

Knowledge Domain: Electrical

Unit: Connections

Skill: Test and Fix Broken Wires within Cables

Tools and Parts Required:

- 1) Electrical Cable
- 2) Multimeter (ohmmeter or continuity tester only)
- 3) Wire Cutters
- 4) Wire Strippers
- 5) Heat Shrink Tubing
- 6) Electrical Tape

Introduction

Electrical cables connect equipment to power and signal sources. Current and information flow through electrical cables from power and signal sources to equipment. Electrical cables can be damaged due to mechanical strain or if a wire inside the cable breaks. Current and information cannot flow across broken wires. Broken wires in electrical cables prevent power or information from reaching the equipment. Broken wires in electrical cables prevent equipment from turning on or operating correctly.

Broken wires in electrical cables can be fixed.

Example

Below is a picture of a removable electrical cable.



Identification and Diagnosis

Equipment that has an on-off switch needs power to turn on. Power can come from batteries or a power supply. Electrical cables connect equipment to power sources.

Cables can also carry information. Equipment may not function properly when an information cable is broken. Equipment may give an error message when a cable is broken.

Damaged electrical cables can prevent equipment from turning on or operating correctly. Damage is usually visible. Damaged cables may be cut or broken. Damaged cables may look chewed. Damaged cables may have wires exposed.

Sometimes the damage is not visible. A wire inside the cable may be broken. When a wire is broken inside a cable, it is very difficult to diagnose.

Always test cables when equipment does not turn on.

Procedure

In most cases, the broken wires will be exposed. If the wires are exposed skip step 1.

1. Test for continuity within the cable.

Finding unexposed broken wires inside a cable cannot be done by visual inspection.

Continuous cables allow current and information to flow. Discontinuous cables prevent current or information from flowing. Continuity can be tested with an ohmmeter or continuity tester. Continuous wires have a resistance very near 0 Ω . Broken wires have an infinite resistance because they are discontinuous.

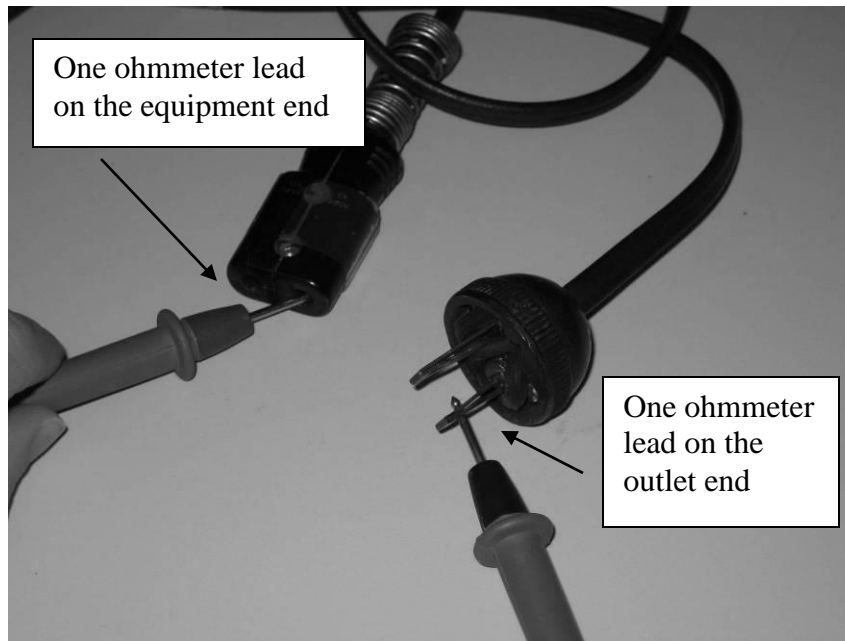
Determine whether or not the electrical cable is removable.

For a Removable Cable

Turn off the machine. Unplug the cable. Disconnect the cable from the piece of equipment. You may need to open the piece of equipment to access the end of the wires.

