Cable Sizes and Wiring

What ties all the components together in an electrical system are the cables. Cables supply the power from power sources for distribution to appliances, lights and equipment. Unfortunately, the most common installation error is to under-size cables relative to the load/s or from the recharge sources.

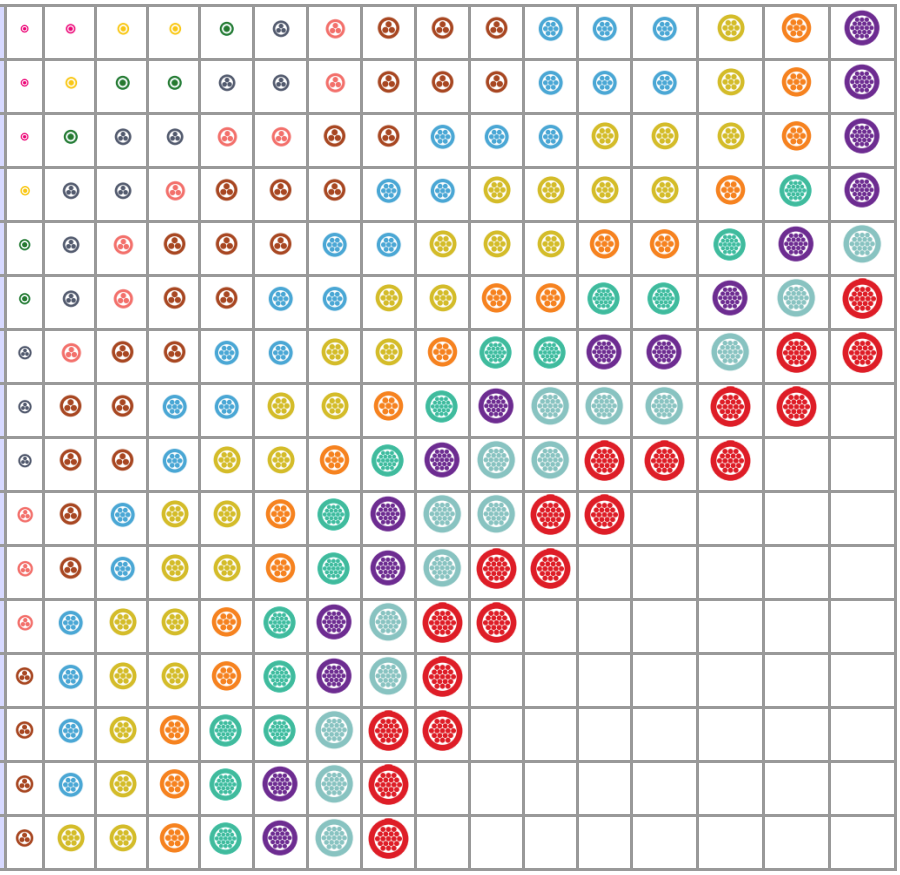
Proper installation is primarily a matter of sizing a cable to match its task, using the correct tools to attach terminals, and providing adequate over-current protection with fuses and circuit breakers. Cable sizing is fairly simple; it is a function of the length of a cable measuring from the power source to the appliance, and the current (amperage) that will flow through it.

The longer the cable, or the higher the amperage, the bigger the cable must be to avoid unacceptable voltage losses. There should always be plenty of extra margin for safety because an appliance may actually use more current than what it is rated for because of heat, low voltage, extra load, or other factors. There's never a performance penalty if a cable is marginally oversized; there is always a performance penalty - and possibly a safety hazard - if it's undersized.

The ground (negative) cable is as much a part of a circuit as the positive cable; it must be sized the same. In general, each appliance should be supplied from the distribution panel with its own positive and negative cables, although lighting circuits sometimes use common supply and ground cables to feed a number of lights (in which case the supply cables must be sized for the total load of all the lights). For 24v systems, the cables size is half that of a 12v setup. Always read product recommendations, or check with the supplier to know and understand exactly what size cable is required for the products.

To better plan and size cables, please reference the cable sizing table below:

	Circuit Type		DC Amps														
	10% Voltage Drop (Non-Critical)	3% Voltage Drop (Critical)	5A	10A	15A	20A	25A	30A	40A	50A	60A	70A	80A	90A	100A	120A	150A	200A

Cable Length in Meters	0-6 m	0-2 m	
	6-9 m	2-3 m	
	9-15 m	3-4.5 m	
	15-19 m	4.5-6 m	
	19-24 m	6-7.5 m	
	24-30 m	7.5-9 m	
	30-40 m	9-12 m	
	40-51 m	12-15 m	
	51-61 m	15-18 m	
		18-21 m	
		21-24 m	
		24-27 m	
		27-30 m	
		30-33 m	
		33-37 m	
		37-40 m	

The above cable sizing table is used by running across the top row until the column with the relevant amperage is found, and then moving down the left-hand column until the row with the relevant distance is reached. Wire sizes are denoted by colour coding.

Gauge:

A common way for referencing a cable size is its “gauge.” The American Wire Gauge (AWG) is used as a standard method of denoting wire diameter, measuring the diameter of the conductor - measured as only the bare wire with the insulation removed. AWG is sometimes also known as Brown and Sharpe (B&S) Wire Gauge.

Below is a conversion chart from AWG/B&S to mm^2. This table gives the closest equivalent size cross references between metric and American wire sizes. In Europe and Australia, wire sizes are expressed in cross sectional area in mm^2.

