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ETAG 002

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**GUIDELINE FOR EUROPEAN TECHNICAL APPROVAL
FOR**

**STRUCTURAL SEALANT
GLAZING SYSTEMS (SSGS)**

PART 2: COATED ALUMINIUM SYSTEMS

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Introductory notes

This part of the guideline deals with coated aluminium used as structural seal adhesion surface in structural sealant glazing.

The same paragraph numbering as in the part 1 applies. The paragraphs of the present document complement those of the part 1. When a paragraph is not mentioned in the present document, part one of the guideline applies without modification.

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2. Scope

2.1 Scope of Part 2

This Part of the Guideline covers the general requirements for system assessment and the specific requirements for supported types (I and II) and unsupported (types III and IV) systems (see 2.2 part 1 of the guideline) where a structural seal adhesion surface is coated aluminium.

5. Method of verification

TABLE 3 Part 2 Verification of performance - complementary table

	Reference (see Annex 3)	term ¹	² element involved
5.1.4 Safety in use			
5.1.4.2.6 Filiform corrosion	-	LT	SF
5.1.4.2.7 Mechanical fatigue of the coating	SSGS part 1	LT	SF
5.2 Verification methods related to identification of products			
5.2.5 Coated aluminium structural adhesion surface			
5.2.5.1 Alloy of aluminium	EN 573-3	ST	SF
5.2.5.2 Pre-treatment - Weight of the pre-treatment layer	prEN 12206-1/2	ST	SF
5.2.5.3 Organic coating	prEN 12206-1/2		
5.2.5.3.1 Surface appearance	-	ST	SF
5.2.5.3.2 Colour	ISO 3668- ISO 7724-3	ST	SF
5.2.5.3.3 Gloss	EN ISO 2813	ST	SF
5.2.5.3.4 Thickness	ISO 2360	ST	SF
5.2.5.4 Suitable coatings	prEN 12206-1/2	ST	SF
5.2.5.5 Evaluation of the suitability	-	-	SF
5.2.5.6 Description of the process	-	-	SF
5.2.5.7 Extrapolation rules	-	-	SF

(1) ST: short term or initial state, LT: long term or aged state - (2) K = kit, SF = structural seal support frame, G = glass, S = sealant, D = devices (mechanical mean of transferring the self weight, retaining devices, anchorage of the support frame on the façade structure)

5.1.4 ER4 Safety in use

General

- Complementary specifications to part 1 “5.1.4 ER4 Safety in use” applicable when the structural seal adhesion surface is made of coated aluminium

The ETA applicant shall declare the range for the coating thickness.

Regarding the thickness

The test § 5.1.4.2.1 "Immersion in water at high temperature" is to be performed without radiation on samples having the maximum coating thickness; the test § 5.1.4.2.6 is on the minimum thickness. For the other tests any value of thickness is prescribed inside the range declared by the manufacturer. The test report of each test performed with coated aluminium shall mention the samples thickness of the coating.

Regarding the colour

The pigments are inert components imbedded in resin.

One different colour shall be chosen for each of the different adhesion/cohesion tests required, § 5.1.4.1, 5.1.4.2.1, 5.1.4.2.2, 5.1.4.2.3, 5.1.4.2.6, 5.1.4.2.7. (e.g. red, green, blue, yellow, white, black)

5.1.4.2.6 Filiform corrosion

In addition to compliance with the relevant parts of the prEN12206/1, it is necessary to verify that the bond of the coating, and thereby the structural bond integrity is not at risk due to filiform corrosion. The tests apply to coatings prepared from powder and liquid materials.

Test samples

Sections of profile, minimum 200 mm in length are cut from the extruded bar. The samples shall be prepared by the manufacturer or in accordance with their instructions, using the same materials as specified for the system. This shall include the structural sealant, the glass, the aluminium alloy and coating and the surface preparation (cleaning and/or priming). (note: for the coating colour, thickness, see § 5.1.4 - General)

Four pieces are required for the evaluation of initial mechanical strength and a further four for evaluation of residual strength.

The cut ends of the samples shall be protected with a suitable coating such as wax.

