Standard Specification for Aluminum Rectangular and Square Wire for Electrical Purposes[1]

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, resitivity 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 Materials[2]

B 233 Specification for Aluminum 1350 Drawing Stock for Electrical Purposes[2]

B 279 Test Method for Stiffness of Bare Soft Square and Rectangular Copper and Aluminum Wire for Magnet Wire Fabrication[2]

B 557 Test Methods of Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products[3]

B 830 Specification for Uniform Test Methods and Frequency[2]

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications[4]

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

2.3 *ANSI Standard:*

H35.1 Standard for Alloy and Temper Designation Systems for Aluminum[6]

2.4 *American National Standards:*

NBS *Handbook 100—Copper Wire Tables*[7]

NBS *Handbook 109—Aluminum Wire Tables*[7]

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 $\Omega \cdot mm^2/m$ (17.002 Ω·cmil/ft) at 20°C, (61.0 Volume Conductivity % IACS).

6.2.2 *For 1350-O*—0.027898 $\Omega \cdot mm^2/m$ (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 valve 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.

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	
	ksi	MPa	ksi	MPa
−0	14.0	97	8.5	59
−H12, − H22	17.0	117	12.0	83
−H14, − H24	20.0	138	15.0	103
−H16, − H26	22.0	152	17.0	117
−H19	29.0	200	22.0	152

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 2 Permissible Variations in Thickness

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

TABLE 3 Permissible Variations in Width

Specified Width, in. (mm)	Permissible Variations in Width in. (mm), plus and minus
0.520 (12.5) and over	1 %[A]
Under 0.520 to 0.315 (12.5 to 8.00), incl	0.003 (0.076)
Under 0.315 to 0.098 (8.00 to 2.50), incl	1 %
Under 0.098 to 0.063 (2.50 to 1.60), incl	0.001 (0.025)

[A] But not to exceed 0.016 in. (0.406 mm).

$$\text{kg/km} = 2.705 \times A_1$$

$$\text{Length ft/lb} = (0.8547 \times 10^6)/A$$

$$\text{km/kg} = (0.36969)/A_1$$

where:

A = nominal cross-sectional area obtained in accordance with 9.1, mil^2, and

A_1 = nominal cross-sectional area obtained in accordance with 9.1, mm^2.

9.3 *Density*—For the purpose of calculating linear density, (Note 2), cross sections, etc., the density of aluminum 1350 shall be taken as 0.0975 lb/in.^{3} (2705 kg/m^3) at 20°C.

NOTE 2—The term mass per unit length is used in the standard as being technically correct, and it replaces the terms "weight" or" linear density."

9.4 *Rules for Rounding-Off*—All calculations for the standard nominal dimensions and properties shall be rounded in the final value only, in accordance with the rounding method of Practice E 29.

9.5 For the purpose of this specification, all wire dimensions and properties shall be considered as occurring at the internationally standardized reference temperature of 20°C. When measurements are made at temperatures other than this, corrections shall be applied to bring the results to the reference temperature.

10. Sampling Plan and Conformance Criteria

10.1 *Sampling Plan*—Determine the conformance of the material to the requirements of Sections 6, 7, and 8 by statistical sampling and inspection of each lot of wire presented for inspection in accordance with ASTM B 830.

10.2 *Conformance Criteria*:

10.2.1 Failure of a specimen to conform to the applicable requirements of Section 6, 7, and 8 shall constitute failure of the production unit from which the specimen was taken.

10.2.2 Any lot of wire that has been sampled in accordance with 10.1 and from which the number of specimens failing to comply with the requirements of Sections 6, 7, and 8 does not equal or exceed the appropriate reject number of the sampling table used shall be considered as complying with the requirements of Sections 6, 7, and 8.

10.2.3 Rejected lots may be screened to remove nonconforming production units by testing one specimen from each production unit in the lot for the failing characteristic.

11. Test Methods

11.1 *Tensile Strength*—The tensile strength, when tested in accordance with Test Methods B 557, shall be obtained by dividing the maximum load carried by the specimen during the tension test by the cross-sectional area of the specimen obtained in 9.1 (Explanatory Note 9).

11.1.1 If any part of the fracture takes place in the jaws of the tensile machine, or if an examination indicates that there was external damage, the value obtained may not be representative of the material. In such cases, the test may be discarded and a new test made.

