Designation: B682 – 01 (Reapproved 2016)

Standard Specification for Standard Metric Sizes of Electrical Conductors[1]

This standard is issued under the fixed designation B682; 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 and prescribes the recommended standard metric sizes of solid round electrical conductors.

1.2 This specification prescribes the recommended standard metric size designations of stranded electrical conductors (see Explanatory Note 1).

NOTE 1—Physical properties, construction requirements, and manufacturing tolerances for specific products should be included in individual product specifications developed in accordance with appropriate sizes in this specification.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3.1 Exceptions — 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. Rounded values appear in Table 1.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

F205 Test Method for Measuring Diameter of Fine Wire by Weighing

2.2 *IEC Standards:*

IEC 182 Basic Dimensions of Winding Wires[3]

IEC 228 Nominal Cross-Sectional Areas and Composition of Conductors of Insulated Cables[3]

2.3 *ISO Standards:*

ISO R388 Metric Series for Basic Thickness of Sheet and Diameters of Wire[3]

3. Standard Reference Temperature

3.1 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.

4. Preferred Numbers

4.1 The diameters in Table 1 and preferred cross-sectional areas in Table 2 are rounded preferred numbers from R (Renard) series in accordance with ISO R388.

NOTE 2—The use of preferred numbers has many advantages and the values selected do not vary significantly from the calculated numbers of the series used. The preferred and second preference size designations, using a Renard series of numbers, provides a schedule of interrelated sizes for aluminum and copper conductors.

NOTE 3—Should sizes be needed either larger or smaller than those listed in Table 1 or Table 2, the respective R series may be expanded upward or downward.

5. Standard Rules for Rounding

5.1 All calculations for dimensions and properties, other than as provided in Section 4, shall be rounded in the *final* values only, in accordance with the rounding method of Practice E29.

6. Standard Round-Wire Diameters (Note 2)

6.1 The standard diameters of metric sizes of wires are preferred numbers calculated in accordance with the conventional mathematical principles of an R series of 20 numbers from 1 to 10 with multiples and submultiples of 10.

6.2 The wire diameters shall be expressed to no more than three significant figures plus zeros.

6.3 For wire diameters 0.050 mm and over, diameters shall be expressed to three decimal places.

6.4 For wire diameters less than 0.050 mm, diameters shall be expressed to four decimal places.

6.5 The standard diameters expressed in millimetres in accordance with these rules and practices are given in Table 1 for convenient reference.

NOTE 4—Solid wires of the listed diameters are used for film coating,

[1] This specification is under the jurisdiction of ASTM Committee B01 on Electrical Conductorsand is the direct responsibility of Subcommittee B01.02 on Methods of Test and Sampling Procedure.

Current edition approved Oct. 1, 2016. Published October 2016. Originally approved in 1981. Last previous edition approved in 2009 as B682 – 01 (2009)ε1. DOI: 10.1520/B0682-01R16.

[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] International Electrotechnical Commission and International Organization for Standardization documents are available from the American National Standards Institute (ANSI), 11 West 42nd St., 13th Floor, New York, NY 10036.

TABLE 1 Standard Metric Diameters and Cross-Sectional Areas of Solid Round Wires at 20°C

