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# Standard Specification for Palladium-Silver-Copper Electrical Contact Alloy[1]

This standard is issued under the fixed designation B563; 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 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 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 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 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) 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.

## 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 B476 shall apply to all materials produced to this specification.

## 7. Test Methods

7.1 Test methods are in accordance with Specification B476.

7.2 All tension tests are in accordance with Test Methods E8 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 E384. 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.

[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 | 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 |

**TABLE 2 Mechanical Requirements for Wire 0.003 to 0.020 in. (0.13 to 0.51 mm) Diameter[A]**

| 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 | $HK_{100}$ [B] | 170–250 | 260–330 | 320–380 |
| Hardness, Vickers | $HV_{100}$ [B] | 170–240 | 240–330 | 290–370 |

[A] See 7.1.
[B] See 7.3.

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,

**TABLE 3 Mechanical Requirements for Wire Over 0.020 to 0.060 in. (0.51 to 1.52 mm) Diameter[A]**

| 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 | $HK_{100}$ [B] | 170–250 | 340–400 |
| Hardness, Vickers | $HV_{100}$ [B] | 170–240 | 310–390 |

[A] See 7.1.
[B] See 7.3.

**TABLE 4 Mechanical Requirements for Strip 0.003 to 0.015 in. (0.076 to 0.38 mm) Thick[A]**

| 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 | $HK_{100}$ [B] | 170–250 | 260–330 | 320–380 |
| Hardness, Vickers | $HV_{100}$ [B] | 170–240 | 250–320 | 290–370 |

[A] See 7.1.
[B] See 7.3.

8.1.3 Dimensional inspection, and

8.1.4 Chemical analysis when indicated by the purchase order.

## 9. Keywords

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

## 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 [A] | Stress Relieved [A] | Age Hardened |
|---|---|---|---|
| Resistivity: | | | |
| Ω·cmil/ft | 185 | 180 | 155 |
| μΩ·cm | 30.7 | 29.9 | 25.8 |
| Density, g/cm $^3$ | 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), μ V/°C | −18 | ... | −23 |
| Softening voltage, mV | ... | ... | 200 |
| Melting voltage, mV | ... | ... | 390 |
| Fatigue strength (rotating-bending) at 10° 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 | $110 \times 10^3$ | $110 \times 10^3$ | $110 \times 10^3$ |

[A] 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.