Commercial and Industrial Wiring and Raceway Chart

Overcurrent Protection Size	Copper [1] Wire 75°C Terminal	Maximum [2] Continuous Ampere Load	Raceway [3]	Equipment [4] Ground Wire	Maximum Continuous Single-Phase VA Load [2]					Maximum Continuous Three-Phase VA Load [2]		
					120V	208V	240V	277V	480V	208V	240V	480V
15	14	12	½"	14	1,440	2,496	2,880	3,324	5,760	4,323	4,988	9,976
20	12	16	½"	12	1,920	3,328	3,840	4,432	7,680	5,764	6,651	13,302
25	10	20	¾"	10	2,400	4,160	4,800	5,540	9,600	7,205	8,314	16,627
30	10	24	¾"	10	2,880	4,992	5,760	6,648	11,520	8,646	9,976	19,953
35	8	28	1"	10	3,360	5,824	6,720	7,756	13,440	10,087	11,639	23,278
40	8	32	1"	10	3,840	6,656	7,680	8,864	15,360	11,528	13,302	26,604
45	8	36	1"	10	4,320	7,488	8,640	9,972	17,280	12,969	14,964	29,929
50	8	40	1"	10	4,800	8,320	9,600	11,080	19,200	14,410	16,627	33,254
60	6	48	1"	10	5,760	9,984	11,520	13,296	23,040	17,292	19,953	39,905
70	4	56	1¼"	8	6,720	11,648	13,440	15,512	26,880	20,174	23,278	46,556
80	4	64	1¼"	8	7,680	13,312	15,360	17,728	30,720	23,056	26,604	53,207
90	3	72	1¼"	8	8,640	14,976	17,280	19,944	34,560	25,938	29,929	59,858
100	3	80	1¼"	8	9,600	16,640	19,200	22,160	38,400	28,820	33,254	66,509
110	2	88	1½"	6	10,560	18,304	21,120	24,376	42,240	31,703	36,580	73,160
125	1	100	2"	6	12,000	20,800	24,000	27,700	48,000	36,026	41,568	83,136
150	1/0	120	2"	6	14,400	24,960	28,800	33,240	57,600	43,231	49,882	99,763
175	2/0	140	2"	6	16,800	29,120	33,600	38,780	67,200	50,436	58,195	116,390
200	3/0	160	2½"	6	19,200	33,280	38,400	44,320	76,800	57,641	66,509	133,018
225	4/0	180	2½"	4	21,600	37,440	43,200	49,860	86,400	64,846	74,822	149,645
250	250 kcmil	200	3"	4	24,000	41,600	48,000	55,400	96,000	72,051	83,136	166,272
300	350 kcmil	240	3½"	4	28,800	49,920	57,600	66,480	115,200	86,461	99,763	199,526
350	400 kcmil	268[5]	3½"	3	32,160	55,744	64,320	74,236	128,640	96,549	111,402	222,804
400	500 kcmil	304[5]	4"	3	36,480	63,232	72,960	84,208	145,920	109,518	126,367	252,733
400	600 kcmil	320	4"	3	38,400	66,560	76,800	88,640	153,600	115,282	133,108	266,035

[1] Conductor size based on 75°C terminal rating [110.14(C)(1)]. Ampacity based on four 90°C current-carrying conductors [Table 310.15(B)(3)(a) and Table 310.15(B)(16)].

[2] Maximum continuous nonlinear load in an ambient temperature of 30°C limited to 80 percent of the overcurrent device rating or the conductor ampacity, whichever is less [210.19(A), 240.6(A), and 215.2(A)(1)].

[3] To ensure ease of installation, raceways are sized to six THHN conductors in PVC conduit [Annex C.10].

[4] Copper equipment grounding conductor is sized in accordance with Table 250.122.

[5] Maximum continuous load is limited to 80 percent of 75°C conductor ampacity because the conductor ampacity is lower than the overcurrent protection device rating.

Formulas

Conversion Formulas

Area of Circle = πr^2

Break-even Dollars = Overhead Cost $/Gross Profit %

Busbar Ampacity AL = 700A sq. in. and CU = 1,000A sq. in.

