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Copper and Copper Alloy Capillary Tube

铜及铜合金毛细管

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Standardization Administration of the People's Republic of China.

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Copper and Copper Alloy Capillary Tube

1 Scope

This Standard specifies the technical requirements, test methods, inspection rules, signs, packaging, transportation, storage, quality certificate and order sheet (or contract) content of copper and copper alloy capillary tubes.

This Standard is applicable to copper and copper alloy capillary tubes used for air conditioners, refrigeration equipment, instruments, and apparatuses (hereinafter referred to as tubes).

2 Normative References

The following documents are indispensable to the application of this document. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to this document.

GB/T 242 *Method for Flaring Test on Tubes of Metals*

GB/T 245 *Metallic Materials - Tube - Flanging Test*

GB/T 2828.1 *Sampling Procedures for Inspection by Attribute - Part 1: Sampling Schemes Indexed by Acceptance Quality Limit (AQL) for Lot-by-lot Inspection*

GB/T 4340.1 *Metallic Materials - Vickers Hardness Test - Part 1: Test Method*

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 8170 *Rules of Rounding off for Numerical Values & Expression and Judgement of Limiting Values*

GB/T 8888 *Wrought Heavy Non-ferrous Metal Products - Packing, Marking, Transportation, Storing and Certificate of Quality*

GB/T 10567.2 *Wrought Copper and Copper Alloys - Detection of Residual Stress - Ammonia Test*

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 *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*

YS/T 999 *Capillary Tube of Copper and Copper Alloy-eddy Current Testing Method*

3 Terms and Definitions

The following terms and definitions are applicable to this document.

3.1 Capillary

Capillary refers to a copper tube for current limiting, and with an outer diameter of not greater than 6.1 mm and an inner diameter of not greater than 4.45 mm.

3.2 Pressure Difference

Pressure difference refers to the resistance drop of the inner hole of tubes of a certain length.

3.3 Flow

Flow refers to the volume of air flow passing through a tube per unit time at a certain temperature, a certain atmospheric pressure and a certain inlet pressure.

3.4 Residue

Residue refers to solid impurities remaining on the inner surface of a tube unit.

3.5 Oil Content

Oil content refers to processing oil remaining on the inner surface of a tube unit.

3.6 Bulge Circle (limit)

6 Test Methods

6.1 Chemical Composition

The analysis method for the chemical composition of the tubes shall comply with the stipulations of GB/T 5121 (all parts) or YS/T 482 and YS/T 483. The arbitration shall comply with the stipulations of GB/T 5121 (all parts).

6.2 Overall Dimensions and Allowable Deviations

The measurement method for the overall dimensions and allowable deviations of the tubes shall comply with the stipulations of GB/T 26303.1.

6.3 Mechanical Properties

The tensile test of the tubes shall be conducted in accordance with the stipulations of GB/T 34505; the tensile test specimens shall comply with the stipulations of full-section test specimens in GB/T 34505.

The Vickers hardness test of the tubes shall be conducted in accordance with the stipulations of GB/T 4340.1.

6.4 Process Properties

6.4.1 Air permeability

The air permeability test of the tubes shall be conducted under the air pressure of not greater than 7.8 MPa; continuously pressurize it, and when there is relatively violent bubble-turning phenomenon at one end of the tube placed in the water, it proves that the tube is unblocked.

6.4.2 Air tightness

For the air tightness test of the tubes, seal one end of the tube; immerse it in the water; ventilate at the other end, so that it complies with the test requirements of Table 8.

6.4.3 Pressure difference

The test method for the pressure difference of the tubes shall take Appendix A as a reference. When there are special requirements, the test method shall be determined by the demand-side and the supply-side through negotiation.

6.4.4 Flow rate test

The test method for the flow rate of the tubes shall take Appendix B as a reference. When there are special requirements, the test method shall be determined by the demand-side and the supply-side through negotiation.

supply-side in the written form, and the supply-side and the demand-side shall solve this through negotiation. Objections related to surface quality and overall dimensions shall be proposed within 1 month from the date of receipt of the products; objections related to other properties shall be proposed within 3 months from the date of receipt of the products. If arbitration is required, it may be entrusted to an organization acknowledged by the demand-side and the supply-side, and samples shall be jointly taken at the demand-side's place.

