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**Nonferrous Metals Industry Standard of the People's Republic of China**

YS/T 1097-2016

**Chromium copper and zirconium copper wire for electrode materials**

**电极材料用铬、锆铜线材**

*(English Translation)*

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**FOREWORD**

SAC/TC243 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.

This standard was proposed by China Nonferrous Metals Industry Association./National Nonferrous Metals Standardization Technical Committee.

This standard was drafted in accordance with the rules given in GB/T 1.1-2009.

This standard was prepared by National Standardization Technical Committee of Non-ferrous Metals (SAC/TC 243).

**Chromium copper and zirconium copper wire for electrode materials**

**1. Scope**

This standard specifes the requirement,test method,inspection rule and marks,package,transportation,storage,quality and the order (or contract ) of the chromium copper and zirconium copper wire for electrode materials.

This standard is applicable for the round,square ,rectangle and hexagon wire (hereinafter referred to as wire )which is used to manufacture the electrode in the field of welding industry .

**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 228.1-2010 Metallic materials — Tensile testing — Part 1: Method of test at room temperature

GB/T230.1 Metallic materials--- Rockwell hardness test —Part 1:experiment method (A、B、C、D、E、F、G、H、K、N、T ruler)

GB/T 351 Method of testing the electrical resistivity of the metallic material

GB/T 2828.1 Counting sampling test procedure Part 1：batch –by –batch sampling plan searched by AQL

GB/T 4340.1 Metallic material Vickers-hardness test Part 1 : experiment method

GB/T 5121(all parts )Chemical analysis method of copper and copper alloys

GB/T 5231 Designation and chemical composition of the processing copper and copper alloys

GB/T 8888 Packaging ,marks transportation, storage and the quality certificate of heavy non-ferrous metal processing products

GB/T 26303.2 Method of testing outer dimension of the machinable copper and copper alloys

YS/T 336 Method for testing the copper,nickel and their alloy pipes and bars

YS/T 478 Copper and copper alloys conductivity eddy current testing method

YS/T 482 Copper and copper alloys analysis method Photoelectron emission spectroscopy

YS/T 483 Copper and copper alloys analysis method X-ray fluorescence spectrometry (wavelength dispersion type )

YS/T 668 Copper and copper alloys physical and chemical detection sampling method

YS/T 815 Preparation method of mechanical property and processing property of the copper and copper alloys

**3 Term and definition**

The following terms and definitions apply to this article .

**3.1**

**Softening temperature**

After 2 hours of heat preservation, the material was quenched into water at room temperature, the softening temperature is the holding temperature corresponding to the hardness of 85% of its original hardness.

**4 Requirements**

**4.1 Products classification**

**4.1.1 Designation, temper，****and Specification**

The designation ,temper and specification of the products shall conform to Table 1.

Table 1 **Designation, Status , and Specification of the products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Designation | Code name | Temper | Diameter (opposite distance ) mm | Shape |
| TZr0.15 | C15000 | Solid solution heat treatment +cold working (hard)+precipitate heat treatment (TH04)、Solid solution heat treatment +precipitate heat treatment (TF00) | 1.5 ~22.0 |  |
| TCr1-0.15 | C18150 |
| TCr1-0.18 | T18160 |
| TCr1 | C18200 |
| Remarks: After consultation of both parties ,the wires can be straight or U-shape | | | | |

**4.1.2 Example of label**

The products shall be marked in the sequence of product name, standard number, designation ( code), temper and specification,the examples of marking are shown as below:

Example 1:The round wire made of the TCr1-0.15(C18150),the status is TH04 and the diameter is 8.8mm , can be marked as :

Round wire YS/T 1097-TCr1—0.15 TH04 –φ8.8

Or round wire YS/T 1097-C18150TH04 –φ8.8

Example 2: The hexagon wire made of the TCr1（C18200），the status is TF00 and the distance of opposite side is 12.65mm ,can be marked as :

Hexagon wire YS/T1097 –TCr1TF00-s12.65

Or hexagon wire YS/T 1097-C18200TF00-s12.65

Example 3: The hexagon wire made of TZr0.15(C15000),the status is TH04 and the distance of opposite side is 12.7mm, can be marked as :

Square wire YS/T 1097-TZr0.15 TH04-a12.7

Or square wire YS/T 1097-c15000TH04 –a12.7

Example4: The rectangle wire made of TCr1-0.18(T18160),the status is TH04 and the short side is 6.35mm,the long side is 12.7mm, can be marked as :

Rectangle wire YS/T1097-TCr1-0.18 TH04-6.35x12.7

Or rectangle YS/T 1097-T18160 TH 04-6.35x12.7

**4.2 Chemical composition**

The composition of wire of various designation should conform to the requirements of responding designation in GB/T5231 .

