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GB/T 20928-2020

Replacing GB/T 20928-2007

Seamless inner grooved copper tube

无缝内螺纹铜管

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Standardization Administration of the PRC.

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Foreword

This Standard is drafted in accordance with the rules given in GB/T 1.1-2009.

This Standard replaces GB/T 20928-2007 "Seamless inner grooved copper tube". Compared with GB/T 20928-2007, the main technical changes are as follows:

- Modify the representation method of designation and state (see Table 1; Table 1 of the 2007 edition);

- ADD two designations: TU1 and TU2; specify their mechanical properties and grain size requirements (see Table 1, Table 8, Table 9);

- Modify the cut slope index of straight tube, from "not greater than 2 mm" to "not greater than 0.40 mm" (see 5.2.3; 4.3.3 of the 2007 edition);

- Modify the previous "specified non-proportional elongation strength $R_{P0.2}$" in the mechanical properties to "specified plastic elongation strength $R_{P0.2}$" (see Table 8; Table 6 of the 2007 edition);

- Delete Table 7 and Table 8 of the previous standard. Modify to "The artificial defects of the standard sample tube shall meet the requirements of GB/T 5248" (see 5.6; 4.6 of the 2007 edition);

- Modify the test method of mechanical properties from "in accordance with the provisions of GB/T 228" to "in accordance with the provisions of GB/T 34505" (see 6.3; 5.2 of the 2007 edition);

- Modify the grain size. The grain size of the softening annealing (O60) state is changed from "0.020 mm~0.060 mm" to "0.015 mm~0.060 mm". The grain size of the light annealing (O50) state is changed from "0.015 mm~0.035 mm" to "0.010 mm~0.035 mm" (see Table 9; Table 6 of the 2007 edition);

- ADD "The sampling method shall be carried out in accordance with YS/T 668. The preparation of drift-expending test pieces shall be carried out in accordance with YS/T 815." (see 7.4);

- Delete the normative appendix "Measurement method of tooth profile parameters of seamless inner grooved copper tube" (see Appendix A of the 2007 edition).

This Standard was proposed by China Nonferrous Metals Industry Association.

This Standard shall be under the jurisdiction of National Technical Committee

Seamless inner grooved copper tube

1 Scope

This Standard specifies the classification and labeling, technical requirements, test methods, inspection rules, marking, packing, transporting, storing and quality certificate, and order form (or contract) content of seamless inner grooved copper tube.

This Standard applies to seamless inner grooved copper tube for air conditioning and refrigeration equipment (hereinafter referred to as "tube").

2 Normative references

The following documents are indispensable for the application of this document. For the dated references, only the editions with the dates indicated are applicable to this document. For the undated references, the latest edition (including all the amendments) are applicable to this document.

GB/T 242 Metal materials - Tube - Drift-expending test

GB/T 2828.1 Sampling procedures for inspection by attributes - Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection

GB/T 5121 (all parts) Methods for chemical analysis of copper and copper alloys

GB/T 5231 Designation and chemical composition of wrought copper and copper alloys

GB/T 5248 Electromagnetic (eddy-current) examination of copper and copper alloy seamless tube

GB/T 8170 Rules of rounding off for numerical values and expression and judgement of limiting values

GB/T 8888 Wrought heavy non-ferrous metal products - Packing, marking, transporting, storing and quality certificate

GB/T 26303.1 Measuring method for dimensions and shapes of wrought copper and copper alloy - Part 1: Tube

GB/T 34505 Copper and copper alloy materials - Tensile testing at room temperature

YS/T 347 Copper and copper alloys - Estimation of average grain size

YS/T 482 Methods for analysis of copper and copper alloys - The atomic emission spectrometry

YS/T 483 Methods for analysis of copper and copper alloys - X-Ray fluorescence spectrometric (wavelength dispersive)

YS/T 668 The sampling method of physical and chemical testing for copper and copper alloys

YS/T 815 Preparation method of test pieces for mechanical and technological properties of copper and copper alloys

3 Terms and definitions

The following terms and definitions apply to this document.

3.1

Seamless inner grooved copper tube

The copper tube with a smooth outer surface, a certain number of regular grooves on the inner surface, and a continuous section circumference.

3.2

Weight per metre

The mass of the inner grooved copper tube per 1 m length, in grams per metre (g/m).