7.2 Batch

The products shall be submitted for acceptance inspection in batches. Each batch shall be composed of products of the same designation, the same state and the same specification. The weight of each batch shall not exceed 500 kg.

7.3 Inspection Items

The inspection items of the tubes shall comply with the stipulations of Table 11.

Under any of the following circumstances, type inspection shall be carried out in accordance with the stipulations of this Standard:

a) During trial production and appraisal of new products;

b) After formal production, if there are relatively significant changes in structures, materials and processes that might affect product performance;

c) When type inspection has not been carried out for two consecutive years;

d) When requested by the demand-side;

e) When a national quality supervisory institution requests for type inspection.

c) Specification;

d) Batch No.;

e) Net weight or quantity;

f) Production date;

g) Inspection seal of the supply-side's technical supervision department;

h) Implemented standard;

i) Others.

8.1.2 Packaging signs

The signs of the packaging box of the tubes shall comply with the stipulations of GB/T 8888.

8.2 Packaging, Transportation, Storage and Quality Certificate

8.2.1 The requirements for the packaging, transportation, storage and quality certificate of the tubes shall comply with the stipulations of GB/T 8888.

8.2.2 When there are special requirements for the packaging mode, they shall be determined by the demand-side and the supply-side through negotiation.

9 Order Sheet (or contract) Content

The order sheet (or contract) ordering the materials listed in this Standard shall include the following content:

a) Product name;

b) Alloy designation;

c) State;

d) Specification;

e) Dimensions and accuracy grade (the outer diameter, inner diameter or other dimensional requirements of the tubes; the accuracy grade must be indicated in the contract, otherwise, choose the ordinary grade by default);

f) Shape of delivery;

g) Weight or quantity;

A.3.5 The gas temperature shall maintain relatively constant, and generally 20 °C ± 5 °C.

A.3.6 The inner hole of the tested tube shall be clean, and free of oil stains, oxides and other impurities. The tube mouth of the tested tube shall be rounded off, and without bending or breakage phenomenon.

A.4 Test Procedures

A.4.1 Accurately measure the inner diameter and length of the tube.

A.4.2 On the test device, close the shut-off valve; open the gas source switch. Adjust the pressure regulator, so that the pointer of the inlet pressure gauge reaches the pressure required by the process.

A.4.3 Insert the tested tube into the test hole.

A.4.4 Open the shut-off valve; observe changes of the pointer of the outlet pressure gauge, and whether the value of the outlet pressure gauge of the tube complies with the specified requirements.

A.4.5 Close the shut-off valve; remove the tested tube.

A.4.6 For continuous determination, the second tube may be inserted into the test hole.

A.5 Measurement Accuracy

The measurement accuracy is ± 0.01 MPa.

Appendix C

(informative)

Internal Surface Residue Determination Method of Tubes

C.1 Method Summary

Use an extractant to clean the internal surface of the tube; use a microporous membrane to filter the extractant. After drying, through weighing, calculate the solid impurity content on the internal surface of the tube. In accordance with the area of the internal surface, calculate the amount of residual solid impurities per unit surface area.

C.2 Instruments, Equipment and Reagents

C.2.1 Vacuum filter.

C.2.2 Microporous membrane.

C.2.3 Glass dish.

C.2.4 Crucible clamp.

C.2.5 Analytical balance (division value: 0.1 mg).

C.2.6 Constant-temperature drying oven.

C.2.7 Beaker (50 mL).

C.2.8 Syringe (20 mL).

C.2.9 Blocking cap.

C.2.10 Carbon tetrachloride, tetrachloroethylene, a mixture of methanol and acetone, or other extractants.

C.3 Test Procedures

C.3.1 Place the microporous membrane in a glass dish; place it in a constant-temperature drying oven at 110 °C to dry for 20 min; weigh it and record it as G_0.

