

Designation: B172 - 10 B172 - 10 (Reapproved 2015)

Standard Specification for Rope-Lay-Stranded Copper Conductors Having Bunch-Stranded Members, for Electrical Conductors¹

This standard is issued under the fixed designation B172; 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 bare rope-lay-stranded conductors having bunch-stranded members made from round copper wires, either uncoated or coated with tin, lead, or lead-alloy for use as electrical conductors (Explanatory Notes 1 and 2).
- 1.2 Coated wires shall include only those wires with finished diameters and densities substantially equal to the respective diameters and densities of uncoated wires.
- 1.3 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 values from the two systems may result in nonconformance with the specification. 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.
 - 1.3.1 For density, resistivity, and temperature, the values stated in SI units are to be regarded as standard.

2. Referenced Documents

- 2.1 The following documents of the issue in effect at the time of reference form a part of this specification to the extent referenced herein:
 - 2.2 ASTM Standards:²
 - Document Preview **B3** Specification for Soft or Annealed Copper Wire
 - B33 Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes
 - B173 Specification for Rope-Lay-Stranded Copper Conductors Having Concentric-Stranded Members, for Electrical Conduc-
 - B189 Specification for Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes m-b172-102015
 - B193 Test Method for Resistivity of Electrical Conductor Materials
 - B263 Test Method for Determination of Cross-Sectional Area of Stranded Conductors
 - B354 Terminology Relating to Uninsulated Metallic Electrical Conductors
 - 2.3 American National StandardStandard:
 - ANSI C42.35 Definitions of Electrical Terms³

3. Classification

- 3.1 For the purpose of this specification rope-lay-stranded conductors having bunch-stranded members are classifed as follows:
- 3.1.1 Class I—Conductors consisting of wires 0.0201-in. (0.511-mm) diameter (No. 24 AWG) to produce rope-lay-stranded conductors up to 2 000 000 cmil (1013 mm²) in total cross-sectional area. (Typical use is for special apparatus conductor.)
- 3.1.2 Class K—Conductors consisting of wires 0.0100-in. (0.254-mm) diameter (No. 30 AWG) to produce rope-lay-stranded conductors up to 1 000 000 cmil (507 mm²) in total cross-sectional area. (Typical use is for special portable cord and conductors.)

¹ This specification is under the jurisdiction of ASTM Committee B01 on Electrical Conductors and is the direct responsibility of Subcommittee B01.04 on Conductors of Copper and Copper Alloys.

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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 standard's Document Summary page on the ASTM website.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

3.1.3 Class M—Conductors consisting of wires 0.0063-in. (0.160-mm) diameter (No. 34 AWG) to produce rope-lay-stranded conductors up to 1 000 000 cmil (507 mm²) in total cross-sectional area. (Typical use is for welding conductors.)

4. Ordering Information

- 4.1 Orders for material under this specification shall include the following information:
- 4.1.1 Quantity of each size and class,
- 4.1.2 Conductor size: circular-mil area or AWG (see 7.1),
- 4.1.3 Class (Section 4 and Tables 1-3),
- 4.1.4 Whether coated or uncoated; if coated, designate type of coating (see 11.1),
- 4.1.5 Details of special-purpose lays, if required (see 6.2, 6.3, and Explanatory Note 3),
- 4.1.6 Package size (see 15.1),
- 4.1.7 Special package marking, if required (Section 14),
- 4.1.8 Lagging, if required (see 15.2), and
- 4.1.9 Place of inspection (Section 13).

