International Quality Regulations for the Coating of Building Components

GSB AL 631-7 **GSB ST 663-7**

Measuring and Testing Methods
Standards and Guidelines

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Measuring and Testing Methods
Standards and Guidelines

1 General

In this section, all of the measuring and testing methods set out for testing the technical requirements for pre-treatments, coating materials, as well as for quality assessment and monitoring of coating companies are defined.

When taking measurements, the operating instructions of the manufacturer of the equipment must be observed.

All tests are conducted based on the standards and guidelines referred to in this section.

2 Sampling

The number of samples is determined by the number of parts in a batch:

Size of delivery	Number of samples (random selection)	Limit of acceptability that does not correspond to the standard
1 to 10	All	0
11 to 200	10	1
201 to 300	15	1
301 to 500	20	2
501 to 800	30	3
801 to 1300	40	3
1301 to 3200	55	4
3201 to 8000	75	6
8001 to 22000	115	8
22001 to 110000	150	11

[a] A batch is a complete customer order or a part of the order that is in production.

Guidance on the selection of appropriate sampling methods is given in ISO 2859-1.

3 Rounding of measured values

The following rounding rule applies to all results of the measuring and testing procedures prescribed in these quality guidelines:

All measured values must be rounded to the last digit of the specified limit value - the rounding digit.

Decisive for the rounding is the digit following the rounding digit.

The rounding rule is that for values of the next digit from ≥ 5 is rounded up and for values of the next digit of < 5, it is rounded down.

For example, if the setpoint is 2.0, the first digit after the decimal point must be considered when rounding the measured value. In this case this is the 0.

Examples (rounding digit, following digit)

Limit value	Measured value	Evaluation value
2,**0**	2,**0**8	2,**1**
7,**1**5	7,184	7,**1**8
5	5,4	5

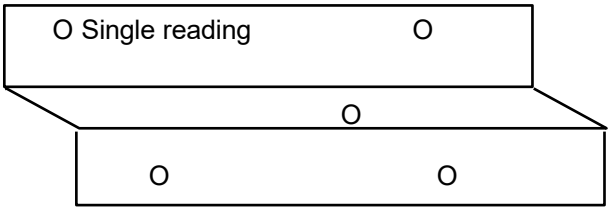
This rounding rule should only be applied to final results. Values used in formulae to calculate final results must not be rounded.

4 Coating thickness ISO 2360

When calculating the coating thickness, the effects on the measuring device of the alloy from the carrier material must be taken into account.

4.1 Evaluation at the coating company

When testing any sample, a measurement should be taken from at least 5 measuring points (1 cm²) spread across the surface in question.



If a measuring point displays less than 80% of the prescribed coating thickness, then the sample must be rejected and assigned to column 3 in the table in XYZ.

The mean average value of the 5 measuring points on a sample must at least correspond to the prescribed coating thickness. If this mean average value is below the prescribed coating thickness but still above the 80% threshold, the sample must be rejected and assigned to column 3 in the above table in Section XYZ.

The test is marked as failed if the average value of a sample is < 80% of the prescribed coating thickness. In addition, the number of samples below the prescribed coating thickness, but still above the 80% threshold, must not exceed the limit of acceptability.

Assessment using 4 typical examples with 50 □m:

Example 1:	Measured values in µm: Assessment	58 64 70 64 60 This sample is perfect.
Example 2:	Measured values in µm: Assessment	58 52 54 50 48 This sample is good because the average coating thickness is over 50 µm and none of the measured values are under 40 µm (80% of 50 µm).
Example 3	Measured values in µm: Assessment	48 42 44 46 48 This sample is unsatisfactory and falls under the category of “non-corresponding samples” in the table in Section XYZ.
Example 4:	Measured values in µm: Assessment	58 52 54 50 48 This sample is unsatisfactory although the average coating thickness is over 50 µm. Since the measured value of 38 µm is below the tolerance threshold of 80% (40 µm), the test is marked as failed.

The specifications cited do not apply to parts that place special demands on the coating company due to their geometry.

