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Designation: F 1883 - 9803

# Standard Practice for Selection of Wire and Cable Size in AWG or Metric Units<sup>1</sup>

This standard is issued under the fixed designation F 1883; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This practice is intended as a guide to shipbuilders, shipowners, and design agents for use in the selection of conductor size for single conductor or multiple conductor cable sizes either in American Wire Gauge (AWG) or metric designations for commercial ship design and construction.

1.2 The comparison chart of electrical conductor sizes shown in Table 1 presents a combined listing of international standard sizes of <u>annealed Class 2 stranded</u> copper conductors in accordance with AWG (Specification B 8) English units or IEC (IEC 60228) metric units.

1.3 As a precautionary caveat, some conductor sizes listed in Table 1 may exceed minimal size requirements of the U.S. Coast Guard, the American Bureau of Shipping, and IEEE STD 45 for specific applications.

1.4 The values stated for ampacity and dc resistance are presented as typical maximum values and are provided for information only.

Size	0:	Area in	Ampacity <sup>A</sup>	dc Resistances at 20°C <sup>B</sup>	
Metric, mm <sup>2</sup>	Size AWG/MCM	<del>Circ Mils (Nominal)</del>		<del>Ohms</del> <del>per 1000 ft</del>	<del>Ohms</del> <del>per km</del>
	<del>2000*</del> C	2 000 000	<del>1155</del> -	0.0053	0.0174
<del>1000*</del>		<del>1 970 000</del>	<del>1145</del>	0.0054	<del>0.0176</del>
	<del>1750*</del>	<del>1 750 000</del>	<del>1070</del> -	0.0063	0.0199
<del>800*</del>		<del>1 580 000</del>	<del>1009 -</del>	0.0067	<del>0.0218</del>
	<del>1500*</del>	<del>1 500 000</del>	<del>980</del>	<del>0.0071</del>	0.0232
	<del>1250*</del>	<del>1 250 000</del>	<del>890</del>	0.0085	<del>0.0278</del>
<del>630*</del>		<del>1 240 000</del>	<del>886</del>	0.0096	0.0280
	<del>1000*</del>	<del>1 000 000</del>	<del>780</del>	<del>0.0106</del>	<del>0.0347</del>
<del>500*</del>		<del>987 000</del>	772	<del>0.0105</del>	<del>0.0347</del>
<del>400*</del>		<del>789 000</del>	<del>675</del>	<del>0.0133</del>	<del>0.0438</del>
	<del>750*</del>	750 000	<del>655</del>	<del>0.0141</del>	0.0463
	<del>600*</del>	600 000	<del>575</del>	<del>0.0176</del>	<del>0.0578</del>
<del>300*</del>		<del>592 000</del>	<del>570</del>	<del>0.0211</del>	0.0580
	<del>500*</del>	<del>500 000</del>	<del>515</del>	<del>0.0211</del>	<del>0.0694</del>
<del>240*</del>		<del>474 000</del>	<del>499</del>	<del>0.0219</del>	<del>0.0720</del>
	<del>400*</del>	400 000	<del>455</del>	0.0264	0.0867
<del>185*</del>		<del>365 000</del>	<del>431</del>	0.0286	0.0938
	<del>350*</del>	350 000	<del>420</del>	0.0302	0.0990
	<del>300*</del>	300 000	<del>375</del>	<del>0.0353</del>	<del>0.1157</del>
<del>150*</del>		<del>296 000</del>	<del>372</del>	<del>0.0353</del>	<del>0.1157</del>
	<del>250*</del>	<del>250 000</del>	<del>340</del>	<del>0.0423</del>	<del>0.1388</del>
<del>120*</del>		<del>237 000</del>	<del>327</del>	<del>0.0436</del>	<del>0.1492</del>
	<del>4/0*</del>	<del>211 600</del>	<del>300</del>	0.0500	<del>0.1639</del>
<del>95*</del>		<del>187 000</del>	<del>265</del>	<del>0.0551</del>	<del>0.1808</del>
	<del>3/0*</del>	<del>167 000</del>	<del>260</del>	<del>0.0631</del>	0.2065
<del>70*</del>		<del>138 000</del>	<del>230</del>	<del>0.0752</del>	<del>0.2467</del>
	<del>2/0*</del>	<del>133 100</del>	<del>225</del>	<del>0.0794</del>	<del>0.2605</del>
	<del>1/0*</del>	<del>105 600</del>	<del>195</del>	0.1002	0.3288
<del>50*</del>		<del>98 000</del>	<del>185</del>	<del>0.1044</del>	<del>0.3424</del>
	4	<del>83 690</del>	<del>165</del>	<del>0.1261</del>	<del>0.4139</del>
<del>35*</del>		<del>69 100</del>	<del>144</del>	<del>0.1495</del>	0.4904
<del>30"</del>	<del>2*</del>	<del>69 100</del> <del>66 360</del>	<del>144</del> <del>140</del>	<del>0.1588</del>	0.4 0.5