11.2 *Resistivity*—The electrical resistivity of the wire shall be determined by resistance measurements in accordance with Test Method B 193 (Explanatory Note 2 and Table 7).

11.2.1 Nominal resistance and other values derived from the resistivity units shall be calculated from the nominal wire dimensions in accordance with the following equations and all values so derived shall be rounded off in the final value only, 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.

11.2.1.1 *All tempers except 1350-O*:

d-c resistance at 20°C,

$$\Omega/\text{ft} = 13.353/A$$
$$\Omega/\text{km} = 28.264/A_1$$

d-c resistance at 20°C,

$$\Omega/\text{lb} = (11.413 \times 10^6)/A^2$$
$$\Omega/\text{kg} = 10.449/A_1^2$$

Length at 20°C,

$$\text{ft}/\Omega = 0.07489 \times A$$
$$\text{km}/\Omega = 0.03538 \times A_1$$

Mass at 20°C,

$$\text{lb}/\Omega = 0.087619 \times A^2 \times 10^{-6}$$
$$\text{kc}/\Omega = 0.095703 \times A_1^2$$

11.2.1.2 *1350-O*:

d-c resistance at 20°C,

$$\Omega/\text{ft} = 13.181/A$$
$$\Omega/\text{km} = 27.898/A_1$$

d-c resistance at 20°C,

$$\Omega/\text{lb} = (11.266 \times 10^6)/A^2$$
$$\Omega/\text{kg} = 10.313/A_1^2$$

Length at 20°C,

$$\text{ft}/\Omega = 0.075867 \times A$$
$$\text{km}/\Omega = 0.03584 \times A_1$$

Mass at 20°C,

$$\text{lb}/\Omega = 0.088763 \times A^2 \times 10^{-6}$$
$$\text{kg}/\Omega = 0.096965 \times A_1^2$$

where:

A = nominal cross-sectional area of the wire obtained in accordance with 9.1, mil^2.

A_1 = nominal cross-sectional area of the wire obtained in accordance with 9.1, mm^2.

11.3 *Dimensional Measurements*—Samples of coils, reels or spools shall be gaged at each end for both width and thickness. If the inner end is not accessible, the gaging representing the inner end shall be made on the outside end of the coil produced immediately prior to the coil under test, provided no adjustments or changes have been made in the production equipment.

12. Inspection

12.1 Unless otherwise specified in the contract or purchase order, the manufacturer shall be responsible for the performance of all inspection and test requirements specified.

12.2 All inspections and tests shall be made at the place of manufacture unless otherwise especially agreed to by the

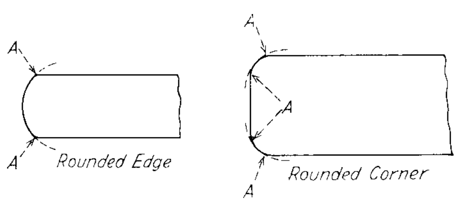
TABLE 4 Requirements for Rounded Corners and Rounded Edges

NOTE 1—Tabular size ranges given represent values in a preferred number series. Preferred numbers were recommended by the International Electrotechnical Commission (IEC) Technical Committee No. 55 for round wires in 1962. An affiliate of the International Organization for Standardization, preferred numbers were also recommended by the latter group in 1966 for general use. In 1967, the IEC recommended the extension of preferred numbers to rectangular wire sizes. Since that time, the National Electrical Manufacturers Association (NEMA) has adopted preferred numbers to rectangular sizes.

NOTE 2— Preferred number sizes represent geometrical series derived from either the 20th (R-20) or the 40th (R-40) roots of the number 10. Each series represents a constant ratio between adjacent numbers. The ranges of sizes shown in this table represent R-40 series for both thickness and width. These sizes are intermediate to R-20 series sizes so that R-20 sizes will lie within the ranges given. Original series computations are in millimetres with conversion to inches.