Customer requirements that depart from these specifications are excluded, provided that there is a verifiable written agreement to this effect.

5 Mechanical testing

5.1 Cross-cut test ISO 2409

The distance between cuts depends on the dry coating thickness measured.

Following the test, an adhesive tape tear-off must be performed, according to section 5.5.

5.2 Mandrel bending test ISO 1519

The mandrel bending test shall be performed in accordance with ISO 1519.

5.3 Cupping test ISO 1520

Following the test, an adhesive tape tear-off shall be performed, according to section 5.5.

5.4 Ball impact test (powder coatings) ASTM D 2794

The test shall be carried out with a ball diameter of 15.9 mm, with a film thickness of 70 µm ± 10 µm and 1 hour after coating at a temperature of 20 °C to 25 °C. The test shall be carried out without any aids. The visual assessment is carried out without aids.

Following the test, an adhesive tape tear-off shall be performed, according to section 5.5.

5.5 Scratch resistance ISO 1518-1

Scratch resistance is tested using a load of 20 N on a scribe needle A with a carbide hemispherical tip with a radius of 0.50 ± 0.01 mm.

5.6 Adhesive tape removal ISO 2409

Adhesive tape is affixed as per ISO 2409 on the coated side of the sample metal sheet after mechanical deformation. Press down firmly on the coating in order to avoid cavities or air bubbles. After one minute, quickly remove the adhesive tape at a right angle to the surface of the metal sheet. No equipment is used for the visual inspection.

5.7 Behaviour when drilled or sawed

It must be possible to work on the coated components with standard tools and cutting devices without visually disruptive spalling appearing on the coating. These tests must be carried out on suitable materials (e.g. profile sections) following appropriate pre-treatment and application of paint.

6 Crosslinking tests (for thermally cured and two-component liquid paints)

6.1 MEK test

A square, four-ply cheese cloth measuring 5 cm in length along its edge must be laid flush on the area to be tested, soaked with 1 ml of MEK (methyl ethyl ketone) and covered immediately with a watch glass. Exposure time: 2 minutes

After removing the damp cloth, the remaining solvent must be wiped away immediately.

Prior to hardness testing, artificial ageing must be carried out for 60 minutes at a minimum of 120 °C. The subsequent Buchholz hardness measurement must be at least 80 (indentation length □ 1.25 mm). There must not be any surface flaws (lines, reduction of gloss, removal of supporting surface etc.).

6.2 Acetone test

A square, four-ply cheese cloth measuring 5 cm in length along its edge must be laid flush on the surface to be tested, soaked with 1 ml of acetone and covered immediately with a watch glass. Exposure time: 2 minutes

After removing the damp cloth, the remaining solvent must be wiped away immediately.

Prior to hardness testing, artificial ageing must be carried out for 60 minutes at a minimum of 120 °C. The subsequent Buchholz hardness measurement must be at least 80 (indentation length □ 1.25 mm). There must not be any surface flaws (lines, reduction of gloss, removal of supporting surface etc.).

7 Corrosion tests

7.1 Condensation constant atmosphere ISO 6270-2

Prior to the test, a T-cut must be made in the samples to be tested down to the metal using a Sikkens scribe needle (1 mm).

Evaluation: Degree of blistering in accordance with ISO 4628-2

Delamination of the scratch in accordance with ISO 4628-8

7.2 Condensation variable atmosphere ISO 3231 (0.2 l SO_2)

Prior to the test, a T-cut must be made in the samples to be tested down to the metal using a Sikkens scribe needle (1 mm).

Evaluation: Degree of blistering in accordance with ISO 4628-2

Delamination of the scratch in accordance with ISO 4628-8

7.3 Salt spray test

- **Neutral salt spray test ISO 9227 (NSS=SS)**

  Prior to the test, a T-cut must be made in the samples to be tested down to the metal using a Sikkens scribe needle (1 mm).

