It is important to avoid any surface scratching.

3. Testing method to evaluate contact mark areas

Use a piece of a pretreated aluminium extrusion that has been marked by a separator. The area on the bar with the marks shall be identified.

The **boiling water test** (2.16 of the Specifications – Resistance to Boiling Water) shall be carried out on the coated samples.

Allow the test piece to cool after the test and examine it for any blistering on the identified area.

Requirements:

No blistering in excess of 2 (S2) according to ISO 4628-2.

Colour change is acceptable but there shall not be any defect or loss of adhesion.

This testing method shall be used by the inspectors whenever a licence is to be granted.

Kommentiert [PB41]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

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**A8 – List of colour tolerances before granting or renewing an approval
(for QUALICOAT laboratories)²²**

Kommentiert [PB42]: SPEC 2021 – US11 – New RAL colours and amended list of class 2 critical colours

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RAL	Tolerance	RAL	Tolerance	RAL	Tolerance	RAL	Tolerance	RAL	Tolerance	RAL	Tolerance
1000	2.0	3000	2.8	5000	2.0	6000	2.0	7000	2.0	8000	2.0
1001	2.0	3001	2.8	5001	2.0	6001	2.8	7001	2.0	8001	2.0
1002	2.0	3002	2.8	5002	2.0	6002	2.8	7002	1.4	8002	2.0
1003	3.6	3003	2.8	5003	2.0	6003	2.0	7003	1.4	8003	2.0
1004	3.6	3004	2.0	5004	2.0	6004	2.0	7004	1.0	8004	2.0
1005	3.6	3005	2.0	5005	2.0	6005	2.0	7005	1.4	8007	2.0
1006	3.6	3007	1.4	5007	2.0	6006	1.4	7006	1.4	8008	2.0
1007	3.6	3009	2.0	5008	2.0	6007	1.4	7008	2.0	8011	2.0
1011	2.0	3011	2.8	5009	2.0	6008	1.4	7009	1.4	8012	2.0
1012	2.8	3012	2.0	5010	2.0	6009	1.4	7010	1.4	8014	1.4
1013	1.0	3013	2.8	5011	2.0	6010	2.8	7011	1.4	8015	2.0
1014	2.0	3014	2.0	5012	2.0	6011	2.0	7012	1.4	8016	1.4
1015	1.0	3015	1.0	5013	2.0	6012	1.4	7013	1.4	8017	1.4
1016	2.8	3016	2.8	5014	2.0	6013	2.0	7015	1.4	8019	1.4
1017	2.8	3017	2.8	5015	2.0	6014	1.4	7016	2.0	8022	1.4
1018	2.8	3018	2.8	5017	2.0	6015	1.4	7021	1.4	8023	2.8
1019	1.0	3020	2.8	5018	2.0	6016	2.0	7022	1.4	8024	2.8
1020	2.0	3022	2.8	5019	2.0	6017	2.8	7023	1.4	8025	1.4
1021	3.6	3027	2.8	5020	2.0	6018	2.8	7024	1.4	8028	1.4
1023	3.6	3028	2.8	5021	2.0	6019	1.2	7026	2.0	9001	1.0
1024	2.0	3031	2.8	5022	2.0	6020	1.4	7030	1.0	9002	1.0
1027	2.8	4001	1.4	5023	2.0	6021	2.0	7031	2.0	9003	1.0
1028	3.6	4002	2.0	5024	2.0	6022	1.4	7032	1.0	9004	1.4
1032	3.6	4003	1.4			6024	2.8	7033	1.4	9005	1.4
1033	3.6	4004	2.0			6025	2.8	7034	1.4	9010	1.0
1034	2.8	4005	2.0			6026	2.0	7035	1.0	9011	1.4
1037	3.6	4006	1.4			6027	2.0	7036	1.0	9012	1.0
2000	3.6	4007	1.4			6028	2.0	7037	1.4	9016	1.0
2001	2.8	4008	1.4			6029	2.0	7038	1.0	9017	1.4
2002	2.8	4009	1.2			6032	2.8	7039	1.4	9018	1.0
2003	2.8	4010	2.0			6033	2.0	7040	1.0		
2004	3.6					6034	2.0	7042	1.0		
2008	3.6					6037	2.8	7043	1.4		
2009	3.6							7044	1.0		
2010	2.8							7045	1.0		
2011	3.6							7046	1.4		
2012	2.8							7047	1.0		

²² The powder manufacturers shall indicate which RAL card they use on the label, so that the laboratory knows which reference to work with. QUALICOAT recommends using the RAL GL Card for categories 2 and 3 solid powder coatings and RAL HR for category 1 and for textured coatings.

The tolerance indicated in the table may be extended with a corrective factor of 1.3 for matt and textured finishes in combination with a final visual assessment.



