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Wrought aluminum and aluminum alloys extruded profiles for general engineering

一般工业用铝及铝合金挤压型材

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Wrought aluminum and aluminum alloys extruded profiles for general engineering

1 Scope

This document specifies the product classification, technical requirements, test methods, inspection rules, signs, packaging, transportation, storage, quality certificates and order forms (or contracts) of wrought aluminum and aluminum alloys extruded profiles for general engineering.

This document is suitable for aluminum and aluminum alloy profiles for general engineering (hereinafter referred to as profiles).

2 Normative references

The provisions in following documents become the provisions of this Standard through reference in this Standard. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) is applicable to this standard.

GB/T 231.1 Metallic materials - Brinell hardness test - Part 1: Test method

GB/T 232 Metallic materials - Bend test

GB/T 3190 Chemical composition of wrought aluminium and aluminium alloys

GB/T 3199 Wrought aluminium and aluminium alloy products - Packing, marking, transporting and storing

GB/T 3246.1 Inspection method for structure of wrought aluminum and aluminum alloy products - Part 1: Inspection method for microstructure

GB/T 3246.2 Inspection method for structure of wrought aluminum and aluminum alloy products - Part 2: Inspection method for macrostructure

GB/T 3251 Compression test method for aluminium and aluminium alloy products

GB/T 5237.2 Wrought aluminium alloy extruded profiles for architecture - Part 2: Anodized profiles

GB/T 5237.3 Wrought aluminium alloy extruded profiles for architecture - Part 3: Electrophoretic coating profiles

GB/T 26492.5 Defects for wrought aluminium and aluminium alloys ingots and products - Part 5: Defects for tubes, rods or bars, profiles, wires

GB/T 32790 Methods for evaluating the weld quality of seam welds in aluminium and aluminium alloy extrusion

GB/T 34487 Shear testing method of aluminium alloy products for structural members

GB/T 37616 Aluminium alloys extruded profiles-axial force controlled fatigue testing method

GB/T 42914 Test method for fracture toughness of aluminium alloy products

GB/T 42916 Identification marking of aluminium and aluminium alloy products

JJG 475 Verification regulation of electronic universal testing machine

YS/T 1630.1-2023 Aviation aluminum alloy pipe, rod, profile - Part 1: 7050 aluminum alloy profile

ISO 15614-2 Specification and qualification of welding procedures for metallic materials - Welding procedure test - Part 2: Arc welding of aluminum and its alloys

ISO 25239-4 Friction stir welding - Aluminum - Part 4: Specification and qualification of welding procedures

3 Terms and definitions

The terms and definitions, which are defined in GB/T 8005.1 and GB/T 26492.5, are applicable to this document.

4 Product classification

4.1 Composition category

The profile is divided into category I and II, according to the composition, as shown in Table 1.

7 Inspection rules

7.1 Inspection and acceptance

7.1.1 The product shall be inspected by the supplier, to ensure that the product quality complies with the provisions of this document and the order form (or contract), meanwhile a quality certificate shall be filled out.

7.1.2 The purchaser shall inspect the received products, in accordance with the provisions of this document. If the inspection results are inconsistent with the provisions of this document and the order form (or contract), it shall be submitted to the supplier in writing, to be resolved through negotiation between the supplier and the buyer. Objections related to surface quality and dimensional deviation shall be raised, within 1 month from the date of receipt of the product. Objections to other performance shall be raised, within 3 months from the date of receipt of the product. If arbitration is needed, it can be entrusted to an organization, as recognized by both the supplier and the buyer; sampling can be done jointly at the buyer's premises.

7.2 Group-batching

Products shall be submitted for acceptance in batches. Each batch shall be composed of products of the same designation, status, size specifications, film layer code, surface treatment process. When the purchaser requires group-batching according to melting number and heat treatment furnaces, this shall be noted in the order form (or contract).

7.3 Weighting

Products shall be checked by weight.

7.4 Inspection items and process assurance items

Where there are no special requirements specified in the order form (or contract), the product exit-factory inspection items, periodic inspection items, process assurance items shall comply with the provisions of Table 12.

7.6.1 Chemical composition

When the chemical composition of any specimen fails, if the melting order of the profile can be distinguished, the melting order profile represented by the specimen will be judged to be unqualified; other melting order profiles will be inspected in sequence, the qualified ones will be delivered. If the melting order cannot be distinguished, the batch of profiles is deemed to be unqualified.

7.6.2 Size deviation

If the size deviation of any specimen fails, the batch of profiles will be deemed unqualified. However, suppliers are allowed to inspect one by one; those that pass the standard will be delivered.

7.6.3 Tensile mechanical properties at room temperature, compression properties, bending properties, shear properties, fatigue properties, pin-type support, stress corrosion resistance, spalling corrosion resistance, intergranular corrosion sensitivity, salt spray corrosion resistance, welding performance

7.6.3.1 If any specimen fails, the batch (or heat treatment furnace number) of profiles will be deemed to be unqualified OR shall be implemented in accordance with 7.6.3.2.