TABLE 1 Construction Requirements of Class I Rope-Lay Stranded Copper Conductors Having Bunch Stranded Members^A

Area of Cross Section Mominal Size Number (according to the property) Approximate (base) de resistance (base) de resistance (base) de resistance (base) de resistance (base) de Cross (base									Uncoated C	opper	Coated Copper				
Size Number AbyB by C° AbyB by C°	Area of Cross Section		Diameter 0.0201 in. (0.511					dc resistance		dc resistance		dc resistance		Maximum dc resistanc @ 20°C	
1900 000 963	cmil	mm ²		Number	Construction			Ohm / kft	Ohm / km			Ohm / kft	Ohm / km		Ohm / km
1800 000															
1750 000	1 900 000					6265									
1700 000															
1600 000 811 3990 19 by 7 by 28 4873 7252 0.00740 0.0243 0.00765 0.0233 0.00769 0.0237 0.00784 0.00769 0.0233 0.00769 0.0235 0.00784 0.00784 0.00789 0.0260 0.00809 0.0265 0.00864 0.0270 0.00840 0.00784 0.00784 0.00784 0.00781 0.00800 0.0869 0.0265 0.00884 0.0270 0.00840 0.00800 0.0869 0.00864 0.0270 0.00888 0.0291 0.00986 0.00891 0.00980 0.00981															
1 500 000 760															
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83 690 42.4 1 210 7 by 30 267 397 0.129 0.423 0.132 0.431 0.134 0.440 0.137 0.4 66 360 33.6 2 161 7 by 23 205 305 0.163 0.533 0.166 0.544 0.169 0.555 0.172 0.5 52 620 26.7 3 133 7 by 19 169 252 0.205 0.673 0.209 0.686 0.213 0.699 0.217 0.7 41 740 21.1 4 105 7 by 15 134 199 0.258 0.848 0.263 0.865 0.269 0.882 0.274 0.9 33 090 16.8 5 84 7 by 12 107 159 0.326 1.07 0.333 1.09 0.339 1.11 0.346 1.					•										0.285
66 360 33.6 2 161 7 by 23 205 305 0.163 0.533 0.166 0.544 0.169 0.555 0.172 0.55			-		•										0.359
52 620 26.7 3 133 7 by 19 169 252 0.205 0.673 0.209 0.686 0.213 0.699 0.217 0.7 41 740 21.1 4 105 7 by 15 134 199 0.258 0.848 0.263 0.865 0.269 0.882 0.274 0.9 33 090 16.8 5 84 7 by 12 107 159 0.326 1.07 0.333 1.09 0.339 1.11 0.346 1.7															0.449
41 740 21.1 4 105 7 by 15 134 199 0.258 0.848 0.263 0.865 0.269 0.882 0.274 0.9 33 090 16.8 5 84 7 by 12 107 159 0.326 1.07 0.333 1.09 0.339 1.11 0.346 1.					•										0.566
33 090 16.8 5 84 7 by 12 107 159 0.326 1.07 0.333 1.09 0.339 1.11 0.346 1.			-		•										0.713 0.900
,			-		,										1.13
26 240 13.3 6 63 7 by 9 80 119 0.411 1.35 0.419 1.38 0.427 1.40 0.436 1.4															1.13

^A The constructions shown in this table are typical of those used in the industry. It is not intended that this table preclude other constructions which may be desireable for specific applications. The constructions shown provide for finished, covered or non-covered, stranded conductor approximately of the area indicated. When specified by the purchaser, the number of strands may be increased to provide additional area to compensate for draw-down during subsequent processing.

^B Values for the mass of the completed conductor are approximate. The mass values are based upon the standard stranding increments listed in Explanatory Note 6.

^C Strand Construction—#A by #B by #C: where #C is the number of wires in each bunch-stranded member; #B is the number of bunch stranded members which make-up each rope-stranded member; and #A (where used) is the number of rope-stranded members in the conductor. Where #A is not given, the conductor consists of one rope-stranded member. For example, 19 by 7 by 32 indicates a construction consisting of 19 rope-stranded members, each of which consists of 7 bunch-stranded members with 32 wires each.

