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Wires and Cables

A **wire** is defined as one electrical conductor, while a **cable** is defined as a group of individually insulated wires (conductors) encased together in sheathing. Sheathing is a non-conducting material with protective properties to shield the conducting part of the wire/cable. Although wire is a good conductor, it can still have some resistance. Wires and cables can be made from various materials, such as copper, gold, and aluminum.

The materials each have different resistances. Thick wire will have a lower resistance than thin wire made from the same material. Resistance of the wire can change proportionally with change in temperature or length of the wire. Wire size indicates the diameter of the metal conductor of the wire. When choosing the size of wire, you must consider the gauge of the wire, wire capacity, and what purpose the wire will be used for. If the wire is too small, too much current will be sent through, causing the wire to drop more power, in the form of watts, because there is such high resistance.

Wires

The two categories of single-conductor wires are_ solid and stranded (also called braided).

- Solid wire is rigid and conducts electricity better.
- Stranded wire consists of smaller wires braided together.
- Stranded wires are less prone to breakage when flexed repeatedly, which is why this type of wire is common in phone chargers.

Wires

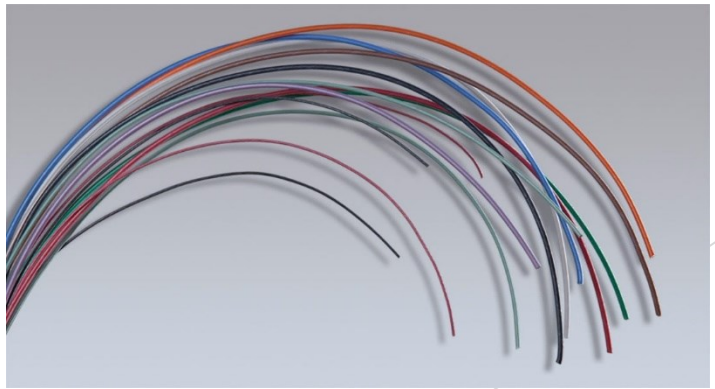
Jumper Wires are pre-cut flexible stranded wires of different lengths that have stiff ends to allow the wire to be easily inserted in a breadboard.

Hook-up wire is typically single conductor insulated wire used in low current, low voltage (<600 Volts) applications for making internal connections.

- It comes in a range of gauges and lengths.
- Once the hook-up wire is cut to the desired length a wire stripper can be used to strip off the insulation, allowing the metal conductor to be attached to a circuit.

Magnet wire is a copper or aluminum wire coated with a very thin layer of insulation.

- Magnet wire allows multiple layers of wire to be wound together without short circuiting.
- When the wire is wound into a coil and energized, it creates an electromagnetic field.
- Magnet wire is often used in transformers, inductors, motors, electromagnets, Tesla coils, and other applications that require tight coils of insulated wire.



Wires

Wire-wrap wire is ideal for wire wrapping, hence the name. The silver-plated copper wire is highly flexible and well insulated, yet resistant to abrasion. Wire wrapping is great for prototypes because it is easy to make point-to-point connections and to repair them. The connections made with wire wrapping is more reliable than soldered connections because of the amount of contact the wire makes with the post.

Muscle wire is an extremely thin wire made from Nitinol that is known for its ability to contract when an electric current is applied. It has been used for micro latches on Microsoft® Surface Book laptops.

Cables

- Electric cables are current-carrying wires which are bonded, twisted, or braided together in a single assembly.
- These wires are made from electrically conducting materials that are secured with one or more insulation layers.
- The entire setup is called a Cable Assembly.
- These cables carry electrical signals and aid the generation, transmission, and distribution of electric power.

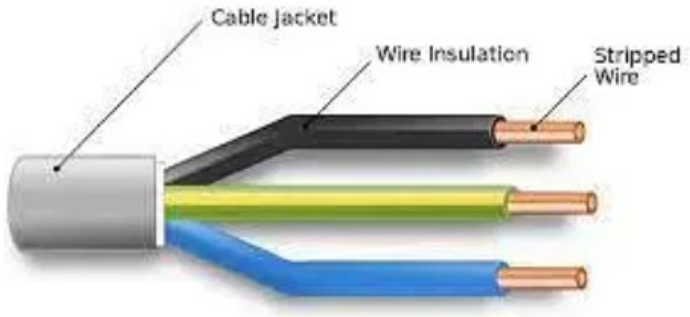
Cables

Components of an Electrical Cable

1.Conductors: Conductors are the electricity transmitting wires in a cable. These are made from high conducting metals like Copper and Aluminum which have low resistance and can be used for high voltage applications.

