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National Standard of the People's Republic of China

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Replace GB/T 5237.5—2008

Wrought aluminium alloy extruded profiles for architecture—Part 5: Paint coating profiles

铝合金建筑型材　第5部分：喷漆型材

(*English Translation*)

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Foreword

SAC/TC 243 is in charge of this English translation. In case of any doubt about the contents of English translation, the Chinese original shall be considered authoritative.

The GB/T 5237 *Wrought aluminum alloy extruded profiles for architecture* consists of following six parts under the general title:

—*Part 1: Mill finish profiles*;

—*Part 2: Anodized profiles*;

—*Part 3: Electrodeposition coating profiles*;

—*Part 4: Powder coating profiles*;

—*Part 5: Paint coating profiles*;

—*Part 6: Thermal barrier profiles*.

This is the fifth part of GB/T 5237.

This part is drafted in accordance with the rules given in the GB/T 1.1—2009.

This part replaces the GB/T 5237.5—2008 *Wrought aluminium alloy extruded profiles for architecture—Part 5: PVDF coating profiles* in whole. In addition to a number of editorial changes, the following technical deviations have been made with respect to the GB/T 5237.5—2008:

—Modified the name of standard (See the cover, the cover of 2008 edition);

—Deleted the statement in the foreword "In this part, article 4.5.3.1 and 4.5.5 are compulsory. Other contents are recommended." (See the foreword of 2008 edition);

—Deleted the statement in the foreword "This part is amended refer to AAMA 2650—2005 *Voluntary Specification, Performance Requirements And Test Procedures for Superior Performing Organic Coatings On Aluminum Extrusions And Panels*." (See the foreword of 2008 edition);

—Modified the scope of this part (See clause 1, clause 1 of 2008 edition);

—Modified the boot of the normative references (See clause 2, clause 2 of 2008 edition);

—Deleted the normative reference GB/T 228—2002(See clause 2 and subclause 5.2 of 2008 edition);

—Deleted the normative reference GB/T 5237.4—2008(See clause 2 and subclause 5.4.7 of 2008 edition);

—Deleted the normative reference GB/T 6461(See clause 2 of 2008 edition);

—Deleted the normative reference GB/T 16585(See clause 2 of 2008 edition);

—Deleted the normative reference GB/T 20975(See clause 2 and subclause 5.1 of 2008 edition);

—Deleted the normative reference JC/T 480(See clause 2 and subclause 5.4.10 of 2008 edition);

—Added the normative reference GB/T 5237.2(See clause 2 and subclause 7.3);

—Added the normative reference GB/T 8005.3(See clause 2 and 3);

—Added the normative reference GB/T 14684(See clause 2 and subclause 5.4.11.1);

—Added the normative reference GB/T 17671(See clause 2 and subclause 5.4.8);

—Added the normative reference JC/T 479(See clause 2 and subclause 5.4.11.1);

—Modified the normative reference "GB/T 1865—1997" as "GB/T 1865—2009"(See clause 2 and subclause 5.4.16.1, clause 2 and subclause 5.4.15.1 of 2008 edition);

—Replaced the dated reference GB/T 8013.3—2007 with the undated reference GB/T 8013.3 (See clause 2 and subclause 4.6.17, 5.4.8, 5.4.17 and 6.4, clauses 2, 3 and subclause 4.2, 4.5.16.1, 4.5.16.2 and 5.4.16 of 2008 edition);

—Modified the guide language of the terms and definitions (See clause 3, clause 3 of 2008 edition);

—Modified the definition of exposed surfaces (See subclause 3.1, subclause 3.2 of 2008 edition);

—Deleted the definition of "film", "thickness of coating", "local thickness", "minimum local thickness" and "average thickness"(See subclause 3.1, 3.3, 3.4, 3.5 and 3.6 of 2008 edition);

—In product classification, added the types, coating code, coating composition, the characteristics of the coating and the application environment of the corresponding profiles(See subclause 4.1.2);

—Modified "Marking and examples" in Product Classification(See subclause 4.1.3, 4.1.2 of 2008 edition);

—Added "Quality assurance"(See subclause 4.2);

—Modified "Color and color difference" as "Color difference"(See subclause 4.6.3 , 5.4.3 and clause 6, subclause 4.5.2, 5.4.2 and clause 6 of 2008 edition);

—Added the requirements and test methods of the boiling water resistance(See subclause 4.6.6 and 5.4.6);

—Modified the requirements and test methods of the solvent resistance (See subclause 4.6.12 and 5.4.12, subclause 4.5.11 and 5.4.11 of 2008 edition);

—Modified the requirements of humidity resistance as "the overall damage level of the coating surface should be grade 1"(See subclause 4.6.15, subclause 4.5.14 of 2008 edition);

—Modified the requirements and test methods of the accelerated weathering resistance (See subclause 4.6.16.1 and 5.4.16.1, subclause 4.5.15.1 and 5.4.15.1 of 2008 edition);

—Modified the requirements and test methods of the natural exposure resistance (See subclause 4.6.16.2 and 5.4.16.2, subclause 4.5.15.2 and 5.4.15.2 of 2008 edition);

—Modified the test methods of chemical composition and mechanical properties (See subclause 5.1 and 5.2, subclause 5.1 and 5.2 of 2008 edition);

—Modified the test methods of the coating thickness(See subclause 5.4.1, subclause 5.4.3 of 2008 edition);

—In the test method of impact resistance, modified the weight tolerance of the hammer mass (See subclause 5.4.7, subclause 5.4.6 of 2008 edition);