TABLE 2 Construction Requirements of Class K Rope-Lay Stranded Copper Conductors Having Bunch Stranded Members^A

Area of Cross Section			Wire Diameter 0.0100 In. (0.254 mm		pproximate	Mass ^B			Unc	oated Copper			Coated Copper				
cmil mm ²		Size AWC		Strand	Lb/1000 f	t Kg/km	Nominal dc		Maximum dc		Nominal dc		Maximum dc				
			Number	Construction			res	resistance @ 20°C		resistance @ 20°C		resistance @ 20°C		resistance @ 20°C			
			of Wires	A by B by $C^{\mathcal{C}}$													
1,000,000	507		10101	37 by 7 by 39	3272	4869	0.0111		0.0364	0.0113	0.0371	0.0119	0.0391	0.0121	0.0399		
900,000	456		9065	37 by 7 by 35	2936	4369	0.0123		0.0405	0.0125	0.0413	0.0132	0.0434	0.0135	0.0443		
800,000	405		7980	19 by 7 by 60	2585	3846	0.0139		0.0455	0.0142	0.0464	0.0149	0.0489	0.0152	0.0499		
750,000	380		7581	19 by 7 by 57	2455	3654	0.0148		0.0485	0.0151	0.0495	0.0159	0.0521	0.0162	0.0531		
700,000	355		6916	19 by 7 by 52	2240	3333	0.0159		0.0520	0.0162	0.0530	0.0170	0.0558	0.0173	0.0569		
650,000	329		6517	19 by 7 by 49	2111	3141	0.0171		0.0560	0.0174	0.0571	0.0183	0.0601	0.0187	0.0613		
600,000	304		5985	19 by 7 by 45	1938	2885	0.0185		0.0607	0.0189	0.0619	0.0199	0.0651	0.0203	0.0664		
550,000	279		5453	19 by 7 by 41	1766	2628	0.0202		0.0662	0.0206	0.0675	0.0217	0.0711	0.0221	0.0725	<u>.</u>	
500,000	253		5054	19 by 7 by 38	1637	2436	0.0222		0.0728	0.0226	0.0743	0.0238	0.0782	0.0243	0.0798	\$	
450,000	228		4522	19 by 7 by 34	1465	2180	0.0247		0.0809	0.0252	0.0825	0.0265	0.0869	0.0270	0.0886	1/2	
400,000	203		3990	19 by 7 by 30	1292	1923	0.0277		0.0910	0.0283	0.0928	0.0298	0.0977	0.0304	0.0997	П	
350,000	177		3458	19 by 7 by 26	1120	1667	0.0317		0.104	0.0323	0.106	0.0340	0.112	0.0347	0.114	Ω.	
300,000	152		2989	7 by 7 by 61	959	1427	0.0366		0.120	0.0373	0.122	0.0393	0.129	0.0401	0.132	7	
250,000	127		2499	7 by 7 by 51	802	1193	0.0440		0.144	0.0449	0.147	0.0472	0.155	0.0481	0.158	Ŋ	
211,600	107	0000	2107	7 by 7 by 43	676	1006	0.0520		0.171	0.0530	0.174	0.0558	0.183	0.0569	0.187	- 1	
167,800	85	000	1666	7 by 7 by 34	535	795	0.0655		0.215	0.0668	0.219	0.0703	0.231	0.0717	0.236	10	
133,100	67.4	00	1323	7 by 7 by 27	424	632	0.0826		0.271	0.0843	0.276	0.0887	0.291	0.0905	0.297		
105,600	53.5	0	1064	19 by 56	338	503	0.103		0.338	0.105	0.345	0.111	0.363	0.113	0.370	N	
83,690	42.4	1	836	19 by 44	266	395	A 0.130		0.427	0.133	0.435	0.140	0.458	0.142	0.467	(201	
66,360	33.6	2	665	19 by 35	211	315	0.164		0.538	0.167	0.549	0.176	0.578	0.180	0.590	5	
52,620	26.7	3	532	19 by 28	169	Sta252 and S	0.207		0.679	80.211 SIST	0.693	0.222	0.729	0.227	0.744		
41,740	21.1	4	420	7 by 60	132	197	0.258		0.848	0.264	0.865	0.277	0.910	0.283	0.928		
33,090	16.8	5	336	7 by 48	106	4/157-241	0.326		1.07 3/28	0.333	1.09	0.350	1.15	0.357	1.17		
26,240	13.3	6	266	7 by 38	84	125	0.411		1.35	0.419	1.38	0.441	1.45	0.450	1.48		
20,820	10.5	7	210	7 by 30	66	98	0.518		1.70	0.528	1.73	0.556	1.82	0.567	1.86		
16,510	8.37	8	168	7 by 24	53	79	0.653		2.14	0.666	2.19	0.701	2.30	0.715	2.35		
13,090	6.63	9	133	7 by 19	42	62	0.824		2.70	0.840	2.76	0.885	2.90	0.902	2.96		