A9 – List of relevant standards²³

Nº	YEAR	TITLE	SPECIFICATIONS
ISO 2813	2014	Paints and varnishes -- Determination of gloss value at 20° degrees, 60° and 85°	Gloss 2.2 , 2.12 , 2.13 , 6.3.1
ISO 2360	2017	Non-conductive coatings on non-magnetic electrically conductive basis materials - Measurement of coating thickness - Amplitude-sensitive eddy current method	Coating thickness 2.3 , 6.3.2
ISO 2409	2013	Paints and varnishes -- Cross-cut test	Adhesion 2.4 , 6.3.4
ISO 2815	2003	Paints and varnishes -- Buchholz indentation test	Buchholz Indentation 2.5
ISO 1520	2006	Paints and varnishes -- Cupping test	Cupping test 2.6
ISO 1519	2011	Paints and varnishes -- Bend test (cylindrical mandrel)	Bend test 2.7 , 6.3.7
ISO 6272-1	2011	Paints and varnishes -- Rapid-deformation (impact resistance) tests -- Part 1: Falling-weight test, large-area indenter	Impact test 2.8
ISO 6272- 2	2011	Paints and varnishes -- Rapid-deformation (impact resistance) tests -- Part 2: Falling-weight test, small-area indenter	Impact test 2.8
ASTM D2794	2010	Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)	Impact test 2.8
ISO 22479	2019	Paints and varnishes -- Determination of resistance to humid atmospheres containing sulphur dioxide	Resistance to humid atmospheres containing sulphur dioxide 2.9
ISO 4628-2	2016	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	Blistering 2.9 - 2.10 – 2.16
ISO 9227	2012	Corrosion tests in artificial atmospheres -- Salt spray tests	Acetic acid salt spray resistance 2.10

²³ This list refers to ISO standards and their relevant year of issue. It is continuously updated on the Internet (www.qualicoat.net).



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N°	YEAR	TITLE	SPECIFICATIONS
ISO 16474- 2	2013	Paints and varnishes – Method of exposure to laboratory light sources –Part 2 – Xenon-arc lamps	Accelerated weathering test 2.12
ISO 11664-4	2008	Colorimetry -- Part 4: CIE 1976 L*a*b* Colour space	Colour variation 2.12– 2.13
ISO 2810	2004	Paints and varnishes -- Natural weathering of coatings -- Exposure and assessment	Natural weathering test 2.13
EN 12206-1	2004	Paints and varnishes – Coating of aluminium and aluminium alloys for architectural purposes – Part 1: Coatings prepared from coating powder	Resistance to mortar 2.15
ISO 6270-2	2017	Paints and varnishes – Determination of resistance to humidity – Part 2: Procedure for exposing test specimens in condensation – water atmospheres	Constant climate condensation water test 2.17
ISO 4623–2	2003	Paints and varnishes – Determination of resistance to filiform corrosion – Part 2 Aluminium substrates	Filiform corrosion test 2.19
ISO 4628-10	2016	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	Filiform corrosion test 2.19
CEN/TS 16611	2016	Furniture - Assessment of the surface resistance to microscratching	Scratch and mar resistance test (Martindale) 2.21
ISO 10546	1993	Chemical conversion coatings – Rinsed and non-rinsed chromate conversion coatings on aluminium and aluminium alloys	Chromate conversion 3.3.1
ISO 3892	2000	Conversion coatings on metallic materials -- Determination of coating mass per unit area - - Gravimetric methods	Chromate conversion 6.2.2
EN 1706	2010	Aluminium and aluminium alloys - Castings - Chemical composition and mechanical properties	Cast accessories Appendix A5



A10 – Summary of requirements for the approval of organic coating materials (all classes)

TESTS	STANDARDS	QUALICOAT SPECIFICATIONS			
		CLASS 1	CLASS 1.5	CLASS 2	CLASS 3
COLOUR 2.1	ISO 11664-4	The colour deviation from the certified RAL card shall not be greater than the limit prescribed in Appendix A8 .	Same as class 1	Same as class 1	Same as class 1
GLOSS 2.2	ISO 2813	Permissible variation from the nominal value specified by the coating supplier: Gloss cat. 1: 0 – 30 +/- 5 units Gloss cat. 2: 31 - 70 +/- 7 units Gloss cat. 3: 71 – 100 +/- 10 units	Same as class 1	Same as class 1	Same as class 1
COATING THICKNESS 2.3	ISO 2360	Minimum thickness = 60 µm None of the values measured shall be less than 80% of the specified minimum value	Same as class 1	Same as class 1	Minimum thickness= 50 µm None of the values measured shall be less than 80% of the specified minimum value
DRY ADHESION 2.4.1	ISO 2409	The result shall be 0.	Same as class 1	Same as class 1	Same as class 1
BUCHHOIZ INDENTATION 2.5	ISO 2815	Minimum 80 with the specified required coating thickness	Same as class 1	Same as class 1	Same as class 1
CLIPPING TEST 2.6	ISO 1520	Minimum 5 mm Using normal corrected vision, the coating shall not show any sign of cracking or detachment.	Minimum 5 mm Using normal corrected vision, the coating shall not show any sign of detachment following the tape pull adhesion test .	Same as class 1.5	Same as classes 1.5
BEND TEST 2.7	ISO 1519	Using normal corrected vision, the coating shall not show any sign of cracking or detachment.	Using normal corrected vision, the coating shall not show any sign of detachment following the tape pull adhesion test .	Same as class 1.5	Same as classes 1.5
IMPACT TEST 2.8	ISO 6272 ASTM D 2794	Using normal corrected vision, the coating shall not show any sign of cracking or detachment.	Using normal corrected vision, the coating shall not show any sign of detachment following the tape pull adhesion test .	Same as class 1.5	Same as classes 1.5