**4.3 Outer dimension and the tolerance**

4.3.1 The diameter of the wire (or the distance of opposite side ) and the tolerance should conform to the regulation of Table 2.

**Table 2 Diameter of wire (or the distance of opposite side )and tolerance**

Unit : mm

|  |  |  |
| --- | --- | --- |
| Diameter (or distance of opposite side ) | Tolerance | |
| Round | Square /hexagon and rectangle |
| 1.5~3.0 | 0 | 0 |
| —0.05 | —0.07 |
| ＞3.0~6.0 | 0 | 0 |
| —0.07 | —0.09 |
| ＞6.0~12.0 | 0 | 0 |
| —0.09 | —0.11 |
| ＞12.0~22.0 | 0 | 0 |
| —0.11 | —0.13 |
| Remarks: By mutual agreement between the supplier and the purchaser, the wire with other dimensions and tolerances can be supplied. | | |

4.3.2 Roundness of the round profile should not more than half of the tolerance of diameter.

4.3.3 The corner radius of cross-section corner of the square、hexagon and rectangular wire rod shall conform to the requirements in Table 3 .

**Table 3 The corner radius of cross-section corner of the square、hexagon and rectangular wire rod**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distance of opposite side | ≤4.0 | ＞4.0～6.0 | ＞6.0～10.0 | ＞10.0～22.0 |
| Corner radius | ≤0.4 | ≤0.6 | ≤0.8 | ≤1.2 |
| Remarks：For the rectangular wire , the distance of opposite side is the length b of short side . | | | | |

**4.4 Mechanical properties**

4.4.1 The longitudinal tensile properties of the wire rod at the room temperature shall conform to the requirements in Table 4.

**Table 4 The tensile properties of the wires**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Designation | Temper | Diameter (or the distance of opposite side )  mm | Tensile strength Rm  MPa | Proof strength RP0.2  MPa | Elongation / % |  |
| A | A 100 mm |
| Not less than | | | |
| TCr1-0.15(C18150)、 TCr1-0.18(T18160)、TCr1(C18200) | TH 04 | 1.5～4.0 | 450 | 380 | — | 4 |
| ＞4.0～22.0 | 450 | 380 | 13 | — |
| TF00 | 1.5～4.0 | 400 | 330 | — | 5 |
| ＞4.0～22.0 | 400 | 330 | 15 | — |
| TZr0.15 (C15000) | TH04 | 1.5～4.0 | 450 | 380 | — | 4 |
| ＞4.0～22.0 | 420 | 350 | 13 | — |

4.4.2 Hardness of the wires shall conform to the requirement in Table 5.

**Table 5 Hardness of the wire**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Designation | Temper | Diameter (or distance of opposite side ) | Hardness /HRB | | | Hardness /HV | |
| Round wire | | Rectangle 、hexagon、square | Round wire | Rectangle 、hexagon、square |
| Not less than | | | | |
| TCr1-0.15(C18150)、TCr1-0.18(T18160)、  TCr1(C18200) | TH04 | 1.5～4.5 | — | — | | 142 | 130 |
| ＞4.5～22.0 | 78 | 72 | | — | — |
| TF00 | 1.5 ～4.5 | — | — | | 136 | 126 |
| ＞4.5～22.0 | 75 | 70 | | — | — |
| TZr0.15(C15000) | TH04 | 1.5～4.5 | — | — | | 116 | 107 |
| ＞4.5～22.0 | 65 | 60 | | — | — |

**4.5 Electrical conductivity**

The electrical conductivity of wires shall conform to the requirements in Table 6 .

|  |  |  |  |
| --- | --- | --- | --- |
| Designation | Diameter (or distance of opposite side )/mm | Temper | Electric conductivity /% IACS |
| TCr1-0.15 (C18150)、TCr1-0.18(T18160)、TCr1(C18200) | 1.5～22.0 | TH04 | ≥78 |
| TF00 | ≥80 |
| TZr0.15(C15000) | 1.5～22.0 | TH04 | ≥80 |

**4.6 Softening temperature**

The softening temperature of wire shall conform to the requirements in Table 7.