Specified Thickness				Corner Radius for Specified Width[A]					
in.		mm		in.	mm	in.	mm	in.	mm
Under	to, incl	Under	to, incl	0.748 and over	19.0 and over	Under 0.748 to 0.187, incl	Under 19.0 to 4.75, incl	Under 0.187	Under 4.75
0.280	0.177	7.10	4.50	0.063	1.60	0.039	1.00	0.039	1.00
0.177	0.124	4.50	3.15	rounded edge[B]		0.031	0.80	0.031	0.80
0.124	0.098	3.15	2.50	rounded edge[B]		0.031	0.80	0.026	0.67
0.098	0.063	2.50	1.60	rounded edge[B]		0.031	0.80	0.020	0.50
0.063	0.025	1.60	0.63	rounded edge[B]		full rounded edge[C]		full rounded edge[C]	

[A] All nominal radii values shall have a plus or minus 25 % tolerance.
[B] A rounded edge is produced by rolling wire to the size specified either with or without edging rolls or by drawing through a die (see Fig. 1).
[C] Rectangular wire with full rounded edge shall have a radius half the thickness of the wire ±25 %.



NOTE 1—The arc is not necessarily tangent to the flats at point *A*. However the wire shall be commercially free of sharp, rough, or projecting edges.

FIG. 1 Sections of Wire with Rounded Edges and Rounded Corners

manufacturer and the purchaser at the time of the purchase.

12.3 The manufacturer shall afford the inspector representing the purchaser all reasonable manufacturer's facilities to satisfy him that the material is being furnished in accordance with this specification.

13. Packaging and Package Marking

13.1 Package sizes and types shall be agreed upon between the manufacturer and the purchaser in the placing of individual orders (Explanatory Note 10).

13.2 The wire shall be protected against damage in ordinary handling and shipping.

13.3 Unless otherwise agreed upon, the wire shall be shipped in continuous lengths of the following minimum masses:

Nominal Area, Mils^2	Minimum Mass lb	Minimum Mass kg
50 001 and over	200	90
under 50 001 to 20 000 incl	100	45
under 20 000	50	20

13.4 Each package shall bear a tag showing the manufacturer's name or trademark, Aluminum 1350 and temper, size and mass of material. If additional information is to be required, it shall be arranged with the manufacturer at the time of purchase.

14. Keywords

14.1 aluminum bare electrical conductor; aluminum wire

TABLE 5 Areas of Square Aluminum Wire

Nominal Size		Calculated Area of Perfect Square		Nominal Corner Radius		Calculated Departure		Nominal Area		Nominal Area Working Value	
in.	mm	mils[A]	mm[A]	in.	mm	mils[A]	mm[A]	mils[A]	mm[A]	mils[A]	mm[A]
1	2	3	4	5	6	7	8	9	10	11	12
0.0508	1.290	2580.64	1.66493	0.016	0.41	219.75	0.14177	2360.89	1.52315	2.36×10^3	1.52
0.0571	1.450	3260.41	2.10349	0.016	0.41	219.75	0.14177	3040.66	1.96171	3.04	1.96
0.0641	1.628	4108.81	2.65084	0.016	0.41	219.75	0.14177	3889.06	2.50907	3.89	2.51
0.0720	1.829	5184.00	3.34451	0.016	0.41	219.75	0.14177	4964.25	3.20274	4.96	3.20
0.0808	2.052	6528.64	4.21202	0.020	0.51	343.36	0.22151	6185.28	3.99050	6.19	3.99
0.0907	2.304	8226.49	5.30740	0.020	0.51	343.36	0.22151	7883.13	5.08588	7.88	5.09
0.1019	2.588	10383.61	6.69909	0.026	0.66	580.28	0.37437	9803.33	6.32472	9.80	6.32
0.1144	2.906	13087.36	8.44344	0.026	0.66	580.28	0.37437	12507.08	8.06907	12.51	8.07
0.1285	3.264	16512.25	10.65304	0.032	0.81	879.00	0.56710	15633.45	10.08595	15.63	10.09
0.1443	3.665	20822.49	13.43384	0.032	0.81	879.00	0.56710	19943.49	12.86674	19.94	12.87
0.1620	4.115	26244.00	16.93158	0.032	0.81	879.00	0.56710	25365.00	16.36448	25.36	16.36
0.1819	4.640	33087.61	21.34680	0.040	1.02	1373.44	0.88609	31714.17	20.46071	31.71	20.46
0.2043	5.189	41738.49	26.92800	0.040	1.02	1373.44	0.88609	40365.05	26.04192	40.37	26.04
0.2294	5.027	52624.36	33.95113	0.040	1.02	1373.44	0.88609	51250.92	33.06504	51.25	33.07
0.2576	6.543	66357.76	42.81137	0.040	1.02	1373.44	0.88609	64984.32	41.94528	64.98	41.93
0.2893	7.348	83694.49	53.99634	0.040	1.02	1373.44	0.88609	82321.05	53.11025	82.32	53.11
0.3249	8.252	105560.01	68.10310	0.040	1.02	1373.44	0.88609	104186.57	67.21701	104.2	67.22
0.3648	9.266	133097.04	85.86889	0.040	1.02	1373.44	0.88609	131723.60	84.98280	131.7	84.98
0.4096	10.404	167772.16	108.21989	0.040	1.02	1373.44	0.88609	166398.72	107.35380	166.4	107.4
0.4600	11.684	211600.00	136.51586	0.094	2.39	7584.82	4.89342	204015.18	131.62243	204.0	131.6