Kommentiert [PB43]: SPEC 2021 – US08 – Use of modal verbs in the QCT Specifications

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TESTS	STANDARDS	QUALICOAT SPECIFICATIONS			
		CLASS 1	CLASS 1.5	CLASS 2	CLASS 3
RESISTANCE TO HUMID ATMOSPHERES 2.9	ISO 22479	After 24 cycles No infiltration exceeding 1 mm on both sides of the scratch, and no change in colour or blisters in excess of 2 (S2) according to ISO 4628-2.	Same as class 1	Same as class 1	Same as class 1
ACETIC ACID SALT SPRAY RESISTANCE 2.10	ISO 9227	Testing time: 1000 hours RATING A = 3 samples ok, 0 not ok RATING B = 2 samples ok, 1 not ok RATING C = 1 sample ok, 2 not ok RATING D = 0 sample ok, 3 not ok Evaluation: A/B : test result satisfactory C: test result unsatisfactory (repetition of the AASS test) D: test result unsatisfactory (repetition of all laboratory tests)	Same as class 1	Same as class 1	Testing time: 2000 hours Evaluation: same as class 1
ACCELERATED WEATHERING TEST 2.12	ISO 16474-2 (except for class 3)	Exposure time: 1000 hours Gloss retention: at least 50% Colour change: according to the ΔE values stipulated in Appendix A12.	Exposure time: 1000 hours Gloss retention: at least 75% Colour change: not greater than 75% of the limits prescribed in Appendix A12	Exposure time: 1000 hours Gloss retention: at least 90% Colour change: not greater than 50% of the limits prescribed in Appendix A12	Exposure time: 3 years in Florida Gloss retention: at least 80% Colour change: not greater than 50% of the limits prescribed in Appendix A12
POLYMERISATION TEST 2.14 OPTIONAL	----	Ratings: 1: very dull and quite soft coating 2: very dull coating which can be scratched with a finger-nail. 3: slight loss of gloss i.e. less than 5 units 4: no perceptible change. Coating cannot be scratched with a finger-nail. Evaluation: 1/2: test result unsatisfactory 3/4: test result satisfactory	Same as class 1	Same as class 1	Same as class 1
RESISTANCE TO MORTAR 2.15	EN 12206-1 par. 5.9	There shall not be any change in appearance/colour after the mortar test.	Same as class 1	Same as class 1	Same as class 1



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TESTS	STANDARDS	QUALICOAT SPECIFICATIONS			
		CLASS 1	CLASS 1.5	CLASS 2	CLASS 3
WET ADHESION 2.4.2	ISO 2409	Using normal corrected vision, the coating shall not show any sign of blistering or detachment.	Same as class 1	Same as class 1	Same as class 1
CONSTANT CLIMATE CONDENSATION WATER TEST 2.17	ISO 6270	Testing time: 1000 hours No blistering in excess of 2 (S2) according to ISO 4628-2; the maximum infiltration at the cross is 1 mm.	Same as class 1	Same as class 1	Testing time: 2000 hours No blistering in excess of 2 (S2) according to ISO 4628-2; the maximum infiltration at the cross is 1 mm.
WATER SPOT TEST 2.20	---	Colour change The ΔL value shall be less than 4	Same as class 1	Same as class 1	Same as class 1
SCRATCH AND MAR RESISTANCE TEST (Martindale) 2.21	CEN/TS 16611	Gloss retention 40% for coatings with smooth appearance 60% for organic coatings with structured appearance	Same as class 1	Gloss retention 30% for coatings with smooth appearance 60% for organic coatings with structured appearance	Same as class 2
NATURAL WEATHERING TEST (FLORIDA) 2.13	ISO 2810	5° south 4 panels per colour shade Exposure time: 1 year Gloss retention at least 50% Colour change: The ΔE values shall not exceed the maximum values stipulated in Appendix A12	5° south 7 panels per colour shade Exposure time: 2 years with an annual evaluation Gloss retention After 1 year : at least 65% After 2 years : at least 50% Colour change: After 2 years: within the limits prescribed in Appendix A12	5° south 10 panels per colour shade Exposure time: 3 years with an annual evaluation Gloss retention After 1 year : at least 75% After 2 years : at least 60% After 3 years : at least 50% Colour change: After 3 years: within the limits prescribed in Appendix A12	45° south 10 panels per colour shade Exposure time: 10 years with an evaluation after 3 and 7 years Gloss retention After 3 years: at least 80% After 7 years: at least 55% After 10 years: at least 50% Colour change: After 3 years : max. 50% of the limits prescribed in Appendix A12 After 10 years: within the limits prescribed in Appendix A12