**Table 7 Softening temperature of wire**

|  |  |  |
| --- | --- | --- |
| Designation | Diameter (or distance of opposite side ) /mm | Softening Temperature /℃ |
| TCr1-0.15 (C18150)、TCr1-0.18(T18160) | 1.5～22.0 | ≥550 |
| TCr1(C18200) | 1.5～22.0 | ≥475 |
| TZr0.15 (C15000) | 1.5～22.0 | Mutual negotiation by supplier and buyer |

**4.7 Fracture**

The fracture of the wire shall be densed without shrinking pores stratification and inclusions. Allow the existing of light defect which has no influence on operating requirement. For the wire d with diameter (or the distance of the opposite side )less than 5.0mm , the size and quantity of defects shall conform to the requiremenst in Table 8 . For the wire with diameter (or the distance of opposite side ) not less than 5.0mm ,the size and quantity of the defect shall conform to requirement of YS/T 336.

**Table 8 size and quantity of the defect**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Diameter (or distance of opposite side ) mm | Negligible defect diameter  mm | Allowed existing defects | | Distance between two defects /mm |
| Diameter /mm | Quantity |
| 1.5 ～2.0 | ≤0.01 | ＞0.01～0.05 | ≤2 | ≥0.2 |
| ＞2.0～＜5.0 | ≤0.05 | ＞0.05～0.1 | ≤2 | ≥0.5 |

**4.8 Surface quality**

The surface of wire shall be bright and clean. Not allow the existing defect which has influence on the usage of user .

**4.9 weight of coil (spool )**

4.9.1 The weight of coil (spool ) shall conform to the requirement in Table 9 .

**Table 9 The weight of the coil (spool )**

|  |  |  |
| --- | --- | --- |
| Diameter (or distance of opposite side ) mm | Weight of each coil (spool ) /kg | |
| Standard coil | Lighter coil |
| 1.5～2.0 | 22±1.5 | 18±1.5 |
| ＞2.0～4.0 | 25±2 | 20±2 |
| ＞4.0～6.0 | 30±2 | 25±2 |
| ＞6.0～12.0 | 150±20 | 100±20 |
| ＞12.0～22.0 | 1000±100 | 350±50 |

4.9.2 The weight of each lot of delivery approved shall not more than 10% of the lighter wire rod coil (spool).

4.9.3 If buyer has special requirements for the weight of the wire coil (spool), the mutual negotiation can be implemented .

**5 Experiment method**

**5.1 Chemical composition**

The analysis method of chemical composition of wires shall conform to the requirements in GB/T 5121 (all parts) or YS/T 482 or YS/T 483. For arbitration, the tests shall be in accordance with GB/T 5121.(all parts).

**5.2 Dimension and tolerance**

The measuring method of the external dimensions of the wires shall conform to the requirement in GB/T26303.2 .

**5.3 Mechanical properties**

5.3.1 The measuring method of mechanical properties at room temperature of the wire shall conform to the requirements in GB/T228.1─2010. Selection of the sampling number shall conform to the requirements in Table 10 .

**Table 10 Selection of the sampling number**

|  |  |  |
| --- | --- | --- |
| Diameter (or distance of opposite side ) /mm | Sampling number | GB/T228.1 —2010 |
| ≤4.0 | R9 | Appendix C |
| ＞4.0～5.0 | R8 | Appendix D |
| ＞5.0～10.0 | R7 | Appendix D |
| ＞10.0 | R4 | Appendix D |

5.3.2 The measuring method of hardness of the wire with the diameter (or distance of opposite side ) of 1.5mm～4.5 mm shall conform to the requirement in GB/T4340.1 . The measuring method of the hardness of the wire rod with the diameter (or distance of opposite side ) more than 4.5mm but not more than 22.0mm shall conform to the requirement in GB/T 230.1

**5.4 Electrical conductivity**

The detecting method of the electrical conductivity of wire shall conform to the requirements in GB/T 351 or YS/T 478 .

**5.5 Softening temperature**

Heating the furnace to increase its temperature to the softening temperature specified in the Table7 firstly, then put the samples which has be detected the initial hardness to furnace (after the door of furnace is closed ,the temperature shall increase to this softening temperature The samples should be put into the water quenching to cool after holding the temperature for 2 hours, measuring the hardness of trial sample at room temperature .The hardness shall not less than 85% of initial hardness of the sample.

**5.6 Fracture**

The inspection of the wires should conform to the requirement in YS/ T 336.