7.6.3.2 If the heat treatment furnace number can be distinguished for the profile, it shall take double quantity of specimens from the heat treatment furnace number, which is represented by the specimen, to conduct repeated tests on the unqualified item. If the heat treatment furnace number cannot be distinguished, it shall take double quantity of specimens from the batch of profiles again, to repeat the test on the unqualified item (including the profile represented by the unqualified specimen taken for the first time). If all repeated test results are qualified, the batch (or heat treatment furnace number) of profiles will be deemed qualified. If there are still unqualified samples in the repeated test results, the batch (or heat treatment furnace number) of profiles will be deemed unqualified. After agreement between the supplier and the buyer, the supplier is allowed to inspect one by one; those that pass the test will be delivered or implemented in accordance with 7.6.3.3.

7.6.3.3 After repeated heat treatment, the supplier shall inspect all exit-factory inspection items listed in Table 12 according to the furnace number, except chemical composition, size deviation, film layer performance, appearance quality. The sampling quantity shall be as per Table 14. When all inspection results are qualified, the batch of profiles is deemed to be qualified; otherwise, the batch of profiles is deemed to be unqualified.

7.6.4 Plane strain fracture toughness

If the plane strain fracture toughness K_{Ic} value or "batch release K_Q" value of any specimen fails, the batch (or heat treatment furnace number) of the profile will be

judged to be unqualified or shall be implemented in accordance with 7.6.3.2.

7.6.5 Conductivity

If the conductivity of any specimen fails, follow 7.6.3.2.

7.6.6 Matching relationship between electrical conductivity and mechanical properties

If the matching relationship between the electrical conductivity and mechanical properties of any specimen fails, the supplier will inspect each piece one by one; those that pass will be delivered. OR it is judged according to the test results of stress corrosion resistance, or implemented in accordance with 7.6.3.2.

7.6.7 Ultrasonic flaw detection acceptance level

If the ultrasonic flaw detection acceptance level of any specimen fails, the profile will be deemed unqualified.

7.6.8 Welding performance of weld

When the welding performance of the weld is unqualified, it is allowed to cut off a section from the extrusion front end of the hollow profile, to repeat the test, until it is qualified. Then other hollow profiles in the batch shall be cut according to the maximum length of the defect distribution of the inspected profile or one by one; the qualified products will be delivered.

7.6.9 Macrostructure

When the macrostructure of any specimen fails, the judgment shall be made as follows.

a) If the profile fails due to metallurgical defects, such as cracks, bright grains, non-metallic inclusions, foreign metal inclusions, white spots, primary crystals, oxide films, the batch of profiles will be deemed unqualified. However, upon agreement between the supplier and purchaser, the supplier can inspect one by one and deliver the qualified products.

b) When unqualified due to layering, tail shrinkage, or coarse grain rings, it is allowed to cut off a section from the extrusion tail end of the profile, to repeat the test until it is qualified. Then other profiles in the batch shall be tail cut according to the maximum length of the defect distribution of the inspected profile or one by one; the qualified products will be delivered.

c) When the fracture structure of any specimen fails, if the melting order can be distinguished, the melting order represented by the specimen will be judged to be unqualified; the other melting order profiles will be inspected in sequence, the qualified products will be delivered. If the melting orders cannot be distinguished,

the batch of profiles is deemed to be unqualified.

7.6.10 Microstructure

If the microstructure of any specimen is unqualified, the batch (or heat treatment furnace number) of profiles will be deemed unqualified.

7.6.11 Film performance

When the film performance of any profile fails to meet the standards, it shall be judged according to the implementation standards selected in Chapter 5.

7.6.12 Appearance quality

If the appearance quality of any profile is unqualified, the profile will be deemed unqualified.

8 Marking, packaging, transportation, storage, quality certificate

8.1 Marking

8.1.1 Product marking

Product markings shall comply with the requirements of GB/T 42916.

8.1.2 Packing box markings

The packaging box mark of the profile shall comply with the requirements of GB/T 3199.

8.2 Packaging, transportation, storage

The profiles shall not be greased or packed; other aspects shall comply with the requirements of GB/T 3199. If the buyer needs applying grease, packing or using other packing means and methods different from GB/T 3199, it shall be determined through negotiation between the supplier and the purchaser. Meanwhile it shall be indicated in the order form (or contract). The transportation and storage of profiles shall comply with the requirements of GB/T 3199.

8.3 Quality certificate

Each batch of profiles shall be accompanied by a product quality certificate, which shall indicate:

a) Name of supplier;

A.2.2.2 Anodized composite film

The anodized composite film is composed of an anodized film and an organic polymer film. Due to the presence of the aluminum anodized film, it is not susceptible to mechanical damage to the metal matrix AND is not prone to filamentous corrosion under the film. Industrial and urban environments with serious pollution should choose high-quality grade anodized composite films.