2.Insulators: The conducting wires are set apart using insulation materials to prevent any abnormalities in the current flow path. Being bad conductors of electricity, these prevent short circuits and unwanted current flow paths. In earlier times, paper, cloth, or rubber were used as insulating materials, however, these are now replaced with different synthetic polymers based on their application. Examples: Polyethylene, Butyl Rubber, etc.

3.Sheath: These wires protect the cable from atmospheric conditions like high moisture in the air, chemical reactions, or fire attacks. Commonly used sheaths are made from polyvinyl chloride **(PVC)**.



Cables

Properties of Electrical Cable

Listed below are some standard properties of cable wires:

1. **Strength and Flexibility**: Wires must have great insulation against external influences and should be easily installable. Eg: telephone lines, cameras, etc.
2. **Fire Retardant:** Fire accidents and exhausts can cause damage to the wires. A fire-resistant material of wires minimizes damage in times of fire attacks.
3. **Long Life and Heat Resistance:** Frequent maintenance of wirings in public or private facilities is not feasible. Wiring materials should hence be capable of withstanding heat as per standards and should be viable.
4. **Non-toxic and Environment-Friendly:** Based on the site of installation, wiring materials must not contribute to producing pollutants that can damage property and life.
5. **Simple Usage:** Complex circuits limit the application of the wirings. Hence, for domestic and commercial uses, the wirings are mostly comprehendible and outer insulation is ensured for security reasons.
6. **Cost-Effective:** Cables are the backbones of electrical circuits. This makes it necessary to ensure they are available at a fair price.

Cables

An electric cable is measured in volts and, depending on these, they are categorized into one group or another:

•**Low voltage cables (up to 750 V):** in a variety of applications, and with thermoplastic and thermoset coatings. They are designed and built according to harmonized standards.

•**Low Voltage cables (up to 1,000 V):** (also called (0,6/1 kV) The cables in this section are used for industrial power installations in various fields (general industry, public installations, infrastructures, etc.). They are designed according to international standards (UNE, IEC, BS, UL).

•**Medium Voltage cables:** from 1 kV to 36 kV. They are used to distribute electricity from electrical substations to transformer stations.

•**High Voltage cables:** from 36 kV. They are used to transport electricity from the generating plants to the electrical substations.

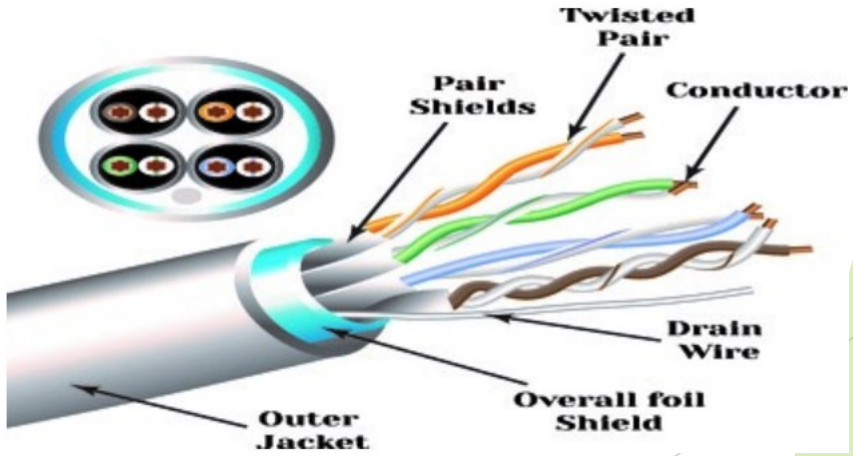
Types of Cables

•Ribbon Electric Cable

It consists of multiple insulated wiring running parallel with one another and used for multiple data transmission like this is used to connect the CPU with motherboard. And are generally used for interconnection of networking device.