**5.7 Surface quality**

The surface quality of wire should checked by visual inspection.

**5.8 Weight of the wire coil (spool )**

The weight of the wire coil (spool)shall be detected by the corresponding precision of detection tools .

**6 Conformity with standards**

**6.1 Inspection and acceptance**

6.1.1 The wire shall be inspectied by the quality control department of supplier to ensure that the products are in conformity with this standard and with the stipulations of the order (or contract). A quality certificate shall be filled out accordingly.

6.1.2 The buyer shall detect the received product in accordance with the requirement of this standard and the order (or contract). If the detection result is not conform with this standard and order (or contract), the buyer shall inform the supplier in writing within 3 months from the date of accepting products , so as to resolve the problem by mutual agreement . Should the arbitration is necessary, the sampling for arbitration shall be implemented by both sides.

**6.2 Lot**

The wire shall be inspected in lots with the same designation, temper and specification. The weight of each lot shall not exceed 1500Kg.

**6.3 Inspection Items**

6.3.1 Each batch of wires shall be detected in chemical composition 、dimensions and tolerance 、mechanical properties 、electrical conductivity 、surface quality and the weight of coil (spool).

6.3.2 If necessary , each batch of wire shall be detected in the fracture and the softening temperature according to the requirementsof buyer.

**6.4 Sampling**

The sampling of the wires shall conform to the requirement in Table 11 .The sampling method shall conform to the requirement in YS/T 668 .The mechanical properties shall conform to the requirement in YS/T 815.

Table 11 Sampling

|  |  |  |  |
| --- | --- | --- | --- |
| Inspection | Sampling rules | Chapter number for the requirements | Chapter number for the test method |
| Chemical Compositonst | The supplier shall take one specimen from each furnace, while the purchaser shall take one specimen from each lot. | 4.2 | 5.1 |
| Dimensions and tolerances | The specimen shall be taken in accordance with GB/T 2828.1 (test level Ⅱ or the level agreed between the supplier and the purchaser). The acceptance quality limit (AQL) is 2.5. | 4.3 | 5.2 |
| Mechanical properties | Take two coils (spools ) from each lot randomly, one specimen from each coil (spool ) | 4.4 | 5.3 |
| Electrical conductivity | Take two coils (spool ) from each lot randomly, one specimen from each coils (spool ) | 4.5 | 5.4 |
| Softening temperature | Take two coils (spool) from each lot randomly, one specimen from each coils (spool ) | 4.6 | 5.5 |
| Fracture | Take two coils (spool ) from each lot randomly, one specimen from each coils (spool ) | 4.7 | 5.6 |
| Surface quality | The specimen shall be taken in accordance with GB/T 2828.1 ( the level agreed between the supplier and the purchaser). The acceptance quality limit (AQL) is 2.5. | 4.8 | 5.7 |
| Weight of the coil (spool) | Coil by coil (spool by spool) | 4.9 | 5.8 |

**6.5 Evaluation of Inspection Results**

6.5.1 If the chemical composition of the wire fails to conform to this standard, the entire lot shall be considered as unqualified.

6.5.2The dimension and the tolerance as well as the surface quality of the wire is unqualified , the coil(spool ) is judged as unqualified . When the quantity of unqualified product of each lot more than AQL ,the whole lot is judged as unqualified . Except for this , supplier can inspect the wire coil by coil ,the unqualified product can be delivered.

6.5.3 When the inspection result of mechanical property ,electric conductivity, softening temperature and fracture is unqualified, double quantity of samples shall be taken from this batch of wire (one sample shall be taken from the unqualified coil of wire which has be detected before ) to retest .If the inspection result of retest is judged as qualified , the whole batch of wire is qualified. If the inspection result is still unqualified, the whole batch of wire is judged as unqualified, or treated by supplier once again.

6.5.4 When the weight of coil (spool) is unqualified, the supplier and purchaser shall discuss with each other.

**7 Marking ,packaging,transportation,storage,and certificate of quality**

The marking,packaging,transportation,storage and certificate of quality of the wire shall be in accordance with GB/T8888 .

**8 Purchasing order (or contract ) content**

The purchasing order for the material which is listed in conformity with this standard shall contain the content as followings :

1. Product name;
2. Designation;
3. temper ;
4. dimension and specification;
5. weight or quantity of coils ;
6. fracture 、softening temperature ;
7. serial number of this standard ,YS/T 1097—2016
8. others .