#### TABLE 1 Conversion Table—AWG/Metric Preferred Sizes of Conductors

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<sup>&</sup>lt;sup>1</sup> This specification is under the jurisdiction of ASTM Committee F-25 on Ships and Marine Technology and is the direct responsibility of Subcommittee F25.10 on Electrical.

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#### TABLE 1 Continued

Size		Area in		dc Resistances at 20°C <sup>B</sup>	
<del>Metric,</del> mm <sup>2</sup>	<del>Size</del> <del>AWG/MCM</del>	<del>Circ Mils-</del> <del>(Nominal)</del>	Ampacity <sup>A</sup>	<del>Ohms</del> <del>per 1000 ft</del>	<del>Ohms</del> <del>per km</del>
	3	<del>52 620</del>	<del>120</del>	-0.2005	<del></del>
<del>25*</del>		<del>49 300</del>	<del>115</del>	-0.2057	<del></del>
	<del>4*</del>	<del>41 740</del>	<del>105</del>	<del>-0.2528</del>	
<del>16*</del>		<del>31 600</del>		-0.3259	<del>-1.069</del>
	<del>6*</del>	<del>26 240</del>		-0.4023	<del>-1.320</del>
<del>10*</del>		<del>19 700</del>	<del>-63</del>	- <del>0.5167</del>	<del>- 1.695</del>
	<del>8*</del>	<del>16 510</del>	-55	-0.6380	<del>2.093</del>
<del>6.0*</del>		<del>11-800</del>	- <del>43</del>	<del>-0.8543</del>	<del>2.803</del>
	<del>10*</del>	<del>10 380</del>	-40	<del>- 1.017</del>	<del>3.335</del>
<del>4.0*</del>		<del>7 890</del>	-30	-1.304	— <u>4.277</u>
	<del>12*</del>	<del>6 530</del>	-25	<del>-1.620</del>	<del>- 5.315</del>
<del>2.5*</del>		<del>4 930</del>		-2.067	<del>- 6.782</del>
	<del>14</del> *	<del>4 110</del>		<del>-2.573</del>	<del>8.442</del>
<del>1.5*</del>		<del>2 960</del>	<del></del>	<del>- 3.417</del>	<del>-11.21</del>
	<del>16*</del>	<del>2 580</del>	<del></del>	-4.020	<del>-13.19</del>
<del>1.0*</del>		<del>1 970</del>	<del></del>	<del>-5.213</del>	<del>- 17.11</del>
<del>0.90</del>		<del>1 773</del>	<del></del>	- <u>6.45</u>	-21.10
	<del>18*</del>	<del>1 620</del>	<del></del>	<del>-6.82</del>	-20.95
<del>0.80</del>		<del>1 576</del>	<del></del>	<del>-6.52</del>	-21.40
<del>0.75*</del>		<del>1 480</del>	<del></del>	<del>-6.82</del>	-22.37
<del>0.60*</del>		<del>1 182</del>	<del></del>	<del>- 9.5</del>	<del>31.16</del>
	<del>20*</del>	<del>1 020</del>	<del></del>	<del>10.5</del>	-34.45
<del>0.50*</del>		<del>987</del>	<del></del>	<del>11.4</del>	-37.40
	<del>22*</del>	<del>640</del>	<del></del>	<del>16.9</del>	-55.44
<del>0.20*</del>	<del>24*</del>	<del>404</del>	<del></del>	<del>26.7</del>	-87.60
	<del>26*</del>	253	<del></del>	<del>43.6</del>	<del>143.04</del>

<sup>A</sup>Ampacity of single-conductor cable in air at ambient temperature of 30°C and maximum conductor temperature not exceeding 60°C.

