How To Guide

Choosing a Cable

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What sort of cable do I need?
There are hundreds of different types and sizes of wire and cable. Although any piece of wire may be used to join point A to point B, some cables are much better at certain jobs than others.

Generally, a wire will contain a single conductor, usually insulated by a plastic sheath so that it will not short out to nearby metal objects, other wires, or allow anyone to be electrocuted. Cables usually contain more than one conducting wire, insulated from each other and then covered by an overall protective and insulating sheath.

Broadly speaking, wires and cables break down into four different areas;

Electrical wire or cable
This usually carries power from one place to another, either inside equipment, or between power sockets and equipment.

Audio cables
These usually contain at least one core wire, covered in an insulating sheath, which is then further covered by an overall grounded metal shielding layer that protects the inner wire from acting as an aerial and picking up interference from nearby power cables, or other equipment. The protective shield layer is in turn covered by at least one protective and insulating plastic sheath.

RF (Radio Frequency) cables
RF cables are constructed in a very similar way to single core audio cables, but are specially constructed to allow high frequency signals to connect from one place to another as efficiently as possible without picking up any other radio or interference signals. Any piece of open wire connected to RF sensitive equipment will act as an aerial, both receiving unwanted signals from the world around it, and sometimes transmitting signals that may cause interference to nearby equipment. Use of the correct RF cable will prevent this happening.

Data cables
These are made up of a number of insulated wires that allow many data signals to be connected from one digital circuit to another. If the data has to travel from one piece of equipment to another, the wires are sometimes wrapped up in an overall shield or screen layer that prevents the data signals from being radiated to other sensitive equipment nearby.

The first thing you need to do is to work out which of these basic types will be most suitable for the job you want your wiring to do. From the descriptions above, this should be fairly easy, but then the more difficult part begins.

Can I make the cable as long as I like?
The answer to this is that, yes, you probably can make the cable as long as you need to, provided you think carefully about the job the cable will be doing, and where it is going to be used.

Once you know what sort of cable you need, you will probably find that there are many different wires or cables that would seem to do the job. However, not all cables will do the job as well as others. Lets go through our main four types again but look at the reasons you might choose one cable or wire over another.

Electrical wiring
The main considerations here are the amount of current to be carried by the cable, and whether it needs to be very flexible, or is fixed in position once wired up.

Cables and wires have a maximum current rating and this should never be exceeded. In fact you should choose a wire or cable with a rating of about 30% higher than the maximum current you expect to flow in the circuit.

If you don't know the current that will be drawn by your circuit, you can either measure it using a multimeter or calculate it if the power consumed by the circuit is known (rated in Watts). It is simple to work out the current that will flow in a supply cable if you know the voltage supplied and the power used. Simply divide the power rating of the equipment by the voltage supplied to it. For example, a 1kW bar fire supplied with 230 Volts will draw 4.35 Amps (1000 / 230 = 4.35).

For mains electrical use, cables are supplied in just a few standard current ratings so once you know the current drawn by the device to be wired, you simply need to look at the appropriate range of cables and pick a cable with a rating comfortably higher than the figure you have calculated.

Cables between mains sockets and equipment generally need to be flexible, and multi stranded round cables are usually the best choice here. The flat three core single strand mains wiring (twin and earth) used within walls and conduits to distribute mains around a building are inflexible and prone to fatigue and break if used in a position where they are allowed to flex.

The choice of mains distribution cables in a house or other building is in any case covered by the IEE Wiring Regulations, which set out the different current ratings of cables to be used for the various types of ring main and spur wiring.

Within equipment, the same considerations exist. You need to work out how much current will flow through internal wiring, then decide whether the wiring will be fixed in place, or whether a multi-stranded, more flexible wire would be more suitable, often the case if occasional movement of circuit boards may be necessary for service or modification.

Power supply and switching contact wiring, amplifier outputs and so on will be carrying the highest currents and you need to choose thicker wires to carry these without heating. Thinner wires offer more resistance than thick ones, meaning that power will be lost in the wiring if too thin a wire is used.

The longer you need a lead to be, the more resistance it will present to the circuitry it is connected to. This means that signal or power will be lost in the lead, but you can minimize this by choosing a cable with a lower resistance, usually a thicker cable.

This is particularly important where the voltages involved are fairly small, and proportionally more voltage drop occurs across a long lead. For example, the use of thin wiring to supply an amplifier in the back of a car from a fuse under the bonnet may result in a drop of several volts along the length of the lead when the amplifier is being used. This reduces the power supply available at the amplifier to perhaps 9 Volts, resulting in a poor quality distorted sound at anything above medium volume.

So, use a thicker wire for less loss and better performance and efficiency, especially over long lengths.

Audio Cables
Having decided that you need a screened audio cable (except for loudspeaker outputs) you simply need make a suitable choice from the many cables on offer.

The simplest audio cables are the thin lapped core cables, suitable for connections between audio or other low level signal boards inside equipment, or very short external runs in non hi-fi applications. They are not suitable for longer runs or for high quality audio connections.

Cables with braided screens are good for general purpose audio use. They allow a high quality signal transfer over short to medium runs and are available in single and twin versions, for mono or stereo connections.