Test procedure

Cuts are made in the bonding surface of the profile, as shown in Figure 1a. The cuts shall be 50 mm in length and between 1 and 2 mm in width. They shall penetrate to the aluminium substrate and shall be free from burrs.

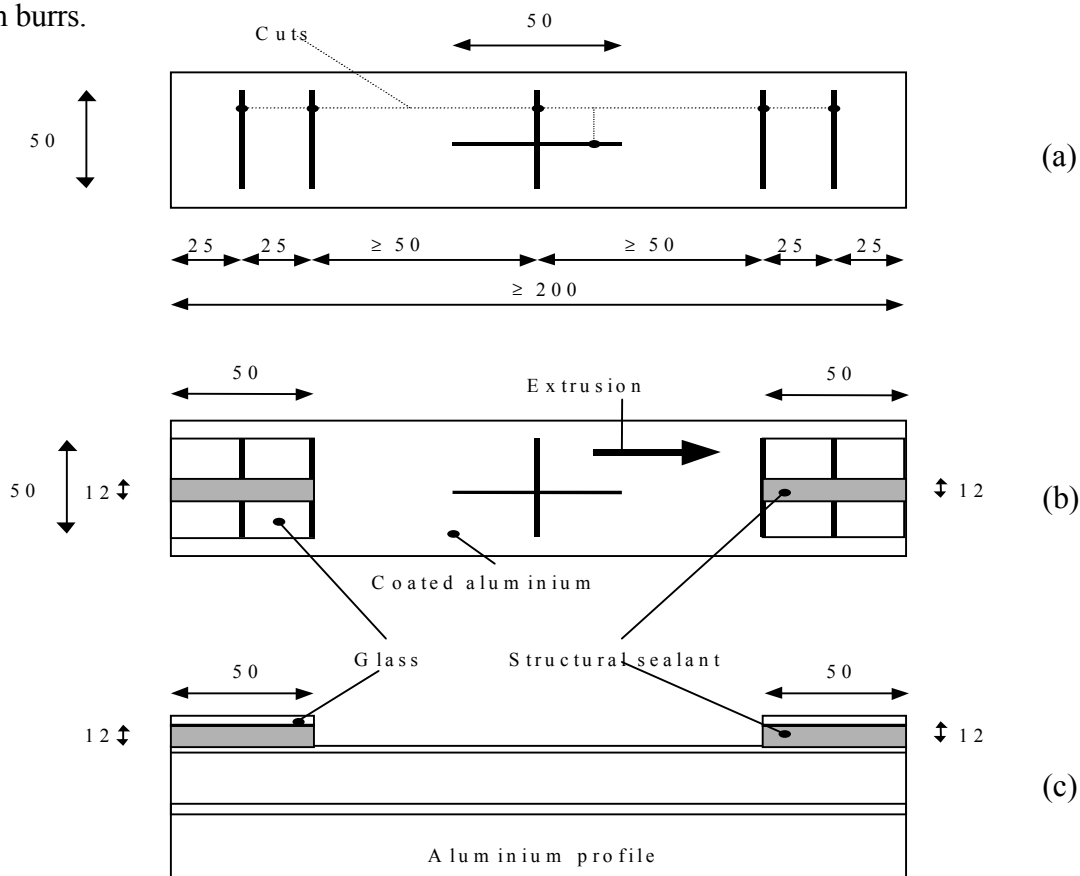


Fig. 1 add 1 - Sample for filiform corrosion tests

On each piece of aluminium, two pieces of glass 50 mm square and as specified in § 5.1.4 of Part 1, are bonded using the structural sealant. See figures 1b and 1c.

After preparation, the eight test pieces are cured for 28 days, $23\text{ °C} \pm 2\text{ °C}$ and relative humidity $50 \pm 5\%$.

Test method

Initial mechanical strength

Four of the bonded glass parts are then subjected to a tensile test in accordance with § 5.1.4 of Part 1 of the Guideline.

Mechanical strength after artificial ageing

The remaining four test samples shall be conditioned in a corrosive environment in accordance with § 5.14.3 of prEN 12206 Part 1.