[A] The reduction in area due to the rounding of the corners.

TABLE 6 Calculated Reduction in Square Mils Due to Rounding of Corners of Rectangular Wire

NOTE 1—See footnote *A* of Table 5 for preferred number sizes used in this table.

Specified Thickness, in. (mm)				Specified Width					
				in.	mm	in.	mm	in.	mm
				0.748 and over	19.0 and over	Under 0.748 to 0.197, incl	Under 19.0 to 5.00, incl	Under 0.197	Under 5.00
				Calculated Reduction					
Under	to, incl.	Under	to, incl.	mils^2	mm^2	mils^2	mm^2	mils^2	mm
0.280	0.167	7.10	4.25	3407.02	2.1975	1305.64	0.85841	1305.64	0.85841
0.167	0.132	4.25	3.35			824.93	0.54938	824.93	0.54938
0.132	0.093	3.35	2.37			824.93	0.54938	536.51	0.36268
0.093	0.067	2.37	1.70			824.93	0.54938	343.36	0.21460
0.067	0.025	1.70	0.63			[A]	[A]	[A]	[A]

[A] For wire with rounded edges, the calculated reduction in area in square mils is equivalent to $214600T^2$, where T is the thickness of the wire in inches, and the calculated reduction in area in square mm is equivalent to $0.2146T_1^2$ where T_1 is the thickness of the wire in millimetres. For square wire see Table 5.

TABLE 7 Equivalent Resistivity Values

NOTE 1—The equivalent resistivity values for 100 % IACS (soft copper) were each computed from the fundamental IEC value ($\frac{1}{58}$ Ω– mm^2/m) using conversion factors each accurate to at least seven significant figures. Corresponding values for other conductivities (aluminum) were derived from these by multiplying by the reciprocal of the conductivity ratios and where applicable also by the density ratios, both accurate to at least seven significant figures.

Material	Volume Conductivity, % IACS	Resistivity Constants at 20°C					
		Weight		Volume			
		Ω·lb/mile^2	Ωg/m^2	Ω·cmil/ft	Ω·mm^2/m	uΩ·in.	uΩ·cm
Copper	100	875.20	0.15327	10.371	0.01724	0.67879	1.7241
Aluminum	61.0	436.56	0.076454	17.002	0.02826	1.1128	2.8264
	61.8	430.91	0.075464	16.782	0.02790	1.0984	2.7898

EXPLANATORY NOTES

NOTE 1—Soft or annealed Aluminum 1350 wire is a wire that has been drawn or rolled to size by customary operations and then annealed. The wire is soft and ductile and subject to damage if not properly handled. The tensile properties and conductivity refer specifically to the wire as produced and put up by the manufacturer, and before being processed by the purchaser.

