INTERNATIONAL STANDARD

ISO 5182

Third edition
2008-01-15

Resistance welding — Materials for electrodes and ancillary equipment

Soudage par résistance — Matériaux pour électrodes et équipements annexes

Reference number
ISO 5182:2008(E)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 5182 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 6, *Resistance welding*.

This third edition cancels and replaces the second edition (ISO 5182:1991), which has been technically revised.

Requests for official interpretations of any aspect of this International Standard should be directed to the Secretariat of ISO/TC 44/SC 6 via your national standards body, a complete listing of which can be found at www.iso.org.

Resistance welding — Materials for electrodes and ancillary equipment

1 Scope

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 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.

ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*

ASTM E1004, *Standard practice for determining electrical conductivity using the electromagnetic (eddy-current) method*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
softening temperature
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 — Copper and copper alloys

This group defines four types of material:

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 specialised 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.

4.2 Group B — Sintered materials

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

Type 10 and **type 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 tungsten and silver.

4.3 Group C — Dispersion-strengthened copper (DSC) alloys

This group comprises two types of materials, manufactured by internal oxidation or ball milling (mechanical alloying).

5 Specifications

5.1 Requirements

The materials shall comply with the required characteristics specified in Table 1.

5.2 Chemical composition

The compositions for the materials are given in Table 1.

5.3 Mechanical properties

The hardness of the materials shall not be less than those given in Table 1.

NOTE These materials are used in particular for resistance welding, and their properties are, therefore, different from those of materials used for general purposes.

5.4 Electrical properties

The electrical conductivity, given in megasiemens per metre (MS/m) or as a percentage of the conductivity of the International Annealed Copper Standard (IACS), of materials shall be not less than those given in Table 1.

6 Methods of test

6.1 Vickers hardness test

The Vickers hardness test with a 300 N load shall be carried out in accordance with ISO 6507-1.

6.2 Electrical properties

The electrical properties should be measured in accordance with ASTM E1004 (eddy-current test). When it is not possible to use this method, the test shall be carried out as agreed between the suppliers, the purchaser, and a mutually acceptable arbitrator.

NOTE Electrical conductivity, when evaluated with eddy-current instruments, is usually expressed as a percentage of the conductivity of the International Annealed Copper Standard (IACS).

6.3 Softening temperature test

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 suppliers and purchaser.

7 Designation

Materials shall be designated by the group, type and number (see Table 1).

EXAMPLE 1 CuCr1 shall be coded as

A 2/1 (ISO 5182:2007)

where

A is the CuCr1 material group (see Clause 4);

2 is the material type (see Clause 4);

1 is the CuCr1 material number (see Table 1).

EXAMPLE 2 W75Cu shall be coded as

B 10 (ISO 5182:2007)

8 Application

For typical applications, see Annex A.

WARNING — For alloys containing beryllium, precautions shall be taken in case of dry grinding, dry polishing or welding to avoid inhalation of dust or fumes over a certain period of time.

9 Hardness conversions

See Annex B.

Table 1 — Composition and properties of materials

Group	Type	Number	Designation	Nominal alloying elements	Forms available	Hardness HV 30	Electrical conductivity		Softening temperature
				%	mm	min.	MS/m min.	% IACS	°C min.
A	1	1	Cu-ETP	Cu (+Al) min. 99,90	drawn ⩾ 25	85	56	96	150
					drawn < 25	90	56	96	
					forged	50	56	96	
					cast	40	50	86	
		3	CuAg0,1P	Ag 0,08 to 0,15	drawn < 25	90	55	95	150
		4	Cu-PHC	P 0,003	drawn	40	56	96	150
	2	1	CuCr1	Cr 0,3 to 1,2	drawn ⩾ 25	125	44	76	475
					drawn < 25	140	44	76	
					forged	100	44	76	
					cast	85	44	76	
		2	CuCr1Zr	Cr 0,5 to 1,4	drawn ⩾ 25	130	43	74	500
				Zr 0,02 to 0,2	drawn < 25	140	43	74	
					forged	100	43	74	
		3	CuCrZr	Cr 0,4 to 1	hardened	150	43	74	500
				Zr 0,02 to 0,15	ground < 45	150	43	74	
		4	CuZr	Zr 0,11 to 0,25	drawn	140	47	81	500
					ground < 30	130	47	81	
	3	1	CuCo2Be	Co 2,0 to 2,8	drawn ⩾ 25	260	23	40	500
				Be 0,4 to 0,7	drawn < 25	270	23	40	
					forged	260	23	40	
					cast	250	23	40	
		2	CuNi2Si	Ni 1,6 to 2,5	drawn ⩾ 25	180	17	29	450
				Si 0,4 to 0,8	drawn < 25	190	18	31	
					forged	170	19	33	
					cast	160	17	29	
		3	CuNi2Be	Ni 1,4 to 2,4 Be 0,2 to 0,6	drawn < 40	240	24	42	450
		4	CuCo1Ni1Be	Co 0,8 to 1,3 Ni 0,8 to 1,3 Be 0,4 to 0,7	drawn < 40	250	23	40	475
	4	1	CuNi1P	Ni 0,8 to 1,2	drawn ⩾ 25	130	29	50	450
				P 0,16 to 0,25	drawn < 25	140	29	50	
					forged	130	29	50	
					cast	110	29	50	
		2	CuBe2CoNi	Be 1,8 to 2,1	drawn ⩾ 25	330	14	25	300
				Co-Ni-Fe 0,20 to 0,60	drawn < 25	340	14	25	
					forged	350	14	25	
					cast	350	14	25	