A.2.2.3 Sprayed film

When the surface of the sprayed film is wet, performance degradation is prone to occur due to the presence of acidic substances in the air; the damage is particularly prominent in heavily polluted industrial areas. Being in a damp heat environment for a long time will accelerate the permeability of water and harmful ions to the film layer. Mechanical damage can also accelerate film erosion in industrial and urban environments. Therefore, in humid tropical environments with serious industrial and urban pollution, it should choose high-quality sprayed films, such as highly weather-resistant powder spray films or fluorocarbon paint spray films.

A.2.3 Marine environment

A.2.3.1 Anodized film

Under environmental conditions without acid pollution, the anodized film has good salt water resistance. However, if acidic environmental conditions cause local dissolution of the film, the presence of chloride ions will accelerate the corrosion of the aluminum substrate. In marine environment areas with large temperature differences, it should choose high-thickness anodized films.

A.2.3.2 Anodized composite film

The anodized composite film is composed of an anodized film and an organic polymer film. Due to the presence of the aluminum anodized film, it is not susceptible to mechanical damage to the metal matrix AND is not prone to filamentous corrosion under the film. In industrial and urban environments with serious pollution, it shall choose high-quality grade composite films.

A.2.3.3 Sprayed film

There are chloride ions in the marine environment; the chloride ions will slowly penetrate the surface of the aluminum matrix and cause the performance of the film to decline. Being in a damp heat environment for a long time and the presence of other ions will increase the permeability of the film layer. Mechanical damage will accelerate the erosion of chloride ions on the substrate. Therefore, in humid tropical marine environments, it should choose high-quality sprayed films, such as highly weather-resistant powder film spray films or fluorocarbon paint spray films.

Appendix B

(Informative)

Dimensional measurement method - Three-dimensional coordinate measuring instrument method

B.1 Method overview

By positioning the probe and the workpiece, record the three-dimensional coordinates of the positioning points; calculate the difference in the three-dimensional coordinates of different positioning points on the workpiece surface, to obtain the required length, height, volume or area and other dimensions.

B.2 Test conditions

B.2.1 Ambient temperature: 20 °C ± 2 °C.

B.2.2 Environmental relative humidity: 60% ± 5%.

B.2.3 Working air pressure: Depends on the equipment requirements. The flow rate of compressed air is not less than 0.0017 m^3/s; the air source pressure is not less than 0.6 MPa; the temperature of the compressed air entering the host is 20 °C ± 5 °C; the relative humidity is not greater than 15%.

B.3 Instruments and equipment

The three-dimensional coordinate measuring instrument mainly consists of a host (host support, guide rails, driving device, workbench), pneumatic system (air bearing system, pneumatic control device, Z-axis pneumatic balance), electrical system, standard ball, measuring probe, measurement software system. The grating resolution is not greater than 0.1 μm; the detection error is not greater than 3 μm.

B.4 Specimen

The surface of the specimen is clean and free of defects, such as flash, burrs, particles that may affect the measurement results.

B.5 Test steps

B.5.1 Before measurement, let the specimen stand still in the test environment, so that the difference between the specimen temperature and the ambient temperature is not greater than 2 °C.

B.5.2 Turn on the three-coordinate measuring instrument; stabilize it for 30 minutes.

B.5.3 According to the measurement requirements, select appropriate probes and fixtures.

Appendix D

(Informative)

Contents of order form (or contract)

D.1 The order form (or contract) for profiles without surface treatment shall include the following:

a) Product name;

b) Designation;

c) Status;

d) Section code and length;

e) Weight;

f) Special requirements of the buyer:

- Brinell hardness,
- Ultrasonic flaw detection performance,
- Conductivity,
- Stress corrosion resistance,
- Spalling corrosion resistance,
- Intergranular corrosion susceptibility,
- Salt spray corrosion resistance,
- Bending properties,
- Shearing performance,
- Compression performance,
- Fatigue performance,
- Fatigue crack growth rate,
- Plane strain fracture toughness,
- Pin-type support,

- Modulus of elasticity,
- Welding performance,
- Weld seam welding performance,
- Packaging requirements,
- Other special requirements;

g) This document number.

D.2 The order form (or contract) for anodized profiles shall include the following:

a) The purpose, type, treatment method of the film layer;

b) Texture type;

c) Environmental grade of the use environment;

d) Effective surface of product film;

e) Contact area location and maximum size;

f) Hole-sealing method;

g) Sampling requirements;

h) Film layer code;

i) Color (or color code);

j) Color difference;

k) Film thickness;

l) Hole-sealing quality;

m) Appearance quality;

n) Special requirements of the buyer:

- Gloss,
- Hardness,
- Preprocessing type,
- Etching amount,

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