Test the electrical cable for continuity. Touch the two ohmmeter leads together and verify that the resistance is 0 Ω or less than 1 Ω .

Touch one ohmmeter lead to one wire at one end of the cable. Touch the other ohmmeter lead to one end at the other end of the cable. Note the resistance. 0 Ω of resistance means that the wire is not broken and that current can flow through it.



You may need to access one end of the cable inside the equipment.

Continue checking each wire at both ends of the cable until you find a wire that does not have continuity to the other end of the cable.

2. Fix the cable.

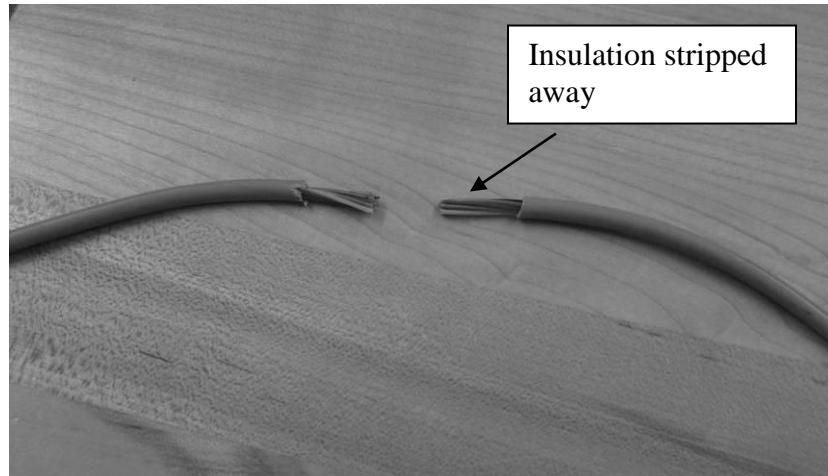
Insure that the machine is turned off and that the cord is unplugged.

Visually inspect the cable.

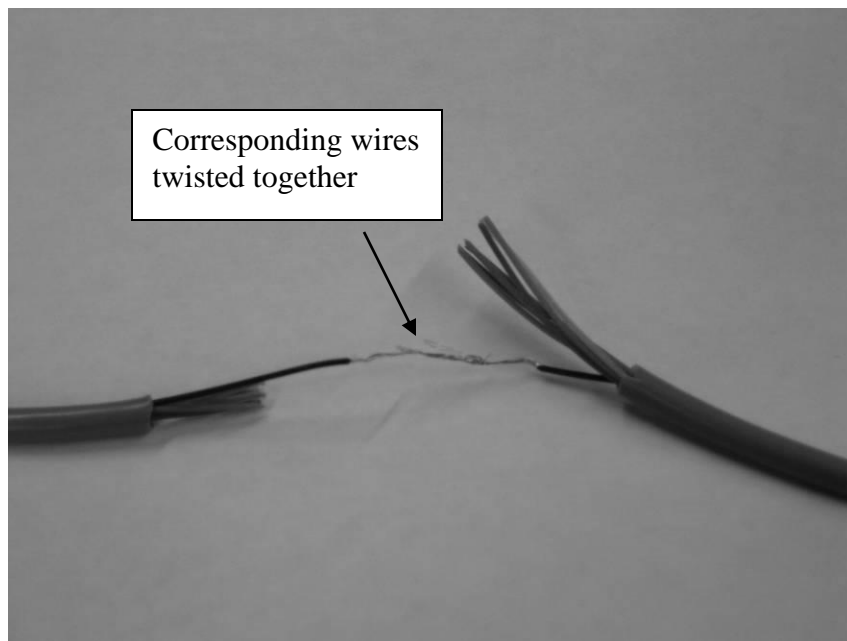
For Visibly Damaged Cables:

Note any damage. The cable may be cut or broken. Wire may be exposed. The cable may appear to have been chewed on. Use wire cutters to sever the cable covering near the damaged portion. If there are few wires inside the cable, the cable can be fixed by reattaching the wires. Cut the cable at the break. Discard the damaged portion. The cable will be in two pieces. If there are several wires inside the cable, attempt to fix the few broken wires. If possible to only reattach the broken wire individually, do not cut the remaining undamaged part of the wire.