  Evaluation: Degree of blistering in accordance with ISO 4628-2

  Delamination of the scratch in accordance with ISO 4628-8

- **Acetic acid salt spray test ISO 9227 (AASS=ESS)**

  Depending on the profile cross section, the cuts are applied with a Sikkens scribe needle (1 mm) in longitudinal and transverse direction

  Evaluation: Degree of blistering in accordance with ISO 4628-2

  Delamination of the scratch in accordance with ISO 4628-8

7.4 Filiform corrosion test ISO 4623-2

7.4.1 Method

Depending on the profile cross section, the scratches are made using a Sikkens scribe needle (1 mm) in vertical and horizontal directions, as described in ISO 4623-2.

7.4.2 Evaluation

The evaluation is made on coated aluminium samples. At least 2 samples must be tested. With this evaluation method, only filaments that can be identified without tools* are taken into consideration. In general, 5 mm at both the head and tail of the scratch are not considered. The filament length is calculated using the distance between the mechanical damage (scratch) and the head of the filament. When measuring, the measuring tool (scale: 0.1 mm) is at an angle of 90° to the scratch. The curvature of the filament is ignored in the measurement.

Both sides along both scratches must be considered prior to evaluation. In each case, the evaluation is made on the side of the scratch that shows the greatest corrosion. In cases of doubt, the side of the scratch that does not fulfil the requirements of the specification must be evaluated. The filament frequency (H) is calculated by counting the individual filaments along the more heavily corroded side of the scratch. The mean average value for the average filament length (l) is calculated by adding the individual lengths of the filaments on the scratch side to be evaluated and then dividing the total length by the number of filaments measured.

The average filament length (l) multiplied by the filament frequency (H) produces the coefficient of filiform corrosion (F).

$H = Z/L$ $F = l * H$

l_{max} = maximum filament length (mm)
l = average filament length (mm)
Z = number of filaments
L = length of scratch (mm)
H = filament frequency
F = index for filiform corrosion

All calculated values must be specified in the test report

*(excluding medical visual aids)

7.5 GSB boil test or pressure cooker test

If blistering occurs during the boil test or pressure cooker test, another sample must be coated on commercially available chromated sheet aluminium and the boil test or pressure cooker test carried out. If blisters also appear in the paint film here, then the test is deemed as failed.

7.5.1 GSB boil test with cross-cut test and adhesive tape removal

Two-hour boil test in deionised water. The surface is visually inspected immediately.

The sample is then stored at room temperature for one hour. This is then followed by the cross-cut test or the cross-cut test with adhesive tape removal (see 5.1 and 5.6).

7.5.2 Pressure cooker test EN 12206-1 with cross-cut test and adhesive tape removal

After cooling, a visual inspection is conducted.

The sample is then stored at room temperature for one hour. This is then followed by the cross-cut test or the cross-cut test with adhesive tape removal (see 5.1 and 5.6).

8 Resistance tests

8.1 Resistance to the effects of moisture

8.1.1 Application and purpose

Here the shelf life of coated aluminium building components subjected to condensation and temperature in sealed plastic film packaging should be tested.

A process is described that involves less moisture than a condensation constant atmosphere, a boil test or exposure to an average temperature.

8.1.2 Method

Five round filters, category no. 1001-055 from Whatman, are laid on top of one another on the correctly coated sample and soaked with 1.5 ml + 0.1 ml of deionised water. The moist sheets of filter paper are pressed down lightly and covered with a watch glass. In order that no moisture can escape, the watch glass is bonded to the sample with insulating tape (Scotch Super 33+ from 3M).

The test metal sheet prepared in this way is stored for 4 hours ± 5 minutes in the drying cabinet at a sample temperature (object temperature) of $T_{BProbeB}$ = 58 ± 2 °C. After the sample has been cooled for 15 minutes, the watch glass and sheets of filter paper are then removed. The sample is conditioned at room temperature (T = 23 ± 2 °C) for a period of t = 20 ± 2 h.

8.1.3 Evaluation

To calculate the colour change, 3 colour measurements excluding gloss are taken on the tested and untested reference sample 3. The average value is evaluated. The samples are also subject to a visual inspection by the quality committee.