—Modified the test methods of the abrasion resistance(See subclause 5.4.8, subclause 5.4.7 of 2008 edition);

—In the test method of the hydrochloric acid resistance, modified "Chemical pure hydrochloric acid" as "analytically pure hydrochloric acid"(See subclause 5.4.9, subclause 5.4.8 of 2008 edition);

—In the test method of the nitric acid resistance, modified the test requirements of temperature and humidity(See subclause 5.4.10, subclause 5.4.9 of 2008 edition);

—In the test method of the mortar resistance, modified "pulverized lime" as "pulverized lime specified in JC/T 479", modified "standard sand" as "sand specified in GB/T 14684"(See subclause 5.4.11.1, subclause 5.4.10 of 2008 edition);

—In the test methods of the salt spray corrosion resistance, added "the line width is 1 mm" (See

subclause 5.4.14);

—Modified the requirement of batch(See subclause 6.2, subclause 6.2 of 2008 edition);

—Added the classification of inspection(See subclause 6.3);

—Modified the regulations of inspection clauses(See subclause 6.4, subclause 6.3 of 2008 edition);

—Modified the regulations of sampling(See subclause 6.5, subclause 6.4 of 2008 edition);

—Modified the judgment for test result(See subclause 6.6, subclause 6.5 of 2008 edition);

—Modified the regulations of the Marking(See subclause 7.1.1, subclause 7.1 of 2008 edition);

—Modified the content requirements of quality certificate(See subclause 7.4, subclause 7.5 of 2008 edition);

—Modified the content requirements of order (or contract)(See clause 8, clause 8 of 2008 edition);

—Added the content requirements of quality assurance(See Annex A);

—Added bibliography(See bibliography).

This part was proposed by China Nonferrous Metals Industry Association.

This part was prepared by SAC/TC 243 State Administration of China for Standardization of Nonferrous Metals.

The previous editions of GB/T 5237.5 are as follows:

—GB/T 5237.5—2000, GB 5237.5—2004, GB/T 5237.5—2008.

Wrought aluminium alloy extruded profiles for architecture— Part 5: Paint coating profiles

1 Scope

This part of GB/T 5237 specifies the terms, definitions, requirements, test methods, conformity with standards, packaging, marking, transporting, storing, quality certificate and contents of contract (or order) of wrought aluminum alloy extruded profiles with liquid coating[1)] for architecture.

This part is applicable to electrostatic spraying wrought aluminium alloy extruded profiles with organic solvent or aqueous solvent polyvinylidene fluoride (PVDF) coating (hereafter referred to as the profiles).

Wrought aluminium alloy extruded profiles with the same surface treatment and of the same use for other industries may also refer to this part.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 1732, *Determination of impact resistance of films*

GB/T 1740, *Determination of resistance to heat and humidity of paint films*

GB/T 1766, *Method of evaluation of degradation (both exterior and accelerated) of paint films*

GB/T 1865—2009, *Paints and varnishes—Artificial weathering and exposure to artificial radiation—Filtered xenon-arc radiation*

GB/T 3199, *Wrought aluminum and aluminum alloy products—Packing, marking, transporting and storing*

GB/T 4957, *Non-conductive coatings on non-magnetic metal substrates—Measurement of coating thickness—Eddy current method*

1) The paint coating in this document only include liquid coating.

GB/T 5237.1, *Wrought aluminum alloy extruded profiles for architecture—Part 1: Mill finish profiles*

GB/T 5237.2, *Wrought aluminum alloy extruded profiles for architecture—Part 2: Anodized profiles*

GB/T 6682, *Water for analytical laboratory use—Specification and test methods*

GB/T 6739, *Paints and varnishes—Determination of film hardness by pencil test*

GB/T 8005.3, *Aluminum and aluminum alloy—Terms and definitions—Part 3: Surface treatment*

GB/T 8013.3, *Anodic oxide coatings and organic polymer coatings on aluminum and its alloys—Part 3: Organic polymer coatings*

GB/T 9276, *Methods of exposure to outdoor weathering of coating*

GB/T 9286, *Paints and varnishes—Cross test for films*

GB/T 9754, *Paints and varnishes—Determination of specular gloss of non-metallic paint films at 20°, 60° and 85°*

GB/T 9761, *Paints and varnishes—Visual comparison of the color of paints*

GB/T 10125, *Corrosion tests in artificial atmospheres salt spray tests*

GB/T 11186.2, *Methods for measuring the color of paint films—Part 2: Color measurement*

GB/T 11186.3, *Methods for measuring the color of paint films—Part 3: Calculation of color difference*

GB/T 14684, *Sand for construction*

GB/T 17671, *Method of testing cements—Determination of strength*

JC/T 479, *Building quicklime*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in GB/T 8005.3 and the following apply.

3.1
exposed surfaces

visible surfaces of profiles after they are machined, assembled and installed in the architecture, inclu-

ding opened or closed status

4 Requirements

4.1 Classification

4.1.1 Alloy, temper and dimension

The alloy, temper and dimension shall be in accordance with the requirements given in GB/T 5237.1.

4.1.2 Coating type, coating code, coating composition, coating characteristics and the corresponding application environment

Coating type, coating code, coating composition, coating characteristics and the corresponding application environment are shown in Table 1.