After the corrosive conditioning, the samples shall be further conditioned for 48 ± 4 hours at $23 \pm 2\text{ °C}$ and $50 \pm 5\%$ RH. The bonded glass parts shall then be subjected to a tensile test in accordance with § 5.1.4 of Part 1 of the Guideline.

After tensile testing the aluminium samples shall be examined, using normal/corrected vision, for signs of corrosion.

The results of the tests shall include:

- the date and time of test
- the temperature, relative humidity and period of initial conditioning
- the date, time, temperature and relative humidity for the tensile test
- the tensile load at break
- the type of failure (cohesive or adhesive)
- presence, characteristics and position of any corrosion
- The thickness of the coating

5.1.4.2.7 Mechanical fatigue of the coating

The aim of this test is to examine the effect of fatigue stresses on the residual mechanical bond strength of the coating on the aluminium.

Ten test pieces in accordance with Figure 6 in part 1 are to be conditioned for 28 days at a temperature of $23 \pm 2\text{ °C}$ and $50 \pm 5\%$ relative humidity.

The test pieces are then to be subjected to repetitive tensile loads with a cycle time of 4 to 8 seconds (Figure 2 add 1) :

- 100 times from $0.1 \sigma_{\text{des}}$ to the design stress σ_{des}
- 250 times from $0.1 \sigma_{\text{des}}$ to $0.8 \times$ the design stress σ_{des}
- 5000 times from $0.1 \sigma_{\text{des}}$ to $0.6 \times$ the design stress σ_{des}

where $\sigma_{\text{des}} = R_{u,5} / 6$ (see clause 6.1.4.1.1 in part 1, with $R_{u,5}$ at 23 °C)

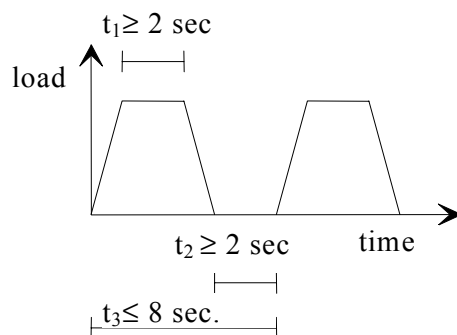


Figure 2 add 1 - Stress cycle for fatigue test
with "t₁" : duration of the peak load, "t₂" : rest time, "t₃" total time of the cycle

After cycling, the structural bonds shall be visually inspected.

The ten test pieces shall then be conditioned for a further 24 ± 4 hours at a temperature of $23 \pm 2^\circ\text{C}$ and $50 \pm 5\%$ relative humidity, and then subjected to the tensile test in accordance with 5.1.4.1 in part 1.

5.2 Verification methods related to identification of the product

5.2.5 Coated aluminium adhesion surface

The coated aluminium structural sealant adhesion surface on which the assessment tests are to be performed is identified as follows : (see table 8.6 regarding possible use of the Qualicoat mark) :

5.2.5.1 Alloy of aluminium

The specification for the aluminium alloy shall be examined for suitability in SSGS.
(see table 3 and table 8.6 part 2)

5.2.5.2 Pre-treatment

- Generic type
- Weight of the pre-treatment layer (g/m^2) prEN 12206-1 annex A

5.2.5.3 Organic coating

The generic type and the form of the organic coating shall be given.

Form : liquid or powder

Generic type : e.g. Polyester	SP (without TGIC)
Silicon polyester	SP-SI
Polyvinylidene fluoride	PVDF
Acrylic	AY
Polyurethane	PUR
Epoxy	EP
Alkyd	AK
Polyamide modified polyurethane	PUR-PA
Modified polyamide -polyester	SP-PA

Pigment : chemical kind

5.2.5.3.1 *Surface appearance*

The surface appearance must be observed with a normal/corrected vision at a distance of 3 metres.

5.2.5.3.2 *Colour*

The following methods can be used : ISO 3668 (not applicable to certain metallic coatings)
ISO 7724 (Lab)

5.2.5.3.3 Gloss: ISO 2813 with an incidence angle of 60° (not suitable to certain metallic coatings)

5.2.5.3.4 Thickness: ISO 2360

5.2.5.4 *Suitable coatings*

Suitable coatings are the organic coatings conforming to the European draft standard prEN 12206-1 and 2: Coating of aluminium and aluminium alloys for architectural purposes. Part 1 Coatings prepared from powder coating material - part 2 Coatings prepared from liquid coating material.