Use wire strippers to strip away 2-3 cm of the outer insulation from each wire. Insure that the wires and/or cables within the main cable stay separated. Insert a large section of heat shrink tubing over one end of the broken wire before starting to mend it. The large heat shrink tubing will be used to provide insulation for the entire wire after reattaching individual wires. Alternatively, you can also use electrical tape to seal off the reattached wires. Use either method, depending on availability. (Refer to *Electrical-Connections-HeatShrinkTubing* and *Electrical-Connections-ElectricalTape*).

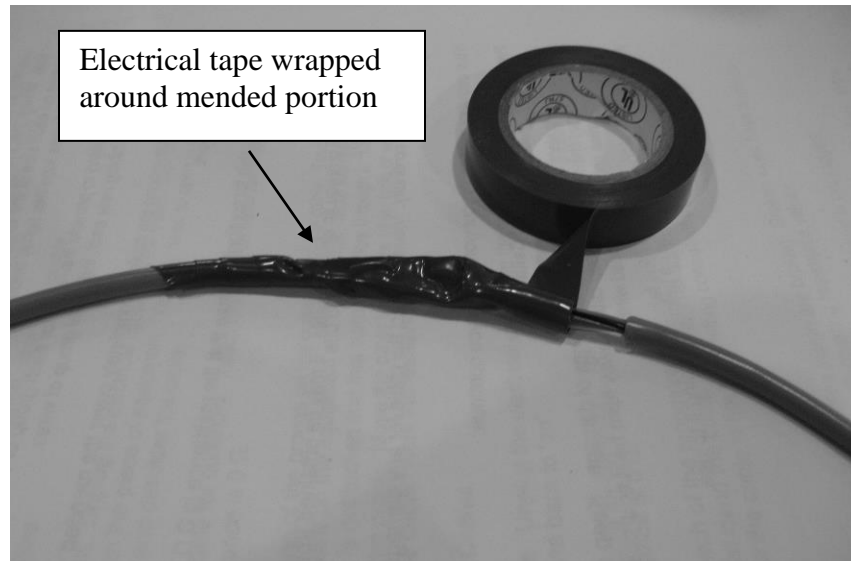


Pair the wires by color. Match the wires on one side of the cable to the corresponding wires on the other side. Twist each group of wires together tightly. Your cable may have a shiny jacket around the wire. The shiny jacket must also be connected between the two halves of the cable.



Use heat shrink tubing to provide insulation for each group of wires. Heat shrink a separate piece of tubing over each individual group of wires (see *Electrical-Connections-HeatShrinkTubing*).

First completely attach all the individual wires. Use the large piece of tubing previously placed over the entire wire to provide insulation for all the wires. Alternately, you can also use electrical tape to cover the wire as shown below.



For broken wires with no visible damage:

Lack of visible damage makes it difficult to isolate the breakpoint in the length of wire.

Discard such cables and replace with other cables.

3. Verify your work.

Test the repaired or replaced cable for continuity. Insure that the resistance is $0\ \Omega$.

Exercise

Your instructor will give you an electrical cable. A cable may be obtained from any piece of electrical equipment.

Visually inspect the cable for any damage. Test the cable for continuity. If necessary, repair the cable.

Your instructor must verify your work before you continue.

Preventative Maintenance and Calibration

Visually inspect electrical cables regularly for signs of damage. Keep cables away from animals that may chew on them. Keep cables away from heat sources that may burn away the insulation and leave exposed wires. Keep cables away from wheels and casters that may damage cable. Do not pull or tug on cables or plugs attached to cables.

Inspect heavily used cables often. If the plastic coating shows signs of wear, remove and replace the cable. If you cannot remove the cable, wrap the cable in electrical tape or heat shrink tubing.

Always calibrate every medical device before returning it to use.