•Shielded Cables

It consists of one or two insulated which are covered by a woven braided shield or aluminium foil for better signal transmission and removing irregularities in frequency and power and external interference in radio. These cables are also used to transmit high voltage and are protected by shield.



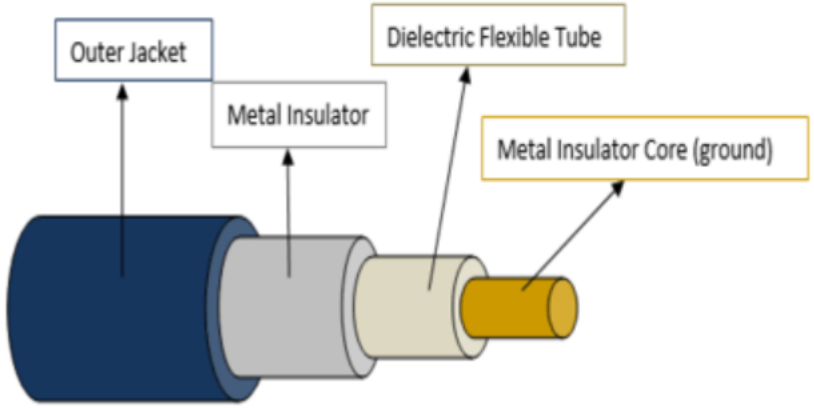
Types of Cables

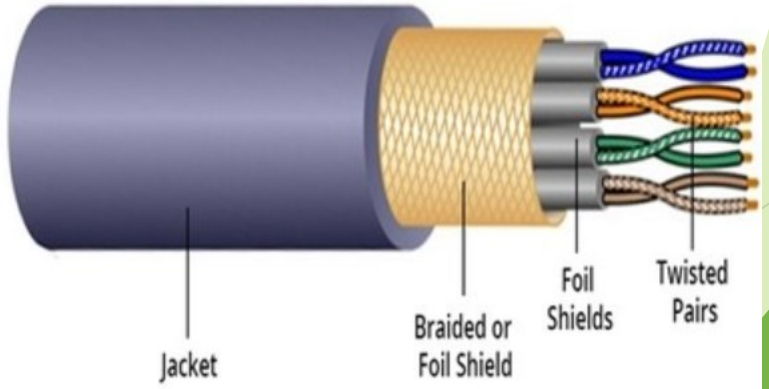
•Coaxial Cable

It consists of solid copper or steel conductor plated with copper which is enclosed in the metallic braid and metallic tape. This is entirely covered by with an insulated protective outer jacket. These types of electric cable are used for computer networking and audio video networking. It is used in telephone trunk line, broadband internet, high speed computer data busses, cable television and connecting radio transmitter.

•Twisted Pair Cables

It has two or more insulated copper wires which are twisted with each other and are colour coded. These are used in telephone cable and resistance to external interference can be measured by number of wires.