^A The constructions shown in this table are typical of those used in the industry. It is not intended that this table preclude other constructions which may be desirable for specific applications. The constructions shown provide for finished covered or non-covered stranded conductor approximately of the area indicated. When specified by the purchaser, the number of strands may be increased to provide additional area to compensate for draw-down during subsequent processing.

^B Values for the mass of the completed conductor are approximate. The mass values are based upon the standard stranding increments listed in Explanatory Note 6.

^C Strand construction – A by B by C where C is the number of wires in each bunch-stranded member, B is the number of bunch-stranded members which make up each rope stranded member, and A (where used) is the number of rope-stranded members in the conductor. Where A is not given, the conductor consists of one rope-stranded member. For example, 19 by 7 by 32 indicates a construction consisting of 19 rope-stranded members each of which consist of 7 bunch-stranded members with 32 wires each.

TABLE 3 Construction requirements of Class M Rope-Lay Stranded Copper Conductors Having Bunch Stranded Members^A

Area of Cro	ss Section		Wire		Approximate Mass ^B Uncoated Copper						Coated Copper				
			Diameter												
			0.0063 In.												
			(0.160 mm)												
cmil	mm ²	Size AWG	Nominal	Strand	Lb/1000 ft	Kg/km		ninal dc		mum dc		ninal dc		imum dc	
			Number of				resistar	ice @ 20°C	resistan	ce @ 20°C	resistan	ce @ 20°C	resistai	nce @ 20°C	
			Wires	A by B by C ^C			0. ""	O. "	01 ""	O. "	01 ""	O. "	01 ""	O. "	
1 000 000	507		05.400	041 71 50	2000	1010	Ohm/kft	Ohm/km	Ohm/kft	Ohm/km	Ohm/kft	Ohm/km	Ohm/kft	Ohm/km	
1,000,000	507		25,193	61 by 7 by 59	3239	4819	0.0111	0.0364	0.0113	0.0371	0.0119	0.0391	0.0121	0.0399	
900,000	456		22,631	61 by 7 by 53	2909	4329	0.0123	0.0404	0.0125	0.0413	0.0132	0.0434	0.0135	0.0443	
800,000	405		20,069	61 by 7 by 47	2580	3839	0.0139	0.0456	0.0142	0.0464	0.0149	0.0489	0.0152	0.0499	
750,00	380		18,788	61 by 7 by 44	2415	3594	0.0148	0.0486	0.0151	0.0495	0.0159	0.0521	0.0162	0.0531	
700,000	355		17,507	61 by 7 by 41	2251	3349	0.0159	0.0522	0.0162	0.0530	0.0170	0.0558	0.0173	0.0569	
650,000	329		16,226	61 by 7 by 38	2086	3104	0.0171	0.0561	0.0174	0.0571	0.0183	0.0601	0.0187	0.0613	
600,000	304		14,945	61 by 7 by 35	1921	2859	0.0185	0.0607	0.0189	0.0619	0.0199	0.0651	0.0203	0.0664	
550,000	279		13,664	61 by 7 by 32	1757	2614	0.0202	0.0663	0.0206	0.0675	0.0217	0.0711	0.0221	0.0725	a B
500,000	253		12,691	37 by 7 by 49	1631	2428	0.0222	0.0728	0.0226	0.0743	0.0238	0.0782	0.0243	0.0798	***************************************
450,000	228		11,396	37 by 7 by 44	1465	2180	0.0247	0.0810	0.0252	0.0825	0.0265	0.0869	0.0270	0.0885	7
