TC 44

INTERNATIONAL STANDARD ISO 5182

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Materials for resistance welding electrodes and ancillary equipment

Matériaux pour électrodes de soudage par résistance et équipements annexes

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 5182 was developed by Technical Committee ISO/TC 44, *Welding*, and was circulated to the member bodies in September 1976.

It has been approved by the member bodies of the following countries :

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The member body of the following country expressed disapproval of the document on technical grounds :

United Kingdom

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Materials for resistance welding electrodes and ancillary equipment

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the characteristics of materials for resistance welding electrodes and ancillary equipment which are used for carrying current and transmitting force to the work.

2 REFERENCES

ISO/R 399, *Vickers hardness test for copper and copper alloys (Test loads from 2,5 to 50 kgf).*

ISO/R 403, *Brinell hardness test for copper and copper alloys.*

ISO 428, *Wrought copper-aluminium alloys — Chemical composition and forms of wrought products.*

ISO/R 1187, *Special wrought copper alloys.*

ISO/R 1336, *Wrought alloyed coppers.*

ISO/R 1337, *Wrought coppers.*

ISO 1634, *Wrought copper and copper alloys — Rolled flat products (plate, sheet, strip) — Mechanical properties.*

ISO 1637, *Wrought copper and copper alloys — Solid products supplied in straight lengths — Mechanical properties.*

ISO 1639, *Wrought copper alloys — Extruded sections — Mechanical properties.*

ISO 1640, *Wrought copper alloys — Forgings — Mechanical properties.*

ISO 2713, *Copper and copper alloys — Rockwell hardness test (B, F and G scales).*

ISO 3486, *Wrought copper and copper alloys — Cold-rolled flat products delivered in straight lengths (sheet) — Dimensions and tolerances.*[1]

ISO 3487, *Wrought copper and copper alloys — Cold-rolled flat products in coils or on reels (strip) — Dimensions and tolerances.*[1]

ISO 3488, *Wrought copper and copper alloys — Extruded round, square and hexagonal bars — Dimensions and tolerances.*[1]

ISO 3489, *Wrought copper and copper alloys — Drawn round bars — Dimensions and tolerances.*[1]

ISO 3490, *Wrought copper and copper alloys — Drawn hexagonal bars — Dimensions and tolerances.*[1]

ISO 3491, *Wrought copper and copper alloys — Drawn square bars — Dimensions and tolerances.*[1]

ISO 3492, *Wrought copper and copper alloys — Drawn round wire — Dimensions and tolerances.*[1]

IEC Publication 468, *Method of measurement of resistivity of metallic materials.*

3 DEFINITION

For the purpose of this International Standard, the following definition applies.

softening temperature : The maximum temperature that, if maintained for 2 h, will result in a reduction in ambient temperature hardness of a maximum of 15 % of the "as received" value.

4 CLASSIFICATION

4.1 Group A — Coppers and copper alloys

This sub-clause defines four types of material, namely :

Type 1 : Non-heat-treatable alloys of high conductivity and medium hardness, the wrought forms of which are given their strengths by cold working during manufacture.

Type 2 : Alloys which are harder than type 1 and in which the mechanical properties have been developed by heat treatment during manufacture or by a combination of heat treatment and cold working.

Type 3 : Heat-treated alloys which have superior mechanical properties to type 2 but a lower electrical conductivity than either type 1 or type 2.

Type 4 : Alloys having certain specialized properties which may, in some cases, be obtained either by cold working or by heat treatment. Alloys of this type are not necessarily interchangeable with each other.

1) At present at the stage of draft.

4.2 Group B — Sintered materials

This group comprises six types of material based upon the constituents used :

Types 10 and 11 : Sintered products of copper and tungsten.

Type 12 : A sintered product of copper and tungsten carbide.

Type 13 : A sintered and worked product of molybdenum.

Type 14 : A sintered and worked product of tungsten.

Type 15 : A sintered product of silver and tungsten.

5 SPECIFICATION

5.1 Requirements

The materials shall comply with the required characteristics set out in table 2.

5.2 Chemical composition

The compositions and maximum impurities for some of the materials are standardized in the ISO publications listed in table 1.