<sup>B</sup>Temperature correction: the conductor resistance may be corrected for moderate temperature differences from the noted reference temperature by the following auation. The parameter of *T*, varies with conductivity and temperature. For a list of common temperature coefficients see Test Methods B 193

requiring the parameter, a 7, value with conductivity and temperature. For a list of common temperature been list in temperature been
$P = P \left[ 1 + \alpha \left( t - T \right) \right] \tag{1}$
$K_T = K_t \left[ 1 + \alpha_T (t - t) \right] $

where:

 $R_T$  = resistance at reference temperature T,

 $R_t$  = resistance as measured at temperature t,

α<sub>7</sub> = known or given temperature coefficient of resistance of the conductor being measured at reference temperature 7. At 20°C, the value is 0.003 93;

F = reference temperature, and

t = temperature at which measurement is made.

<sup>C</sup>An asterisk (\*) indicates preferred sizes for wires of American Wire Gauge or per IEC 228 (metric) as appropriate.

#### 2. Referenced Documents

#### 2.1 ASTM Standards:

B 8 Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft<sup>2</sup>

B 193 Test Method for Resistivity of Electrical Conductor Materials<sup>2</sup>

2.2 IEC Standards:<sup>3</sup>

IEC 60092-350 Electrical Installations in Ships—Part-3: Cables (Construction, Testing, 350: Shipboard Power: Cables—General Construction and Installations) Test Requirements

IEC 60228 Conductors of Insulated Cables

2.3 IEEE Standard:<sup>4</sup>

IEEE STD 45 Recommended Practice for Electric Installations on Shipboard

## 3. Significance and Use

3.1 The selection criteria is to be applied for uses of (1) new cable and (2) replacement cable.

3.2 For the selection of new cable or the selection of replacement cable, this practice defines the choice criteria for conductor selection for cables in AWG (ASTM) or metric (IEC) sizes.

## 4. Selection Criteria

4.1 When selecting cable for any application, AWG or metric sizing should be selected according to preferred sizes. The sizes of conductors that have been marked with an asterisk in Table 1 designate preferred sizes per Specification B 8 and IEC  $\underline{60}228$ . Those sizes not marked are given for reference, and it is recommended that their use be discouraged.

<sup>&</sup>lt;sup>2</sup> Annual Book of ASTM Standards, Vol 02.03.

<sup>&</sup>lt;sup>3</sup> Available from International Electrochemical Commission, 1 rue de Varembe, Geneva, Switzerland.

<sup>&</sup>lt;sup>4</sup> Available from Institute of Electrical and Electronics Engineers, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08554.

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#### TABLE 1 Conversion Table—AWG/Metric Preferred Sizes of Conductors