Table 1—Coating type, coating code, coating composition, coating characteristics and corresponding application environment

coating type	coating code[a]	coating composition	coating characteristics and corresponding application environment
two-layer	LF2-25	primer and topcoat	Usually two-layercoating systems are the coating with solid color or pearlescent effect by mica, which doesn't need the protection of varnish. Two-layer coating applies to the environment with strong solar radiation and atmospheric corrosion
three-layer	LF3-34	primer, topcoat and varnish	Usually three-layer coating systems are the coating with metallic effect and the topcoat used milled aluminium flakes. The metallic effect is different from two-layer coating systems containing mica. Because aluminium flakes is easy to be oxided or peel off and the surface of coating needs protection of varnish to assure comprehensive performance. Metallic aluminium flakes paint is seldom used in two-layer coating system. Three-layer applies to the environment with comparatively strong solar radiation and atmospheric corrosion
four- layer	LF4-55	primer, barrier coat, topcoat and varnish	Four-layer coating systems have metallic effect with higher performance requirement. The four-layer is based on the three coating system with added the barrier coat to improve the UV resistance. Four-layer coating applies to the environment with extremely strong solar radiation and atmospheric corrosion
NOTE Table A.2 shows the characteristics of primer, barrier coat, topcoat and varnish.			
[a] "LF" in coating code means spray coating, the first number next "LF" means coat type, the suffix behind "-"means the minimum local film thickness.			

4.1.3 Marking and example

The marking of products shall be expressed in the order of product name, the standard number of this part, alloy, temper, profile reference number and length, color (or color code), coating code. Examples of marking are listed as follows:

EXAMPLE 1

Aluminum profiles , which are made of alloy 6063, temper T5, reference No. (section code) YST10002, with specific length 4 000 mm , color code 2345, four-layer PVDF coating are marked as:

Liquid coating profiles GB/T 5237.5-6063T5- YST10002×4 000 color2345 LF4-55

EXAMPLE 2:

Aluminum profiles, which are made of alloy 6063, temper T5, reference No. (section code) YST10002, with specific length 4 000 mm, red, two-layer PVDF coating are marked as:

Liquid coating profiles GB/T 5237.5-6063T5- YST10 002×4 000 color Red LF2-25

4.2 Quality assurance

4.2.1 Process

Process assurance see A.1.

4.2.2 Raw material

The quality requirements of mill finish profiles, and pretreatment chemical agent and polyvinylidene fluoride paint see A.2.

4.3 Chemical composition

The chemical composition shall be in accordance with the requirements given in GB/T 5237.1.

4.4 Mechanical properties

The mechanical properties shall be in accordance with the requirements specified in GB/T 5237.1.

4.5 Dimension tolerance

Dimension tolerance of profiles shall be in accordance with the requirements given in GB/T 5237.1, after removing the coating layer, the change of the dimension caused by the coating thickness shall not affect assembly and use of profiles.

4.6 Performances of coating

4.6.1 Coating thickness

4.6.1.1 The coatings thickness on exposed surface shall be in accordance with the requirements given in Table 2.

Table 2—Coating thickness

coating type	average thickness μm	local thickness[a] μm
two-layer	≥30	≥25
three-layer	≥40	≥34
four-layer	≥65	≥55

[a] Due to the complexity of the cross sections shape, it is allowable that the local thickness of some surface (such as internal angles, channel sections, etc.) is less than the provision values in Table 2. But foundation exposing is not allowed.

4.6.1.2 If the non-exposed surfaces have coating thickness requirements, it shall be agreed by the supplier and the purchaser, and indicated in the order (or contract).

4.6.2 Gloss

The gloss value of the coating shall be in accordance with the order (or contract). The permissible deviation is ±5 units.

4.6.3 Color difference

The color shall be basically consistent with the sample agreed by the supplier and the purchaser. When measured by instrumental test, the color difference between the solid color coating and the sample must be $\Delta E^*_{ab} \leqslant 1.5$ and the color difference between profiles in the same batch (batch to be delivered) must be $\Delta E^*_{ab} \leqslant 1.5$.

4.6.4 Hardness

After pencil scratch test, the hardness of the coating shall not be less than 1H.

4.6.5 Adhesion

Dry adhesion, wet adhesion and boiling water adhesion of the coating shall meet grade 0.

4.6.6 Boiling water resistance

After the high pressure water immersion test, the coating surface shall not exist detachment, wrinkle, blisters, gloss loss, color change and other defects, and adhesion shall meet grade 0.

4.6.7 Impact resistance

After impact resistant test, slightly cracking is acceptable. But, detachment is not allowed.

4.6.8 Abrasion resistance

After sand-falling test, abrasion coefficient shall not be less than 1.6 L/μm.

4.6.9 Hydrochloric acid resistance

After the hydrochloric acid resistance test, the coating surface shall not exist any blister and other obvious changes.

4.6.10 Nitric acid resistance

After the nitric acid resistance test, color difference of solid color coating shall be $\Delta E^*_{ab} \leqslant 5.0$.

4.6.11 Mortar resistance

After the mortar resistance test, the coating surface shall not exist any detachment and other obvious changes.

4.6.12 Solvent resistance

After the solvent resistance test, base material shall not be exposed.

4.6.13 Detergent resistance

After the detergent resistance test, the coating surface shall not exist any blister, detachment and other obvious changes.

4.6.14 Salt-spray corrosion resistance

After the salt spray corrosion resistance test, the length of any single infiltration shall not exceed 2.0 mm. There shall be no corrosion on the coating surface beyond 2.0 mm both sides of the lineation.

4.6.15 Humidity resistance

After the humidity resistance test, the comprehensive damage grade of the coating surface shall be

meet grade 1.