A11 – RAL families and critical colours

1. Introduction

QUALICOAT has introduced the concept of RAL families for class 2 and class 3 organic coatings in the specifications for colour change after the natural weathering test (see § 4.2.1) because if a manufacturer's coating material shows a colour change failure in one RAL colour after Florida exposure, this indicates a technological deficiency affecting similar colours.

2. Critical colours and classification of RAL families for class 2

30 groups of homogeneous colours (solid colours of a similar hue and shade) have been defined as RAL families for renewals of class 2 approvals. QUALICOAT has excluded 9 critical RAL colours which, as powder coating technology stands today, do not have sufficient resistance to colour change after 3 years of outdoor exposure.

SUMMARY	
Number of solid RAL colours (excluding metallic and pearl RAL colours)	191
Solid RAL colours (non-critical)	182
Critical solid RAL colours	9
Number of RAL families	30

9 CRITICAL RAL COLOURS (colours excluded from the RAL families)

RAL 1003	RAL 2004	RAL 3015	RAL 4001
RAL 1028	RAL 2011	RAL 3017	
RAL 1033		RAL 3018	

182 SOLID RAL COLOURS (non-critical)

30 RAL FAMILIES

RAL 1XXX	FAMILY 1/A	FAMILY 1/B	FAMILY 1/C	FAMILY 1/D
DESCRIPTION	IVORY AND BEIGE	GREENISH YELLOW	REDDISH YELLOW	OCHRE / DARK YELLOW
RAL	1000 - 1001 - 1002 - 1013 - 1014 - 1015	1012 - 1016 - 1018 - 1021 - 1023	1004 - 1005 - 1006 - 1007 - 1017 - 1032 - 1034 - 1037	1011 - 1019 - 1020 - 1024 - 1027
Total 24 colours	6	5	8	5

RAL 2XXX	FAMILY 2/A	FAMILY 2/B
DESCRIPTION	YELLOWISH ORANGE	REDDISH ORANGE
RAL	2000 - 2003 - 2008 - 2009 - 2010	2001 - 2002 - 2012
Total 8 colours	5	3

Kommentiert [PB45]: SPEC 2021 – US11 – New RAL colours and amended list of class 2 critical colours

Amendments list of critical colours (numbers), in RAL families 1/B, 3/B, and 9/A

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RAL 3XXX	FAMILY 3/A	FAMILY 3/B	FAMILY 3/C
DESCRIPTION	LIGHT RED AND PINK	RED	DARK RED
RAL	3012 - 3014 - 3022	3000 - 3001 - 3002 - 3003 - 3013 - 3016 - 3020 - 3027 - 3028 - 3031	3004 - 3005 - 3007 - 3009 - 3011
Total 18 colours	3	10	5

RAL 4XXX	FAMILY 4/A	FAMILY 4/B	FAMILY 4/C
DESCRIPTION	REDDISH VIOLET	BLUEISH VIOLET	DARK AND PASTEL VIOLET
RAL	4002 - 4003 - 4010	4004 - 4005 - 4006 - 4008	4007 - 4009
Total 9 colours	3	4	2

RAL 5XXX	FAMILY 5/A	FAMILY 5/B	FAMILY 5/C	FAMILY 5/D
DESCRIPTION	REDDISH BLUE	GREENISH BLUE	DARK BLUE	LIGHT BLUE
RAL	5000 - 5002 - 5003 - 5005 - 5010 - 5013 - 5017 - 5022	5001 - 5007 - 5009 - 5018 - 5019 - 5021	5004 - 5008 - 5011 - 5020	5012 - 5014 - 5015 - 5023 - 5024
Total 23 colours	8	6	4	5

RAL 6XXX	FAMILY 6/A	FAMILY 6/B	FAMILY 6/C	FAMILY 6/D	FAMILY 6/E
DESCRIPTION	BLUISH GREEN	YELLOWISH GREEN	INORGANIC GREEN	DARK GREEN	LIGHT GREEN
RAL	6000 - 6004 - 6005 - 6009 - 6016 - 6026	6001 - 6002 - 6006 - 6010 - 6017 - 6018 - 6024 - 6029 - 6032 - 6033 - 6037	6003 - 6011 - 6013 - 6014 - 6025 - 6028	6007 - 6008 - 6012 - 6015 - 6020 - 6022	6019 - 6021 - 6027 - 6034
Total 33 colours	6	11	6	6	4