C.3.2 Accurately measure-take 1 m ~ 2 m length of the test specimen.

C.3.3 Use a cotton ball dipped in the reagent to wipe off the oil stains on the external surface of the both ends of the test specimen.

C.3.4 Add blocking caps on both ends of the test specimen. Use a syringe to inject the reagent into the specimen with the blocking cap at one end; fill it up.

Appendix D

(informative)

Internal Surface Oil Content Determination Method of Tubes

D.1 Method Summary

Use a special solvent to dissolve the remaining oil on the internal surface of the tube. At the wavelength of 3.4 μm ~ 3.5 μm in the infrared region, there is a characteristic absorption spectral line of C-H bond. Through quantitative analysis of the intensity of the spectral line, the oil content can be obtained.

D.2 Instruments, Equipment and Reagents

D.2.1 OCMA-305 oil content analyzer.

D.2.2 H-997 extractant.

D.2.3 The domestic infrared spectrophotometer and corresponding reagents (carbon tetrachloride, tetrachloroethylene, etc.) may also be selected.

D.3 Test Procedures

D.3.1 Sample preparation

Take a tube of 1 m length; place it at an angle of about 70°. Use a syringe to draw 20 mL of reagent; inject it from the upper end of the tube; place a clean beaker on the lower end for reception. Each time, rotate the sample by about 90° and rinse it for 4 times; the received volume is about 80 mL.

D.3.2 Instrument preheating

Turn on the instrument; preheat it for 20 min. At the solvent discharge port, place a 200 mL beaker to receive the discharged solvent.

D.3.3 Blank measurement

D.3.3.1 Set the extraction time to 40 s; close the inlet valve and discharge valve.

D.3.3.2 Use a syringe to take 20 mL of the reagent in the same bottle used to rinse the sample; inject it from the small hole above the extraction pool.

D.3.3.3 Press the extraction button to perform extraction. After extraction, press the measurement button, until the solvent is completely discharged.

D.3.3.4 Repeat for 3 times. Record the instrument display as M_0, then, return to the initial state. Among them, the first 2 times are used for system cleaning.

Appendix E

(informative)

Internal Surface Water Content Determination Method of Tubes

E.1 Method Summary

Use dry nitrogen to bring the water content in the tube into the detector. The water content is absorbed by P_2O_5 in the detector and electrolyzed into hydrogen and oxygen to be discharged. The power consumption is integrated and converted into water content.

E.2 Instruments and Equipment

Type USI-3 refrigerator system water content tester.

E.3 Test Procedures

E.3.1 Sample preparation: from a finished tube with both ends being sealed, take a 1 m ~ 2 m long sample; seal both ends of the sample.

E.3.2 Connect the gas source. Firstly, open the main valve of the nitrogen cylinder, then, slowly open the pressure reducing valve to maintain at the flow rate of 70 mL/min ± 20 mL/min.

E.3.3 Turn on the power (turn the power switch on), meanwhile, pressure the “Zero Adjustment” key. At this moment, the instrument value is relatively high, and as the air flow system gradually dries, the displayed value gradually decreases, until it drops to below 0.050 mg and is basically stable.

E.3.4 Zero adjustment: after pressing the “Zero Adjustment” key, firstly, turn the “Zero Adjustment” knob to the left end. After the displayed value is less than 0.050 mg, turn the “Zero Adjustment” knob to the right (clockwise) to reduce the displayed value, until the displayed value is 0.001 mg ~ 0.005 mg (cannot be adjusted to display 0.000 mg). After zero adjustment is completed, in the following continuous determination process, the position of this knob maintains stationary.

E.3.5 Press the bypass gear for 20 min.

E.3.6 Press the “Measurement” gear. Use a cutter to cut one end of the sample, then, quickly connect it to the A end of the instrument; connect the other end to the B end of the instrument (A end before B end is merely allowed). Then, immediately press the “Reset” switch; the instrument starts to display the cumulative water content (the shorter the above operation time, the more reliable the displayed value).

E.3.7 When the solenoid valve stops switching, the accumulative speed gradually

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