TABLE 1 — **ISO publications relating to chemical composition**

Designation	ISO publication
Cu-ETP	ISO/R 1337
Cu Cd1	ISO/R 1336
Cu Cr1	ISO/R 1336
Cu Co2 Be	ISO/R 1187
Cu Ni2 Si	ISO/R 1187
Cu Be2 Co Ni	ISO/R 1187
Cu Al10 Fe5 Ni5	ISO 428

5.3 Mechanical properties

The hardness of the materials shall be not less than that given in table 2.

NOTE — These materials are used in particular for resistance welding, and their properties are therefore different from those of materials used for general purposes. For certain of these alloys, information on tensile strength, 0,2 % proof stress and elongations may be obtained if required from the following ISO publications for mechanical properties of coppers and copper alloys : ISO 1634, ISO 1637, ISO 1639, ISO 1640.

5.4 Electrical properties

Electrical conductivities of materials shall be not less than those given in table 2.

6 METHODS OF TEST

6.1 The Vickers hardness test with 30 kg load shall be carried out in accordance with ISO/R 399.

6.2 The electrical properties shall be measured in accordance with IEC publication 468, where the size of the sample permits. When it is not possible to use this method, the test shall be carried out as agreed between the supplier, the purchaser and a mutually acceptable arbitrator.

6.3 Hardness and conductivity tests normally guarantee the quality of the material and allow verification of the softening temperature. The softening temperature test is not normally carried out on each batch of material.

Pending the finalization of a standard method for carrying out the softening temperature test, the test can only be made as agreed between supplier and purchaser.

7 DESIGNATION

Materials shall be designated by the group, type and number (see table 2).

Examples : Cu Cr1 shall be coded as **A 2/1 — ISO 5182**
W75 Cu shall be coded as **B 10 — ISO 5182**

8 APPLICATION

For typical applications, see annex A.

9 HARDNESS CONVERSIONS

See annex B.

TABLE 2 – **Composition and properties or materials**

Material								**Softening temperature** °C min.
Group	**Type**	**Number**	**Designation**	**Nominal composition**[1] %	**Forms available** (values in mm)	**Hardness** HV (30 kg) minimum	**Electrical conductivity** MS/m minimum	
A	1	1	Cu-ETP	Cu (+ Ag) min. 99,90	drawn ⩾ 25	85	56	150
					drawn < 25	90	56	
					forged	50	56	
					cast	40	50	
		2	Cu Cd1	Cd 0,7 to 1,3	drawn ⩾ 25	90	45	250
					drawn < 25	95	43	
					forged	90	45	
	2	1	Cu Cr1	Cr 0,3 to 1,2	drawn ⩾ 25	125	43	475
					drawn < 25	140	43	
					forged	100	43	
					cast	85	43	
		2	Cu Cr1 Zr	Cr 0,5 to 1,4 Zr 0,02 to 0,2	drawn ⩾ 25	130	43	500
					drawn < 25	140	43	
					forged	100	43	
	3	1	Cu Co2 Be	Co 2,0 to 2,8 Be 0,4 to 0,7	drawn ⩾ 25	180	23	475
					drawn < 25	190	23	
					forged	180	23	
					cast	180	23	
		2	Cu Ni2 Si	Ni 1,6 to 2,5 Si 0,5 to 0,8	drawn ⩾ 25	200	18	500
					drawn < 25	200	17	
					forged	168	19	
					cast	158	17	
	4	1	Cu Ni1 P	Ni 0,8 to 1,2 P 0,16 to 0,25	drawn ⩾ 25	130	29	475
					drawn < 25	140	29	
					forged	130	29	
					cast	110	29	
		2	Cu Be2 Co Ni	Be 1,8 to 2,1 Co-Ni-Fe 0,20 to 0,60	drawn ⩾ 25	350	12	300
					drawn < 25	350	12	
					forged	350	12	
					cast	350	12	
		3	Cu Ag6	Ag 6 to 7	forged ⩽ 25	140	40	400
					forged 25 to 50	120	40	
		4	Cu Al10 Fe5 Ni5	Al 8,5 to 11,5 Fe 2,0 to 6,0 Ni 4,0 to 6,0 Mn 0 to 2,0	forged	170	4	650
					cast	170	4	
B	10		W75 Cu	Cu 25		220	17	1 000
	11		W78 Cu	Cu 23		240	16	1 000
	12		WC70 Cu	Cu 30		300	12	1 000
	13		Mo	Mo 99,5		150	17	1 000
	14		W	W 99,5		420	17	1 000
	15		W65 Ag	35 Ag		140	29	900

1) The nominal composition of materials is for information only. The material shall be manufactured to the properties shown in the table.