Table 1 (*continued*)

Group	Type	Number	Designation	Nominal alloying elements	Forms available	Hardness HV 30	Electrical conductivity		Softening temperature
				%	mm	min.	MS/m min.	% IACS	°C min.
A	4	4	CuAl10Fe5Ni5	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	7	650
					cast	170	4	7	
		5	CuZn40Pb2	Cu 57 to 59, Pb 1,6 to 2,5	bars and tubes, max. diameter 60 mm	120	10	17	
B	10		W75Cu	Cu 25		220	17	29	1 000
	11		W78Cu	Cu 23		240	16	27	1 000
	12		WC70Cu	Cu 30		300	12	20	1 000
	13		Mo	Mo 99,5		150	17	29	1 000
	14		W	W 99,5		420	17	29	1 000
	15		W65Ag	35 Ag		140	29	50	900
C	20	1	CuAl2O3	Al2O3 1,1	extruded	150	44	76	980
					work hardened	160	44	76	980
		2	CuAl2O3	Al2O3 0,5	extruded	140	50	86	980
					work hardened	150	50	86	980
		3	CuAl2O3	Al2O3 0,3	extruded	120	54	92	950
					work hardened	140	54	92	980
		4	CuAl2O3	Al2O3 1,5 B max. 0,2	extruded	155	43	74	980
		5	CuAl2O3	Al2O3 1,0 B max. 0,2	extruded	140	45	77	980
		6	CuAl2O3	Al2O3 0,6 B max. 0,2	extruded	130	50	86	950

NOTE The nominal alloying elements of the listed grades are for information only. The materials are manufactured to the properties shown in the table. Group A and C alloys are copper based; refractory materials are listed in group B.

Annex A
(informative)

Typical applications

See Table A.1.

Table A.1 — Typical applications

Material	Spot welding	Seam welding	Projection welding	Flash or butt welding	Auxiliary applications
A 1/1	—	—	—	—	Unstressed current-carrying parts; laminated shunts
A 1/3	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.)	—	Electrodes or inserts for welding mild steel	Electrodes for high-frequency resistance welding of non-ferrous metals
A 1/4	—	—	—	—	Unstressed current-carrying parts; laminated shunts; weldable cables
A 2/1	Electrodes for welding mild steel Holder and shafts and back-ups	Electrodes for welding mild steel	Large electrodes	Electrodes 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	Electrodes and inserts	—	Stressed current-carrying parts Parts for guns, e.g. holders, shafts and arms
A 2/3	Electrodes for welding mild steel, coated steel and advanced high-strength steel	Electrode wheels for welding mild steel and coated steel	Electrodes and inserts	—	Stressed current-carrying parts Parts for guns, e.g. holders, shafts
A 2/4	Electrodes for welding mild steel, coated steel and advanced high-strength steel	Electrode wheels for welding mild steel and coated steel	Electrodes and inserts	—	Stressed current-carrying parts
A 3/1	Electrodes for welding stainless and heat-resistant steels Stressed electrode holders, shafts and arms	Welding wheels for stainless and heat-resistant steels Shafts and bushings	Electrodes and inserts	Electrodes 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

Table A.1 (*continued*)