4.6.16 Weathering resistance

4.6.16.1 Accelerated weathering resistance

After the accelerated weathering resistance test, the gloss retention (percentage of the coating gloss value after test to that before test) shall be no less than 75%, color difference shall be $\Delta E^*_{ab} \leqslant 3.0$ and chalking grade shall be meet grade 0.

4.6.16.2 Natural exposure resistance

If the natural exposure resistance is required by the customer, it shall be specified in the order (or contract). After 10 years of natural exposure test (for different atmospheric corrosion test station setting different test time, but no less than 10 years), the gloss retention (percentage of the coating gloss value after test to that before test) shall be no less than 50%, color difference shall be $\Delta E^*_{ab} \leqslant 5.0$ and coating thickness loss shall be no more than 10%.

4.6.17 Others

If other performance is required by the customer, it shall be subject to agreement between the supplier and the purchaser according to GB/T 8013.3, and it shall be specified in the order (or contract).

4.7 Appearance

The coating on the exposed surfaces shall be smooth and uniform. Flows, wrinkle, blister, detachment or other defects are not allowed.

5 Test methods

5.1 Chemical composition

The chemical composition analysis shall be in accordance with GB/T 5237.1. The coating of the specimen shall be removed before test.

5.2 Mechanical property

The mechanical property test shall be in accordance with GB/T 5237.1. The coating of the specimen shall be removed before test.

5.3 Dimension tolerance

The dimension tolerance test shall be in accordance with GB/T 5237.1. The coating of the specimen

shall be removed before test.

5.4 Performances of coating

5.4.1 Coating thickness

The coating thickness test shall be in accordance with GB/T 4957, The average value of the 5 local coating thickness is recorded as the average coating thickness of the film to be measured.

5.4.2 Gloss

The gloss test shall be in accordance with GB/T 9754. It shall be carried out with determination at angel of 60°.

5.4.3 Color difference

5.4.3.1 Visual method

The visual method shall be carried out in accordance with GB/T 9761.

5.4.3.2 Instrumental measurement method

It is the referee test that shall be in accordance with GB/T 11186.2 and GB/T 11186.3 by using colorimeter.

5.4.4 Hardness

The hardness test shall be in accordance with GB/T 6739. The test result shall be judged by the scratches of the surface.

5.4.5 Adhesion

5.4.5.1 Dry adhesion

5.4.5.1.1 Make cross-cut in accordance with GB/T 9286, the cross-cut parallel spacing is 1 mm.

5.4.5.1.2 Cover the cut area of the specimen surface with adhesive tape[2)] which has adhesive power of 10 N/25 mm (or more). Press the tape firmly to eliminate air bubbles, and take the tape off perpendicularly from the specimen immediately. Then evaluate the adhesion of coating according to GB/T 9286.

2) The adhesive tape of Scotch 610 or Permacel 99 are the suitable examples in the market. It is just to offer more convenience to the user of this part instead of showing the recognition.

5.4.5.2 Wet adhesion

Make cross-cut in accordance with 5.4.5.1.1, and immerse specimen in 38 ℃ ±5 ℃ water of class 3 specified in GB/T 6682 for 24 h. Take the specimen out and wipe it dry. Then test and evaluate the specimen in 5 min according to 5.4.5.1.2.

5.4.5.3 Boiling water adhesion

5.4.5.3.1 Make cross-cut in accordance with 5.4.5.1.1.

5.4.5.3.2 Add water of class 3 specified in GB/T 6682 to a depth of about 80 mm in the beaker, and add 2 or 3 clean ceramic chips. Then heat at the bottom of beaker until the water boils.

5.4.5.3.3 Immerse specimen in the boiling water and keep 20 min, keeping it at a position of 10 mm below the surface of water, but not contacting the bottom of beaker. During the test the temperature of water shall be no less than 95 ℃ and the depth of water shall be maintained no less than 80 mm by the addition of water of class 3 specified in GB/T 6682 at any moment.

5.4.5.3.4 Take the specimen out and wipe it dry. Then test and evaluate the specimen in 5 min according to 5.4.5.1.2.

5.4.6 Boiling water resistance

Add water of class 3 specified in GB/T 6682 to a depth of about 80 mm into the autoclave, immerse about 50 mm long specimen in the water vertically, 10 mm below the water without contacting the bottom of the container, heat water to the pressure up to 0.1 MPa ± 0.01 MPa and keep 1 h with constant pressure, take out and wipe specimen dry, inspect the film surface change visually, adhesion test and rating is carried out according to 5.4.5.1 after specimen is taken out 5 min later.

5.4.7 Impact resistance

5.4.7.1 Method of making the standard test panels: select pure aluminum sheet with the dimension of 150 mm × 75 mm × 1.0 mm, the temper of H24 or H14, with the batch number of profiles using the same processes and curing in the same production line then condition the panel for 24 h.

5.4.7.2 Impact resistance test shall be in accordance with GB/T 1732, and the impactor diameter is 16 mm ± 0.3 mm. Let the impactor (1 000 g ± 5 g) fall freely at a certain height to impact the coated side (direct impact) and the depth of concave area shall be 2.5 mm ± 0.3 mm. Cover the cut concave area of the specimen surface with adhesive tape which has adhesive power of 10 N/25 mm (or more). Press the tape firmly with finger to eliminate air bubbles, and take the tape off perpendicularly from the specimen immediately, inspect the change of the coating of the concave and the circumambience visually.

