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Aluminum and aluminum alloy tubes for the pressure vessel

压力容器用铝及铝合金管材

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Aluminum and aluminum alloy tubes for the pressure vessel

1 Scope

This Standard specifies requirements, test methods, inspection rules and marks, packaging, transportation, storage and quality certificate as well as order sheet (or contract) content of aluminum and aluminum alloy tubes for the pressure vessel.

This Standard is applicable to aluminum and aluminum alloy tubes for the pressure vessel (hereinafter referred to as “the tubes”).

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 230 (all parts), *Metallic Rockwell hardness test*

GB/T 231 (all parts), *Metallic Brinell hardness test*

GB/T 3190, *Wrought aluminum and aluminum alloys - Chemical composition limits*

GB/T 3199, *Wrought Aluminum and Aluminum 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 4436-2012, *Wrought aluminum and aluminum alloy tubes - Dimensions and deviations*

GB/T 6519, *Process for ultrasonic inspection of wrought aluminum alloy products*

GB/T 7999, *Optical emission spectrometric analysis method of aluminum*

3.1.2 Marking example

The mark of the tubes is expressed in the order of product name, reference to this Standard, designation, state, size specification.

Example: The fixed-scale tube of which the designation is 5083, the state is O, the outer diameter is 40.00mm, the wall thickness is 6.00, the length is 4000, is marked as:

Tube GB/T 38512-5083 O-40.00×6.00×4000.

3.2 Chemical composition

The chemical composition of the tube shall comply with the provisions of GB/T 3190.

3.3 Size deviation

3.3.1 Outer diameter, curvature

The outer diameter, curvature of the tube shall comply with the provisions on high precision in GB/T 4436-2012.

3.3.2 Wall thickness

The wall thickness deviation of the tube shall comply with the provisions of GB/T 4436-2012.

3.3.3 Length

The fixed-scale length deviation of the tube shall comply with the provisions on high precision in GB/T 4436-2012. For the tubes that are delivered in double-scale as the fixed-scale, 5mm cutting capacity shall be left for each sawing edge.

3.3.4 Cutting slope

There shall be no burrs at both ends of the tube. The cutting slope shall meet the provisions on high precision level in GB/T 4436-2012.

3.3.5 Others

If the purchaser has other requirements, it shall be indicated in the order sheet (or contract).

3.4 Tensile mechanical properties at room temperature

The longitudinal tensile mechanical properties of the tube at room temperature shall meet the requirements of Table 2. For the tubes of which the wall thickness exceeds the one specified in Table 2, the mechanical properties are determined

3.10 Macrostructure

3.10.1 Cracks, tailing, pores, and bright grains are not allowed on the macrostructure sample of the tube.

3.10.2 Non-metallic inclusions, compound segregation or intermetallic compounds are not allowed on the macrostructure samples of the tube.

3.10.3 The depth of the coarse crystal ring shall be agreed between the supplier and the purchaser and indicated in the drawing or order sheet (or contract).

3.10.4 For the tube that wall thickness requires positive and negative symmetric deviation, the layering depth on the macrostructure sample shall not exceed the negative deviation of the tube wall thickness and the wall thickness deviation of the tube shall not exceed the allowable range. For the tube that wall thickness requires non-positive and negative symmetry deviation, the layering depth on the macrostructure sample shall not exceed half of the allowable deviation of the tube wall thickness. After deducting the thickness of the layer thickness, the size deviation shall not exceed the allowable range.

3.11 Microstructure

The microstructure of the quenched product is not allowed to burn.

3.12 Appearance quality

3.12.1 The surface of the tube shall be smooth, and no cracks, corrosion or foreign inclusions are allowed.

3.12.2 The surface of the tube is allowed to have local defects such as slight peeling, bubbles, scrapes, scratches, bumps, pits that do not affect the use. After deducting the depth of the defect, the wall thickness deviation shall not exceed the allowable range.

3.13 Others

When welding pipes, the mechanical properties of the welds are in Annex A.