Material	Spot welding	Seam welding	Projection welding	Flash or butt welding	Auxiliary applications
A 3/3	Electrodes for welding stainless and heat-resistant steels Stressed electrode holders, shafts and arms	Welding wheels for stainless and heat-resistant steels Shafts and bushings	Electrodes and inserts	Electrodes or inserts under high clamping force	Stressed current-carrying parts
A 3/4	Electrodes for welding stainless and heat-resistant steels Stressed electrode holders, shafts and arms	Welding wheels for stainless and heat-resistant steels Shafts and bushings	Electrodes and inserts	Electrodes or inserts under high clamping force	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	Electrodes or inserts under high electrode forces	Long electrodes for flash welding	—
A 4/4	Electrode holders	Shafts and bushings under light electrical loading	Plattens and electrodes	—	—
A 4/5	Bars and tubes for gun arms, inserts in welding tools	—	Inserts in tools	—	Various parts in tooling and welding machines
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 electrodes 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
C 20	Electrodes for welding mild steel, coated steel and advanced high strength steel	Electrode wheels for welding mild steel and coated steel	Electrodes and inserts	—	Stressed current-carrying parts

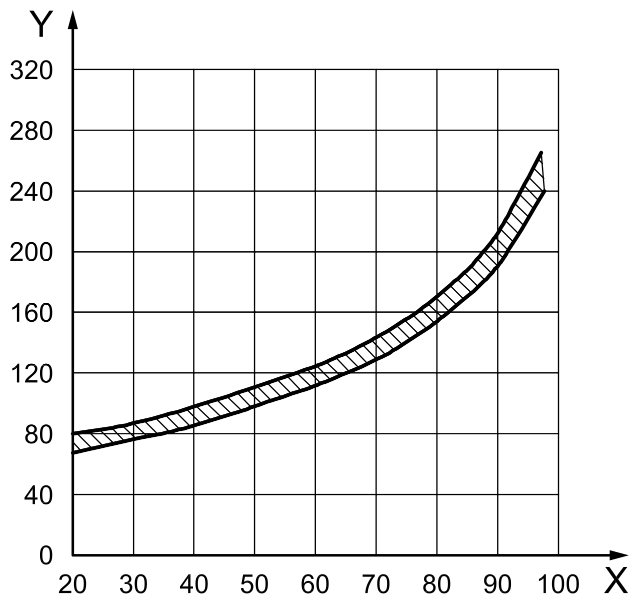
Annex B
(informative)

Hardness conversion

For resistance welding materials, it is common to measure hardness by Vickers, Brinell or Rockwell methods, in accordance with ISO 6507-1, ISO 6506-1 or ISO 6508-1. 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 when comparing Vickers, Brinell and Rockwell results on Group A2 alloys that the values do not correspond to the standard comparisons normally used for copper and brasses (References [3] and [4]). Figure B.1 is, therefore, appended to give approximate conversions for CuCr and CuCrZr alloys; it is also valid for CuCo2Be and CuNi1P. The band includes 80 % of results and indicates the scatter which may be expected.

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



Key

X HRB

Y HV 30

Figure B.1 — Conversion of Vickers hardness, HV 30, to Rockwell hardness, HRB

Annex C
(informative)

Different alloy designations

Table C.1 — Different alloy designations and comparable properties

ISO 5182 Designation		UNS	RWMA Class	EN 12163
A1/1	Cu-ETP			CW004A
A1/3	Cu Ag0,1P			
A1/4	Cu-PHC			CW020A
A2/1	CuCr1	C18200	2	CW105C
A2/2	CuCr1Zr	C18150	2	CW106C
A2/3	CuCrZr			CW106C
A2/4	CuZr	C15000	1	CW120C
A3/1	CuCo2Be	C17500	3	CW104C
A3/2	CuNi2Si			CW111C
A3/3	CuNi2Be	C17510	3	CW110C
A3/4	CuCo1Ni1Be			CW103C
A4/1	CuNi1P			CW108C
A4/2	CuBe2Ni	C17200	4	CW101C
A4/4	CuAl10Fe5Ni5			CW307G
A4/5	CuZn40Pb2			CW617N
B10	W75Cu		11	
B11	W78Cu		12	
B12	WC70Cu			
B13	Mo		14	
B14	W		13	
B15	W65Ag			
C20/1	CuAl2O3	C17560	20	
C20/2	CuAl2O3	C15735		
C20/3	CuAl2O3	C15725		
C20/4	CuAl2O3			
C20/5	CuAl2O3			
C20/6	CuAl2O3		20	

Bibliography

[1] ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method*

[2] ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)*

[3] ISO 18265, *Metallic materials — Conversion of hardness values*

[4] ASTM E140, *Standard hardness conversion tables for metals — Relationship among Brinell hardness, Vickers hardness, Rockwell hardness, superficial hardness, Knoop hardness and scleroscope hardness*

[5] EN 12163, *Copper and copper alloys — Rod for general purposes*

[6] IEC 60468, *Method of measurement of resistivity of metallic materials*

ICS 25.160.20

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