RAL 7XXX	FAMILY 7/A	FAMILY 7/B	FAMILY 7/C
DESCRIPTION	LIGHT GREY WITH L > 70	MEDIUM GREY WITH L < 70 AND > 50	DARK GREY WITH L < 50
RAL	7032 - 7035 - 7038 - 7044 - 7047	7000 - 7001 - 7002 - 7003 - 7004 - 7005 - 7023 - 7030 - 7033 - 7034 - 7036 - 7037 - 7040 - 7042 - 7045 - 7046	7006 - 7008 - 7009 - 7010 - 7011 - 7012 - 7013 - 7015 - 7016 - 7021 - 7022 - 7024 - 7026 - 7031 - 7039 - 7043
Total 37 colours	5	16	16



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Master version (V01)

RAL 8XXX	FAMILY 8/A	FAMILY 8/B	FAMILY 8/C
DESCRIPTION	LIGHT BROWN	MEDIUM BROWN	DARK BROWN
RAL	8000 - 8001 - 8004 - 8023 - 8024 - 8025	8002 - 8003 - 8007 - 8008 - 8012 - 8015	8011 - 8014 - 8016 - 8017 - 8019 - 8022 - 8028
Total 19 colours	6	6	7

RAL 9XXX	FAMILY 9/A	FAMILY 9/B	FAMILY 9/C
DESCRIPTION	WHITE	CREAM AND GREY WHITE	BLACK
RAL	9003 - 9010 - 9012 - 9016	9001 - 9002 - 9018	9004 - 9005 - 9011 - 9017
Total 11 colours	4	3	4



3. Critical colours and classification of RAL families for class 3

9 groups of homogeneous colours (solid colours of a similar hue and shade) have been defined as RAL families for the renewal of class 3 approvals.

3 RAL families match lightness category LIGHT (CIELAB L* > 70), 3 match lightness category MEDIUM (CIELAB L* between 40 and 70), and 3 match lightness category DARK ((CIELAB L* < 40).

QUALICOAT has excluded **114 critical RAL colours**, which, as powder coating technology stands today, do not have sufficient resistance to colour change after 10 years of outdoor exposure.

114 CRITICAL RAL COLOURS (colours excluded from the RAL families)						
RAL 1004	RAL 1003	RAL 2000	RAL 3000	RAL 4001	RAL 5000	RAL 6000
RAL 1005	RAL 1012	RAL 2001	RAL 3001	RAL 4002	RAL 5001	RAL 6001
RAL 1006	RAL 1016	RAL 2002	RAL 3002	RAL 4003	RAL 5002	RAL 6002
RAL 1007	RAL 1018	RAL 2003	RAL 3003	RAL 4004	RAL 5003	RAL 6003
RAL 1017	RAL 1021	RAL 2004	RAL 3004	RAL 4005	RAL 5004	RAL 6004
RAL 1032	RAL 1023	RAL 2008	RAL 3005	RAL 4006	RAL 5005	RAL 6005
RAL 1034	RAL 1027	RAL 2009	RAL 3007	RAL 4007	RAL 5007	RAL 6006
RAL 1037	RAL 1028	RAL 2010	RAL 3009	RAL 4008	RAL 5008	RAL 6007
	RAL 1033	RAL 2011	RAL 3011	RAL 4009	RAL 5009	RAL 6008
		RAL 2012	RAL 3012	RAL 4010	RAL 5010	RAL 6009
			RAL 3013		RAL 5011	RAL 6010
			RAL 3014		RAL 5012	RAL 6011
			RAL 3015		RAL 5013	RAL 6012
			RAL 3016		RAL 5014	RAL 6013
			RAL 3017		RAL 5015	RAL 6014
			RAL 3018		RAL 5017	RAL 6015
			RAL 3020		RAL 5018	RAL 6016
			RAL 3022		RAL 5019	RAL 6017
			RAL 3027		RAL 5020	RAL 6018
			RAL 3028		RAL 5021	RAL 6019
			RAL 3031		RAL 5022	RAL 6020
					RAL 5023	RAL 6021
					RAL 5024	RAL 6022
						RAL 6024
						RAL 6025
						RAL 6026
						RAL 6027
						RAL 6028
						RAL 6029
						RAL 6032
						RAL 6033
						RAL 6034
						RAL 6037



SUMMARY	
Number of solid RAL colours (excluding metallic and pearl RAL colours)	190
Solid RAL colours (non-critical)	76
Critical solid RAL colours	114
Number of RAL families	9
Lightness category LIGHT (L>70)	3 RAL families 17 RAL colours
Lightness category MEDIUM (<70 > 40)	3 RAL families 41 RAL colours
Lightness category DARK (L<40)	3 RAL families 18 RAL colours