When the prEN 12206 prescribes a solvent test, it is to be performed with the sealant cleaning solvent used to prepare the structural adhesion surface.

Removal of the organic coating and bonding on the pre-treatment layer is not covered by this ETAG.

5.2.5.5 *Evaluation of the suitability of the bonding on coating*

A **coated aluminium system** for structural sealant application is defined with the following parameters:

- The alloy of aluminium used
- The pre-treatment
- The generic type of coating
- The chemical kind of pigment
- The gloss category
- The range of coating thickness
- The cleaning product of the structural seal adhesion surface
- The primer if any
- The structural sealant
- The description of the different step of the coating process (see 5.2.5.6)

For each coated aluminium system, it shall be demonstrated that the bond between the aluminium and coating, between sealant and coating and between any interlayer, is sufficiently strong. Such a demonstration requires adhesion tests and assessment according to the following chapters of this Guideline parts 1 and 2:

- Chapter 4 : Requirements
- Chapter 5 : Methods of verification
 - 5.1.4.1 Initial Mechanical Strength
 - 5.1.4.1.1 Tension rupture and stiffness

- 5.1.4.1.2 Shear rupture
- 5.1.4.2 Residual Mechanical strength after artificial ageing
 - 5.1.4.2.1 Immersion in water at high temperature without U.V. exposure
 - 5.1.4.2.2 Humidity and NaCl
 - 5.1.4.2.3 Humidity and SO₂
 - 5.1.4.2.4 Facade cleaning products
 - 5.1.4.2.6 Filiform corrosion
 - 5.1.4.2.7 Mechanical fatigue of the coating

5.2.5.6 Description of the process

The applicant shall give the approval body the following information:

5.2.5.6.1 Pre-treatment

The generic type (chromate, phosphochromate conversion layer or other), the technique (pre-treatment performed continuously in a booth or by immersion,) and the different steps (e.g. : cleaning, rinsing, scouring, special operation) of the pre-treatment shall be described in detail (e.g. products used, duration, temperature)

5.2.5.6.2 Coating application

The generic type of resin (e.g PVDF, SP, SP-Si), the number of components and their mixing ratio as relevant , the chemical kind of pigment, the technique (e.g. powder or liquid coating, single or several layers) and the application process (e.g : spraying, electrostatic process, special operations) of the coating shall be described in detail (e.g. temperature , coating transition curing time)

5.2.5.7 Extrapolation rules

In the present stage of knowledge, it is assumed that the only extrapolation parameter authorised within the scope of this guideline is the colour and the gloss for so far the definition of the coated system for structural sealant application is respected (see § 5.2.5.5).

Other extrapolations based on e.g. range of thickness, generic type of coating, kind type of pigment are not authorised.

6. Assessing and judging the fitness for use of product for an intended use

6.1 General - test result statistical interpretation

TABLE 8.3 - ER 4 Complementary table

Reference	Verification methods	Reference	Treatment of results and requirements – Criteria
ER4 Safety in use			
5.1.4.2 Residual strength after artificial ageing			
5.1.4.2.6	Filiform corrosion	6.1.4.2.6	- Failure 90% cohesive - tensile strength : $\Delta X_{\text{mean}} \geq \Delta X_{\text{mean,c}} / X_{\text{mean,n}} \geq 0.75$ - No filiform corrosion - use of the coated aluminium is UNRESTRICTED - Corrosion observed (total maximum filaments lengths = 3 mm) adjacent to the silicone or in the cross formed cuts but NOT UNDER THE SILICONE - coating acceptable but not for marine/coastal environments - Corrosion observed UNDER THE SILICONE (even in a limited way) - the coating is NOT SUITABLE FOR SSG
5.1.4.2.7	Fatigue test	6.1.4.2.7	$\Delta X_{\text{mean}} \geq 0,75$; Rupture $\geq 90\%$ cohesive