$ \begin{array}{c c c c c c c c c c c c c c c c c c c $							
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	Size	Size	Area in		dc Resistances at 20°C <sup>B</sup>		
$\begin{array}{c c c c c c c c c c c c c c c c c c c $				Ampacity <sup>A</sup>			
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		0000*6	0.000.000	4455	0.0050	0.0477	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	4000*	2000					
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	1000*						
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		<u>1750*</u>			0.0063		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	800*		1 580 000	1009	0.0067	0.0224	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		1500*	1 500 000	980	0.0071	0.0232	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			1 250 000	890	0.0085	0.0278	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	630*						
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	<u></u>	1000*					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	500*	1000					
$\begin{array}{c c c c c c c c c c c c c c c c c c c $							
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	400	750*					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$					-		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		600*					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	300*		592 000	570	0.0211	0.0607	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		500*	500 000	515	0.0211	0.0694	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	240*		474 000	499	0.0219	0.0762	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		400*	400 000	455	0.0264	0.0867	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	185*						
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	100	350*					
$\begin{array}{c c c c c c c c c c c c c c c c c c c $							
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	150*	300					
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	150"	0.50+					
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		250*					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	<u>120*</u>			327	0.0436	0.1540	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		4/0*	211 600	300	0.0500	0.1639	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	95*		187 000	265	0.0551	0.1950	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		3/0*	167 000	260	0.0631	0.2065	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	70*						
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		2/0*					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$							
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	50*	1/0					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	30	4	-		-		
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	05*	<u> </u>					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	35						
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		2*					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		<u>3</u>					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	<u>25*</u>		<u>49 300</u>	<u>115</u>	0.2057	0.7340	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		4*		105	0.2528	0.8295	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	16*		31 600	89	0.3259	1.160	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		6*	26 240	80	0.4023	1.320	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	10*	_	19 700	63	0.5167	1.840	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		8*					
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	6.0*	<u> </u>					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	0.0	10*			-		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	4 0*	<u></u>					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		10*					
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	0 =*	12					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	2.5	4 4 +	4 930				
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		14*					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	1.5*			<u></u>			
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		<u>16*</u>		<u></u>			
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	1.0*			<u></u>		18.20	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	0.90		1 773		6.45	21.10	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		18*	1 620		6.82		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	0.80						
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$							
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$							
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	0.00	20*		<u></u>			
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	0 50*	20		<u></u>			
<u>0.20*</u> <u>24*</u> <u>404</u> <u>26.7</u> <u>87.60</u>	0.50	0.0*					
	0.00*						
<u>26*</u> <u>253</u> <u></u> <u>43.6</u> <u>143.04</u>	0.20*						
		26*	253	<u></u>	43.6	143.04	

<sup>A</sup> Ampacity of single-conductor cable in air at ambient temperature of 30°C and maximum conductor temperature not exceeding 60°C. <sup>B</sup> Temperature correction: the conductor resistance may be corrected for

moderate temperature differences from the noted reference temperature by the following equation. The parameter,  $\alpha T$ , varies with conductivity and temperature. For a list of common temperature coefficients see Test Methods B 193.  $R_T = R_t [1 + \alpha_T (t - T)]$ (1)

where:

 $\frac{\overline{R_T}}{R_t} = \frac{\text{resistance at reference temperature } T,}{\text{resistance as measured at temperature } t,}$ 

 $\underline{\alpha_{T}} = \frac{\text{known or given temperature coefficient of resistance of the conductor}}{\frac{\text{being measured at reference temperature } T. At 20^{\circ}C, the value is}{0.003 93.}$ 

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- $\underline{T} = \underline{reference temperature, and}$
- t = temperature at which measurement is made.

<sup>C</sup> An asterisk (\*) indicates preferred sizes for wires of American Wire Gauge or per IEC 60228 (metric) as appropriate.

4.2 When selecting cable for any application, AWG or metric sizing should be selected with full consideration of the relationship of type of insulation and ampacity. Direct selection between AWG and metric sizes can be made only after a determination of the equivalence of insulation is made.

4.3 When selecting cable, the conductor size will be determined from analysis of required ampacity, voltage drop considerations, type of cable insulation, and planned installation. Recommended practices for selection and installation of cable systems are detailed in IEEE STD 45 and IEC 60092-350.

4.4 For the selection of cable sizes for new applications, conductor size that satisfies ampacity requirements, voltage drop factors, and the adequacy for application in the available cable space must also be considered.

4.5 For the selection of cable sizes for replacement applications, cable size should be selected in excess of or equal to the replaced cable size. Existing cable space limitations should then be determined to ensure that space for installation of the replacement cable is adequate.

#### 5. Keywords

5.1 AWG conductor sizes; cable selection; conductor comparison; metric conductor sizes

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