4 Test methods

4.1 Chemical composition

4.1.1 The chemical composition analysis method shall be carried out according to GB/T 20975 or GB/T 7999. The arbitration analysis shall use the method specified in GB/T 20975.

4.1.2 "Al" content is calculated according to the method specified in GB/T 3190.

4.8 Pressure resistance

The test method for pressure resistance of the tube shall be negotiated between the supplier and the purchaser and indicated in the order sheet (or contract).

4.9 Macrostructure

The inspection method for the macrostructure of the tube shall be in accordance with GB/T 3246.2.

4.10 Microstructure

The inspection method of the microstructure of the tube shall be in accordance with GB/T 3246.1.

4.11 Appearance quality

Visually check the appearance quality under natural scattered light. If necessary, the size measurement tool can be used to define the size of the defect, and the depth of the defect can be determined by grinding.

4.12 Others

Refer to Annex A for the inspection method of weld mechanical properties.

5 Inspection rules

5.1 Inspection and acceptance

5.1.1 The product shall be inspected by the supplier to ensure that the product quality meets the requirements of this Standard and the order sheet (or contract) and fill in the quality certificate.

5.1.2 The purchaser shall inspect the received products in accordance with this Standard. When the inspection result is inconsistent with the provisions of this Standard and the order sheet (or contract), it shall be submitted to the supplier in written form and resolved by consultation between the supplier and the purchaser. Objections pertaining to surface quality and dimensional deviations shall be raised within one month from the date of receipt of the product. Objections that belong to other properties shall be raised within three months from the date of receipt of the product. If arbitration is required, the organization authorized by both the supplier and the purchaser can be entrusted to conduct the arbitration. The sampling shall be conducted at the purchaser.

5.2 Batching

The products shall be submitted for acceptance in batches. Each batch shall

sample to check the tensile mechanical properties at room temperature, electrical conductivity and peeling corrosion resistance performance.

5.6.6 If the flaw detection result of any specimen fails, this piece shall be determined as nonconforming.

5.6.7 When the macrostructure of any specimen fails, it shall be determined as follows:

a) If the metallurgical defects such as cracks, bright grains, non-metallic inclusions, compound segregation or intermetallic compounds are nonconforming, the batch of tubes shall be determined as nonconforming. However, upon agreement between the supplier and the purchaser, the supplier can inspect the products one by one, and only the conforming ones are delivered.

b) When the tail shrinkage, coarse crystal ring and layering are nonconforming, it is allowed to cut a section from the extruded end of the tube to repeat the test until it is conforming. Then the other tubes in the batch shall be tail-cut or inspected one by one according to the maximum length of the above-mentioned defect distribution of the inspected tubes. Only conforming ones are delivered.

5.6.8 When the microstructure of any specimen is nonconforming, if the tube can distinguish the heat treatment times, then the furnace time represented by this specimen shall be determined as nonconforming. Other furnace times shall be inspected in sequence. Only conforming ones are delivered. If it cannot distinguish the furnace time, this batch of tubes shall be nonconforming.

5.6.9 When the appearance quality of any pipe is nonconforming, this tube shall be determined as nonconforming. Allow the nonconforming part to be re-inspected. Only conforming ones are delivered.

6 Marks, packaging, transport, storage and quality certificate

6.1 Marks

6.1.1 Product marks

Print the identification of the following content (or affix a label containing the following content) on the front end of the qualified tube extrusion:

a) Inspection seal of the supplier's quality inspection department (or the signature or seal of the quality inspection personnel);

7 Order sheet (or contract) content

The order sheet (or contract) for the products listed in this Standard shall include the followings:

a) Product's name;

b) Designation and state;

c) Size specification;

d) Net weight;

e) Packaging;

f) Size deviation level;

g) Analysis and inspection items;

h) Special requirements of the purchaser:

- Special dimensional deviation requirements;
- Special requirements for tensile mechanical properties at room temperature;
- Special conductivity test requirements;
- Special test requirements for peeling corrosion resistance;
- Special inspection requirements;
- Special requirements for testing pressure resistance;
- Other special requirements.

i) Reference to this Standard.

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