TABLE 8.6 - Complementary table

Reference	Verification methods	Reference	Treatment of results and requirements – Criteria
Verification method related to the identification of the product			
5.2.5 Coated aluminium structural adhesion surface			
Note If the coating on the aluminium has a QUALICOAT mark corresponding to the requirements below it may be taken into account by the approval body”:			
5.2.5.1	Alloy of aluminium	6.2.5.1	Chemical composition: The alloys of aluminium commonly use in architecture for this type of application are Alloys EN AW-6060 and EN AW-6063 as per EN 573-3 part 3. Other alloys may be used provided they meet the relevant requirement of this Guideline
5.2.5.2	Pre-treatment Weight of the pre-treatment layer	6.2.5.2	Chromate layer $0,4 \text{ g/m}^2 \leq \underline{W} \leq 1 \text{ g/m}^2$ Phosphochromate layer $0,4 \text{ g/m}^2 \leq \underline{W} \leq 1,2 \text{ g/m}^2$ Other pre-treatments may be presented for approval. The approval body takes into account the global result of tests to establish the assessment for fitness for use
5.2.5.3	Organic coating	6.2.5.3	The generic type of the organic coating (resin + pigment) is to be given
5.2.5.3.1	Surface appearance	6.2.5.3.1	No blisters, craters, pinholes or scratches.
5.2.5.3.2	Colour	6.2.5.3.2	No criteria, identification parameter
5.2.5.3.3	Specular gloss	6.2.5.3.3	No criteria, identification parameter (*) see note here after Category 1 - specular reflection 0 to 30% Category 2 - specular reflection 31 to 70 % Category 3 - specular reflection 71 to 100 %
5.2.5.3.4	Thickness	6.2.5.3.4	The thickness range is to be given by the ETA applicant. Minimum coating thickness : Powder coating : Single-coat

8. Evaluation of conformity

8.3.2.4 Test plan as part of FPC

■ Checks on incoming material

(vii) on coated aluminium

No specific test by the ETA holder is required

However, he shall communicate the declaration provided by the coating applicator which establishes that the coated aluminium product supplied for the project is identical to that described in the ETA regarding the alloy, the surface finish and the extrapolation rules. (See 5.2.5.5, 5.2.5.7)

The technical file accompanying the declaration for the profile delivery shall include:

- a declaration that the profiles are coated in accordance with the prEN 12206 series,
- a declaration that the profiles are coated in accordance with ETA specifications given by the ETA-holder,
- a summary of the test records collected during the factory production control of the coated profile, containing at least the following test results:

TABLE 9.1 - Quality consistency - criteria and tolerances

Tests	Specifications	Frequencies	Quality consistency criteria and tolerances
Visual appearance	-	(*)	No blisters, craters, pinhole or scratches.
Thickness	EN ISO 2360	(*)	The measured thickness shall be in the thickness range declared by the ETA applicant
Pigment	Chemical kind	Not applicable	Chemical kind
Gloss	ISO 2813	Once each 8 hours of production and minimum one per coating campaign	Maximum deviation on the nominal value given in the ETA for one determined category is ± 5 units for the category 1 (specular reflection 0 to 30%) ± 7 units for the category 2 (specular reflection 31 to 70 %) ± 10 units for the category 3 (specular reflection 71 to 100 %)
Cross cut test	EN ISO 2409	Once each 8 hours of production and minimum one per coating campaign	only class 0 is acceptable
Solvent test (the sealant cleaning solvent used to prepare the structural adhesion surface)	prEN 12206-2	Once each 8 hours of production and minimum one per coating campaign	prEN 12206-2 § 4.5.7
Cupping test	EN ISO 1520	Once each 8 hours of production and minimum one per coating campaign	No cracking of the substrate nor detachment between the coating and the substrates
Bend test	EN ISO 1519	Once each 8 hours of production and minimum one per coating campaign	No cracking of the substrate nor detachment between the coating and the substrates

(*) Thickness and visual appearance

Tests required as a function of the produced quantity

Number of pieces in the batch number of samples tested

Number of pieces in the catch	Number of samples
1 - 10	all

11 - 200	10
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201 - 300	15
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301 - 500	20
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If necessary, the approved body can request the relevant performance report from the initial type testing.