8.2 Alkali resistance

8.2.1 Mortar test

Make a mortar using 15 g of slaked lime, 41 g of cement and 244 g of sand with sufficient tap water to create a soft paste (mortar in accordance with EN 12206-1).

Then apply the mortar mixture, whilst still wet, over an area of approx. 5 cm in diameter to a sample that has been coated at least 24 hours before. Then immediately expose the samples for 24 hours to 95 - 100 % relative humidity at T = 40 °C.

After removing the mortar, it can be dipped in acid in accordance with AAMA 2603- 02 to remove the remaining lime deposits. A round filter, category no. 1001-055 from Whatman, is applied to an area of 55 mm in diameter on the tested surface of the sample. This is soaked with 1.5 ml of 10% hydrochloric acid. After being exposed for 15 minutes, the sample is thoroughly cleaned with deionised water and dried. After 24 hours in the test chamber, it must be possible to easily remove the mortar must without leaving behind any residue.

Leave to dry and examine the coating by means of normal or corrected eyesight.

The change in colour and effect is assessed in accordance with Section 10.3. Mechanical damage to the coating caused by grains of sand must not be taken in consideration here.

If effect paints are to be used, which show a change in effect ≥ 3 (see Section 23) after the mortar test, a written confirmation of acceptance for this must be issued by the client. A binding submission of the tested sample in the mortar test must be signed by all the contract partners.

8.2.2 GSB sodium hydroxide test (alternative)

Approx. 1 ml of NaOH solution (2N) is dropped onto the painted surface to be tested and covered with a watch glass. After 60 minutes, the watch glass is removed, the excess NaOH solution sponged off with a soft cloth, the surface cleaned under running tap water and dried again with a towel.

The evaluation is made in accordance with Section 10.3.

Note: This test is not suitable for liquid paints with haematite pigmentation (e.g. DB colours)

9 Adhesion of sealing compounds

Materials needed

- Sealant: DC791 Dow Corning or sealant recommended by paint manufacturer (note expiration date)
- Cartridge gun
- Isopropyl alcohol
- Cutter knife or scalpel
- Pipette
- Paper towels

Implementation

1. cleaning

o Apply 2.5 ml isopropanol to the surface to be tested (approx. 15 x 20 cm) and clean it with a soft paper towel by performing 5 double strokes in the longitudinal direction and 5 double strokes in the transverse direction.

o After wiping in longitudinal and transverse direction, no paint must remain on the cloth and the paint surface must not show any damage.

o Allow the surface to flash off for at least 5 min before applying the sealant.

2. application of the sealing compound

o The unscrewed nozzle of the applicator is cut to 8 mm inside diameter (approx. 35 mm from the tip). An adhesive tape should be applied so that it runs across the caterpillar on the lower part of the test sheet. The caterpillar should end on the tape so that later removal of the caterpillar is facilitated.

o After flash-off, apply two approx. 100 mm long caterpillars of the sealant "to the previously cleaned surface using the cartridge gun.

o The caterpillar should have approximately the following dimensions: 100 mm long, 10 mm wide and 5-7mm high.

o The sample is then stored for 7 days at room temperature (23±2°C) and 50% relative humidity. stored.

3. pull off the caterpillar

o Detach the caterpillar from the adhesive tape and pull it off by hand until the sealant caterpillar itself cracks (cohesive fracture) or completely detaches from the surface (adhesive fracture).

o If the caterpillar tears itself, use a cutter knife or scalpel at a 90° angle (to the sheet metal) to and pulled again until the caterpillar threatens to tear again. This is repeated until the caterpillar is completely removed.

Evaluation

The result of the test is considered "OK" if there is a cohesive fracture. Adhesion fracture is not permissible.

10 Colour measurement

10.1 General

3 colour measurements are made at different places on the exposed, cleaned sample and the unexposed reference sample, with the measuring points always at least 50 mm apart.

The arithmetical mean value is taken from the colorimetric values of the measurements.