5.4.8 Abrasion resistance

Sand falling abrasion test shall be in accordance with GB/T 8013.3, and the abrasive shall be standard sand in accordance with GB/T 17671.

5.4.9 Hydrochloric acid resistance

Prepare hydrochloric acid solution mixed with analytically pure hydrochloric acid (ρ = 1.19 g/mL) and water of class 3 specified in GB/T 6682 with the volume proportion of 1 : 9. Drop ten drops of hydrochloric solution on the coating surface of specimen and cover it with watch glass. Keep it at 18 ℃—27 ℃ for 15 min. At the end of test, rinse the specimen with tap water and make it dry at the end of test. Then visually inspect the surface of coating.

5.4.10 Nitric acid resistance

Fill 100 mL analytically pure HNO_3 (ρ = 1.40 g/mL) into a 200 mL wide-mouth bottle. Place the specimen on the mouth of the bottle with coated side downward for 30 min, remove the specimen and rinse with tap water and wipe it dry, visually inspect the surface of coatings after one-hour recovery. Test temperature is 18 ℃—27 ℃ and humidity is less than 50%.

5.4.11 Mortar resistance

5.4.11.1 Mix 75 g architectural quicklime specified in JC/T 479 and 225 g construction sand specified in GB/T 14684, then add 100 g water of class 3 specified in GB/T 6682 to make pasty mortar.

5.4.11.2 Put pasty mortar on the specimen surface, heap it up to make cylindrical shape with the size of Φ 15 mm × h 6 mm. Then keep it at 38 ℃ ± 3 ℃ and relative humidity 95% ± 5% for 24 h.

5.4.11.3 Remove the mortar and erase the residue on the surface with wet cloth and make it dry. Visually inspect the coating surface after test.

5.4.12 Solvent resistance

At room temperature, wipe on the sample surface along a straight path 100 times at a return rate of once per second (one back and forth is defined as once), with a 1 kg heavy hammer wrapped with at least six layers of medical gauze absorbed butanone (contact area of the head of hammer and the surface of the sample is about 150 mm^2). Keep the gauze wet during the test. Inspect visually the surface of the coating after test.

5.4.13 Detergent resistance

5.4.13.1 Prepare test solution (30 g/L) with detergent whose compositions are shown in Table 3 and water of class 3 specified in GB/T 6682. Place the specimen in the detergent solution at 38 ℃ ± 1 ℃ for

72 h, and then take the specimen out and wipe them dry.

Table 3—Detergent composition

composition	mass fraction %
tetrasodium pyrophosphate	53
sodium sulphate anhydyous	19
sodium linear alkylarylsulfonate	20
sodium metasilicate hydrated	7
sodium carbonate anhydrous	1
totals	100

5.4.13.2 Cover the specimen surface with adhesive tape which has adhesive power of 10 N/25 mm (or more). Press the tape firmly to eliminate air bubbles, and take the tape off perpendicularly from the specimen immediately, inspect visually the surface of coatings after the test.

5.4.14 Salt spray corrosion resistance

5.4.14.1 Make a cross-cut incision deep into the substance along the opposite angle of specimen, the width is 1 mm and the distance between end-point of each incision and corresponding angle shall be equal. Then 4 000 h NSS test shall be carried out according to GB/T 10125.

5.4.14.2 Measure the infiltration of each side of the lineation. Check whether there is corrosion on coating surface beyond 2.0 mm both sides of the lineation.

5.4.15 Humidity resistance

Humidity resistance test shall be in accordce with GB/T 1740, the test temperature is 47 ℃ ±1 ℃, and the test time is 4 000 h.

5.4.16 Weathering resistance

5.4.16.1 Accelerated weathering resistance

Xenon-arc exposure test shall be in accordance with circle A of method 1 given in GB/T 1865—2009 for 4 000 h. Measure the gloss according to GB/T 9754. Measure the color difference value before and after the test according to GB/T 11186.2, GB/T 11186.3, and evaluate the chalking grade according to GB/T 1766.

5.4.16.2 Natural exposure resistance

Ten years natural exposure test shall be in accordance with GB/T 9276. The gloss value and color difference shall be according to 5.4.16.1. The average coating thickness before/after testing shall be

test in accordance with 5.4.1 and calculate the thickness loss by formula (1).

NOTE Many countries choose Florida atmospheric corrosion test station for natural exposure. In the stations for atmospheric corrosion test in China, atmosphere condition in Florida is closer to the atmospheric corrosion test station in Qionghai Station, Hainan province, but there are some differences between the test results in the atmospheric corrosion test station in Qionghai, Hainan province and Florida.

$$\Delta\delta = (\delta_1 - \delta_2)/\delta_1 \times 100 \qquad \cdots\cdots(1)$$

where

$\Delta\delta$ is the thickness loss (%);

δ_1 is the average coating thickness value before test(μm);

δ_2 is the average coating thickness value after test(μm).

5.4.17 Others

The tests of other properties shall be carried out in accordance with GB/T 8013.3 or shall be agreed by the supplier and the purchaser.

5.5 Appearance

The appearance test shall be in accordance with GB/T 12967.6 and carried out under the diffuse sunshine (3 h after sunrise and 3 h before sunset). If the test is carried out under artificial light with standard light source D65, the illumination shall be stronger than 1 000 lx. The background shall be matt black or grey and colorful background is forbidden. The observation distance is 3 m with 90° determination angle.

6 Conformity with standards

6.1 Inspection and acceptance

6.1.1 The profiles shall be inspected by the supplier, ensuring the product quality in accordance with the specification of this standard or the order (or contract), and filling in the product quality assurance certificate.