4 Classification and labeling

4.1 Product classification

The designation, code, state and supply shape of the tube shall meet the requirements of Table 1. The tooth profile of the tube is shown in Figure 1. The specification and dimension range shall meet the requirements of Table 2. The inner and outer diameter and height (width) dimensions of the layer wound coil shall meet the requirements of Table 3. Refer to Appendix A for the recommended specifications of this Standard.

TW - Bottom wall thickness;

H_f - Tooth height;

TWT - Total wall thickness;

W - Groove bottom width;

n - Number of grooves;

α - Addendum angle;

β - Helix angle.

Figure 1 -- Schematic diagram of tooth profile

4.2 Product labeling

The labeling of the tube is indicated in the order of product name, standard number, designation, state, outer diameter, bottom wall thickness, tooth height, addendum angle, helix angle and number of grooves.

Example 1: For right-handed inner grooved coil tube with a designation of TP2 (C12200), state of light annealing (O50), outer diameter of 9.52 mm, bottom wall thickness of 0.30 mm, tooth height of 0.20 mm, addendum angle of 53°, helix angle of 18, and 60 grooves, it is labeled as:

Inner grooved coil tube GB/T 20928-TP2O50-9.52×0.30+0.20-53/18-60

Or Inner grooved coil tube GB/T 20928-C12200O50-9.52×0.30+0.20-53/18-60

Example 2: For left-handed inner grooved straight tube with a designation of TU2 (T10180), state of softening annealing (O60), outer diameter of 7.00 mm, bottom wall thickness of 0.27 mm, tooth height of 0.20 mm, addendum angle of 53°, helix angle of 18, 60 grooves, and length of 3000 mm, it is labeled as:

Inner grooved straight tube GB/T 20928-TU2O60-7.00×0.27+0.20-53/L18-60×3000

Or Inner grooved straight tube GB/T 20928-T10180O60-7.00×0.27+0.20-53/L18-60×3000

The default spiral direction is right-handed. For left-handed, add “L”.

5 Technical requirements

5.1 Chemical composition

The chemical composition shall meet the requirements of GB/T 5231.

5.2 Overall dimensions and their tolerances

5.6 Eddy-current examination

The tube shall be subjected to eddy-current examination. The artificial defects of the standard sample tube shall meet the requirements of GB/T 5248. Eddy-current examination shall adopt a combination of penetration probe and rotating probe. Straight tubes are not allowed to have detected defects. The number of defects of the coil tube shall be negotiated between the supplier and the purchaser. The length of the dark mark of the detected defect of the coil tube shall not be less than 300 mm.

5.7 Cleanliness

Residues on the inner surface of the tube shall not be greater than 0.025 g/m^2.

5.8 Heat transfer property

The tube can be inspected for heat transfer. The heat transfer property index shall be determined through negotiation between the supplier and the purchaser.

5.9 Surface quality

The surface of the tube shall be clean and bright. There shall be no harmful defects that affect the use. Slight processing ring marks on the surface are allowed.

6 Test methods

6.1 Chemical composition

The chemical composition analysis of the tube is carried out in accordance with the provisions of GB/T 5121 (all parts) or YS/T 482 and YS/T 483. The arbitration shall be conducted in accordance with the provisions of GB/T 5121 (all parts).

6.2 Overall dimensions and tolerances

The overall dimensions and tolerances of the tube shall be measured in accordance with the provisions of GB/T 26303.1.

6.3 Mechanical properties

The tensile test of the tube is carried out in accordance with the provisions of GB/T 34505. The tensile test pieces are carried out in accordance with the provisions of the full-section piece in GB/T 34505.

6.4 Grain size

The grain size of the tube shall be carried out in accordance with YS/T 347.

6.5 Drift-expending test

The drift-expending test of the tube shall be carried out in accordance with the provisions of GB/T 242.

6.6 Eddy-current examination

The eddy-current examination of the tube shall be carried out in accordance with the provisions of GB/T 5248.

6.7 Cleanliness

The cleanliness of the tube shall be determined in accordance with the provisions of Appendix B.

6.8 Heat transfer property

The heat transfer property of the tube can be carried out in accordance with the provisions of Appendix C; or carried out by a method approved by both the supplier and the purchaser.

6.9 Surface quality

The quality of the outer surface of the tube shall be inspected visually.

