



Designation: B 324 – 01

Standard Specification for Aluminum Rectangular and Square Wire for Electrical Purposes¹

This standard is issued under the fixed designation B 324; 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.

1. Scope

1.1 This specification covers aluminum 1350-O, annealed, 1350-H12 or -H22 (¼ hard), 1350-H14 or -H24 (½ hard), 1350-H16 or -H26 (¾ hard), and 1350-H19 (extra hard) wire, rectangular or square in shape with rounded corners for use as electrical conductors in insulated magnet wire.

1.2 The values stated in inch-pound or SI units are to be regarded separately as standard. Each system shall be used independently of the other. Combining the values from the two systems may result in non-conformance with the specification. For conductor sizes designated by AWG or kcmil sizes, the requirements in SI units are numerically converted from the corresponding requirements in inch-pound units. For conductor sizes designated by AWG or kcmil, the requirements in SI units have been numerically converted from corresponding values stated or derived in inch-pound units. For conductor sizes designated by SI units only, the requirements are stated or derived in SI units.

1.2.1 For density, resistivity and temperature, the values stated in SI units are to be regarded as standard.

NOTE 1—The aluminum and temper designations conform to ANSI H35.1. Aluminum 1350 corresponds to Unified Numbering System A91350 in accordance with Practice E 527.

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:

B 193 Test Method for Resistivity of Electrical Conductor Materials²

B 233 Specification for Aluminum 1350 Drawing Stock for Electrical Purposes²

B 279 Test Method for Stiffness of Bare Soft Square and Rectangular Copper and Aluminum Wire for Magnet Wire Fabrication²

B 557 Test Methods of Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products³

B 830 Specification for Uniform Test Methods and Frequency²

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁴

E 527 Practice for Numbering Metals and Alloys (UNS)⁵

2.3 ANSI Standard:

H35.1 Standard for Alloy and Temper Designation Systems for Aluminum⁶

2.4 American National Standards:

NBS Handbook 100—Copper Wire Tables⁷

NBS Handbook 109—Aluminum Wire Tables⁷

3. Description of Terms Specific to This Standard

3.1 *lot*—an inspection lot shall consist of an identifiable quantity of wire subjected to inspection at one time. Each lot shall consist of units of wire of the same size and temper, manufactured under essentially the same conditions at essentially the same time. The amount in any case shall not exceed 30 000 lb (14 000 kg).

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

3.3 *sample size*—the number of production units selected.

3.4 *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 and temper of each size and shape (see Section 5),

4.1.2 Wire size; thickness and width in inches or in millimetres (see Section 7),

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² Annual Book of ASTM Standards, Vol 02.03.

³ Annual Book of ASTM Standards, Vol 02.02.

⁴ Annual Book of ASTM Standards, Vol 14.02.

⁵ Annual Book of ASTM Standards, Vol 01.01.

⁶ Available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.

⁷ Available from the National Institute of Standards and Technology, (NIST), Gaithersburg, MD 20899.

4.1.3 Mandrel diameter for the edgewise bend test,

4.1.4 Place of inspection if other than at place of manufacture (see 12.2),

4.1.5 Whether inspection or witness of inspection and tests by purchaser's representative is required prior to shipment (see 12.3),

4.1.6 Packaging and marking (see Section 13), and

4.1.7 Special package marking, if required (see 13.4).

5. Materials and Manufacture

5.1 Material:

5.1.1 The aluminum wire shall be made from rod in accordance with the requirements of Specification B 233.

5.2 Manufacture:

5.2.1 Unless otherwise specified, the manufacturer shall have the option of producing the intermediate tempers by either strain-hardening (only for H12, H14, H16 and H19) or by strain-hardening and annealing (1350-O) or partial annealing H22, H24 and H26) (Explanatory Note 1 and ANSI H35.1).

5.2.1.1 When the manufacturer is given the option in 5.2.1, the intermediate tempers shall be specified as: H12 or H22; H14 or H24; H16 or H26.

5.2.1.2 When the manufacturer is not given the option in 5.2.1, the specific temper should be specified, for example, H19, H22, etc.