The conditions for measurement and colorimetric evaluation are:

- A spectral photometer or a colorimeter must be used in accordance with the tristimulus method as per ISO 11664-3;
- The measuring geometry is d8/Spex. excluding gloss or 45/0
- The colorimetrical evaluation must be for the standard illuminant type D65 and the 10° standard observer in accordance with ISO 11664-2 and DIN 5033 Part 7;
- The coordinates must be calculated in accordance with the CIELAB colour difference formula in accordance with ISO 11664-4 for the sample and reference sample; the differences ΔL* and ΔC_{ab}* must be specified.

The measured differences, rounded to whole numbers, must not exceed the limit values (basic measurement geometry 45/0). If the limit values in the following table are exceeded, a visual inspection is made by the quality committee. If no RAL colour is available, the limit values for the nearest RAL colour apply.

Upon request, an arbitration test can be carried out at the Federal Institute for Materials Research and Testing (BAM) in Berlin using a spectral photometer for measurement geometry 45/0.

10.2 Colour differences ΔL*, ΔC* after weathering

The colour is measured in accordance with ISO 11664-4, illuminant type: D65/10° standard observer; measurement geometry 45/0.

10.3 Assessment of the change in colour and effect (in accordance with GSB standard)

The change in effect for metallics is carried out as per the following assessment system in accordance with ISO 4628 Part 1.

Key value for intensity of change

0	Unchanged, i.e. no perceptible change
1	Very low, i.e. change only just perceptible
2	Low, i.e. clear perceptible change
3	Medium, i.e. very clear perceptible change
4	High, i.e. pronounced change
5	Very strong change

The assessment is made using a reference plate (to be obtained from the GSB International head office).

11 Measurement of gloss (reflectometer value)

The reflectometer value must be measured in accordance with ISO 2813 using an angle of radiation of 60° for all tests. The reflectometer value must be specified in gloss units (GU).

Exception: Matt painted surfaces with an initial gloss □ 40 GU (measured with 60°) can be measured, where agreed, with the 85° geometry.

12 Weathering

12.1 Accelerated UV-B weathering (313 nm)

This test is carried out in accordance with ISO 16474-3. The QUV/SE accelerated weathering tester with Solar Eye radiation control must be used.

Radiation source:	UVB-313 nm	
Cycle:	4 h condensation,	T = 40 °C ± 2 °C
	4 h solar radiation,	T = 50 °C ± 2 °C
Intensity of solar radiation:	0.75 W/m²/nm	

Alternatively, the accelerated weathering tester from Atlas (“UVTest – Fluorescent / UV Instrument”) can be used.

12.2 Natural weathering in Florida

For assessment, the gloss and colour limit values used are those defined in the quality guidelines valid at the time when the external test was started. Dimensions of samples: 100 x 300 x 0.7-0.8 (mm) (sample thickness is not binding). For assessment, the gloss and colour limit values used are those defined at the time when the external test was started.

The samples must be subjected to the external test from approx. April with the total UV radiation and angles specified in the table. The samples must be cleaned in a one-percent aqueous wetting solution using slight pressure with a soft sponge and then rinsed with deionised water. The surface should be kept as free as possible from dirt and impurities. Cleaning is carried out prior to determining the measurement of gloss and colour, as well as at the intervals specified in the table.

Coating class	Standard	Master	Premium
Southern orientation angle / °	5	45	45
Approx. duration / months	Approx. 12	Approx. 36	Approx. 60
Total UV radiation / (MJ/ m²)	300	840	1400
Cleaning	Once prior to evaluation	Every 6 months	Every 6 months

12.3 Natural weathering in Hook of Holland

Geometry of samples:	Metal sheets:	approx. 10 x 20 cm
	Profiles:	Dependent on the profile material used in the field test, length approx. 10-30 cm

The samples are usually subjected to external tests and evaluated once per year. External testing takes place between April and May. External testing runs for 10 years in total. The samples are orientated southwards at an angle of 45°. Interim evaluations are made once per year. The sample is washed down with water prior to evaluation.

The levels of infiltration, filament length and frequency are evaluated.

After 3, 5 and 10 years, an interim report must be produced for the pre-treatment manufacturers and GSB International.

