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## VOLTAGE DROP FORMULAS

The NEC® recommends a maximum 3% voltage drop for either the branch circuit or the feeder.

**Single-Phase:**

$$VD = \frac{2 \times R \times I \times L}{CM}$$

**Three-Phase:**

$$VD = \frac{1.732 \times R \times I \times L}{CM}$$

VD = Volts (voltage drop of the circuit)

R = 12.9 Ohms/Copper or 21.2 Ohms/Aluminum (resistance constants for a 1,000 circular mils conductor that is 1,000 feet long, at an operating temperature of 75° C.)

I = Amps (load at 100 percent)

L = Feet (length of circuit from load to power supply)

CM = Circular-Mils (conductor wire size)

2 = Single-Phase Constant

1.732 = Three-Phase Constant

## CONDUCTOR LENGTH/VOLTAGE DROP

Voltage drop can be reduced by limiting the length of the conductors.

**Single-Phase:**

$$L = \frac{CM \times VD}{2 \times R \times I}$$

**Three-Phase:**

$$L = \frac{CM \times VD}{1.732 \times R \times I}$$

## CONDUCTOR SIZE/VOLTAGE DROP

Increase the size of the conductor to decrease the voltage drop of circuit (reduce its resistance).

**Single-Phase:**

$$CM = \frac{2 \times R \times I \times L}{VD}$$

**Three-Phase:**

$$CM = \frac{1.732 \times R \times I \times L}{VD}$$

# RIGID METALLIC CONDUIT-MAXIMUM NUMBER OF CONDUCTORS

TYPE	SIZE	RMC Trade Size (Inches)											
		1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6
RHH, RHW, RHW-2	14	4	7	12	21	28	46	66	102	136	176	276	398
	12	3	6	10	17	23	38	55	85	113	146	229	330
	10	3	5	8	14	19	31	44	68	91	118	185	267
	8	1	2	4	7	10	16	23	36	48	61	97	139
	6	1	1	3	6	8	13	18	29	38	49	77	112
	4	1	1	2	4	6	10	14	22	30	38	60	87
	3	1	1	2	4	5	9	12	19	26	34	53	76
	2	1	1	1	3	4	7	11	17	23	29	46	66
	1	0	1	1	1	3	5	7	11	15	19	30	44
	1/0	0	1	1	1	2	4	6	10	13	17	26	38
	2/0	0	1	1	1	2	4	5	8	11	14	23	33
	3/0	0	0	1	1	1	3	4	7	10	12	20	28
	4/0	0	0	1	1	1	3	4	6	8	11	17	24
	250	0	0	0	1	1	1	3	4	6	8	13	18
	300	0	0	0	1	1	1	2	4	5	7	11	16
	350	0	0	0	1	1	1	2	4	5	6	10	15
	400	0	0	0	1	1	1	1	3	4	6	9	13
500	0	0	0	1	1	1	1	3	4	5	8	11	
600	0	0	0	0	1	1	1	2	3	4	6	9	
700	0	0	0	0	1	1	1	1	3	4	6	8	
750	0	0	0	0	0	1	1	1	3	3	5	8	
800	0	0	0	0	0	1	1	1	2	3	5	7	
1000	0	0	0	0	0	1	1	1	2	3	4	6	
TW, THHW, THW, THW-2	14	9	15	25	44	59	98	140	216	288	370	581	839
	12	7	12	19	33	45	75	107	165	221	284	446	644
	10	5	9	14	25	34	56	80	123	164	212	332	480
	8	3	5	8	14	19	31	44	68	91	118	185	267
RHH*, RHW*, RHW-2*	14	6	10	17	29	39	65	93	143	191	246	387	558
	12	5	8	13	23	32	52	75	115	154	198	311	448
	10	3	6	10	18	25	41	58	90	120	154	242	350
	8	1	4	6	11	15	24	35	54	72	92	145	209
RHH*, RHW*, RHW-2*, TW, THW, THHW, THW-2	6	1	3	5	8	11	18	27	41	55	71	111	160
	4	1	1	3	6	8	14	20	31	41	53	83	120
	3	1	1	3	5	7	12	17	26	35	45	71	103
	2	1	1	2	4	6	10	14	22	30	38	60	87
	1	1	1	1	3	4	7	10	15	21	27	42	61
	1/0	0	1	1	2	3	6	8	13	18	23	36	52
	2/0	0	1	1	2	3	5	7	11	15	19	31	44
	3/0	0	1	1	1	2	4	6	9	13	16	26	37
	4/0	0	0	1	1	1	3	5	8	10	14	21	31
	250	0	0	1	1	1	3	4	6	8	11	17	25
	300	0	0	1	1	1	2	3	5	7	9	15	22
	350	0	0	0	1	1	1	3	5	6	8	13	19
	400	0	0	0	1	1	1	3	4	6	7	12	17
	500	0	0	0	1	1	1	2	3	5	6	10	14
	600	0	0	0	1	1	1	1	3	4	5	8	12
	700	0	0	0	0	1	1	1	2	3	4	7	10
	750	0	0	0	0	1	1	1	2	3	4	7	10
800	0	0	0	0	1	1	1	2	3	4	6	9	
1000	0	0	0	0	0	1	1	1	2	3	5	8	
THHN, THWN, THWN-2	14	13	22	36	63	85	140	200	309	412	531	833	1202
	12	9	16	26	46	62	102	146	225	301	387	608	877
	10	6	10	17	29	39	64	92	142	189	244	383	552
	8	3	6	9	16	22	37	53	82	109	140	221	318
	6	2	4	7	12	16	27	38	59	79	101	159	230
	4	1	2	4	7	10	16	23	36	48	62	98	141
	3	1	1	3	6	8	14	20	31	41	53	83	120
	2	1	1	3	5	7	11	17	26	34	44	70	100
	1	1	1	1	4	5	8	12	19	25	33	51	74