6.1.2 The purchaser may re-check the received products according to this part. If the result is not in accordance with the specification of this part and the order (or contract), purchaser may inform supplier in a written form, and the problem may be solved through consultation by both sides. The disapproval of the appearance quality and tolerance on dimensions shall be raised within 1 month after

products being received. The disapproval of other properties may be raised within 6 months after products being received. If arbitration inspection is required, the inspection organization shall be agreed by the supplier and purchaser, the arbitration specimens will be supplied by supplier and the arbitration will be preceded between supplier and purchaser.

6.2 Batch

The profiles shall be inspected for acceptance in batches, and each batch shall be consisted of profiles with the same alloy, temper, dimension (or section code), coating color, coating type, component mass fraction and the surface treatment. There is no limit for batch weight.

6.3 Inspection classification

Product inspection includes delivery inspection and routine inspection.

6.4 Inspection item and process assurance item

6.4.1 Delivery inspection item, routine inspection item and process assurance item shall be in accordance with Table 4.

Table 4—Inspection items and process assurance items

inspection items	delivery inspection items	routine inspection items	process assurance items
chemical composition	√	—	—
mechanical properties	√	—	—
dimensions tolerance	√	—	—
coating thickness	√	—	—
gloss	√	—	—
color difference	√	—	—
hardness	√	—	—
adhesion	√	—	—
boiling water resistance	√	—	—
impact resistance	√	—	—
abrasion resistance	[a]	√	√
hydrochloric acid resistance	√	—	—
nitric acid resistance	[a]	√	√
mortar resistance	√	—	—

Table 4 (*continued*)

inspection items		delivery inspection items	routine inspection items	process assurance items
solvent resistance		[a]	√	√
detergent resistance		[a]	√	√
salt-spray corrosion resistance		[a]	√	√
humidity resistance		[a]	√	√
weathering resistance	accelerated weathering resistance	[a]	√	√
	natural exposure resistance	[a]	—	√
other film properties		[a]	—	—
appearance		√	—	—
NOTE "√" indicates the necessary corresponding inspection item or process assurance item, "—" indicates the unnecessary corresponding inspection item or process assurance item.				
[a] Indicates the necessary corresponding inspection item when specified in the order (or contract).				

6.4.2 Routine inspection shall be carried out at least once every three years by the supplier.

6.5 Sampling

Sampling shall be in accordance with Table 5.

Table 5—Sampling

inspection items		sampling specification	subclauses of requirement	subclauses of test method
chemical composition		According to GB/T 5237.1	4.3	5.1
mechanical property			4.4	5.2
dimension tolerance		Inspect piece by piece	4.5	5.3
coating thickness		According to Table 6	4.6.1	5.4.1
gloss		Take 2 pieces in every batch, and one specimen of one piece after the coatings have cured for 24 h	4.6.2	5.4.2
color difference		Inspect piece by piece	4.6.3	5.4.3
hardness		Take 2 pieces in every batch, and one specimen of one piece after the coatings have cured for 24 h	4.6.4	5.4.4
adhesion	dry adhesion		4.6.5	5.4.5
	wet adhesion			
	boiling water adhesion			
boiling water resistance			4.6.6	5.4.6

Table 5 (*continued*)

inspection items		sampling specification	subclauses of requirement	subclauses of test method
impact resistance		Making 2 standard test plate	4.6.7	5.4.7
abrasion resistance		Take 2 pieces in every batch, and one specimen of one piece after the coatings have cured for 24 h	4.6.8	5.4.8
hydrochloric acid resistance		Take 2 pieces in every batch, and one specimen of one piece after the coatings have cured for 24 h	4.6.9	5.4.9
nitric acid resistance		Take 2 pieces in every batch, and one specimen of one piece after the coatings have cured for 24 h	4.6.10	5.4.10
mortar resistance		Take 2 pieces in every batch, and one specimen of one piece after the coatings have cured for 24 h	4.6.11	5.4.11
solvent resistance		Take 2 pieces in every batch, and one specimen of one piece after the coatings have cured for 24 h	4.6.12	5.4.12
detergent resistance			4.6.13	5.4.13
salt-spray corrosion resistance			4.6.14	5.4.14
humidity resistance			4.6.15	5.4.15
weathering resistance	accelerated weathering resistance		4.6.16.1	5.4.16.1
	natural exposure resistance	Take 3 pieces in every batch, and one specimen from each piece. With the agreement of customer, the supplier can make 3 test plates instead of the profile samples with the same thickness class, color, surface treatment method and technology. The effective surface size (length × width) of the sample (or test plate) is suitable for 250 mm × 150 mm	4.6.16.2	5.4.16.2
other coating properties		According to GB/T 8013.3, or other sampling specifications agreed by the customer and supplier	4.6.17	5.4.17
appearance		piece by piece	4.7	5.5

Table 6—Coating thickness sampling and upper limit for failed quantity

In piece

batch quantity	randomly sampling quantity	upper limit for failed quantity
1—10	all	0
11—200	10	1
201—300	15	1

Table 6 (*continued*) In piece

batch quantity	randomly sampling quantity	upper limit for failed quantity
301—500	20	2
501—800	30	3
>800	40	4

6.6 Rejection and retest

6.6.1 When any specimen failed in chemical composition, the corresponding casting batch is unqualified, the others should be inspected in terms of casting batch and deliver the qualified batch. If the casting batch cannot be distinguished, the whole testing batch is unqualified.

