Commercial Wire and Raceway Chart

Overcurrent Protection Size	Copper Wire [1] 60°C Terminal	Copper Wire [2] 75°C Terminal	Maximum [3] Continuous Ampere Load	Raceway [4]	Copper [5] Ground Wire	Max. Continuous 1-Phase VA Load [3]					Max. Continuous 3-Phase VA Load [3]		
						120 V	208 V	240 V	277 V	480 V	208 V	240 V	480 V
15	14	14	12	1/2"	14	1,440	2,496	2,880	3,324	5,760	4,323	4,988	9,976
20	12	12	16	1/2"	12	1,920	3,328	3,840	4,432	7,680	5,764	6,651	13,302
25	10	10	20	3/4"	10	2,400	4,160	4,800	5,540	9,600	7,205	8,314	16,627
30	10	10	24	3/4"	10	2,880	4,992	5,760	6,648	11,520	8,646	9,976	19,953
35	8	8	28	1"	10	3,360	5,824	6,720	7,756	13,440	10,087	11,639	23,278
40	8	8	32	1"	10	3,840	6,656	7,680	8,864	15,360	11,528	13,302	26,604
45	6	8	36	1"	10	4,320	7,488	8,640	9,972	17,280	12,969	14,964	29,929
50	6	8	40	1"	10	4,800	8,320	9,600	11,080	19,200	14,410	16,627	33,254
60	4	6	48	1"	10	5,760	9,984	11,520	13,296	23,040	17,292	19,953	39,905
70	4	4	56	1 ¼"	8	6,720	11,648	13,440	15,512	26,880	20,174	23,278	46,556
80	3	4	64	1 ¼"	8	7,680	13,312	15,360	17,728	30,720	23,056	26,604	53,207
90	2	3	72	1 1/4" [7]	8	8,640	14,976	17,280	19,944	34,560	25,938	29,929	59,858
100	1	3	80	1 1/4" [7]	8	9,600	16,640	19,200	22,160	38,400	28,820	33,254	66,509
110		2	88	1 ½	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	2 ½	6	19,200	33,280	38,400	44,320	76,800	57,641	66,509	133,018
225		4/0	180	2 1/2"	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	3 1/2"	4	28,800	49,920	57,600	66,480	115,200	86,461	99,763	199,526
350		400 kcmil	268[6]	3 1/2"	3	32,160	55,744	64,320	74,236	128,640	96,549	111,402	222,804
400		500 kcmil	304[6]	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 60°C terminal rating. Ampacity based on four 90°C THHN current-carrying conductors [110.14(C), 310.15, Table 310.16].
(2) Conductor size based on 75°C terminal rating. Ampacity based on four 90°C THHN current-carrying conductors [110.14(C), 310.15, Table 310.16].
(3) Maximum continuous nonlinear load in an ambient temperature of 30°C limited to 80 percent of the overcurrent device rating [210.19(A), 240.6(A)].
(4) To ensure ease of installation, raceways are sized to six THHN conductors (based on 75°C column, Note 3) in rigid nonmetallic conduit [Annex C10].
(5) Copper equipment grounding conductor is sized in accordance with Table 250.122.
(6) Maximum continuous load limited to 80 percent of 75°C conductor ampacity, because conductor ampacity is lower than the overcurrent protection device rating.
(7) Raceway size is based on 75°C conductor size, not the 60°C conductor size.

Formulas

Conversion Formulas

Area of Circle = πr^2
Breakeven Dollars = Overhead Cost $/Gross Profit %
Busbar Ampacity AL = 700A Sq. in. and CU = 1000A Sq. in.
Centimeters = Inches x 2.54
Inch = 0.0254 Meters
Inch = 2.54 Centimeters
Inch = 25.4 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 = 5280 ft, 1760 yards, 1609 meters, 1.609 km
Millimeter = 0.03937 Inch
Selling Price = Estimated Cost $/(1 - Gross Profit %)
Speed of Sound (Sea Level) = 1128 fps or 769 mph
Temp C = (Temp F - 32)/1.8
Temp F = (Temp C x 1.8) + 32
Yard = 0.9144 Meters

Electrical Formulas Based on 60 Hz

Capacitive Reactance (X_C) in Ohms = $1/(2\pi f C)$
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
Neutral Current (Wye) = $\sqrt{A^2 + B^2 + C^2 - (AB + BC + AC)}$
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 1-Phase = Volts x Amperes
VA 3-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
RT = 1/(1/R1 + 1/R2 + 1/R3 +...)
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 1-Phase = VA/Volts
Secondary Amperes 3-Phase = VA/Volts x $\sqrt{3}$
Secondary Available Fault 1-Phase = VA/(Volts x %impedance)
Secondary Available Fault 3-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 0.5 x $\sqrt{3}$
Wye: Line Volts = Phase (one winding) Volts x $\sqrt{3}$
Wye: Line Amperes = Phase (one winding) Amperes

Voltage Drop

VD (1-Phase) = 2KID/CM
VD (3-Phase) = $\sqrt{3}$ KID/CM

CM (1-Phase) = 2KID/VD
CM (3-Phase) = $\sqrt{3}$ KID/VD

Code Rules

Breaker/Fuse Ratings – 240.6(A)
Conductor Ampacity – 310.15 and Table 310.16
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

p (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), CM = Circular Mils (Chpt. 9, Tbl. 8), VD = Volts Drop, K75°C = (12.9 ohms CU) (21.2 ohms AL), I = Amperes of load, D = Distance one way

Order Mike's Illustrated Formula book for details, visit www.NECCode.com or call 1.888.NEC.Code.