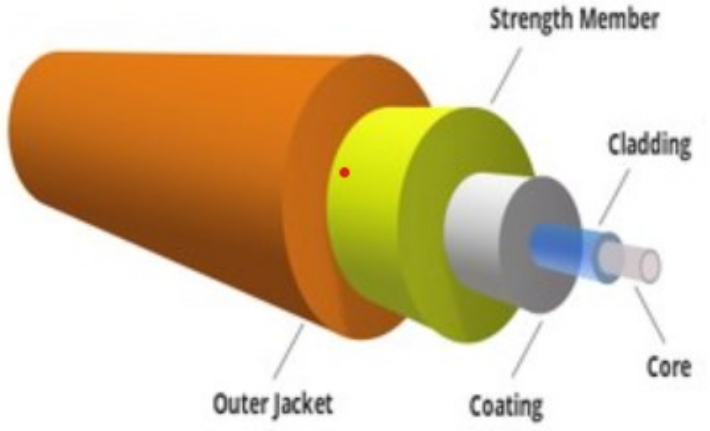
Types of Cables

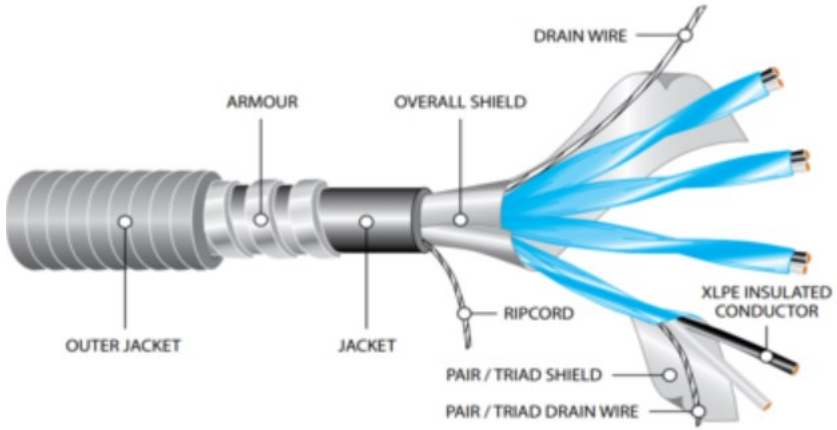
•Fiber Optical Cable

These types of cable are used to transport optical data through light source to the receiver. It is assembled similar to electrical cable but containing one or more optical fiber that are used to carry light. These optical fiber elements are typically individual coated with plastic layer and contained in protective tube suitable for environment

•Instrumentation Cable

These are flexible and shielded cables for transmission of signal between equipment in industrial installation. Especially suitable for optimum data transmission with high level of electromagnetic interference.

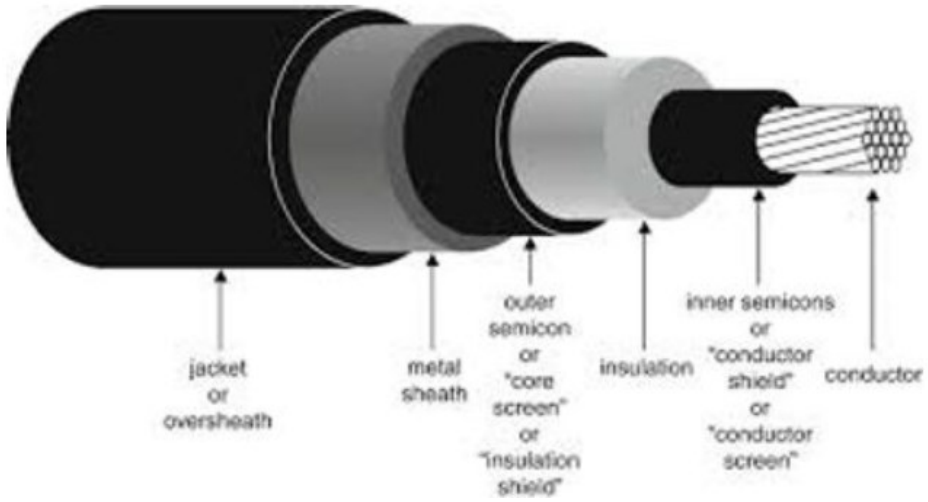




Types of Cables

•Underground Cable

Underground cables are employed to transmit and distribution of electrical power where there is impractical to use overhead transmission line, or this is used in congested area where there is impossible to use overhead transmission line. There are kind of cable used depend upon voltage level and service requirement. Underground cable consists of a central core or more than two or three core made of copper or sometime uses of aluminium and insulated from each other by impregnated paper and metallic sheath is provided to protect insulation from moisture.



