



The fusing current in amperes at which a wire **will melt** can be calculated from the constant (K) that depends on the metal used multiplied by the square root of the wire diameter in inches. Due to the fact there are many factors that can influence the rate of heat loss, these calculations must be considered as approximates and not exact.

If the power supply will provide more current (without shutting down or tripping a circuit breaker or fuse) than the fusing current listed, **it is not a good idea** to use that size wire.

**Basic Equations to use for fuses:**

**Preece Equation:  $i = A * D^{1.5}$**

where A is the constant depending on the metal and D is the diameter of the wire.

**I.M. Onderdonk Equation:  $I_{fuse} = Area * \sqrt{\frac{\ln((T_{melt} - T_{ambient}) / (234 - T_{ambient}) + 1)}{Time * 33}}$**

where

T<sub>melt</sub> - melting temp of wire in deg C

T<sub>ambient</sub> - ambient temp in deg C

Time - melting time in seconds

I<sub>fuse</sub> - fusing current in amps

Area - wire area in circular mils

\*Circular Mils = the diameter of the wire in thousandths of an inch (mils) squared. That is, it is the area of a circle 0.001" in diameter. ( 1 cmil = 0.507E-3 sq mm )

\*This equation isn't as valid for non-circular cross sections, or where there isn't free flow of air around the wire.

Practical Example: Situation is 16 gauge copper wire: T<sub>melt</sub> = 1083, Area = 2581 cmils, Time = 5 seconds, Diameter = .0524 in.

Preece:  $10244 * .0524^{1.5} = 123 \text{ Amps}$

Onderdonk:  $I_{fuse} = 2581 * \sqrt{\frac{\ln((1083-25)/(234-25)+1)}{(5*33)}}$   
 $= 2581 * \sqrt{\frac{\ln(1058/209+1)}{165}}$   
 $= 2581 * \sqrt{.0047}$   
 $= 178 \text{ Amps}$



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## Fusing Currents - Melting Temperature

Fuse Wire	A (d in inches)	A (d in mm)	Melting Temp (Degree C & F)	Boiling Temp (Degree C)
Copper	10244	80.0	1083 C / 1981.4 F	2300
Aluminum	7585	59.3	660 C / 1220 F	1800
AWG Gauge	Diameter (inch)		Alum Wire Fusing Current (A)	Copper Wire Fusing Current (A)
6	0.162000		495.000	668.000
7	0.144300		416.000	561.000
8	0.128500		349.000	472.000
9	0.114400		299.000	396.000
10	0.101900		247.000	333.000
11	0.090740		207.000	280.000
12	0.080810		174.000	235.000
13	0.071960		146.000	197.000
14	0.064080		123.000	166.000
15	0.057070		103.000	140.000
16	0.051200		88.800	117.000
17	0.045260		72.900	98.400
18	0.040300		61.400	82.900
19	0.036890		51.600	69.700
20	0.031960		43.200	58.400
21	0.028460			
22	0.025350		30.500	41.200
23	0.022570			
24	0.020100		21.600	29.200
25	0.017900			
26	0.015940		15.200	20.500
27	0.014200			
28	0.012640		10.700	14.400
29	0.011260			
30	0.010300		7.580	10.200
31	0.008929			
32	0.007960		5.320	
33	0.007080			
34	0.006306		3.790	5.120
35	0.005615			4.280



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Aluminum	7585	59.3	660 C / 1220 F	1800
AWG Gauge	Diameter (inch)		Alum Wire Fusing Current (A)	Copper Wire Fusing Current (A)
36	0.005000		2.680	3.620
37	0.004453			
38	0.003965		1.850	2.500
39	0.003531			
40	0.009146		1.310	1.770
41	0.002800			1.520
42	0.002500			1.280
43	0.002200			1.060
44	0.002000			0.916

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