6. General Requirements

6.1 *Tensile Properties*—The wire shall conform to the requirements for tensile properties prescribed in Table 1.

6.2 *Resistivity*—The electrical resistivity of the wire shall not exceed the following values (Explanatory Note 2):

6.2.1 *All tempers except 1 350-O*, — 0.028264 Ω -mm²/m (17.002 Ω -cmil/ft) at 20°C, (61.0 Volume Conductivity % IACS).

6.2.2 *For 1350-O*—0.027898 Ω -mm²/m (16.782 Ω -cmil/ft) at 20°C, (61.8 Volume Conductivity % IACS).

6.3 *Joints*—The finished wire shall not contain joints except such as have passed through drawing dies or an equivalent rolling operation. Necessary joints in the wire and rods prior to final drawing or rolling shall be made in accordance with good commercial practice.

6.4 *Bending Properties*—1350-O wire shall be capable of being bent edgewise through 180° around a mandrel without cracking under normal conditions of edgewise bending during manufacturing operations. The mandrel diameter shall be as

agreed upon between the manufacturer and the user, and shall be not less than one half the nominal width of the material being bent. In cases where the mandrel diameter used is less than 5/32 in. (3.97 mm) or the thickness of the wire is less than 0.020 in. (0.51 mm) or the ratio of width to thickness of the wire is greater than 12 to 1, the edgewise bending properties of the wire shall be as agreed upon between the user and the manufacturer (see Explanatory Note 3 and Explanatory Note 4).

6.5 *Low Stress Elongation (LSE)*—The annealed wire (0 temper) shall have a minimum LSE value of 1 % determined in accordance with Test Method B 279. LSE test results are affected by small amounts of cold working. The specified 1 % minimum LSE value applies only to bare wires for further processing.

7. Dimensions and Permissible Variations

7.1 The dimensions shall be expressed in decimal fractions of an inch or in millimetres (Explanatory Notes 5-8).

7.1.1 The thickness shall not vary from that specified by more than the amounts shown in Table 2.

7.1.2 The width shall not vary from that specified by more than the amount shown in Table 3.

7.2 The wire shall have rounded corners or rounded edges as specified in Table 4 and as shown in Fig. 1. Where rounded corners are required, the corners of the wire shall be rounded within the limits of radii 25 % under and 25 % over (as determined by a radius gage) those values specified in Table 4.

8. Workmanship, Finish, and Appearance

8.1 The wire shall be free of all imperfections not consistent with good commercial practice.

9. General Methods and Conditions

9.1 *Nominal Cross-Sectional Areas*—Nominal cross-sectional areas in square mils or square millimetres shall be calculated by subtracting the area reductions due to the rounded corners or rounded edges (see Table 5 and Table 6). Values so derived shall be rounded off in accordance with 9.4 to the same number of significant figures as used in expressing the nominal dimensions, but in no case to less than three significant figures.

9.2 *Nominal Mass and Lengths*—Nominal linear density and lengths shall be calculated from the nominal wire dimensions in accordance with the following equations and shall be rounded off in the final values only, in accordance with 9.4, to the same number of significant figures as used in expressing the nominal dimensions, but in no case less than three significant figures.

$$\text{Mass per Unit Length lb/ft} = 1.17 \times A \times 10^{-6}$$

TABLE 1 Tensile Requirements

NOTE 1—For purposes of determining conformance with these specifications, each calculated value of tensile strength shall be rounded off to the nearest 0.1 ksi, in accordance with the rounding method of Practice E 29.

Temper	Tensile Strength			
	Max		Min	
–0	ksi	MPa	ksi	MPa
–H12, – H22	14.0	97	8.5	59
–H14, – H24	17.0	117	12.0	83
–H16, – H26	20.0	138	15.0	103
–H19	22.0	152	17.0	117
	29.0	200	22.0	152

TABLE 2 Permissible Variations in Thickness

Specified Thickness, in. (mm)	Permissible Variations in Thickness, in. (mm), plus and minus
0.280 to 0.098	1 %
(7.10 to 2.50), incl	
Under 0.098 to 0.025	0.001 (0.025)
(2.50 to 0.63), incl	