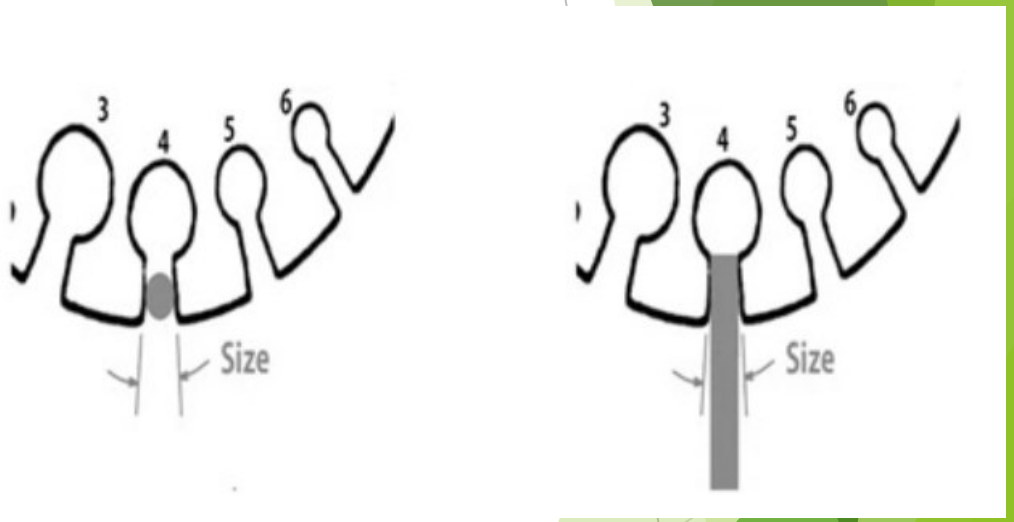
Wire Gauge

The measurement of wire either its cross-sectional area or its diameter is known as **wire gauge**.

The wire's gauge determines how much current can supply throughout the wire, the wire's resistance & its weight for each unit of length.

How to Measure Wire Gauge

Generally, these are accessible in two shapes like a circular otherwise oblong which includes notches through edges of the shape where every notch is stamped by wire size number. This is used to find out the width of sheet metal which is available from 0.1mm to 10mm.



Wire Gauge

The following diagram shows the gauge with stamped and different sizes on the notches. So let's see how to measure the wire diameter otherwise sheet thickness using this gauge.

The following steps involve measuring wire gauges.

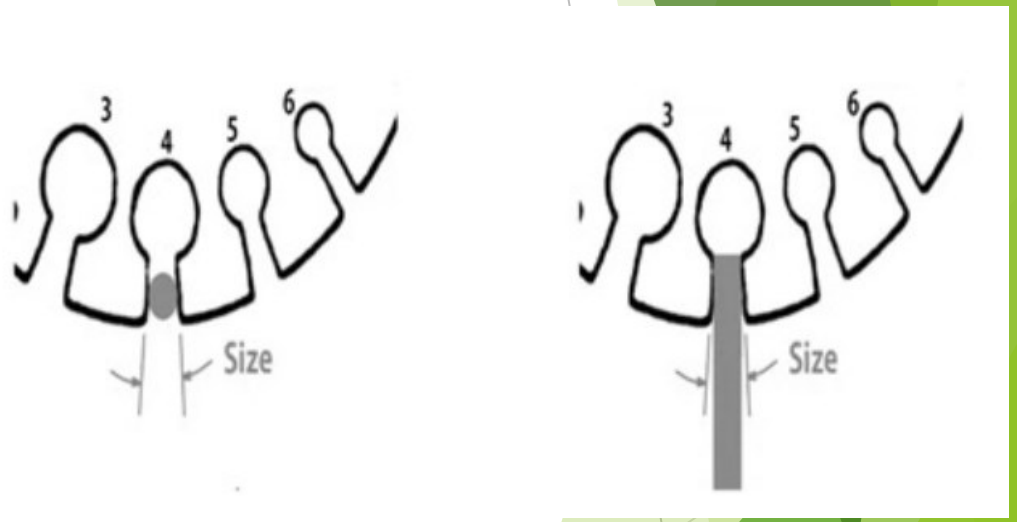
•First, we have to check whether the tool for the measurement of gauge supports AWG or MWG.

•Clip the gauge wire end, and then cut the boundary of the covering to expose the wire.

•Take the wire or Sheet and place it into the notch. Once it is inserted then it must pass throughout the notch.

•Place the exposed wire into a hole on the measurement tool of the gauge that tightly fits the wire. Make sure not to place one of the filaments of wire into a measurement hole that is very small because it may get bent.

•On the outside of the hole, read the measurement on the tool to obtain the measurement of the gauge for the wire.



Wire Gauge

Thank You