ANNEX A

TYPICAL APPLICATIONS

Material	Spot welding	Seam welding	Projection welding	Flash or butt welding	Auxiliary application
A 1/1	Electrodes for welding aluminium	Electrode wheels for welding aluminium	–	–	Unstressed current-carrying parts; laminated shunts
A 1/2	Electrodes for welding aluminium Electrodes for welding coated steel (zinc, tin, aluminium, lead)	Electrodes for welding aluminium Electrode wheels for welding coated steel (zinc, tin, lead etc.)	–	Dies or inserts for welding mild steel	Electrodes for high-frequency resistance welding or non-ferrous metals
A 2/1	Electrodes for welding mild steel Holders and shafts and back-ups	Electrodes for welding mild steel	Large dies	Dies or inserts for welding mild and carbon steels, stainless steels and heat-resistant steels	Stressed current-carrying parts Backing for sintered electrode materials of Group B
A 2/2	Electrodes for welding mild steel and coated steel	Electrode wheels for welding mild steel and coated steel	–	–	–
A 3/1	Electrodes for welding stainless and heat-resistant steels Stressed electrode holders, shafts and arms	Electrode wheels for welding stainless and heat-resistant steels Shafts and bushings	Dies or inserts	Dies or inserts under high clamping force	Stressed current-carrying parts
A 3/2	Stressed electrode holders, shafts and arms	Shafts and bushings	–	–	Stressed current-carrying parts
A 4/1	Electrode holders and bent arms	Shafts and bushings	–	–	Stressed current-carrying parts
A 4/2	Electrode holders and shafts under extreme mechanical stress	Machine arms under extreme mechanical stress	Dies or inserts under high electrode forces	Long dies for flash welding	–
A 4/3	–	Electrode wheels for welding mild steel under high thermal stress	–	–	–
A 4/4	Electrode holders	Shafts and bushings under light electrical loading	Plattens and dies	–	–

Material	Spot welding	Seam welding	Projection welding	Flash or butt welding	Auxiliary application
B 10	–	–	Inserts for welding mild steel	Inserts for welding mild steel under high stress	Inserts for hot riveting and hot up-setting
B 11	–	–	–	–	Inserts for hot riveting and hot up-setting
B 12	–	–	Inserts for welding stainless steel	Small dies or inserts for welding steel	Inserts for hot riveting and hot up-setting
B 13	Inserts for welding copper-based high conductivity materials	–	–	–	Inserts for hot riveting and hot up-setting Inserts for resistance brazing
B 14	Inserts for welding copper-based high conductivity materials	–	–	–	Inserts for hot riveting and hot up-setting Inserts for resistance brazing
B 15	–	–	–	–	Electrodes for high-frequency resistance welding of ferrous materials

ANNEX B

HARDNESS CONVERSIONS

For resistance welding materials, it is common to measure hardness by Vickers, Brinell or Rockwell methods in accordance with ISO/R 399, ISO/R 402 or ISO 2713. In this International Standard, the Vickers method has been adopted since it is generally accepted as being the most accurate referee method used in laboratories on carefully prepared samples. Experience has shown that whatever test method or load is used, a surface layer must be removed before typical hardness values can be measured. This is especially true where oxidation may have occurred during hot working or heat treatment, for example on forgings.

It has been found where comparing Vickers, Brinell and Rockwell results on Group A2 alloys that the values do not correspond to the standard comparisons normally used for coppers and brasses[1] [2]. For information, figures 1 and 2 are therefore appended to give approximate conversions for Cu Cr and Cu Cr Zr alloys; they are also valid for Cu Co2 Be and Cu Ni1 P. The bands include 80 % of results and indicate the scatter which may be expected. The Brinell hardness values were obtained with a variety of ball sizes and loads and the scatter is therefore greater.

