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## Resistance welding — Materials for electrodes and ancillary equipment

*Soudage par résistance — Matériaux pour électrodes et  
équipements annexes*

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

The committee responsible for this document is ISO/TC 44, *Welding and allied processes*, Subcommittee SC 6, *Resistance welding and allied mechanical joining*.

This fourth edition cancels and replaces the third edition (ISO 5182:2008), 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 via your national standards body. A complete listing of these bodies can be found at [www.iso.org](http://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 documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 in accordance with [Table 1](#).

**Table 1 — Group A — Classification of copper and copper alloys**

Type	Description
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.
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.
3	Heat-treated alloys which have superior mechanical properties to type 2 but a lower electrical conductivity than either type 1 or type 2.
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 in accordance with [Table 2](#).

**Table 2 — Group B — Classification of sintered materials**

Type	Description
10 and 11	Sintered products of copper and tungsten.
12	Sintered product of copper and tungsten carbide.
13	Sintered and worked product of molybdenum.
14	Sintered and worked product of tungsten.
15	Sintered product of tungsten and silver.

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

This group comprises two types of materials (see [Table 3](#)):

- C 20/1, C 20/2 and C 20/3, manufactured by internal oxidation;
- C 20/4, C 20/5 and C 20/6, manufactured by ball milling or mechanical alloying.

## 5 Specifications

### 5.1 Requirements

The materials shall comply with [Table 3](#).

### 5.2 Chemical composition

The chemical compositions are given in [Table 3](#).

### 5.3 Mechanical properties

The material hardness shall not be less than as given in [Table 3](#).

NOTE When these materials are used for resistance welding equipment, the required properties are different from those of materials used for general purposes.

### 5.4 Electrical properties

The electrical conductivity, given in mega-Siemens 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 3](#).

## 6 Methods of test

### 6.1 Vickers hardness test

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

### 6.2 Electrical properties

The electrical properties shall be measured in accordance with ASTM E1004. 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 3](#)).

EXAMPLE 1 CuCr1 is designated:

**ISO 5182:2016 – A 2/1**

where

**ISO 5182** is the reference of this International Standard;

**A** is the material group (see [Clause 4](#));

**2** is the material type (see [Clause 4](#));

**1** is the CuCr1 material number (see [Table 3](#)).

EXAMPLE 2 W75Cu is designated:

**ISO 5182:2016 – B 10**

where

**ISO 5182** is the reference of this International Standard;

**B** is the material group (see [Clause 4](#));

**10** is the material type (see [Clause 4](#)).

## 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 3 — Composition and properties of materials**

Group	Type	No.	Designation	Nominal alloying elements %	Forms available mm	Hardness HV 30 min.	Electrical conductivity		Softening temperature °C min.											
							MS/m min.	% IACS												
A	1	1	Cu-ETP	Cu (+Ag) min. 99,90	drawn ≥25	85	57	98	150											
					drawn <25	100	57	98												
					forged	45	57	98												
					cast	40	50	86												
	1	2	Cu-EPT1	Cu min 99,90 O max.0,04	wire d ≤ 2,5/ -0,04	a	57,5	99	150											
					3	CuAg0,10P	Ag 0,08 to 0,12	drawn <25	90	55	95	150								
													4	Cu-PHC	P 0,001 to 0,006	drawn	85	57	98	150
	2	1	CuCr1	Cr 0,5 to 1,2	drawn <25	140	44	76	475											
					forged	100	44	76												
					cast	85	44	76												
					drawn ≥25	135	43	74												
	2	2	CuCr1Zr	Cr 0,5 to 1,4 Zr 0,03 to 0,3	drawn <25	140	43	74	500											
					forged	100	43	74												
					cast	85	44	76												
					drawn ≥25	135	43	74												
	3	3	CuCrZr	Cr 0,4 to 1 Zr 0,02 to 0,15	drawn <25	150	43	74	500											
					forged	100	43	74												
					cast	85	44	76												
					drawn ≥25	135	43	74												
	4	4	CuZr	Zr 0,1 to 0,2	drawn	140	47	81	500											
					ground <30	130	47	81												
					drawn ≥25	260	23	40												
					drawn <25	270	23	40												
3	1	CuCo2Be	Co 2,0 to 2,8 Be 0,4 to 0,7	forged	260	23	40	500												
				cast	250	23	40													
				drawn ≥25	180	17	29													
				drawn <25	190	18	31													
3	2	CuNi2Si	Ni 1,6 to 2,5 Si 0,4 to 0,8	forged	170	19	33	450												
				cast	160	17	29													
				drawn ≥25	180	17	29													
				drawn <25	190	18	31													
3	3	CuNi2Be	Ni 1,4 to 2,4 Be 0,2 to 0,6	drawn <40	240	24	42	450												
				drawn <40	250	23	40													
3	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												
				drawn <40	250	23	40													

<sup>a</sup> Rm min = 270 MPa, Rp/Rm ≥ 0,7.

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.



Table 3 (continued)

Group	Type	No.	Designation	Nominal alloying elements %	Forms available mm	Hardness HV 30 min.	Electrical conductivity		Softening temperature °C min.																												
							MS/m min.	% IACS																													
A	4	1	CuNi1P	Ni 0,8 to 1,2 P 0,15 to 0,25	drawn ≥25	210	29	50	450																												
					drawn <25	220	29	50																													
					forged	130	29	50																													
					cast	110	29	50																													
		2	CuBe2	Be 1,8 to 2,1 Co-Ni-Fe 0,20 to 0,30	drawn ≥25	330	14	25	300																												
					drawn <25	340	14	25																													
					forged	350	14	25																													
		4	CuAl10Ni5Fe4	Al 8,5 to 11 Fe 3,0 to 5,0 Ni 4,0 to 6,0 Mn 0 to 1,0	forged	170	4	7	650																												
					cast	170	4	7																													
		5	CuZn40Pb2	Cu 57 to 59, Pb 1,6 to 2,5	bars and tubes, diameter 60 mm max.	120	15	17	650																												
6	CuZn21Si3P									Cu 76 Zn 21 Si 3, P 0,05	bars and tubes diameter 60 mm and above	130	4,5	7,8																							
		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
		C	20	1	CuAl2O3	Al <sub>2</sub> O <sub>3</sub> 1,1	extruded	150	44																												
extruded	140						45,6	78	980																												
2	CuAl2O3			Al <sub>2</sub> O <sub>3</sub> 0,6	work hardened	150	45,6	78	980																												
					extruded	120	54	92	950																												
3	CuAl2O3			Al <sub>2</sub> O <sub>3</sub> 0,25	work hardened	140	54	92	980																												
					extruded	155	43	74	980																												
4	CuAl2O3	Al <sub>2</sub> O <sub>3</sub> 1,5 B max. 0,2	extruded	155	43	74	980																														
			extruded	140	45	77	980																														
5	CuAl2O3 C15790	Al <sub>2</sub> O <sub>3</sub> 0,92 B max. 0,22	extruded	140	45	77	980																														
			extruded	130	50	86	950																														
6	C15780	Al <sub>2</sub> O <sub>3</sub> 0,70 B max. 0,22	extruded	130	50	86	950																														

<sup>a</sup> Rm min = 270 MPa, Rp/Rm ≥ 0,7.

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.