Cable Design Formulas

Weight of Conductor:

Weight	=	**340.5 D^2 GNK** = lbs./1,000 ft.
D	=	diameter of conductor in inches
G	=	specific gravity of conductor material; (8.89 for copper, 2.71 for aluminum)
N	=	number of strands
K	=	weight increase factor for stranded conductor. (K = 1 for solid conductor)

No. of strands	**K**
19	1.02
37	1.026
49	1.03
133 or more	1.04

Weight of Insulation:

Weight	=	**340.5 (D^2 - d^2) G** = lbs./1,000 ft.
D	=	diameter over insulation in inches
d	=	diameter over conductor in inches
G	=	specific gravity of insulation

Weight of Jacket:

Weight	=	**340.5 (D^2 - d^2) G** = lbs./1,000 ft.
D	=	**diameter over jacket in inches**
d	=	**diameter under jacket in inches**
G	=	**specific gravity of jacket material**

Weight of Tape:

Weight	=	**1362 Gt ((d+t)+(d+3t) f)** = lbs./1,000 ft.
G	=	specific gravity of tape
t	=	tape thickness in inches
d	=	diameter of cable under tape in inches
f	=	multiplying factor from % lap

% Lap	**f**
17.5	0.35
25	0.5
33	0.67
50	1

Total Weight of Cabled Conductor:

Weight	=	**N x L x W** = lbs./1,000 ft.
N	=	number of conductors
L	=	twisting loss factor = 1.03
W	=	weight of one conductor

Cable Design Formulas

Cabling Factors:

Number of Conductors	Factor	Number of Conductors	Factor
2	2	12	4.155
3	2.154	16	4.7
4	2.414	19	5
5	2.7	27	6.155
6	3	37	7
7	3	41	8
10	4	61	9

Use the following formula for other combinations:

O.D. = 1.155 x (Number of Conductors) x
(Diameter of Individual Conductor)

To determine the approximate O.D. of the finished cable, double the wall thickness of the wire, add this figure to the O.D. of the desired stranded conductor and multiply this dimension by the indicated factor for the number of conductors to be in the cable. Add 0.025" for a bare, tinned, or silver-plated copper shield of #36 gauge wire; e.g., 6 conductors of 24 gauge, 19/36 stranded, Type E wire with overall shield - 2 x 0.010" (wall) = 0.020" + 0.025" (conductor O.D.) = 0.045" (finished wire). Taking 0.045" (finished wire) x 3 (Factor for 6 conductors) = 0.135". Add the 0.135" to the shield diameter of 0.025" which yields a finished cable diameter (no jacket) of 0.160".

Percent of Shield Coverage:

Percent coverage = (2F - F^2) x 100

F	=	**N P d / Sin (a)**
N	=	number of ends (strands) per carrier
P	=	picks per inch
D	=	diameter over dielectric core in inches
d	=	diameter of shielding strand in inches
a	=	the smaller of the two angles between the longitudinal axis of the cable and the lay of the braid.
C	=	number of carriers (groups of ends around the diameter of the cable) in a "two over" "two under" woven basket weave.
p	=	3.14159265
Tan (a)	=	**2 p (D+2d) P / C**

AWG Size	d (inches)	W (lbs./1,000 ft)
#40	0.0031	0.0291
#38	0.004	0.0481
#36	0.005	0.0757
#34	0.0063	0.12
#32	0.008	0.194
#30	0.01	0.303

Diameter of Shield:

The formula to determine adders for diameter over the shield diameter of a multi-conductor cable is:

Shield O.D. = diameter under shield + adder

AWG Size (braid)	Adder (inches)
#40	0.014
#38	0.018
#36	0.022
#34	0.028
#32	0.035
#30	0.044
#28	0.056

Cable Design Formulas

Property Values (nominal):

Material	Specific Gravity	K 1 MC	Max. Oper. Temp. °C
TFE	2.15	1.95	260
FEP	2.15	2.15	200
Polyvinylidene fluoride	1.76	7.5	125
FEP/polyimide film	1.67	2.35	200
Polyester film	1.4	2.8	150
Semi-rigid PVC	1.39	4	80
PVC	1.38	4.6	105
Neoprene®	1.38	-	60
EP rubber	1.3	3.7	105
Fire resistant polyethylene	1.29	2.7	80
Polyethylene/polyester film	1.26	2.8	105
Polysulfone	1.24	3.3	125
Polyurethane	1.12	-	80
Nylon	1.09	4.8	105
Polyethylene	0.92	2.26	80
Polypropylene	0.91	2.3	80
Cellular polyethylene	0.55	1.5	80

Twisting Loss:

Approximately 3% for all cables

Weight of Shield:

$$\text{Weight} = \frac{N \times C \times W}{\cos(a)} \times 1.03 = \text{lbs./1,000 ft.}$$

N = number of ends per carrier

C = number of carriers

W = weight of one of the shielding strands (lbs./1,000 ft.), see

a = braid angle

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