For other alloys these comparisons may be valid, but equivalents should be agreed between the supplier and the purchaser.

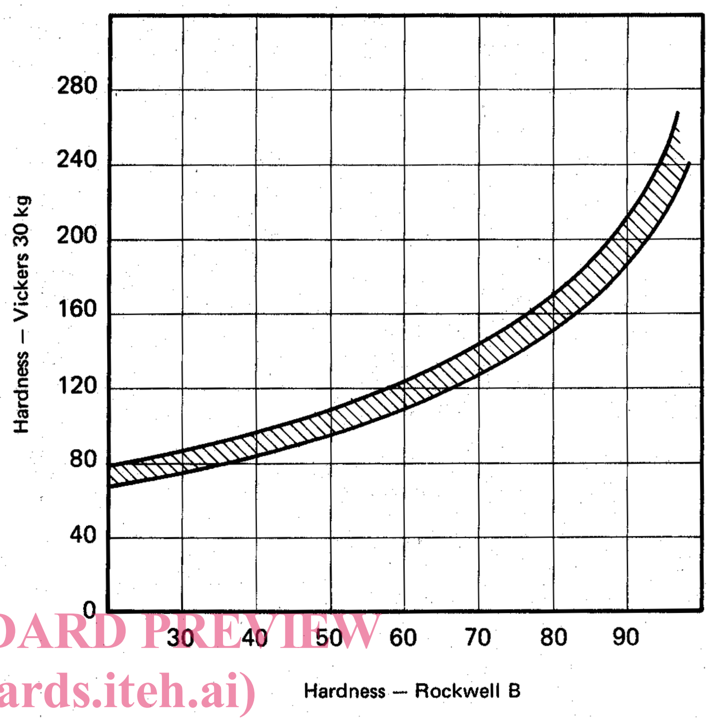

FIGURE 1 — **Conversion of Vickers 30 kg hardness to Rockwell B Hardness**

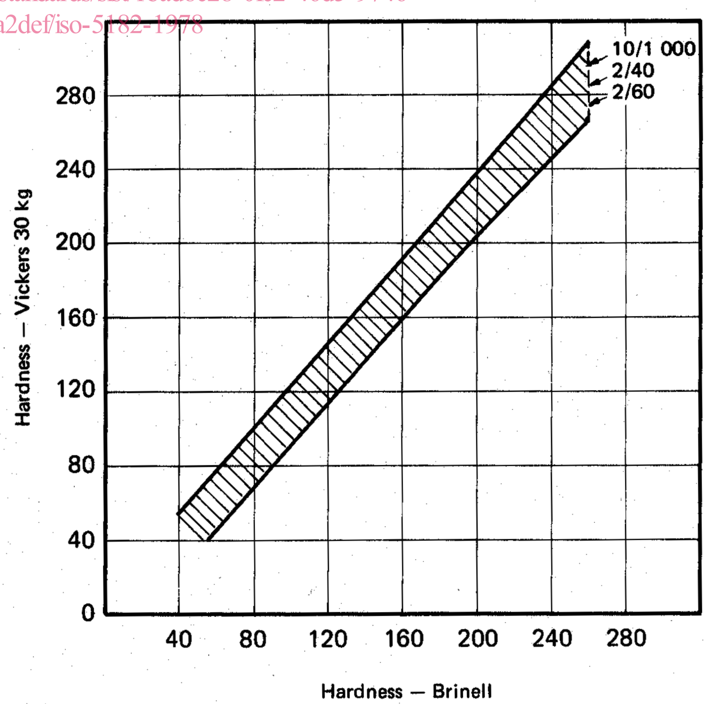

FIGURE 2 — **Conversion of Vickers 30 kg hardness to Brinell hardness**

[1] British Standard 860 : 1967, *Tables for comparison of hardness scales.*

[2] ASTM E140-71, *Standard hardness conversion tables for metals.*