Centimeters = Inches/2.54

Inch = 0.0254 Meters

Inch = 2.54 Centimeters

Inch = 25.40 Millimeters

Kilometer = 0.6213 Miles

Length of Coiled Wire =
Diameter of Coil (average) x Number of Coils x π

Lightning Distance in Miles =
Seconds between flash and thunder/4.68

Meter = 39.37 Inches

Mile = 5,280 ft, 1,760 yards, 1,609 meters, 1.609 km

Millimeter = 0.03937 Inch

Selling Price = Estimated Cost $/(1 - Gross Profit %)

Speed of Sound (Sea Level) = 1,128 fps or 769 mph

Temp C = (Temp F - 32)/1.80

Temp F = (Temp C x 1.80) + 32

Yard = 0.9144 Meters

Electrical Formulas Based on 60 Hz

Capacitive Reactance (X_C) in Ohms = $1/(2\pi fC)$

Effective (RMS) ac Amperes = Peak Amperes x 0.707

Effective (RMS) ac Volts = Peak Volts x 0.707

Efficiency (percent) = Output/Input x 100

Efficiency = Output/Input

Horsepower = Output Watts/746

Inductive Reactance (X_L) in Ohms = $2\pi f L$

Input = Output/Efficiency

Electrical Formulas Based on 60 Hz (continued)

Neutral Current (Wye) =
$\sqrt{(L1^2 + L2^2 + L3^2) - [(L1 \times L2) + (L2 \times L3) + (L1 \times L3)]}$

Output = Input x Efficiency

Peak ac Volts = Effective (RMS) ac Volts x $\sqrt{2}$

Peak Amperes = Effective (RMS) Amperes x $\sqrt{2}$

Power Factor (PF) = Watts/VA

VA (apparent power) = Volts x Ampere or Watts/Power Factor

VA Single-Phase = Volts x Amperes

VA Three-Phase = Volts x Amperes x $\sqrt{3}$

Watts (real power) Single-Phase = Volts x Amperes x Power Factor

Watts (real power) Three-Phase = Volts x Amperes x
Power Factor x $\sqrt{3}$

Parallel Circuits

Note 1: Total resistance is always less than the smallest resistor
$R_T = 1/[(1/R_1) + (1/R_2) + (1/R_3) ...]$

Note 2: Total current is equal to the sum of the currents of all parallel resistors

Note 3: Total power is equal to the sum of power of all parallel resistors

Note 4: Voltage is the same across each of the parallel resistors

Series Circuits

Note 1: Total resistance is equal to the sum of all the resistors

Note 2: Current in the circuit remains the same through all the resistors

Note 3: Voltage source is equal to the sum of voltage drops of all resistors

Note 4: Power of the circuit is equal to the sum of the power of all resistors

Transformer Amperes

Secondary Amperes Single-Phase = VA/Volts

Secondary Amperes Three-Phase = VA/(Volts x $\sqrt{3}$)

Secondary Available Fault Single-Phase =
VA/(Volts x %impedance)

Secondary Available Fault Three-Phase =
VA/(Volts x $\sqrt{3}$ x %Impedance)

Delta 4-Wire: Line Amperes =
Phase (one winding) Amperes x $\sqrt{3}$

Delta 4-Wire: Line Volts = Phase (one winding) Volts

Delta 4-Wire: High-Leg Voltage (L-to-G) =
Phase (one winding) Volts x 0.50 x $\sqrt{3}$

Wye: Line Volts = Phase (one winding) Volts x $\sqrt{3}$

Wye: Line Amperes = Phase (one winding) Amperes

Voltage Drop

VD (Single-Phase) = 2KID/Cmils

VD (Three-Phase) = $\sqrt{3}$ KID/Cmils

Cmils (Single-Phase) = 2KID/VD

Cmils (Three-Phase) = $\sqrt{3}$ KID/VD

Code Rules

Breaker/Fuse Ratings – 240.6(A)

Conductor Ampacity – 310.15 and Table 310.15(B)(16)

Equipment Grounding Conductor – 250.122

Grounding Electrode Conductor – 250.66

Motor Conductor Size – 430.22 (Single)
430.24 (Multiple)

Motor Short-Circuit Protection – 430.52

Transformer Overcurrent Protection – 450.3

Legend

π (Pi) = 3.142 (approximately)

$\sqrt{2}$ = 1.414 (approximately)

$\sqrt{3}$ = 1.732 (approximately)

f = frequency

r = radius

d = diameter

C = Capacitance (farads)

L = Inductance (henrys)

Cmils = Circular Mils

VD = Volts Drop

I = Amperes of load

D = Distance one way

K75°C = (12.90 ohms CU)
(21.20 ohms AL)