Designation: B596 – 89 (Reapproved 2017)

Standard Specification for Gold-Copper Alloy Electrical Contact Material[1]

This standard is issued under the fixed designation B596; 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 (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This specification covers a wrought alloy containing gold and copper in the form of wire, rod, strip, and tubing for electrical contacts.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 The following precautionary statement pertains to the test method portion only, Section 7, of this standard: *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 Safety Data Sheet (SDS) for this product/material as provided by the manufacturer, to establish appropriate safety and health practices, and determine the applicability of regulatory limitations prior to use.*

1.4 *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]

B476 Specification for General Requirements for Wrought Precious Metal Electrical Contact Materials

E8 Test Methods for Tension Testing of Metallic Materials

E384 Test Method for Microindentation Hardness of Materials

3. Materials and Manufacture

3.1 Raw materials shall be of such quality and purity that the finished product will have the properties and characteristics prescribed in this specification.

3.2 The material shall be finished by such operations (cold working, heat treating, annealing, turning, grinding, pickling) as are required to produce the prescribed properties.

4. Chemical Composition

4.1 Materials produced under the specification shall meet the requirements of chemical composition shown in Table 1.

5. Mechanical Properties

5.1 The contract or order may specify ultimate tensile strength, elongation, microhardness (Knoop or Vickers), hardness (Rockwell or Rockwell Superficial), or a combination of these mechanical properties as temper criterion. If the contract or order does not specify a temper criterion, then the criterion for temper designation will be ultimate tensile strength.

5.2 The material shall conform to the mechanical properties shown in Table 2, Table 3, Table 4, or Table 5.

5.3 The material shall be free of stress corrosion (as tested) in accordance with 7.3.

6. General Requirements

6.1 Specification B476 shall apply to all materials produced to this specification.

7. Test Methods

7.1 Test methods shall be in accordance with Specification B476.

7.1.1 Knoop hardness tests shall be in accordance with Test Method E384. Material 0.005 in. (0.13 mm) in thickness (or diameter) and larger shall be tested using a 100-g indenter load. A minimum of five hardness indentations shall be made on each specimen. The hardness value reported shall be the average of the five indentations. Material less than 0.005 in. in thickness (or diameter) shall be tested with a 50-g indenter load.

7.1.2 All tension tests shall be in accordance with Test Methods E8 and test specimens shall be full cross section, when practical.

[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.

TABLE 1 Chemical Requirements

Element	Weight, %
Gold	89.0–91.0
Copper balance	9.0–11.0
Total, noble metal impurities	0.2 max
Total, all other impurities	0.2 max

TABLE 2 Mechanical Properties of Wire (0.005 to 0.020 in. (0.13 to 0.51 mm) diameter)

Property	Temper,	
	Annealed	Hard Drawn
Tensile strength, ksi (MPa)	75 max (520 max)	90 min (620 min)
Elongation in 2 in. or 50 mm, %	15 min	3 max
Hardness, Knoop, HK_{100} [A]	170 max	200 min

[A] See 7.1.1.

TABLE 3 Mechanical Properties of Wire (Over 0.020 to 0.060 in. (0.51 to 1.52 mm) diameter)

Property	Temper,	
	Annealed	Hard Drawn
Tensile strength, ksi (MPa)	65 max (450 max)	80 min (550 min)
Elongation in 2 in. or 50 mm, %	25 min	5 max
Hardness, Knoop, HK_{100} [A]	170 max	200 min

[A] See 7.1.1.

TABLE 4 Mechanical Properties of Strip (0.003 to 0.015 in. (0.076 to 0.38 mm) thick)

Property	Temper,	
	Annealed	Hard Rolled
Tensile strength, ksi (MPa)	75 max (520 max)	90 min (620 min)
Elongation in 2 in. or 50 mm, %	15 min	3 max
Hardness, Knoop, HK_{100} [A]	170 max	200 min

[A] See 7.1.1.

7.1.3 All tests shall be conducted at room temperature, 65 to 85°F (18 to 29°C).

7.2 Chemical analysis shall be performed by spectrochemical or wet analysis methods. Fire assay is an acceptable alternative method for gold analysis.

7.3 The stress corrosion test shall be performed as follows:

7.3.1 Immerse test samples in a test solution of the following proportions for 30 min at room temperature:

TABLE 5 Mechanical Properties of Tubing (0.025 to 2.0 in. (0.64 to 51 mm) outside diameter)

Property	Temper,	
	Annealed	Hard Drawn
Tensile strength, ksi (MPa)	75 max (520 max)	90 min (620 min)
Elongation in 2 in. or 50 mm, %	15 min	3 max
Hardness, Knoop, HK_{100} [A]	170 max	200 min

[A] See 7.1.1.

7.3.1.1 *Ferric Chloride* ($FeCl_3$)—20 g,

7.3.1.2 *Hydrochloric Acid* (HCl) (*conc*)—80 mL, and

7.3.1.3 *Distilled Water*—250 mL.

7.3.2 Remove the samples, thoroughly rinse, and dry. Discard the solution; do not reuse.

7.3.3 Examine for cracks visible to the naked eye.

7.3.4 If no cracks are visible, carry out the following procedure:

7.3.4.1 Compress the ring or tube samples with pliers over a mandrel whose outside diameter is approximately one half the inside diameter of the ring.

7.3.4.2 Bend wire, rod or tube or strip samples 180° around a pin whose diameter is approximately five times the wire or strip thickness.

7.3.4.3 The material shall be considered free of stress corrosion if the samples do not exhibit spontaneous cracking, and if the samples do not show a greater tendency to crack than samples that have not been immersed in the test solution but have been compressed in the same manner.

8. Inspection and Testing

8.1 Material furnished under this specification shall be inspected and tested by the manufacturer as listed below:

8.1.1 Visual inspection at 10× magnification.

8.1.2 Tension or hardness test, or both, for temper verification.

8.1.3 Dimensional inspection.

8.1.4 Chemical analysis when indicated by the purchase order.

8.1.5 Stress corrosion test.

9. Keywords

9.1 coin gold; contacts; electrical contacts; gold alloy; low contact resistance; low energy contact; non arcing contact

APPENDIX

(Nonmandatory Information)

X1. REFERENCE PROPERTIES FOR GOLD—COPPER ELECTRICAL CONTACT MATERIAL

X1.1 The following is a list of typical property values which are useful for engineering calculations in electrical contact design and application.

	Annealed
Resistivity	
Ω·cmil/ft	76.4
μΩ·cm	12.7
Density, g/cm^3	17.32
Solidus temperature,°C	930