7 Inspection rules

7.1 Inspection and acceptance

7.1.1 The product shall be inspected by the supplier, to ensure that the quality of the product meets the requirements of this Standard and the order form (or contract). The quality certificate shall be filled in.

7.1.2 The purchaser shall inspect the received products in accordance with the provisions of this Standard. If the inspection result does not conform to the provisions of this Standard and the order form (or contract), it shall be submitted to the supplier in written form; the supplier and the purchaser shall negotiate and resolve. Objections to appearance quality or dimensions shall be raised within one month of receipt. Objections related to other properties shall be raised within three months from the date of receipt of the product. If arbitration is required, it shall be determined through negotiation between the supplier and the purchaser.

8.1.2 The packing box mark of the tube shall comply with the regulations of GB/T 8888.

8.2 Packing, transporting, storing and quality certificate

The packing, transporting, storing and quality certificate of the tube shall meet the requirements of GB/T 8888.

9 Order form (or contract) content

The order form (or contract) shall include the following:

a) Product name;

b) Alloy designation;

c) State;

d) Specifications;

e) Delivery shape;

f) Dimension tolerances (when there are special requirements);

g) Weight (number of pieces or coils);

h) Heat transfer property (when there are special requirements);

i) Number of this Standard;

j) Others.

Appendix B

(Normative)

Determination method for internal surface residues of inner grooved copper tube

B.1 Method summary

USE an organic solvent such as carbon tetrachloride to clean the internal surface of the copper tube; EXTRACT the residue on the internal surface of the tube into the solvent. After the organic solvent is heated and evaporated in the beaker, the increase in the weight of the beaker is the residue on the internal surface of the tube.

B.2 Apparatus and reagents

B.2.1 Ultrasonic oscillator: Power is not less than 2 kW; effective volume is not less than 70 L.

B.2.2 Analytical balance (division value is 0.1 mg).

B.2.3 Solvent: Analytically pure carbon tetrachloride or trichloroethylene.

B.3 Test procedure

B.3.1 CLEAN the beaker and dry it in an oven at 105 °C±5 °C for 60 min; TAKE it out and put it in a desiccator; COOL for 60 min and weigh G_1.

B.3.2 CUT the test piece: When the inner diameter of the test piece is not less than 5 mm, the length of the test piece taken is 1500 mm. When the inner diameter of the test piece is less than 5 mm, the length taken is 2000 mm. USE a tube cutter to cut it out to avoid copper shavings.

B.3.3 BEND the test piece into a U shape; LAY it flat on the table; then bend the two ends upward.

B.3.4 USE a syringe to inject a quantitative solvent (B.2.3) into the test piece nearly full; carefully put it into the ultrasonic oscillator (B.2.1); oscillate for 10 min. The amount of solvent injected is shown in Table B.1.

Appendix C

(Informative)

Method for determining heat transfer coefficient and fluid resistance characteristics of seamless inner grooved copper tube

C.1 Method summary

The vapor compression refrigeration system is composed of a compressor, a condenser, an expansion valve, and an evaporator, which are connected by tubes to form a sealed system. The test part is composed of a double-tube heat exchanger. The tube to be tested is its inner tube. Pass the refrigerant into the tube to be tested; pass the heat exchange water into the outer tube; make the two flow in the opposite direction. Measure the relevant parameters (flow rate, temperature, pressure, etc.) of the inlet and outlet on the water side and the refrigerant side. The total heat transfer coefficient of the test section can be determined. Through thermal resistance analysis, the heat transfer coefficient of the internal surface of the tube to be tested under the test conditions can be obtained.

By measuring the pressure drop of the inlet and outlet of the refrigerant flowing through the tube to be tested, the fluid flow resistance characteristics under test conditions can be obtained.

C.2 Apparatus and reagents

C.2.1 Apparatus

The schematic diagram of the test device system is shown in Figure C.1.

λ_t - The thermal conductivity of the test tube, in watts per metre Kelvin [W/(m · K)];

D - The outer diameter of the test tube, in metres (m);

h_w - The heat transfer coefficient on the water side, in watts per square metre Kelvin [W/(m^2 · K)].

C.4.2 Data collation

C.4.2.1 PLOT the relationship curve between the heat transfer coefficient h on the internal surface of the seamless inner grooved copper tube and the refrigerant mass velocity G_r.

C.4.2.2 PLOT the relationship curve between the refrigerant pressure drop per unit length and the refrigerant mass velocity G_r.

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