6.6.2 When any specimen failed in mechanical property, double specimens should be taken from the same batch and be tested again. If the retest result is qualified, the whole batch is qualified. If any specimen failed in the second test, the whole batch failed. But after the discussion between the customer and the supplier, the supplier is allowed to check the others in the same batch piece by piece and deliver the qualified ones to the customer.

6.6.3 The whole batch is unqualified when any specimen failed in dimensions tolerance. But supplier is allowed to check the others of the same batch piece by piece and deliver qualified ones to the buyer.

6.6.4 If the quantity of the unqualified coatings thickness exceeds the upper limit as shown in Table 6, double specimens shall be taken from the same batch to test again. If the quantity of the failed coatings thickness of the retest is less than twice of the upper limit as shown in Table 6, the whole batch is qualified, otherwise the whole batch failed. Especially, with the agreement of the customer, it is allowed to check the others in the same batch piece by piece and deliver qualified ones.

6.6.5 The whole batch is unqualified when any specimen failed in gloss.

6.6.6 This piece is unqualified when any specimen failed in color difference.

6.6.7 The whole batch is unqualified when any specimen failed in hardness.

6.6.8 The whole batch is unqualified when any specimen failed in adhesion.

6.6.9 The whole batch is unqualified when any specimen failed in boiling water resistance.

6.6.10 The whole batch is unqualified when any specimen failed in impact resistance.

6.6.11 The whole batch is unqualified when any specimen failed in abrasion resistance.

6.6.12 The whole batch is unqualified when any specimen failed in hydrochloric acid resistance.

6.6.13 The whole batch is unqualified when any specimen failed in nitric acid resistance.

6.6.14 The whole batch is unqualified when any specimen failed in mortar resistance.

6.6.15 The whole batch is unqualified when any specimen failed in solvent resistance.

6.6.16 The whole batch is unqualified when any specimen failed in detergent resistance.

6.6.17 The whole batch is unqualified when any specimen failed in salt spray corrosion resistance.

6.6.18 The whole batch is unqualified when any specimen failed in humidity resistance.

6.6.19 The whole batch is unqualified when any specimen failed in weathering resistance.

6.6.20 The whole batch is unqualified when any specimen failed in other coating properties.

6.6.21 This piece is unqualified when any specimen failed in appearance quality.

6.6.22 If the routine inspection results are not acceptable, the reassessment shall be performed for the quality of the mill finish profiles, PVDF paint quality, and the production process. And the re-inspection should be carried out until qualified.

7 Marking, packaging, transporting, storing and quality certificate

7.1 Marking

7.1.1 Product marking

The qualified products shall be marked with the following content (or have label with the following contents):

a) name and address of supplier;

b) product name;

c) inspection stamp of supplier's quality control department (or signature or seal of quality inspection personnel);

d) alloy, temper and dimension (or section code);

e) coating code, color (or color code);

f) batch number or production date;

g) the standard number of this part;

h) production license number and QS mark.

7.1.2 Packaging box marking

The Packaging box marking of the profiles shall be in accordance with GB/T 3199.

7.2 Packaging

The exposed surface of profiles shall be protected by materials such as paper and foam; other packing shall be in accordance with GB/T 3199.

7.3 Transporting and storing

The transporting and storing of profiles shall be in accordance with GB/T 3199. The protection measures for profiles during transporting and usage see GB/T 5237.2.

7.4 Quality certificate

Any batch of profiles shall be attached with quality certificate, with following content:

a) supplier name;

b) product name;

c) alloy, temper and dimension (or section code);

d) coating code, color (or color code);

e) batch number or production date;

f) weight or pieces;

g) test results and inspection stamp of the supplier's quality control department;

h) the standard number of this part;

i) production license number.

8 Order (or contract) content

Purchasing order (or contract) for the profiles involved in this part shall include the following contents:

a) name of supplier;

b) product name;

c) alloy, temper and dimension (or section code);

d) tolerance class;

e) gloss of coating, coating code, color (or color code);

f) weight or total number;

g) special requirements from purchaser:

—the test requirement of abrasion resistance;

—the test requirement of hydrochloric acid resistance;

—the test requirement of nitric acid resistance;

—the test requirement of mortar resistance;

—the test requirement of solvent resistance;

—the test requirement of detergent resistance;

—the test requirement of salt spray corrosion resistance;

—the test requirement of humidity resistance;

—the test requirement of accelerated weathering resistance;

—the test requirement of natural exposure resistance;

—the special requirements of coating thickness;

—the special requirements of packaging;

—other special requirement;

h) the standard number of this part.

Annex A
(informative)
Quality assurance

A.1 Process assurance

Technical process has a great effect on coating properties. To ensure the coating quality, technical process should be carried out according to YS/T 714. The quality of chromate-free conversion coating shall be in accordance with YS/T 1189, and it shall be carried out according to YS/T 1189.

A.2 Quality assurance of raw material

A.2.1 Mill finish profiles

Quality of mill finish profiles shall be in accordance with GB/T 5237.1.

A.2.2 Chromate-free chemical pretreatment reagent

Chromate-free chemical pretreatment reagent shall be in accordance with YS/T 1189.

A.2.3 PVDF paint

A.2.3.1 PVDF paint types, main components, characteristics and requirements

PVDF paint types, main components, characteristics and requirements are shown in Table A.1.