Diameter		Cross-Sectional Area			
mm (R 20 Series)	in.[A]	mm^2	$in.^{2}$ [A]	kcmil[A]	cmil[A]
18.0	0.7087	254.5	0.3944	502.2	
16.0	0.6299	201.1	0.3116	396.8	
14.0	0.5518	153.9	0.2386	303.8	
12.5	0.4921	122.7	0.1902	242.2	
11.2	0.4409	98.52	0.1527	194.4	
10.0	0.3937	78.54	0.1217	155.0	
9.00	0.3543	63.62	0.09861	125.6	
8.00	0.3150	50.27	0.07791	99.2	
7.10	0.2795	39.59	0.06137	78.14	
6.30	0.2480	31.17	0.04832	61.52	
5.60	0.2205	24.63	0.03818	48.61	
5.00	0.1969	19.63	0.03043	38.75	
4.50	0.1772	15.90	0.02465	31.39	
4.00	0.1575	12.57	0.01948	24.80	
3.55	0.1398	9.898	0.01534	19.53	
3.15	0.1240	7.793	0.01208	15.38	
2.80	0.1102	6.158	0.00954	12.15	
2.50	0.0984	4.909	0.00761	9.69	
2.24	0.0882	3.941	0.00611	7.78	
2.00	0.0787	3.142	0.00487	6.20	
1.80	0.0709	2.545	0.00394	5.02	
1.60	0.0630	2.011	0.00312	3.97	
1.40	0.0551	1.539	0.00239	3.04	
1.25	0.0492	1.227	0.00190	2.42	
1.12	0.0441	0.985	0.00153	1.94	
1.00	0.0394	0.785	0.00122	1.55	
0.900	0.0354	0.636	0.000986	1.26	
0.800	0.0315	0.503	0.000779	0.992	
0.710	0.0280	0.396	0.000614	0.781	
0.630	0.0248	0.312	0.000483	0.615	
0.560	0.0220	0.246	0.000382	0.486	
0.500	0.0197	0.196	0.000304	0.388	
0.450	0.0177	0.159	0.000247	0.314	
0.400	0.0157	0.126	0.000195	0.248	
0.355	0.0140	0.0990	0.000153	0.195	
0.315	0.0124	0.0779	0.000121		154
0.280	0.0010	0.0616	0.0000954		122
0.250	0.0098	0.0491	0.0000761		96.9
0.224	0.0088	0.0394	0.0000611		77.8
0.200	0.0079	0.0314	0.0000487		62.0
0.180	0.0071	0.0254	0.0000394		50.2
0.160	0.0063	0.0201	0.0000312		39.7
0.140	0.0055	0.0154	0.0000239		30.4
0.125	0.0049	0.0123	0.0000190		24.2
0.112	0.0044	0.00985	0.0000153		19.4
0.100	0.0039	0.00785	0.0000122		15.5
0.090	0.0035	0.00636	0.00000986		12.6
0.080	0.0031	0.00503	0.00000779		9.92
0.071	0.0028	0.00396	0.00000614		7.81
0.063	0.0025	0.00312	0.00000483		6.15
0.056	0.0022	0.00246	0.00000382		4.86
0.050	0.0020	0.00196	0.00000304		3.88
0.045	0.00177	0.00159	0.00000247		3.14
0.040	0.00157	0.00126	0.00000195		2.48
0.036	0.00142	0.00102	0.00000158		2.01
0.032	0.00126	0.000804	0.00000125		1.59
0.028	0.00110	0.000616	0.000000954		1.22
0.025	0.00098	0.000491	0.000000761		0.969
0.022	0.00088	0.000394	0.000000611		0.778

TABLE 1 *Continued*

Diameter		Cross-Sectional Area			
mm (R 20 Series)	in.[A]	mm^2	$in.^{2,A}$	kcmil[A]	cmil[A]
0.0200	0.00079	0.000314	0.000000487		0.620
0.0180	0.00071	0.000254	0.000000394		0.502
0.0160	0.00063	0.000201	0.000000312		0.397
0.0140	0.00055	0.000154	0.000000239		0.304
0.0125	0.00049	0.000123	0.000000190		0.242
0.0112	0.00044	0.000099	0.000000153		0.194
0.0100	0.00039	0.000079	0.000000122		0.155

[A] The inch diameters, square inch areas, and circular mil areas are rounded values calculated from the metric diameters.

TABLE 2 Standard Metric Size Designations of Stranded Conductors at 20°C

Area, mm^2				Area, mm^{2A}			
Preferred Sizes (R 10 Series)[B]	Second Preference Sizes[B]	Third Preference Sizes[C]	Equivalent Area, kcmil	Preferred Sizes (R 5 Series)[D]	Second Preference Sizes[D]	Third Preference Sizes[C]	Equivalent Area, kcmil
2500			4934	100			197.4
	2240		4421			95	187.5
2000			3947		80.0		157.9
	1800		3552			70	138.1
1600			3158	63.0			124.3
	1400		2763		50.0		98.68
1250			2467	40.0			78.94
		1200	2368			35	69.07
	1120		2210		31.5		62.17
1000			1974	25.0			49.34
	900		1776		20.0		39.47
800			1579	16.0			31.58
	710		1401		12.5		24.67
630			1243	10.0			19.74
	560		1105		8.00		15.79
500			986.8	6.30			12.43
	450		888.1			6	11.84
400			789.4		5.00		9.868
	355		700.6	4.00			7.894
315			621.7		3.15		6.217
		300	592.1	2.50			4.934
	280		552.6		2.00		3.947
250			493.4	1.60			3.158
		240	473.6			1.5	2.960
	224		442.1		1.25		2.467
200			394.7	1.00			1.974
		185	365.1		0.80		1.579
	180		355.2			0.75	1.480
160			315.8	0.63			1.243
		150	296.0		0.50		0.987
	140		276.3	0.40			0.789
125			246.7		0.32		0.622
		120	236.8	0.25			0.493
	112		221.0		0.20		0.395
				0.16			0.316
					0.12		0.237
				0.10			0.197
					0.08		0.158
				0.06			0.124
					0.05		0.099
				0.04			0.079
					0.03		0.059