76 SOLID RAL COLOURS (non-critical) ²⁴
9 RAL FAMILIES

RAL 1XXX	FAMILY 1/LIGHT	FAMILY 1/MEDIUM
DESCRIPTION	IVORY AND BEIGE	OCHRE / YELLOW MEDIUM
RAL	1000 - 1001 - 1002 - 1013 - 1014 - <u>1015</u>	<u>1011</u> - 1019 - 1020 - 1024
Total 10 colours	6	4

RAL 7XXX	FAMILY 7/LIGHT	FAMILY 7/MEDIUM	FAMILY 7/DARK
DESCRIPTION	LIGHT GREY	MEDIUM GREY	DARK GREY
RAL	7032 - <u>7035</u> - 7038 - 7044 - 7047	7000 - 7001 - 7002 - 7003 - 7004 - 7005 - 7006 - 7008 - 7009 - 7010 - 7011 - 7012 - - 7015 - 7023 - 7030 - 7031 - 7033 - 7034 - 7036 - 7037 - 7039 - <u>7040</u> - 7042 - 7043 - 7045 - 7046	7013 - <u>7016</u> - 7021 - 7022 - 7024 - 7026
Total 37 colours	5	26	6

RAL 8XXX	FAMILY 8/MEDIUM	FAMILY 8/DARK
DESCRIPTION	MEDIUM BROWN	DARK BROWN
RAL	8000 - 8001 - 8002 - 8003 - 8004 - 8008 - 8012 - 8015 - 8023 - <u>8024</u> - 8025	8007 - 8011 - 8014 - 8016 - 8017 - <u>8019</u> - 8022 - 8028
Total 19 colours	11	8

RAL 9XXX	FAMILY 9/LIGHT	FAMILY 9/DARK
DESCRIPTION	WHITE - CREAM AND GREY WHITE	BLACK
RAL	9001 - 9002 - 9003 - <u>9010</u> - 9016 - 9018	9004 - <u>9005</u> - 9011 - 9017
Total 10 colours	6	4

²⁴ Colours underlined = basic colours (see Section [4.1.4](#))



A12 – Lists of colour tolerances after weathering tests for granting or renewing an approval (for QUALICOAT laboratories)

Kommentiert [PB46]: SPEC 2021 – US11 – New RAL colours and amended list of class 2 critical colours

Amendments

Ratified on 19.11.2021

Applicable from 1 January 2022

Colour tolerances after the weathering test for Class 1 & 1.5 organic coatings ²⁵															
RAL	Δ E	RAL	Δ E	RAL	Δ E	RAL	Δ E	RAL	Δ E	RAL	Δ E	RAL	Δ E	RAL	Δ E
1000	3.0	2000	4.0	<u>3000</u>	5.0	4001	4.0	5000	4.0	6000	4.0	7000	3.0	8000	3.0
<u>1001</u>	3.0	<u>2001</u>	5.0	3001	5.0	4002	4.0	5001	4.0	6001	4.0	<u>7001</u>	3.0	<u>8001</u>	3.0
1002	3.0	2002	6.0	<u>3002</u>	5.0	<u>4003</u>	5.0	<u>5002</u>	4.0	<u>6002</u>	4.0	7002	3.0	8003	3.0
<u>1003</u>	4.0	2003	6.0	<u>3003</u>	4.0	4004	4.0	<u>5003</u>	4.0	<u>6003</u>	4.0	7003	3.0	8004	3.0
<u>1004</u>	4.0	<u>2004</u>	4.0	3004	4.0	<u>4005</u>	4.0	5004	4.0	6004	4.0	<u>7004</u>	3.0	<u>8007</u>	3.0
1005	5.0	2008	6.0	<u>3005</u>	4.0	4006	4.0	<u>5005</u>	4.0	<u>6005</u>	3.0	7005	3.0	<u>8008</u>	3.0
1006	5.0	<u>2009</u>	4.0	3007	4.0	4007	4.0	<u>5007</u>	3.0	6006	4.0	7006	3.0	<u>8011</u>	3.0
<u>1007</u>	5.0	2010	6.0	<u>3009</u>	4.0	4008	4.0	<u>5008</u>	4.0	6007	3.0	7008	3.0	<u>8012</u>	3.0
<u>1011</u>	3.0	2011	6.0	<u>3011</u>	4.0	4009	4.0	5009	4.0	6008	3.0	7009	3.0	<u>8014</u>	3.0
<u>1012</u>	3.0	2012	4.0	<u>3012</u>	2.0	4010	4.0	<u>5010</u>	4.0	<u>6009</u>	4.0	7010	3.0	8015	3.0
<u>1013</u>	2.0			3013	5.0			<u>5011</u>	4.0	<u>6010</u>	4.0	7011	3.0	8016	3.0
1014	3.0			3014	4.0			5012	4.0	<u>6011</u>	4.0	<u>7012</u>	3.0	<u>8017</u>	3.0
<u>1015</u>	2.0			3015	4.0			5013	4.0	<u>6012</u>	3.0	7013	3.0	<u>8019</u>	3.0
1016	6.0			<u>3016</u>	5.0			<u>5014</u>	4.0	<u>6013</u>	3.0	<u>7015</u>	3.0	8022	3.0
1017	3.0			3017	8.0			<u>5015</u>	3.0	<u>6014</u>	4.0	<u>7016</u>	3.0	<u>8023</u>	3.0
1018	6.0			<u>3018</u>	6.0			<u>5017</u>	4.0	6015	3.0	<u>7021</u>	3.0	8024	3.0
<u>1019</u>	3.0			<u>3020</u>	4.0			5018	4.0	<u>6016</u>	4.0	<u>7022</u>	3.0	8025	3.0
<u>1020</u>	3.0			<u>3022</u>	4.0			5019	4.0	<u>6017</u>	4.0	7023	3.0	<u>8028</u>	3.0
1021	6.0			3027	5.0			5020	4.0	<u>6018</u>	4.0	<u>7024</u>	3.0		
1023	6.0			3031	4.0			5021	4.0	6019	2.0	7026	3.0		
1024	3.0							<u>5022</u>	4.0	<u>6020</u>	3.0	7030	3.0		
1027	3.0							<u>5023</u>	4.0	<u>6021</u>	2.0	7031	3.0		
<u>1028</u>	8.0							5024	4.0	6022	3.0	<u>7032</u>	2.0		
1032	5.0									<u>6024</u>	3.0	7033	3.0		
1033	8.0									6025	4.0	7034	3.0		
1034	4.0									<u>6026</u>	4.0	<u>7035</u>	2.0		
1037	5.0									6027	2.0	7036	3.0		
										6028	4.0	<u>7037</u>	3.0		
										<u>6029</u>	4.0	<u>7038</u>	2.0		
										<u>6032</u>	3.0	<u>7039</u>	3.0		
										<u>6033</u>	3.0	<u>7040</u>	3.0		
										<u>6034</u>	2.0	<u>7042</u>	3.0		
												<u>7043</u>	3.0		
												<u>7044</u>	2.0		
												7045	3.0		
												7046	3.0		
												<u>7047</u>	2.0		

