



Designation: B559 – 12 (Reapproved 2023)

Standard Specification for Nickel-Coated, Copper-Clad Steel Wire for Electronic Application¹

This standard is issued under the fixed designation B559; 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 nickel-coated, round, copper-clad steel wire for electronic application.

1.2 Nickel coatings in mass percentages of the total mass of the coated wire are as follows: 2 %, 4 %, 7 %, 10 %, and 27 %. Nickel-coated wire having different minimum mass percentages of nickel may be obtained by mutual agreement between the manufacturer and the purchaser. For information purposes, the thickness of coating in micrometers provided by the percentages listed above is shown in [Table 1](#).

1.3 Four classes of nickel-coated, copper-clad steel wire are covered as follows:

1.3.1 *Class N30HS*—Nominal 30 % conductivity, hard drawn.

1.3.2 *Class N30A*—Nominal 30 % conductivity, annealed.

1.3.3 *Class N40HS*—Nominal 40 % conductivity, hard drawn.

1.3.4 *Class N40A*—Nominal 40 % conductivity, annealed.

1.4 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.

1.4.1 *Exception*—The SI values for resistivity are to be regarded as standard.

1.5 The following safety hazards caveat pertains only to the test method described in 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* (**Warning**—Consideration should be given to toxicity and flammability when selecting solvent cleaners.)

¹ This specification is under the jurisdiction of ASTM Committee B01 on Electrical Conductors and is the direct responsibility of Subcommittee B01.06 on Bi-Metallic Conductors.

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1.6 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 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein:

2.2 *ASTM Standards*:²

[B193 Test Method for Resistivity of Electrical Conductor Materials](#)

[B258 Specification for Standard Nominal Diameters and Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors](#)

[B452 Specification for Copper-Clad Steel Wire for Electronic Application](#)

[E75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys](#) (Withdrawn 2010)³

2.3 *American Chemical Society*:⁴

[Standard Reagents Tests](#)

2.4 *NIST Standard*:⁵

[NBS Handbook 100 Copper Wire Tables](#)

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

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.

⁴ *ACS Reagent Chemicals, Specifications and Procedures for Reagents and Standard-Grade Reference Materials*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analabs Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.

⁵ Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, <http://www.nist.gov>.

TABLE 1 Nickel Mass Percent and Thickness of Coating

Diameter		Cross-Sectional Area at 20 °C			Thickness of Nickel, μ in. (for information only)				
in.	mm	cmil	in. ²	mm ²	2.0 %	4.0 %	7.0 %	10.0 %	27.0 %
0.0720	1.829	5 180	0.00407	2.63	334	637	1 181	1 703	4 892
0.0641	1.628	4 110	0.00323	2.08	298	566	1 050	1 514	4 349
0.0571	1.450	3 260	0.00256	1.65	266	505	936	1 350	3 880
0.0508	1.290	2 580	0.00203	1.31	236	450	833	1 200	3 452
0.0453	1.151	2 050	0.00161	1.04	211	401	743	1 071	3 077
0.0403	1.024	1 620	0.00128	0.823	202	357	661	953	2 738
0.0359	0.912	1 290	0.00101	0.653	167	318	589	849	2 439
0.0320	0.813	1 020	0.000804	0.519	149	283	525	757	2 174
0.0285	0.724	812	0.000638	0.412	133	252	467	686	1 937
0.0253	0.643	640	0.000503	0.324	118	224	415	598	1 719
0.0226	0.574	511	0.000401	0.259	105	200	371	535	1 536
0.0201	0.511	404	0.000317	0.205	94	178	330	475	1 366
0.0179	0.455	320	0.000252	0.162	83	158	294	423	1 216
0.0159	0.404	253	0.000199	0.128	74	141	261	376	1 080
0.0142	0.361	202	0.000158	0.102	66	126	233	336	965
0.0126	0.320	159	0.000125	0.0804	59	112	207	298	856
0.0113	0.287	128	0.000100	0.0647	53	100	185	267	768
0.0100	0.254	100	0.0000785	0.0507	47	89	164	237	680
0.0089	0.226	79.2	0.0000622	0.0401	41	80	146	211	605
0.0080	0.203	64.0	0.0000503	0.0324	...	71	131	189	544
0.0071	0.180	50.4	0.0000396	0.0255	...	63	116	168	482
0.0063	0.160	39.7	0.0000312	0.0201	...	56	103	149	428
0.0056	0.142	31.4	0.0000246	0.0159	...	50	92	132	381
0.0050	0.127	25.0	0.0000196	0.0127	...	44	82	118	340
0.0045	0.114	20.2	0.0000159	0.0103	...	40	74	106	306
0.0040	0.102	16.0	0.0000126	0.00811	...	...	66	95	272
0.0035	0.089	12.2	0.00000962	0.00621	...	...	57	83	238
0.0031	0.079	9.61	0.00000755	0.00487	...	...	51	73	211

3.1.1 *lot*—any amount of wire of one class and size presented for acceptance at one time, such amount, however, not to exceed 10 000 lb (4500 kg) (**Note 1**).

NOTE 1—A lot should comprise material taken from a product regularly meeting the requirements of this specification. Inspection of individual lots of less than 500 lb (230 kg) of wire cannot be justified economically. For small lots of 500 lb (230 kg) or less, the purchaser may agree to the manufacturers' regular inspection of the product as a whole as evidence of acceptability of such small lots.

3.1.2 *sample*—a quantity of production units (coils, reels, etc.) selected at random from the lot for the purpose of determining conformance of the lot to the requirements of this specification.

3.1.3 *specimen*—a length of wire removed for test purposes from any individual production unit of the sample.

4. Ordering Information

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

- 4.1.1 Quantity of each size.
- 4.1.2 Wire size (see Section 7 and **Table 1**).
- 4.1.3 Class of basis wire (see **1.3**).
- 4.1.4 Mass percentage of nickel coating (see **1.2** and **Table 1**).
- 4.1.5 Package size (see **14.2** and Section 14). Packaging inspection, if required (see **9.1.3**).
- 4.1.6 Special package marking, if required.
- 4.1.7 Place of inspection (see **13.1**).

5. Materials and Manufacture

5.1 The basis material shall consist of copper-clad steel wire conforming to the product description, quality and specification requirements of Specification **B452**.

5.2 The nickel-coated wire shall consist of the basis wire coated with nickel (**Note 2**). The quality of the nickel-coated wire shall be such that the finished product meets the properties and requirements in this specification.

NOTE 2—Nickel on copper-clad steel wire provides a protective coating for a prevention of oxidation of the copper either during fabrication or service.

6. General Requirements

6.1 Tensile strength and elongation of the nickel-coated wire shall conform to the requirements of Specification **B452** for the applicable size and class of copper-clad steel wire.

6.2 *Resistivity*—The electrical resistivity at a temperature of 20 °C shall not exceed the values prescribed in **Table 2** (Explanatory **Note 1**).

6.3 *Continuity of Coating*—The nickel coating shall be continuous. The continuity of the coating shall be determined on representative samples taken before stranding or insulating and shall be determined by the sodium polysulfide test, in accordance with **10.2**. Wire whose coating weight corresponds to a thickness less than 50 μ in. (0.00005 in.) (1.3 μ m) shall not be subject to this test.

6.4 *Adherence of Coating*—The nickel coating shall be firmly adhered to the surface of the copper-clad steel wire. The