Standard	Unit												
AWG	0000	000	00	0	1	2	4	6	8	10	12	14	16
Diameter (mm)	11.68	10.40	9.27	8.25	7.35	6.54	5.19	4.11	3.26	2.59	2.05	1.63	1.29

Standard	Unit												
Cross Section (mm2)	**107.1**	**84.9**	**67.5**	**53.5**	**42.4**	**33.6**	**21.2**	**13.3**	**8.4**	**5.3**	**3.3**	**2.1**	**1.3**
Colour Code													

A printable guide to sizing cables can be downloaded here.

Title
Guide - Cable Sizing Chart

Colour Coding

While is possible to use the same cables for AC and DC circuits, it is advisable to use different coloured cables between the two types of currents, both to increase handling safety but also to make installation and repair work much faster. If existing appliances or installations have colours, logistics managers may consider replacing or standardising them by re-colour coding the wires with an external paint or marking in a method that makes sense.

A general colour cod for AC looks like:

- **Neutral:** Blue.
- **Phase:** Brown or black.
- **Ground:** Green/yellow.

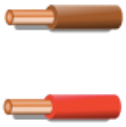
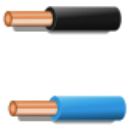
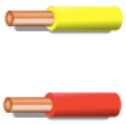
The neutral and the phase are the two connections for the electricity, the ground is for safety.

Colour code for DC (direct current, battery):

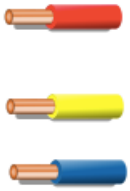
+ = red or blue
- = black or brown

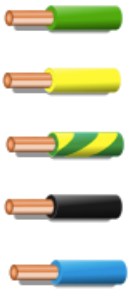
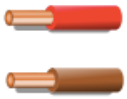
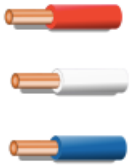
Many differing international standards apply however. Please reference the below table for colour coding of different countries and regions around the world.

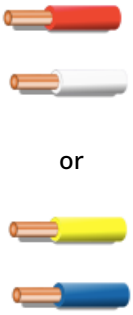
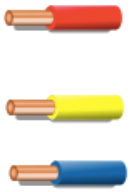
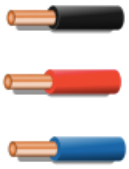
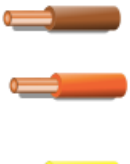
Standard Wire Colours for Flexible Cable **(e.g. Extension Cords, power cords and lamp cords)**			
Region or Country	**Phases**	**Neutral**	**Protective Earth/Ground**
European Union (EU), Argentina, Australia, South Africa			

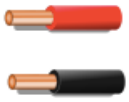
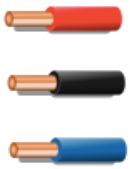
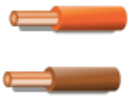
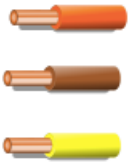
Standard Wire Colours for Flexible Cable (e.g. Extension Cords, power cords and lamp cords)			
Region or Country	**Phases**	**Neutral**	**Protective Earth/Ground**
Australia, New Zealand			
Brazil			
United States, Canada	 (brass)	 (silver)	 (green) or  (green/yellow)

Standard Wire Colours for Fixed Cables (e.g. In/On/Behind the wall wiring cables)			
Region or Country	**Phases**	**Neutral**	**Protective Earth/Ground**
Argentina			

Standard Wire Colours for Fixed Cables (e.g. In/On/Behind the wall wiring cables)			
Region or Country	**Phases**	**Neutral**	**Protective Earth/Ground**
European Union and UK			
UK Prior to March 2004			  (formerly)

Standard Wire Colours for Fixed Cables (e.g. In/On/Behind the wall wiring cables)			
Region or Country	**Phases**	**Neutral**	**Protective Earth/Ground**
Australia, New Zealand	Any colours other than:  Recommended for single-phase:  Recommended for multi-phase: 	 or 	 (since 1980)  (since 1980)  bare conductor, sleeved at terminations (formerly)
Brazil			

Standard Wire Colours for Fixed Cables (e.g. In/On/Behind the wall wiring cables)			
Region or Country	**Phases**	**Neutral**	**Protective Earth/Ground**
South Africa	 or		 bare conductor, sleeved at terminations
India, Pakistan			
United States	 (120/208/240V) (brass)  (277/480V)	 (120/208/240V) (Silver)  (277/480V)	 (green)  bare conductor  (ground or isolated ground)

Standard Wire Colours for Fixed Cables (e.g. In/On/Behind the wall wiring cables)			
Region or Country	**Phases**	**Neutral**	**Protective Earth/Ground**
Canada	 (120/208/240V)  (600/347V)  (single-phase isolated systems)  (three phase isolated systems)	 (120/208/240V)  (600/347V)	 (green)  bare conductor  (isolated ground)

Important points to note when wiring:

- All circuits should be removed from the floor and be as high as possible with no connections in or near water or damp areas.
- All cable lug connections should be securely crimped to the wire termination with a band, and not soldered in place.
- Tinned cable – copper wire that has been coated with a thin layer of tin to prevent corrosion - It is preferable to use where possible in a marine environment or near salt water.
- Never tap into or splice existing circuits when installing new equipment; run a properly sized new duplex cable (positive and negative cable in a common sheath) from the

distribution panel (or a source of power) to the appliance.

- It is recommended to label all cables at both ends, and to an updated wiring plan to aid in future troubleshooting. Copies of the wiring plans can be even be stored in locations such as the fuse box or distribution box so that future users can reference them.
- Each circuit should have an independent ground cable, and all the ground cables should eventually be tied back to a common ground point/busbar.
- Unless in a conduit, cables should be physically supported at least every 450mm.
- Although black is often used for DC negative, it is also used for the live wire in AC circuits in the USA. That means there is potential for dangerous confusion. DC and AC wiring should be kept separate; if they have to be run in the same bundle, one or the other should be in a sheath to maintain separation and ensure safety.