Table A.1—PVDF paint types, main components, characteristics and requirements

paint types	main components		characteristics and requirements
organic solvent type and aqueous solvent type	resin	poly vinylidene difluoride ("PVDF resin")	PVDF paints are mainly composed of PVDF resin. PVDF resin is made through polymerization of VDF monomers. It contains 59.3% of fluorine. Because the chemical-bond energy of C-F in its molecular structure is relatively high, PVDF resin has excellent weathering resistance and chemical stability. FEVE resin is another kind of thermosetting fluorocarbon resin. It contains 27% to 29% of fluorine with thermosetting temperature of 160 ℃. It doesn't belong to the resin selection scope of this standard
		acrylic resin	Acrylic resin offers gloss, hardness and adhesion which coating needs
		epoxy resin	Epoxy resin improves the coating adhesion

Table A.1 (*continued*)

paint types	main components		characteristics and requirements
organic solvent type and aqueous solvent type	pigment		It should choose inorganic mineral materials, ball grinding aluminum flakes and pearlescent mica as pigments. Organic pigments have poor weathering resistance, which are not recommended
	solvent	organic solvent	Solvent-based PVDF needs a certain amount of organic solvents to be diluted during spraying production; while water-based PVDF use water as main liquid component and only contains few organic solvents, which is more environment-friendly to the production
		water	

A.2.3.2 Fluorocarbon coating usage, coating and paint characteristics and control requirements

Fluorocarbon coating usage, coating and paint characteristics and control requirements are shown in Table A.2.

Table A.2—Fluorocarbon coating usage, coating and paint characteristics and control requirements

coating application	coating characteristics	coating characteristics and requirements
primer	Primer is mainly used to improve adhesion between fluorocarbon coating films and aluminum substrates, so primer shall have good adhesion to aluminum substrates and topcoat film both. The dry film thickness of primer shall be controlled between 5 μm and 8 μm	The primer resin generally contains PVDF resin, acrylic resin and epoxy resin which respectively accounts for approximately 30%, 68%—70% and 1%—2% of total resins. Primer normally includes white color and grey color
barrier coat	Barrier coat is mainly used to reduce the chalking of epoxy resin in primer and improve the coating film adhesion. The dry film thickness of barrier coat shall be no less than 25 μm	Barrier coat is usually white color which has the same components as topcoat
topcoat	Topcoat mainly contribute the decorative effect and weathering resistance of fluorocarbon coating film. Topcoat shall ensure the adhesion to primer, barrier coat or clear coat. The dry film thickness of topcoat shall be no less than 25 μm	Topcoat normally include solid color and metallic color containing aluminum flakes or mica, in which aluminum flake is commonly used. Aluminum flakes shall choose ball-grinding aluminum flakes made by nitrogen atomization. Encapsulation treatment (generally silicon dioxide or resin) of aluminum flakes or mica will improve the acid & alkaline resistance of the coating film. Waterproof treatment shall be considered for aluminum flakes used in water-based fluorocarbon coating. The whole resin components include approximately 70% PVDF resin and 30% acrylic resin, which offer the best comprehensive performance

Table A.2 (*continued*)

coating application	coating characteristics	coating characteristics and requirements
varnish	Varnish offers the protection to topcoat and additional weathering resistance and anti-pollution capacity. The dry film thickness of clear coat is normally between 10 μm and 13 μm	clear coat is also called finishing varnish. The whole resin components of clear coat include around 70% of PVDF resin,30% of acrylic resin

A.2.3.3 Hazardous substances limitation

The limits to hazardous substances in fluorocarbon coatings (except special exotic colors) see Table A.3.

Table A.3—Limits to harmful substances in fluorocarbon coating

harmful substance	mass fraction
polybrominated biphenyls (PBB)	≤0.1%
polybrominated diphenyl Ethers (PBDE)	≤0.1%
diethylhexyl phthalate (DEHP)	≤0.1%
butyl benzyl phthalate (BBP)	≤0.1%
dibutyl phthalate (DBP)	≤0.1%
diisobutyl phthalate (DIBP)	≤0.1%
dissoluble Lead (Pb)	≤90 mg/kg
dissoluble cadmium (Cd)	≤75 mg/kg
dissoluble chromium (Cr)	≤60 mg/kg
dissoluble mercury (Hg)	≤60 mg/kg

A.2.3.4 Fluorocarbon coating Materials Safety Data Sheet

Fluorocarbon coating manufacturer shall provide Material Safety Data Sheet (MSDS) of their fluorocarbon coating.

A.2.3.5 Fluorocarbon coating quality certificate

To ensure the quality reliability of fluorocarbon coating,aluminum profile manufacturers shall discuss the contents of quality warranty with fluorocarbon coating supplier. The quality certificate shall at least include:

a) density;

b) fineness;

c) viscosity;

d) solid content;

e) pigment type;

f) PVDF resin percentage in resin component;

g) volatile organic compounds (VOC) content;

h) salt spray testing result, impact resistance testing result of the coating;

i) resin manufacturer name, resin batch number and model number;

j) the natural exposure test result (color difference, gloss retention and chalking grade shall be included) of solid color coating and metallic color coating which are produced based on standard formulation.

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[1] YS/T 714, *Technical specfication for organic polymer spraying on worught aluminuium alloy extuded profiles for architecture*

[2] YS/T 1189, *Chromium-free chemical pre-coatings aluminum and its allloys*

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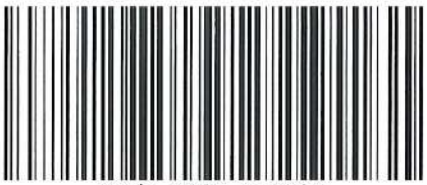

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