# AMPACITIES OF COPPER CONDUCTORS (3)

AMPACITIES OF NOT MORE THAN 3 INSULATED CONDUCTORS RATED 0-2000 VOLTS IN CABLE OR RACEWAY

IN CABLE, RACEWAY OR EARTH, AMBIENT TEMPERATURE 30°C(86°F)				IN CABLE OR RACEWAY, AMBIENT TEMPERATURE 40°C(104°F)			
WIRE SIZE	60°C (140°F)	75°C (167°F)	90°C (194°F)	150°C (302°F)	200°C (392°F)	250°C (482°F)	WIRE SIZE
AWG kcmil	TYPES TW UF	TYPES RHW, THHW, THW, THWN, XHHW, USE, ZW	TYPES TBS, SA, SIS, FEP, MI FEPB, ZW-2, RHH, RHW-2, THHN, THHW, THW-2, XHH, USE-2, THWN-2 XHHW, XHHW-2	TYPE Z	TYPES FEP, FEPB, PFA	TYPES PFAH, TFE  NICKEL OR NICKEL- COATED COPPER	AWG kcmil
	14*	20	20	25	34	36	
12*	25	25	30	43	45	54	12
10*	30	35	40	55	60	73	10
8	40	50	55	76	83	93	8
6	55	65	75	96	110	117	6
4	70	85	95	120	125	148	4
3	85	100	110	143	152	166	3
2	95	115	130	160	171	191	2
1	110	130	150	186	197	215	1
1/0	125	150	170	215	229	244	1/0
2/0	145	175	195	251	260	273	2/0
3/0	165	200	225	288	297	308	3/0
4/0	195	230	260	332	346	361	4/0
250	215	255	290				250

### TEMPERATURE CORRECTION FACTORS

Ambient Temp.°C	FOR OTHER THAN 30°C			FOR OTHER THAN 40°C			Ambient Temp.°C
	MULTIPLY THE AMPACITIES ABOVE BY THE FACTORS BELOW						
21-25	1.08	1.05	1.04	.95	.97	.98	41-50
26-30	1.00	1.00	1.00	.90	.94	.95	51-60
31-35	.91	.94	.96	.85	.90	.93	61-70
36-40	.82	.88	.91	.80	.87	.90	71-80
41-45	.71	.82	.87	.74	.83	.87	81-90
46-50	.58	.75	.82	.67	.79	.85	91-100
51-55	.41	.67	.76	.52	.71	.79	101-120
56-60		.58	.71	.30	.61	.72	121-140
61-70		.33	.58		.50	.65	141-160
71-80			.41		.35	.58	161-180
						.49	181-200
						.35	201-225

\*Unless specifically permitted by the NEC®, overcurrent protection for copper conductors shall not exceed 15 amps for No. 14 AWG, 20 amps for No. 12 AWG and 30 amps for No. 10 AWG.