13 Measurement of conductivity

The measurement is used to calculate the conductivity of the water that drips off the visible surfaces of the pre-treated and rinsed parts after the final rinsing with deionised water. In addition, conductivity is measured at the spray nozzles and in the container used for the final rinse.

The water that has dripped off is caught in a suitable container (e.g. a beaker). The collecting vessel must be clean.

Prior to taking measurements, the conductivity measuring equipment must be tested using a calibration solution and set to the corresponding measuring range. In the case of equipment without temperature compensation, the water temperature must be monitored and the measuring device adjusted accordingly.

14 Calculation of the etch rate

The sample material must have a minimum length of 10 cm and must only be used once.

- **Preparation of samples**

  Wipe the surface clean using acetone or isopropanol
  Weigh the samples using an analytical balance (accuracy ± 0.1 mg)

- **Treatment of samples**

  The samples must be treated under production conditions. Depending on the pre-treatment system, the samples should be removed from the production process as follows:

  - Acceptance of the sample prior to chromating / chromium-free pre-treatment
  - Acceptance of the sample prior to the residual water dryer, removal of the passivation layer / conversion layer by etching.

  The bath parameters must correspond to the specifications of the chemical supplier.

- **Calculation of the etch rate**

  a. Dry the sample at 80 °C

  b. Weigh the sample using an analytical balance (accuracy ± 0.1 mg)

  c. Calculate the erosion (loss of weight / sample surface)

15 Calculation of the surface-based loss of mass

The coating layer for the chemical pre-treatment layer (chromating or chromium-free / chromium(VI)-free pre-treatment) is calculated according to the specifications of the pre-treatment chemical manufacturer. If no relevant test specification is available, you can proceed as follows. To do this, it must be possible for the relevant chemical pre-treatment with 65% nitric acid to be removed at 25 °C. This regulation can only be carried out for freshly generated pre-treatment layers.

The sample material must only be used once.

- **Treatment of samples**

  a. The samples must be pre-treated under production conditions.

  b. Acceptance of the sample after chromating / chromium-free pre-treatment after the residual water dryer. Cool to 20 – 23 °C.

  c. Weigh the sample using an analytical balance (accuracy ± 0.1 mg).

  d. Remove the passivation layer / conversion layer by etching the chemical pre-treatment layer (with 65 % nitric acid, density 1.4 g / cm³, for 5 to 10 minutes at a temperature 25 °C).

- **Calculation of the layer weight of the chemical pre-treatment**

  a. Dry the sample at 80 °C. Cool to 20 – 23 °C.

  b. Weigh the sample using an analytical balance (accuracy ± 0.1 mg).

  c. Calculate the eroded layer weight (loss of weight / sample surface). Specified in mg / m².

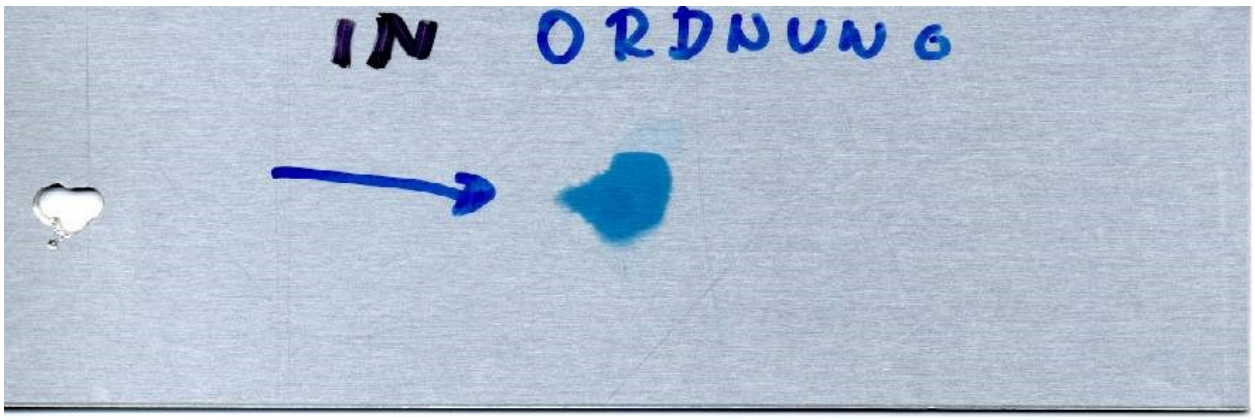
16 Colour drop test to prove “open porosity” of the oxide layer (in accordance with ISO 2143)

