

Knowledge Domain: Electrical
Unit: Connections
Skill: Selecting Wire

Tools and Parts Required:

- 1) Solid wire
- 2) Stranded wire
- 3) Aluminum wire
- 4) Copper wire
- 5) Various gauges of wire

Introduction

Electrical wires transport electricity. Electrical wires carry electric current. Electrical wires have four essential properties: size, type, insulation, and material. Selecting electrical wire with the wrong properties can cause equipment to malfunction. Selecting electrical wire with the wrong properties can cause a fire when the wire overheats. The correct type of electrical wire for your project should be selected based on size, type, insulation, and material.

Example

Below is a picture of a spool of electrical wire:



Identification and Diagnosis

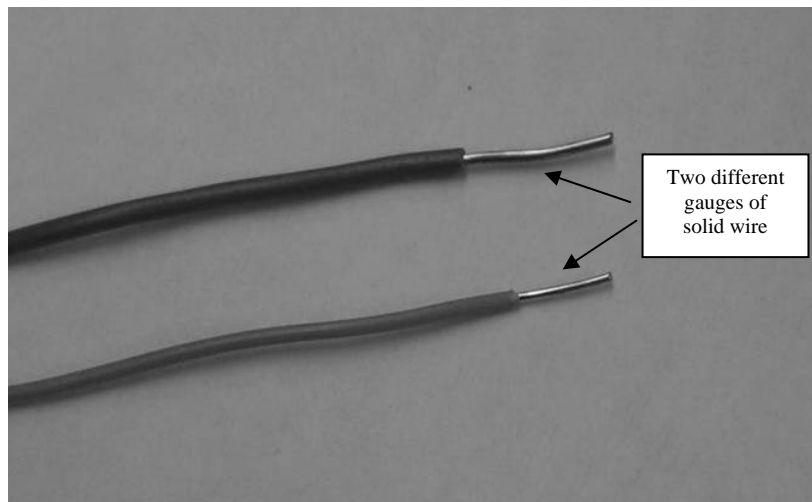
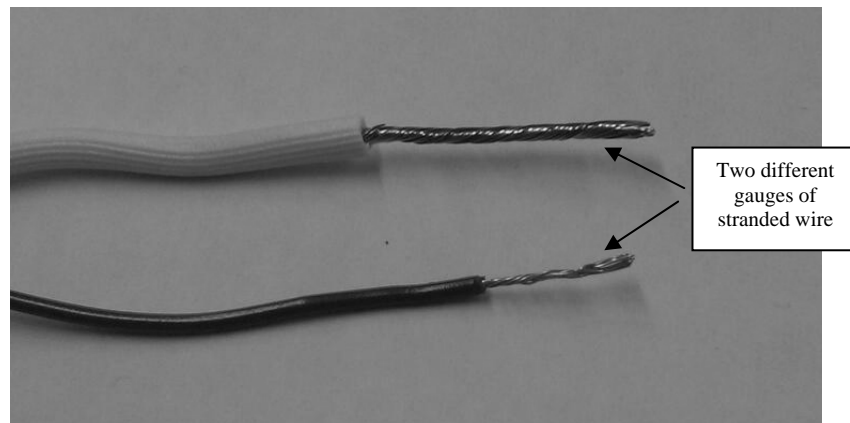
Electrical wires are used in many applications within a hospital. Electrical wires are found inside leads and power cords. Electrical wires are found on circuit boards within pieces of medical equipment. Electrical wires are found in walls and behind power outlets.

Electrical wires that are broken or corroded need to be replaced. Broken wires are not continuous. Discontinuity can be tested with an ohmmeter or a multimeter. Corroded

wires may be missing insulation. Corroded wires may look black or flaky. Select an appropriate replacement for broken or corroded electrical wires.

Wire Size

Wire size or thickness is called gauge. Wire must be sized according to the amount of current that will typically flow through the wire. Selecting the correct wire gauge is important for safety. Allowing too much current to flow through a small wire could start a fire. The wire must be large enough to carry the current safely. The amount of current is called the amperage.



Wire is sized according to standard gauges. The two primary wire gauges are the American Wire Gauge (AWG) and the Metric Wire Gauge (MWG).

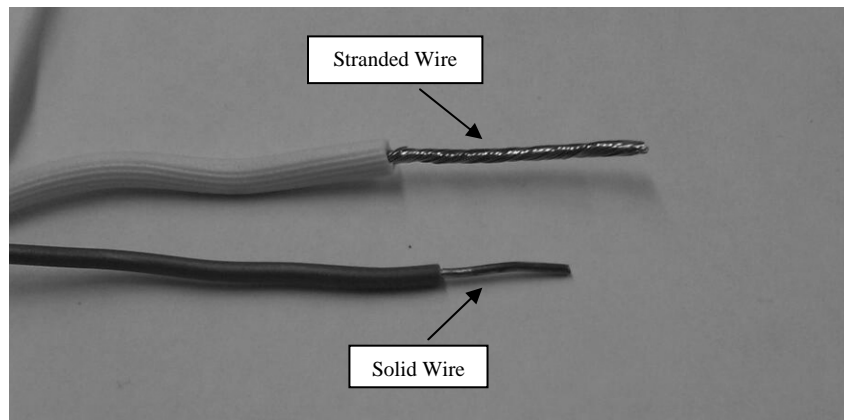
The most common gauge is the American Wire Gauge (AWG). Larger wires have *smaller* gauge numbers in the AWG system. Use an AWG table to determine the correct gauge size for your project.