At the top of the range come various special cables for the very best signal transfer and mimimum interference and hum pick up. High grade cables include oxygen free copper, special additional insulating sheaths, silver plated conductors for minimum connection resistance and surface resistance.

Where capacitance per metre is quoted, lower capacitance leads will have less of a loading effect on high frequency signals and are suitable for longer runs.

If you need to make up long leads for line level connection of (for example) a video recorder and a Dolby surround amplifier, then use the best cable you can afford for the job. if on the other-hand you just need a point to point run in a peice of equipment, an inexpensive thin lapped cable will be fine.

Speaker leads
Although part of the audio range, loudspeaker wiring is very different and needs a little consideration. little loudpeakers in equipment may be wired up using almost any wire, as may intercom type circuits and so on.

Hi-Fi loudspeaker cabling and In Car
Entertainment speaker wiring is much more critical. It is very easy to drop a significant part of the output of an audio amplifier over a medium to long run of inadequate but inexpensive speaker cable. Many people automatically use a thin figure of eight "Zip" wire for speaker connections, but for any amplifier delivering over a few Watts, a thicker and more substantial cable is needed for a quality reproduction of sound without burning part of your output as heat and having to have the volume higher to achieve the same volume at lower quality.

Look at heavy duty and Hi-Fi loudspeaker cables, or if the increased bulk of those is a problem, there are several special flat variants that will go under the carpet easily. Silver plated and Oxygen free copper are also available and provide a very clean transfer of power to your loudspeakers.

Radio Frequency (RF) cables
The first thing to consider with an RF cable is impedance. Impedance is a combination of DC resistance as well as capacitive and inductive effects in the cable. It may be considered as the effective resistance of a cable to an AC signal.

Most RF equipment is designed to work with a cable of a specific impedanence. TV's, Video recorders and satellite equipment are designed to use 75 Ohm cables, whereas radio transmitters and some recievers are designed to use 50 Ohm cable. It is important to select a cable with the correct impedence for the job, otherwise a bad match will be made between the equipment and signal will be lost, resulting in poor reception. In the case of Transmitters, it is possible that this will cause the output stages to heat up in use or even burn out.

The other associated figure to look at when choosing an RF cable is attenuation. Attenuation is a measure of how much signal you will lose over a given length of cable at a stated frequency, expressed in Decibels. The explaination of both impedence and attenuation is beyond the scope of this guide, but suffice it to say that a cable of the correct impedance for the application, with the lowest attenuation figure at the frequency range to be used, will give the very best results, although the voltage rating of the cable is also important at very high transmitter output levels.

Impedance is also important for some professional audio uses, such as the use of balanced microphones in studio or stage situations. Check the Impedance rating of the equipment and use the correct cable and connectors for the job.

Data cables
Networking connections that use the BNC connector are designed to use 50 Ohm RF cable to interconnect computer equipment. Newer networking connections tend to be made using special multi way twisted pair cables that help to reduce both radiation of the very sharp edged RF data signals as well as reducing the likelyhood of pick up of interference from other electrical equipment. There are various standards for these data cables (Category 5 for example) and it is always best to check the instructions supplied with each unit before choosing a cable.

What else do I need?
If you intend to do a lot of cabling, there are a number of special cable stripping tools that will make the job a lot easier.

Many connectors need soldering onto the cables, and sharp cutters, a craft knife and small scewdrivers for any screw fixed connectors will be needed.

A multimeter or continuity tester is ideal for reassuring you that your completed cable and connector assembly really does connect as you think it does, with no open or short circuits that could cause damage or other problems later.

Consider the use of conduits or trunking to box up, hide and protect long cable runs. Wiring inside equipment may be secured by using cable ties, lacing cord or spiral wrapping. There is a large range of different cable clips that will also help tidy your wiring and keep it in place after installation.

If your cables or wires have lots of different terminations, you may wish to use coloured or numbered sleeving at each end of each wire to aid later fault finding or rewiring. Heat shrink sleeving will allow you to join cables in places where no connectors are required, and then shrink the sleeving over the individual joins to remake the insulating layer, or just provide an additional protective layer for a cable in a vulnerable position.

Cable glands and grommets will allow you to make neat entry to boxes or through panels, and will prevent the cable chafing on metal edges.

It is never ideal to run a cable across the floor, but if you have no alternative, consider using a cable protector, which is a heavy rubber strip the cable lies protected inside on the floor, shaped to minimise tripping over it.

How do I join up the ends?
It seems fairly obvious that the ends of your cable will somehow need to be securely attached to the equipment, either by directly soldering each conductor to a terminal or tag, or by screw or clamp terminals, or via a suitable set of connectors. check before choosing connectors that their current and voltage rating is sufficient and safe for the job in hand.

RF cables must be properly connected and joined by suitable FR connectors of the same impedance. Use of the wrong connector, or a hard wired soldered or screw terminal joint, may result in a break in the smooth transfer of RF energy that may result in the signal being reflected back up the cable instead of passing through it.

Note that, especially for RF, a soldered connector is usually far better than a screwed one, and that TV aerial and distribution wiring should always be soldered for best long term results.

We hope that this guide to cables has helped you to think about what you need from your cables and wiring and that you now feel ready to make your choice.

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