Cable Basics 101

Minimum Bend Radius (MBR): This is the most common question we receive about our cables and one with a complicated answer. MBR is always application and environment dependent and can vary with cable type too. Some cables can be tied in a knot and others (k)not so much. Is the cable a multi element cable? Is it under load? Is it in use? A good Rule of Thumb is MBR = 20 x Cable O.D.

Safe Working Load (SWL): Our cables are rated to an Ultimate Tensile Strength (UTS), which is the maximum load it will support (for a short time) before it physically breaks. Like MBR, SWL is application and environment dependent. For more complicated hybrid cables with optics it is best to operate between 15% and 20% of the rated UTS. A cable strengthened with torque balanced aramid fibers brought to 50% UTS may see up to 3% elongation.

Optical Loss: Optical fibers transmit data along their length in the form of light, usually at wavelengths of 850nm, 1310nm or 1550nm. As the light bounces down the core of the fiber inevitably some of the photons escape into the cladding and are lost. This loss is measured in Decibels (dB) and can be as low as 0.25 dB/km for some singlemode fibers and as much as 4 dB/km for multimode fibers. Higher loss limits effective working length.

Lay Length: Cables with multiple elements are twisted down the length of the cable. This is down to increase flexibility and protect these elements from being over strained. The Lay Length is the linear distance for one full twist. A shorter lay length yields a more flexible cable, but changes some characteristics related to weight size and performance. For cables with optics, the effective MBR must be considered to mitigate Optical Loss.

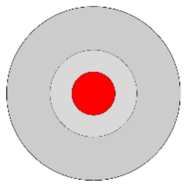
Waterproofing: There are several methods of moisture protection ranging from tape wrap, gel filling, metal tube enclosure. Optical fibers can be made hermetic by carbon deposition or LCP jacketing. LCP has been shown to be better than carbon in terms of moisture protection and it also allows for low cost, fast manufacturing.

Conductors: Conductors come in many shapes and sizes, but the most common is stranded, tin-plated copper. We use the American Wire Gauge (AWG) system (conversion to mm^2 on the next page). Generally, the larger the wire (smaller the gauge) the larger its current carrying capacity. The gauge number refers to the number of drawing processes the wire must go through to reach its size, hence the inverse relationship between gauge size and OD. Interestingly for gauges 5 through 14, the gauge is the number for wires that will fit side-by-side in one inch.

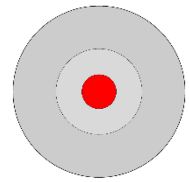
Fiber Basics 101

Common Fiber Types:

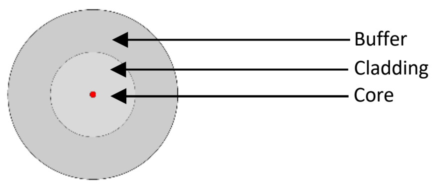
Multimode 62.5/125/250
Larger core = larger power budget
Typical maximum length <300 m



Multimode 50/125/250
Higher Bandwidth than 62.5
Typical maximum length <1km



Singlemode
Small core = Very high bandwidth
Typical maximum length 50,000m



dB Loss to Power Ratio Conversion

dB (loss)	Power ratio
0	1.000
0.1	0.977
0.2	0.955
0.3	0.933
0.4	0.912
0.5	0.891
0.6	0.871
0.7	0.851
0.8	0.832
0.9	0.813
1	0.794
2	0.631
3	0.501
4	0.398
5	0.316
6	0.251
7	0.200
8	0.158
9	0.126
10	0.1
20	0.01
30	0.001
40	0.0001
50	0.00001
60	0.000

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Wire Charts

AWG to mm² Conversion

#AWG	Diameter (in)	Diameter (mm)	Cross Sectional Area (mm^2)
1	0.289	7.35	42.4
2	0.258	6.54	33.6
4	0.204	5.19	21.1
6	0.162	4.11	13.3
8	0.129	3.26	8.36
10	0.102	2.59	5.26
12	0.0808	2.05	3.31
14	0.0641	1.63	2.08
16	0.0508	1.29	1.31
18	0.0403	1.02	0.82
20	0.032	0.81	0.52
22	0.0254	0.65	0.33
24	0.0201	0.51	0.2
26	0.0159	0.4	0.13
28	0.0126	0.32	0.081
30	0.0984	0.25	0.051
32	0.0787	0.2	0.035

Wire Weight and Resistance

AWG Size	Strands / Strand Size	Approximate Weight		Maximum DC Resistance	
		lbs/ 1000 ft	Kg/Km	Ohms/1000 ft	Ohms/Km
34	7/42	0.136	0.2	265	869
34	19/46	0.147	0.22	247	809
32	7/40	0.21	0.31	170	556
32	19/44	0.237	0.35	156	511
30	7/38	0.349	0.52	100	329
30	19/42	0.37	0.55	97.6	320
28	7/36	0.546	0.81	63.6	209
28	19/40	0.569	0.85	62.5	205
26	7/34	0.866	1.3	39.7	130
26	19/38	0.947	1.4	37	121
24	7/32	1.4	2.1	24.5	80.2
24	19/36	1.48	2.2	23.4	76.8
22	7/30	2.18	3.3	15.6	51.1
22	19/34	2.35	3.5	14.6	48
20	7/28	3.32	5.2	9.77	32
20	19/32	3.79	5.6	9.01	29.6
18	7/26	5.52	8.2	6.19	20.3
18	19/30	5.92	8.8	5.74	18.8
16	7/24	8.82	13.1	3.85	12.6
16	19/29	7.56	11.3	4.48	14.7
14	7/22	11.9	17.7	3.15	10.03
14	19/27	11.9	17.8	2.83	9.28

Cable Definitions

Ampere — Amount of current that flows when one volt is applied across one ohm of resistance. One ampere (A) is produced by one coulomb of charge passing a point in one second.

Attenuation — The decrease in magnitude of a signal as it travels through any medium. It is usually expressed in decibels (dB). See power conversion chart above.

Braid Angle — The angle between a strand of wire in a braid shield and the longitudinal axis (i.e. axis along the length of the center) of the cable it is wound around. Also expressed in picks per inch (ppi).

Current Carrying Capacity — The maximum current a conductor can carry without being heated beyond a safe limit. Ampacity.

Impedance — The effective resistance of an electric circuit or component to alternating current, arising from the combined effects of ohmic resistance and reactance.

Ohm — The unit of electrical resistance. The value of resistance through which a potential difference of one volt will maintain a current of one ampere.

Ohm's Law — Stated $V=IR$, $I=V/R$ or $R=V/I$. The current I in a circuit is directly proportional to the voltage V, and inversely proportional to the resistance R.

Power — The amount of work per unit of time; Watts. Power equals the product of voltage and current ($P = V \times I$).

Resistance — In DC circuits, the opposition a material offers to current flow, measured in ohms. In AC circuits, resistance is the real component of impedance, and may be higher than the value measured at DC.

Shield — A tape, serve or braid placed around or between electric circuits or cables or their components, to prevent signal leakage or interference.

Voltage — also called electromotive force, is a quantitative expression of the potential difference in charge between two points in an electrical field.

Voltage Drop — The voltage developed across a component or conductor by the current flow through the resistance or impedance of the component or conductor.

Voltage Rating — The highest voltage that may be continuously applied to a cable construction in conformance with standards or specifications.