Application	AWG Size	Diameter in mm
Hospital Power and electrical wiring	12-14	2.053 – 1.628
Power Supply inside equipment	16-18	0.0508 – 0.0403
Signals (non-power cables)	24-28	0.0201 – 0.0126

Another gauge system is the Metric Wire Gauge (MWG). Metric gauges are calculated by multiplying the diameter of the wire (in millimeters) by 10. A wire that is 5 mm in diameter is a 50-gauge wire. The diameter of a wire is determined by dividing its metric gauge by 10. A 20-gauge wire is 2 mm in diameter. Larger wires have *larger* gauge numbers in the MWG system.

Wire Type

Wire can either be solid or stranded. Solid wire is one thick strip of metal. Stranded wire consists of multiple thinner wires wrapped together.

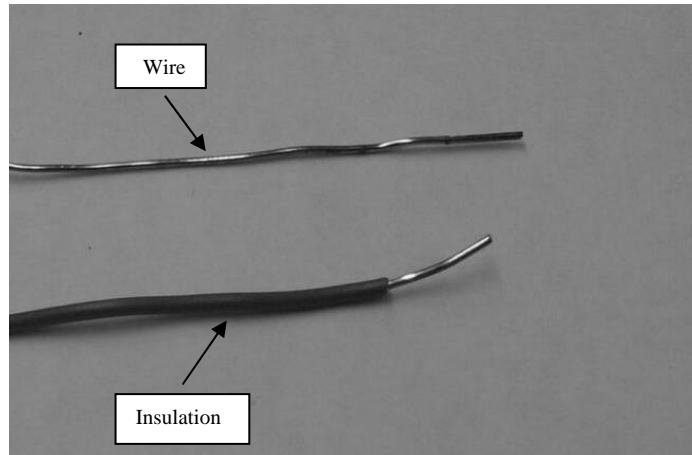


Solid wire conducts well. Solid wire is very stiff. Solid wire may break if it is forced to bend. Solid wire should always be used unless the wire must be able to bend or move easily.

Stranded wire should be used only when the wire must be able to bend or move easily. Stranded wire is a less reliable conductor. Stranded wire is very flexible. Stranded wire can be easily maneuvered during installation.

Insulating Material

Insulation covers the outside of the metal wire. Insulation protects the wire from moisture, heat, and chemicals. Insulation prevents the wires from touching. Wires that touch can start electrical fires. Wires that touch can cause short circuits.



Many different non-conducting materials can be used as insulation. Plastic insulation can be used for most projects. Plastic insulation is low-cost. Plastic insulation is appropriate for dry environments. Plastic insulation can be used for color-coding.

Insulating material that is resistant to corrosion should be used near chemicals or gasses. Silicone rubber, nylon, glass, or Teflon insulation should be used for wires near chemicals or gases.

Waterproof insulation must be used for wires exposed to high levels of moisture.

Electrical tape can be used to insulate low-voltage wires.

Wire Material

Wire can be made of copper or aluminum.

Copper wire is the best conductor. Copper wire is expensive. Copper wire is shiny and gold-colored. Sometimes copper wire is tinned. Tinned copper wire is shiny and silver-colored. Scrape off some of the tin with a pocket knife. Copper wire is gold underneath the tinning.

Aluminum wire is a less effective conductor. Aluminum wire is less expensive. Aluminum wire is shiny and silver-colored.

Copper and aluminum wires should not be mixed. Corrosion occurs when copper and aluminum wires are mixed. If copper and aluminum wires *must* be mixed, tin or shrink-wrap the copper wire. Tinning or shrink-wrapping will minimize corrosion.

Procedure

To select a replacement wire:

1. Examine the wire that is currently in use.
2. Note the wire's approximate diameter.
3. Determine whether the wire is solid or stranded.
4. Evaluate the type of insulation (if any) that surrounds the wire.
5. Determine whether the wire is copper or aluminum.
6. Select a replacement wire that has similar properties to the wire that is currently in use.

To select a wire for a new project:

1. Use the intended application of the wire to determine the correct wire size.
2. Assess the importance of wire mobility. Determine whether solid or stranded wire is most appropriate.
3. Choose an appropriate type of insulation.
4. Choose an appropriate wire material.
5. Select a new wire with the correct combination of properties.

Exercise

Your instructor will give you several different samples of wire. Describe the four essential properties of each wire sample. How do these properties affect the ways the wires can be used?

Your instructor must verify your work before you continue.

Preventative Maintenance and Calibration

Visually inspect wires regularly for signs of damage. Keep wires away from animals that may chew on them. Keep wires away from heat sources that may burn the insulation and leave exposed wires. Keep wires out of moist environments. Keep wires away from gases and chemicals.

If the insulation shows signs of wear, wrap the wire in electrical tape or heat shrink tubing. Replace the wire if possible.

Always calibrate every medical device before returning it to use.