T A B L E 10 - Checks necessary over a two-days cycle of production
Complementary table applicable for coated aluminium system

Company:			Project name:		Production date :
	First day; third day; fifth day		Second day; fourth day, sixth day		
	Morning	afternoon	morning	afternoon	packaging change
<u>6.Coated aluminium</u> Colour	With naked eyes : continuous		With naked eyes: continuous		Naked eyes comparison with colour standard sample
<u>7. additional adhesion testing on H – pieces in case of coated aluminium only (7)</u> adhesion development time: alternative 1 samples 4, 5, 6 after 24 h in water 95±2°C rupture ≥ 90 % cohesive tensile strength (N) alternative 2 • samples 4, 5, 6 after 7 days in water 23°C rupture ≥ 90 % cohesive tensile strength (N) • samples 7, 8, 9 after 7 days in oven at 100°C rupture ≥ 90 % cohesive tensile strength (N)	<u>H - pieces (4)</u> value pass/fail value pass/fail value pass/fail value	<u>Peel-test (6)</u> not applicable	<u>Peel-test (6)</u> not applicable	<u>Peel-test (6)</u> not applicable	<u>H pieces (4)</u> value pass/fail value pass/fail value pass/fail value

(4) and (6) are to be found in ETAG 002 part 1 table 10

(7) Adhesion-cohesion test on coated aluminium

Adhesion-cohesion under tension to rupture on the actual coated aluminium and glass used in the project. Those samples are complementary to those required in ETAG part 1 table 10 row “5. Adhesion testing on H – pieces”.

The adhesion development on the substrates is not only a function of the sealant cure degree but depends, amongst others, of coating surface tension. It is then variable from coating system to coating system so that it is the responsibility of the ETA holder to give the time to wait before conditioning and testing.

Alternative 1

Three test pieces are immersed in water at $95 \pm 2^\circ\text{C}$ for 24 hours. They are then conditioned for 48 ± 4 hours at a temperature of $23 \pm 2^\circ\text{C}$ and $50 \pm 5\%$ relative humidity. These test pieces are then subjected to the tensile test to rupture.

Alternative 2

Three test pieces are conditioned 7days in oven at $100 \pm 2^\circ\text{C}$. They are then conditioned for 48 ± 4 hours at a temperature of $23 \pm 2^\circ\text{C}$ and $50 \pm 5\%$ relative humidity. These test pieces are then subjected to the tensile test to rupture.

9. ETA content

9.1 *ETA contents*

9.1.2.2 *Components and accessories*

aluminium and coating

- description of the process § 5.2.5.6
- the parameters of the coated aluminium system for structural sealant glazing sealant as defined in §.5.2.5.5
- the coating mark and the coating applicator

9.2 *Additional information*

9.2.1.14 Coated aluminium

For the aluminium used to perform the tests mentioned in chapters 5, the file will contain the following information:

- the characteristics of the coating required in chapter 5.2.5
- the shape of the aluminium adhesion surface
- the name of the firm which applied the coating.
- The name of the primer and cleaning product applied before bonding
- reports of tests required following table 8.1 to 8.6

Annexe 3 - Reference documents

prEN 12206-1/2 Paints and varnishes - Coating of aluminium and aluminium alloys for architectural purposes

part 1 Coatings prepared from powder coating materials 10/95

part 2 Coatings prepared from liquid organic coating materials 01/95

ISO 3668:1998 Paints and varnishes - Visual comparison of the colour of the paints.

ISO 7724-1:1984

ISO 7724-2:1984

ISO 7724-3:1984 Paints and varnishes - Colorimetry - Calculation of the colour differences

ISO 2813:1994 Paints and varnishes - Determination of the specular gloss of non metallic paint films at 20°, 60°, 85°.

ISO 2360:1992 Non-conductive coatings on non magnetic basis metals - Measurements of coating thickness - Eddy current method

ISO 2409:1992 Paints and varnishes - Crosscut test

ISO 1520 1973 Paints and varnishes - Cupping test

ISO 2815 1973 Paints and varnishes - Buchholz indentation

ISO 1519:1973 Paints and varnishes - Bend test (cylindrical mandrel)

ISO 2409:1992 Paints and varnishes Crosscut test