²⁵ Underlined colours are colours that have already been tested.



Colour tolerances after the weathering test for Class 2 organic coatings²⁶

RAL	Δ E	RAL	Δ E	RAL	Δ E	RAL	Δ E	RAL	Δ E	RAL	Δ E	RAL	Δ E	RAL	Δ E
1000	3.0	2000	6.0	<u>3000</u>	6.0	4002	4.0	5000	4.0	6000	5.0	7000	4.0	8000	4.0
1001	3.0	<u>2001</u>	5.0	3001	6.0	<u>4003</u>	5.0	<u>5001</u>	4.0	6001	5.0	<u>7001</u>	3.0	<u>8001</u>	3.0
<u>1002</u>	3.0	2002	8.0	<u>3002</u>	6.0	4004	5.0	<u>5002</u>	4.0	<u>6002</u>	4.0	7002	4.0	8003	3.0
<u>1004</u>	4.0	2003	6.0	<u>3003</u>	4.0	<u>4005</u>	4.0	<u>5003</u>	4.0	<u>6003</u>	5.0	7003	4.0	8004	4.0
1005	6.0	2008	6.0	3004	4.0	4006	5.0	5004	5.0	6004	5.0	<u>7004</u>	4.0	<u>8007</u>	4.0
1006	6.0	<u>2009</u>	4.0	<u>3005</u>	4.0	4007	5.0	<u>5005</u>	4.0	<u>6005</u>	3.0	7005	4.0	8008	4.0
<u>1007</u>	6.0	2010	6.0	<u>3007</u>	4.0	4008	4.0	<u>5007</u>	3.0	6006	4.0	7006	4.0	<u>8011</u>	4.0
<u>1011</u>	3.0	2012	4.0	<u>3009</u>	4.0	4009	4.0	<u>5008</u>	5.0	6007	4.0	7008	4.0	8012	4.0
<u>1012</u>	3.0			<u>3011</u>	5.0	4010	5.0	5009	4.0	6008	5.0	7009	4.0	<u>8014</u>	3.0
<u>1013</u>	2.0			<u>3012</u>	2.0			<u>5010</u>	4.0	<u>6009</u>	4.0	7010	4.0	8015	4.0
1014	3.0			3013	6.0			<u>5011</u>	5.0	<u>6010</u>	5.0	7011	4.0	8016	4.0
<u>1015</u>	2.0			3014	4.0			5012	4.0	<u>6011</u>	4.0	<u>7012</u>	4.0	<u>8017</u>	4.0
1016	6.0			<u>3016</u>	5.0			5013	5.0	<u>6012</u>	4.0	7013	4.0	<u>8019</u>	3.0
1017	3.0			<u>3020</u>	4.0			<u>5014</u>	4.0	<u>6013</u>	3.0	7015	4.0	8022	5.0
<u>1018</u>	6.0			<u>3022</u>	4.0			<u>5015</u>	3.0	<u>6014</u>	4.0	<u>7016</u>	3.0	<u>8023</u>	4.0
<u>1019</u>	2.5			3027	6.0			<u>5017</u>	5.0	6015	4.0	<u>7021</u>	4.0	8024	4.0
<u>1020</u>	6.0			3031	4.0			5018	5.0	<u>6016</u>	5.0	<u>7022</u>	4.0	8025	4.0
1021	6.0							<u>5019</u>	4.0	<u>6017</u>	5.0	7023	3.0	<u>8028</u>	3.0
1023	3.0							5020	5.0	<u>6018</u>	4.0	7024	4.0		
1024	3.0							5021	4.0	6019	2.0	7026	4.0		
1027	3.0							5022	5.0	<u>6020</u>	2.0	7030	2.0		
1032	6.0							<u>5023</u>	4.0	<u>6021</u>	4.0	7031	4.0		
1034	4.0							5024	4.0	6022	4.0	<u>7032</u>	2.0		
1037	6.0									<u>6024</u>	3.0	7033	3.0		
										6025	5.0	7034	3.0		
										<u>6026</u>	5.0	<u>7035</u>	2.0		
										6027	2.0	7036	3.0		
										6028	5.0	<u>7037</u>	2.5		
										<u>6029</u>	4.0	<u>7038</u>	2.0		
										<u>6032</u>	3.0	<u>7039</u>	4.0		
										<u>6033</u>	2.0	<u>7040</u>	3.0		
										<u>6034</u>	2.0	<u>7042</u>	3.0		
												<u>7043</u>	3.0		
												<u>7044</u>	2.0		
												7045	3.0		
												7046	4.0		
												<u>7047</u>	2.0		