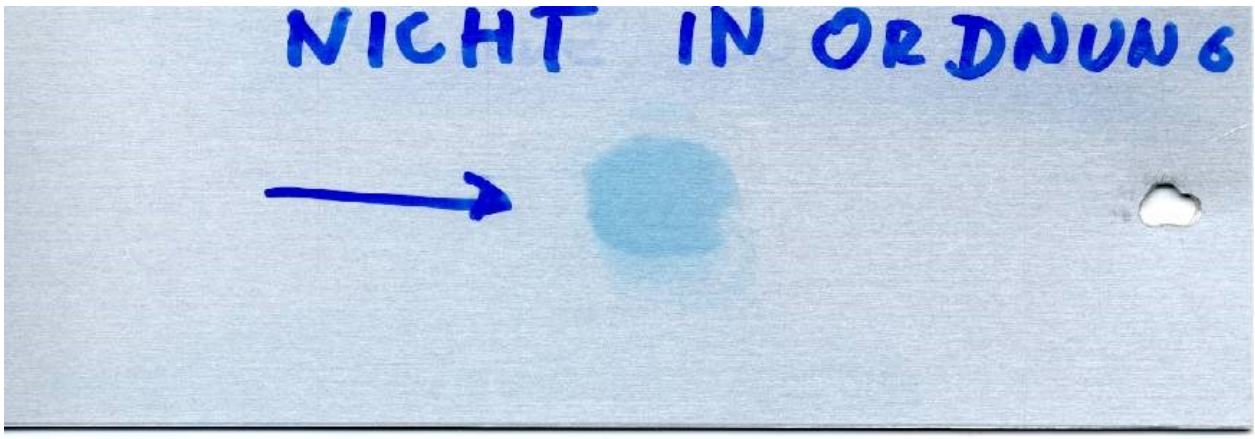
Prior to coating, a colour drop test must be carried out using Sanodye Blue 2 LW on five different profile sections of the batch with “pre-anodising” to be coated.

Dry and clean gloves must be worn at all times to handle the sections.

The test solution (= 5 g / l Sanodye Blue 2 LW pH 5.7 ± 0.5) is left to act upon the pre-anodised and carefully rinsed surface of the sample section for 1 minute and then wiped dry with a soft towel.

If the first test is negative, it should be repeated immediately.





A sample section, which has been treated with a drop of the acid solution before being subjected to the test solution and carefully rinsed with deionised water, can be used as a reference for an “openly porous” oxide layer.

(Acid solution: 25 ml / l H_2SO_4 (density 1.84 g / ml) and 10 g / l KF).

17 Visual inspection of the surface for finished products

Assessing the decorative appearance of the industrially produced surface in terms of uniformity of colour, gloss and structure must be carried out without aids in diffuse daylight, at a distance of ≥ 3 m for external components and ≥ 2 m for internal components. All of the samples must match in terms of gloss, colour and structure.

When assessing the uniformity of the façade, it is recommended to use larger viewing distances – refer to the following information sheets:

VFF Information Sheet AL.02	Visual assessment of organically coated (lacquered) aluminium surfaces
VFF Information Sheet ST.02	Visual assessment of organically coated (lacquered) steel surfaces
	VFF, Verband Fenster + Fassade (German Window and Façade Association), Frankfurt (www.window.de)

When assessing the coating quality, irregularities in the supporting surface, such as scratches, streaks, corrosion scars and weld seams are not important.

Alternative viewing distances and criteria can also be agreed between the contract partners.

18 Distribution list

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