This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: B702 – 93 (Reapproved 2019)

Standard Specification for Copper-Tungsten Electrical Contact Material [1]

This standard is issued under the fixed designation B702; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (′) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers electrical contact components made from copper tungsten by powder metallurgical procedures.

1.2 This specification covers compositions within the cop- per tungsten system normally specified by users of contacts.

1.3 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to become familiar with all hazards including those identified in the appropriate Data Safety Sheet (SDS) for this product/material as provided by the manufacturer, to establish appropriate safety, health, and environmental practices, and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

B328 Test Method for Density, Oil Content, and Interconnected Porosity of Sintered Metal Structural Parts and Oil-Impregnated Bearings (Withdrawn 2009) [3]

3. Significance and Use

3.1 Proprietary methods for manufacture of these materials vary significantly among suppliers and these methods influence such properties as arc erosion, contact resistance, and tendency to weld in service. Since the performance of contacts in a device depends on numerous factors outside the contact itself (opening speed, closing speed, contact pressure, contact bounce, environmental variations, assembly technique and variations, etc.) this specification cannot ensure performance control in the application. As part of the qualification on initial samples it is recommended that the user functionally electrically test the materials for all devices applicable to the material's use. This specification will provide a means for the contact manufacturer and contact user to reach agreement on the details of material to be supplied for a specified use and reasonable assurance that future lots will be similar in properties and microstructure to the initial test or sample contacts supplied.

4. Ordering Information

4.1 Orders for this material under this specification shall include the following information:

4.1.1 Dimensions (see Section 8),

4.1.2 Chemical composition (see reference tables in Related Material as possible guideline),

4.1.3 Physical properties (see Section 6 and reference tables as guideline),

4.1.4 Certification (see Section 11), and

4.1.5 Other features as agreed upon between the vendor and the user.

5. Chemical Requirements

5.1 The material shall conform to composition limits as agreed upon between the manufacturer and the user.

5.2 The chemical analysis shall be made in accordance with the methods prescribed in the newest edition of *Annual Book of ASTM Standards*, or by any other approved method agreed upon between the manufacturer and the purchaser.

6. Other Properties

6.1 The manufacturer and the purchaser shall agree on qualification tests for determination of physical properties.

6.2 The tests shall be performed on production parts, wherever practical or applicable. (Small size contacts do not lend themselves to accurate conductivity measurement.)

[1] This specification is under the jurisdiction of ASTM Committee B02 on Nonferrous Metals and Alloys and is the direct responsibility of Subcommittee B02.05 on Precious Metals and Electrical Contact Materials.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

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6.3 The tests shall be determined after consideration of the function of the part.

6.4 The typical properties of five most common types of copper-tungsten contacts are given in Appendix X1.

7. Dimensions and Permissible Variations

7.1 Permissible variations in dimensions shall be within the limits specified on drawings describing the contacts and accompanying the order, or shall be within the limits specified in the purchase order.

8. Workmanship, Finish, and Appearance

8.1 The parts shall be free of defects in material or processing, which would seriously affect their performance.

9. Sampling and Inspection

9.1 *Lot*—Unless otherwise specified, a lot shall consist of parts of the same form, and dimensions, made of powders of the same particle size range and composition, processed under the same conditions, and submitted for inspection at one time.

9.2 *Chemical Analysis*—At least one sample for chemical analysis shall be taken from each lot. A representative sample of chips may be obtained by milling, drilling, or crushing at least two pieces with dry tools, without lubrication. In order to obtain oil-free chips, the parts selected for test shall have the oil extracted in accordance with Test Method B328, if neces- sary.

9.2.1 These specification limits do not preclude the possible presence of other unnamed elements, impurities or additives. Analysis shall be regularly made only for the minor elements listed in the table. However, if a user knows of elements that might be detrimental to their application or has other reasons for requiring analysis for specific elements, then agreement between manufacturer and purchaser for both limits and methods of analysis should be required for elements not specified.

9.3 *Physical Tests*—The manufacturer and the purchaser shall agree on a representative number of specimens for physical tests including microstructure.

10. Rejection and Rehearing

10.1 Unless otherwise specified, rejections based on tests made in accordance with the specification shall be reported to the manufacturer within 30 days of the receipt of shipment.

11. Certification

11.1 A certification, when requested by the user, based on the manufacturer's quality control, that the material conforms to the requirements of this specification shall be furnished upon request of the purchaser, provided the request is made at the time of cost quotation and at the time of order placement.

12. Keywords

12.1 contacts; copper; copper–tungsten; powder metallurgy; tungsten; tungsten–copper

APPENDIX

(Nonmandatory Information)

X1. TYPICAL PROPERTY VALUES

X1.1 Scope

X1.1.1 The following information provides guidelines for users and manufacturers of copper-tungsten contact material. Typical ranges of chemistry and properties are given for the range of compositions available. Some manufacturers offer specific compositions other than those listed. Properties are influenced by the particle size, shape, and distribution of the tungsten as well as by the presence of additives or other manufacturing process variables. The best choice for a given application should be mutually decided between the purchaser and the supplier using their mutual experience and application engineering knowledge.

X1.1.2 With the knowledge that several types of material are available, care should be taken to ensure that production lots are the same in all respects as samples and that if a vendor change is made, noticeable property or performance variables are possible. See Table X1.1.

TABLE X1.1 Chemical Requirements [A]

	Class A	Class B	Class C	Class D	Class E
Copper, %	48–52	38–42	28–32	23–27	18–22
Tungsten, %	balance	balance	balance	balance	balance
Additives (Individual or total), max,%	1.00	1.00	1.00	1.00	1.00
			Physical Properties [B]		
	Class A	Class B	Class C	Class D	Class E
Hardness, Rockwell B	69–83	77–90	85–98	89–102	94–106
Density, Mg/m ^{3} at 96 % theoretical	11.7	12.7	13.7	14.3	15.0
Electrical conductivity, [C] % IACS	56–64	49–57	44–52	41–48	38–45
Electrical conductivity, [D] % IACS	38–56	34–49	29–43	27–41	25–37
Note—Hardness and density values cover both types.					
			Physical Properties [E]		
	Class A	Class B	Class C	Class D	Class E
Tensile Strength, ksi	50–60	55–65	75–85	85–95	90–100
MPa	344–413	379–448	516–585	585–654	620–689
Modulus of Rupture, ksi	75–85	110–120	130–140	140–150	150–160
MPa	517–586	758–827	896–965	965–1034	1034–1103
Coefficient of Expansion, in./in.·°F	7.2×10^{-6}	6.6×10^{-6}	5.7×10^{-6}	5.3×10^{-6}	4.9×10^{-6}
m/m·K	13×10^{-6}	11.9×10^{-6}	10.3×10^{-6}	9.5×10^{-6}	8.8×10^{-6}

[A] Analysis is regularly made for the elements for which specific limits are listed. If, however, the presence of “other” elements is suspected or indicated in the course of routine analysis, further analysis shall be made to determine that the total of these “other” elements and the listed impurities are not in excess of the total impurities limit.

[B] These data do not constitute a part of the specifications. They indicate to the purchaser the properties that may be expected from a given particle size of powder. The values will vary to some degree with the size of part, configuration of part, composition, and microstructure. Certain specific applications may require modification of these basic materials. In such case, the properties required are determined by agreement between the purchaser and the supplier.

[C] Typical values for infiltrated type.

[D] Typical values for liquid phase sintered type.

[E] Items that are normally useful for engineering calculations in contact design but are not specified.

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