400,000	203		10,101	37 by 7 by 39	1298	1932	0.0277	0.0909	0.0283	0.0928	0.0298	0.0977	0.0304	0.0997	п
350,000	177		8,806	37 by 7 by 34	1132	1685	0.0317	0.104	0.0323	0.106	0.0340	0.112	0.0347	0.114	0
300,000	152		7,581	19 by 7 by 57	975	1450	0.0370	0.121	0.0377	0.123	0.0397	0.130	0.0405	0.133	
250,000	127		6,384	19 by 7 by 48	821	1221	0.0444	0.146	0.0453	0.149	0.0476	0.156	0.0486	0.159	N
211,600	107	0000	5,320	19 by 7 by 40	684	1018	0.0524	0.172	0.0534	0.175	0.0563	0.185	0.0574	0.188	ı
167,800	85	000	4,256	19 by 7 by 32	547	814	0.0661	0.217	0.0674	0.221	0.0710	0.233	0.0724	0.238	5
133,100	67.4	00	3,325	19 by 7 by 25	427	636	0.0834	0.274	0.0851	0.279	0.0895	0.294	0.0913	0.299	
105,600	53.5	0	2,646	7 by 7 by 54	337	501	0.104	0.341	0.106	0.348	0.112	0.367	0.114	0.374	$\overline{}$
83,690	42.4	1	2,107	7 by 7 by 43	268	399	0.131	0.430	0.134	0.440	0.141	0.463	0.144	0.472	(2010)
66,360	33.6	2	1.666	7 by 7 by 34	212	316	0.166	0.545	0.169	0.555	0.178	0.583	0.181	0.595	-
52,620	26.7	3	1.323	7 by 7 by 27	168	251eh.ai/	0.209	0.686	0.213	0.699	0.224	0.736	0.229	0.751	3
41,740	21.1	4	1,064	19 by 56	134	200	0.261	0.856	0.266	0.873	0.280	0.919	0.286	0.937	
33,090	16.8	5	836	19 by 44	_4105 8_8	44157.7a4a	0.329	a1.08 b 1 7	0.336	1.10	0.353	1.16	0.360	1.18	
26,240	13.3	6	665	19 by 35	84	125	0.415	1.36	0.423	1.39	0.446	1.46	0.454	1.49	
20,820	10.5	7	532	19 by 28	67	100	0.523	1.72	0.533	1.75	0.562	1.84	0.573	1.88	
16,510	8.37	8	420	7 by 60	52	78	0.653	2.14	0.666	2.18	0.701	2.30	0.715	2.35	
13,090	6.63	9	336	7 by 48	42	62	0.824	2.70	0.840	2.75	0.885	2.90	0.902	2.96	
10,380	5.26	10	259	7 by 37	32	48	1.04	3.41	1.06	3.48	1.12	3.66	1.14	3.73	
6,530	3.31	12	168	7 by 24	21	31	1.65	5.41	1.68	5.53	1.77	5.82	1.81	5.93	

^A The constructions shown in this table are typical of those used in the industry. It is not intended that this table preclude other constructions which may be desirable for specific applications. The constructions shown provide for finished covered or non-covered stranded conductor approximately of the area indicated. When specified by the purchaser, the number of strands may be increased to provide additional area to compensate for draw-down during subsequent processing.

^B Values for the mass of the completed conductor are approximate. The mass values are based upon the standard stranding increments listed in Explanatory Note 6.

^C Strand construction – A by B by C where C is the number of wires in each bunch-stranded member, B is the number of bunch-stranded members which make up each rope stranded member, and A (where used) is the number of rope-stranded members in the conductor. Where A is not given, the conductor consists of one rope-stranded member. For example, 19 by 7 by 32 indicates a construction consisting of 19 rope-stranded members each of which consist of 7 bunch-stranded members with 32 wires each.