NOTE 2—Relationships which may be useful in connection with the values of electrical resistivity prescribed in this specification are shown in Table 7. Resistivity units are based on the International Annealed Copper Standard (IACS) adopted by IEC in 1913, which is 1/58 Ω-mm^2/m at 20°C for 100 % conductivity. The value of 0.017241 Ω-mm^2/m and the value of 0.15328Ω -gram/m^2 at 20°C are respectively the international equivalent of volume and weight resistivity of annealed copper equal (to five significant figures) to 100 % conductivity. The latter term means that a copper wire 1 m in length and weighing 1 g would have a resistance of 0.15328 Ω. This is equivalent to a resistivity value of 875.20 Ω-lb/mile^2, which signifies the resistance of a copper wire 1 mile in length weighing 1 lb. It is also equivalent, for example, to 1.7241 μΩ/cm of length of a copper bar 1 cm^2 in cross section. A complete discussion of this subject is contained in *NBS Handbook 100*. The use of five significant figures in expressing resistivity does not imply the need for greater accuracy of measurement than that specified in Test Method B 193. The use of five significant figures are required for reasonably accurate reversible conversion from one set of resistivity units to another. The equivalent resistivity values in the table were derived from the fundamental IEC value (1/58 Ω-mm^2/m) computed to seven significant figures and then rounded to five significant figures.

NOTE 3—At the present time, no standard definitive test for determining the edgewise bend characteristics of soft rectangular aluminum wire is available. When such a test has been developed, it is contemplated that Section 6 of this specification will be revised to include definite test requirements.

NOTE 4—It is expected that the product furnished by the manufacturer will withstand the specified edgewise bend during fabrication by the purchaser and that its ability to do so will be determined prior to shipment by means agreed upon between the purchaser and the manufacturer.

NOTE 5—It is urged that gage numbers be avoided entirely in connection with rectangular wire. Not only are there several systems of gage numbers, but confusion is likely to result even if the identity of the particular gage is known, since it may not be clear whether the gage number refers to the thickness dimension or to the area of a round wire having a diameter equal to that gage number. Definite dimensions of thickness and width in decimal fractions of an inch are preferred (see Explanatory Note 8).

NOTE 6—Table 5 gives data on the cross-sectional area of square wire in sizes 0.0508 to 0.4600 in. (1.290 to 11.684-mm) inclusive, allowance having been made for reduction of the theoretical area of a perfect square wire due to the rounding of its four corners as shown in Table 4 of this specification. These areas are for the nominal dimensions shown in Column 1 of Table 5 and do not take into account the variations in the dimensions of an actual wire as permitted by the tolerances given in this specification. The significance of these nominal working area values should not extend beyond the significance of the values in Column 1 and it is for this reason that the nominal working area values have been rounded off as shown in Column 11. Attention is also called to the fact that the values obtained by the equations of 9.2 and 11.2 are for wire of nominal dimensions and do not take into account probable increase or decrease of the values due to the variations of the dimensions of an actural wire within the limits of the specified tolerances.“ Square mils” is a term used to express cross-sectional area of square and rectangular sections. A square mil is the area of a square, one mil on each side. Thus, if dimensions of a rectangular section are expressed in mils, the area of that section in square mils is the product of thickness times width. The relationship between circular mils and square mils is that of a circle to its circumscribing square. Thus, 1 cmil = 0.7854 mil^2.

NOTE 7—Table 6 gives the calculated area in square mils to be deducted, because of the rounding of the four corners of the rectangular wire from the area of a circumscribing rectangle having the same thickness and width, in order to obtain the working met area of the wire. The areas to be deducted are based on the radii specified in Table 4 of this specification and do not take into account probable increase or decrease of the area of an actual wire due to the variation in its dimensions within the limits of the tolerances given in this specification—as in the case of square wire, working met areas of rectangular wire should not extend to a number of significant figures greater than that employed in specifying its thickness and width. This is also true of any other derived values such as circular mil area, linear density or electrical resistance.

NOTE 8—Square wire sizes sometimes are expressed in terms of Awg sizes, as“ No. 8 AWG Square.” This terminology is confusing and its use is not recommended. However, when a square wire size is expressed in this manner, it refers to a square circumscribing a circle whose diameter is that of a round wire of the specified Awg size (see Explanatory Note 5).

NOTE 9—The values for tensile strength of annealed and intermediate temper wire are affected by testing speed. It is therefore recommended that for compliance criteria of these tempers the testing speed should not exceed 0.5 in./in. (0.5 mm/mm) of gage length, or distance between grips, per minute.

NOTE 10—Attention is called to the desirability for agreement between the manufacturer and the purchaser on package sizes which will be sufficiently large and yet not so heavy or bulky that the wire may likely be damaged in handling.