[A] Sizes 40 mm^2 and smaller may have uses as solid single strand wire as well as stranded conductors of various flexibilities.
[B] The sizes in these two columns combine to form the R20 series.
[C] Third preference sizes are those IEC 228 sizes that do not conform to the Renard series of preferred numbers (see 7.1).
[D] The sizes in these two columns combine to form the R10 series.

as wires in some stranded conductors, and as solid conductors in some insulated and covered conductors.

7. Standard Stranded-Conductor Size Designations

7.1 The standard metric size designations of stranded conductors and equivalent cross-sectional area are shown in Table 2. Preferred and second preference sizes are preferred numbers in the R10 series up through 100 mm^2 and in the R20 series over 100 mm^2 through 2500 mm^2. Third preference sizes are those IEC 228 sizes that do not conform to the Renard series of preferred numbers (Note 2).

7.2 The standard areas shall be expressed to three significant figures, but to no more decimal places than 0.01 mm^2.

7.3 The standard areas expressed in square millimetres in accordance with these rules and practices are given in Table 2 for convenient reference.

NOTE 5—Stranded conductors of the listed cross-sectional areas are used in insulated as well as bare conductors. They may be of any type of construction.

8. Equivalent Areas and Diameters

8.1 The areas of the standard diameters in Table 1 and the diameters of solid wires of the area sizes in Table 2 shall be calculated and rounded in accordance with Section 5 and expressed to the same number of significant figures as used in expressing the standard diameters, but in no case to less than three significant figures.

9. Tolerances

9.1 Standard dimensions are given in Table 1 and Table 2. This standard is not concerned with quantitative values of tolerances *per se*, but it is contemplated that the standard wire and stranded-conductor sizes in Table 1 and Table 2, and the properties derived therefrom, shall be subject to tolerances as indicated in the individual product specifications applicable to the wires and stranded conductors of various materials and tempers.

9.2 Actual cross-sectional areas of stranded conductors may vary from the standard values depending upon the constructions, diameters of wire specified, and tolerances specified in product specifications. The use of the preferred numbers for the size designations is intended for easier identification.

10. Keywords

10.1 electrical conductors round electrical conductors round wire; stranded conductor stranded electrical conductors

EXPLANATORY NOTES

NOTE 1—The purpose of this specification is to provide logical geometrically progressive series of sizes for guidance to individuals and organizations preparing hard metric specifications for all types of round wire and stranded electrical conductors. The preferred sizes have been established to avoid proliferation of non-preferred sizes. They provide a series of sizes intended to be acceptable for most applications. The use of metric sizes will depend upon commercial factors, and their existence does not render obsolete existing specifications with inch-pound units as standard. This specification and hard metric conductor specifications prepared in accordance with it are not intended to replace any of the existing specifications having inch-pound units as the standard, with or without the inclusion of soft metric conversion.

Terminology:

hard metric specification—a specification for bare, insulated, or covered electrical conductors incorporating SI units as the standard, and including a series of standard sizes differing from those in inch-pound conductor specifications.

soft metric conversion—The addition of SI units, converted from U.S. customary units, to a specification for bare, insulated, or covered electrical conductors which includes the inch-pound units as the standard and retains the customary series of standard sizes.

NOTE 2—Micrometer calipers graduated to measure 0.002 mm should be considered satisfactory for measuring the diameters of wires 0.050 mm and larger. For greater accuracy in obtaining the mean diameter of ultrafine wire smaller than 0.050 mm. Test Method F205 should be considered satisfactory.