



# Standard Specification for Palladium-Silver-Copper Electrical Contact Alloy<sup>1</sup>

This standard is issued under the fixed designation B 563; 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 Department of Defense.*

## 1. Scope

1.1 This specification covers an alloy containing palladium, silver, copper, platinum, and nickel in the form of wire, rod, and strip for electrical contacts.

1.2 The values stated in inch-pound units are to be regarded as the standard. The SI units given in parentheses are for information only.

1.3 The following precautionary statement pertains to the test method portion only, Section 7, of this specification: *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 establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

### 2.1 ASTM Standards:

B 476 Specification for General Requirements for Wrought Precious Metal Electrical Contact Materials<sup>2</sup>

E 8 Test Methods of Tension Testing of Metallic Materials<sup>3</sup>

E 384 Test Method for Microhardness of Materials<sup>3</sup>

## 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) and are required to produce the prescribed properties.

## 4. Chemical Composition

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

<sup>1</sup> This test method 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.

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<sup>2</sup> Annual Book of ASTM Standards, Vol 03.04.

<sup>3</sup> Annual Book of ASTM Standards, Vol 03.01.

TABLE 1 Chemical Requirements

Element	Composition, weight %
Palladium	43.0–45.0
Silver	37.0–39.0
Copper	15.5–16.5
Platinum	0.8–1.2
Nickel	0.8–1.2
Total noble metal impurities	0.2 max
Total base metal impurities	0.2 max

## 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 and elongation.

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

## 6. General Requirements

6.1 Specification B 476 shall apply to all materials produced to this specification.

## 7. Test Methods

7.1 Test methods are in accordance with Specification B 476.

TABLE 2 Mechanical Requirements for Wire 0.003 to 0.020 in. (0.13 to 0.51 mm) Diameter<sup>A</sup>

Property	Units	Temper		Age Hardened
		Solution Annealed	Stress Relieved	
Tensile strength	ksi	100–120	135–165	160–210
	MPa	689–827	930–1137	1034–1344
Elongation	percent	20 min	8 min	1–10
Hardness, Knoop	HK <sub>100</sub> <sup>B</sup>	170–250	260–330	320–380
Hardness, Vickers	HV <sub>100</sub> <sup>B</sup>	170–240	240–330	290–370

<sup>A</sup>See 7.1.

<sup>B</sup>See 7.3.

**TABLE 3 Mechanical Requirements for Wire Over 0.020 to 0.060 in. (0.51 to 1.52 mm) Diameter <sup>A</sup>**

Property	Units	Temper	
		Solution Annealed	Age Hardened
Tensile strength	ksi	100–120	160–210
	MPa	689–827	1000–1310
Elongation	percent	15 min	1–10
Hardness, Knoop	HK <sub>100</sub> <sup>B</sup>	170–250	340–400
Hardness, Vickers	HV <sub>100</sub> <sup>B</sup>	170–240	310–390

<sup>A</sup>See 7.1.

<sup>B</sup>See 7.3.

**TABLE 4 Mechanical Requirements for Strip 0.003 to 0.015 in. (0.076 to 0.38 mm) Thick <sup>A</sup>**

Property	Units	Temper		Age Hardened
		Solution Annealed	Stress Relieved	
Tensile strength	ksi	100–120	140–170	150–195
	MPa	689–827	965–1171	1034–1344
Elongation	percent	15 min	8 min	1–13
Hardness, Knoop	HK <sub>100</sub> <sup>B</sup>	170–250	260–330	320–380
Hardness, Vickers	HV <sub>100</sub> <sup>B</sup>	170–240	250–320	290–370

<sup>A</sup>See 7.1.

<sup>B</sup>See 7.3.

7.2 All tension tests are in accordance with Methods E 8 and tensile specimens are full cross-section size when practical. Elongation measurements should be based on a 2 in. (50 mm) gage length.

7.3 Hardness is in accordance with Test Method E 384. Test material 0.005 in. (0.13 mm) in thickness (diameter) and larger using a 100 g indenter load. Test material less than 0.005 in. in thickness (diameter) using a 50 g indenter load. Make a minimum of five hardness indentations on each specimen. Make all indentations so that the long axis of the Knoop indenter is parallel to the rolling or drawing direction of the material.

7.4 Perform chemical analysis by spectrochemical or wet analysis methods.

7.5 Conduct all tests at room temperature (65 to 85°F), (18 to 29°C).

## 8. Inspection and Testing

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

8.1.1 Visual inspection at 10× magnification,

8.1.2 Tension or hardness tests, or both, for temper verification,

8.1.3 Dimensional inspection, and

8.1.4 Chemical analysis when indicated by the purchase order.

## 9. Keywords

9.1 contacts; electrical contacts; palladium alloy; palladium-silver-copper; low contact resistance; low energy contact; non arcing contact

## APPENDIX

### (Nonmandatory Information)

#### X1. REFERENCE PROPERTIES FOR PALLADIUM ELECTRICAL CONTACT MATERIAL

X1.1 Table X1.1 contains a list of typical property values which are useful for engineering calculations in electrical

contact design and application.

**TABLE X1.1 Physical Properties**

	Solution Annealed <sup>A</sup>	Stress Relieved <sup>A</sup>	Age Hardened
Resistivity:			
Ω-cmil/ft	185	180	155
μΩ-cm	30.7	29.9	25.8
Density, g/cm <sup>3</sup>	10.8	10.8	10.8
Solidus temperature, °C	1032	1032	1032
Linear coefficient of thermal expansion, ° C (23 to 100°C)	$13.5 \times 10^{-6}$	$13.5 \times 10^{-6}$	$13.5 \times 10^{-6}$
Thermal emf versus platinum (0–100°C), μV/°C	–18	...	–23
Softening voltage, mV	...	...	200
Melting voltage, mV	...	...	390
Fatigue strength (rotating-bending) at 10 <sup>6</sup> stress reversals:			
ksi			45
MPa			310
Modulus of elasticity in tension:			
ksi	$16 \times 10^3$	$16 \times 10^3$	$16 \times 10^3$
MPa	$110 \times 10^3$	$110 \times 10^3$	$110 \times 10^3$

<sup>A</sup>Material in the solution-annealed and stress-relieved tempers may be age hardened by subjecting it to an elevated temperature for a specified period of time. Temperatures ranging from 800 to 1000°F (430 to 540°C) at times from 10 to 45 min (the lower temperatures require the longer times) are ordinarily useful. When age hardening is to be done by other than the material manufacturer, the manufacturer should be consulted for the time-temperature treatment most suitable for the purchaser's application.

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