²⁶ Underlined colours are colours that have already been tested.



Colour tolerances after the weathering test for Class 3 organic coatings													
RAL	Δ E	RAL	Δ E	RAL	Δ E	RAL	Δ E	RAL	Δ E	RAL	Δ E	RAL	Δ E
1000	3.0	3004	5.0	5000	5.0	6000	5.0	7000	4.0	8000	4.0	9001	3.0
1001	3.0	3005	5.0	5001	5.0	6001	5.0	7001	4.0	<u>8001</u>	4.0	9002	3.0
1002	3.0	3007	5.0	5003	5.0	6002	5.0	7002	4.0	8002	4.0	9003	3.0
1011	3.0	3009	5.0	5004	5.0	6003	5.0	7003	4.0	8003	4.0	9004	5.0
<u>1013</u>	3.0	3011	5.0	5005	5.0	6004	5.0	7004	4.0	8004	4.0	<u>9005</u>	5.0
1014	3.0	3012	5.0	5007	5.0	6005	5.0	7005	4.0	8007	4.0	<u>9006</u>	4.0
1015	3.0			5008	5.0	6006	5.0	7006	4.0	8008	4.0	<u>9007</u>	4.0
1019	3.0			5009	5.0	6007	5.0	7008	4.0	8011	4.0	<u>9010</u>	3.0
1020	6.0			5010	5.0	6008	5.0	7009	4.0	8012	4.0	9011	5.0
<u>1024</u>	3.0			5011	5.0	6009	5.0	7010	4.0	<u>8014</u>	4.0	9016	3.0
				5012	5.0	6010	5.0	7011	4.0	8015	4.0	9017	5.0
				<u>5013</u>	5.0	6011	5.0	7012	4.0	8016	4.0	9018	3.0
				5014	5.0	6012	5.0	7013	4.0	8017	4.0	9022	4.0
				5015	5.0	6013	5.0	<u>7015</u>	4.0	8019	4.0		
				5017	5.0	6014	5.0	<u>7016</u>	4.0	8022	5.0		
				5018	5.0	6015	5.0	7021	4.0	8023	4.0		
				5019	5.0	6017	5.0	7022	4.0	<u>8024</u>	4.0		
				5020	5.0	6020	5.0	7023	4.0	8025	4.0		
				5021	5.0	<u>6021</u>	5.0	7024	4.0	8028	4.0		
				5022	5.0	6022	5.0	7026	4.0				
				5023	5.0	6025	5.0	7030	4.0				
				5024	5.0	6026	5.0	7031	4.0				
						6028	5.0	<u>7032</u>	3.0				
						6033	5.0	7033	4.0				
								7034	4.0				
								7035	3.0				
								7036	4.0				
								7037	4.0				
								7038	3.0				
								7039	4.0				
								7040	4.0				
								7042	4.0				
								7043	4.0				
								7044	3.0				
								7045	4.0				
								7046	4.0				
								<u>7047</u>	3.0				