Knowledge Domain: Electrical Simple
Unit: Connectors
Skill: Strain Relief

Tools and Parts Required:

1) **Cables and wires**
2) **Pencil grips or mechanical pencils with grips**
3) **Insulated alligator clips**
4) **Cable with strain relief boot (e.g. phone charger that can be disassembled)**
5) **Electrical tape or duct tape**
6) **Heat-Shrink tubing (optional)**
7) **Lighter or heat source to shrink heat-shrink tubing (optional)**
8) **Glue (acrylic glue, white glue, wood glue and if necessary epoxy)**
9) **Button(s)**
10) **Knife**
11) **Drill (optional)**
12) **Weight (about 450 g)**

Introduction

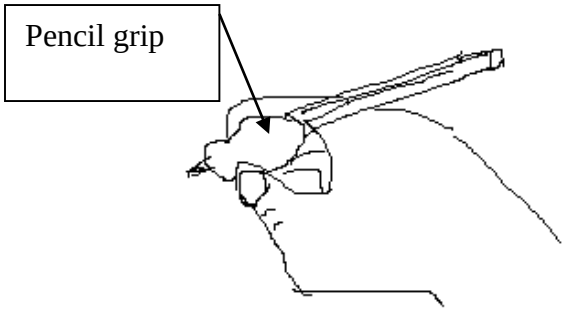
Cable strain relief systems are important to protect the cable fiber at the plug or the connector. Cable strain relief systems are conical polymers that allow the fiber within the cable to bend, minimizing the stress where the cabling and the connector adjoin. Strain relief systems allow cable movement without damage to the insulation. Thus, the user is protected. Device life is extended. Strain relief is often provided by a series of ridges at point of cable attachment. This is called a strain relief boot.
Cable strain relief provides extra protection to cables and wiring, and extends cord life.

Identification and Diagnosis

Check all the wires/cables on medical devices for wear at the location where they enter the box. If the wires inside the cable are exposed, the cord must be replaced. If the insulation is breaking, but the wires are not exposed, the strain relief must be replaced.

Procedure

<u>Method 1: Pencil grips as replacement strain relief boots</u>
Either purchase pencil grips, or remove them from mechanical pencils:

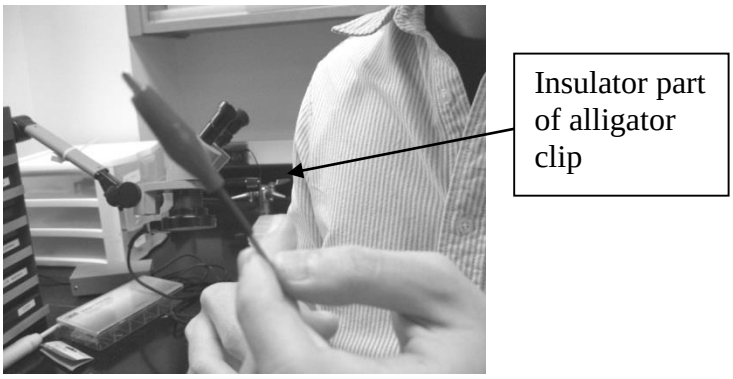


1. Use the knife to cut the pencil grip lengthwise and put glue inside the pencil grip. Acrylic glue is the best. If acrylic glue is not available try other glues. (If there is no other choice, epoxy may work. Use a very thin layer of epoxy.) You many sand the pencil grip or cable to improve adhesion.
2. Open the pencil grip and fit it onto the cable's device end. The pencil grip must be at the end of the cable, where it enters the box or probe.
3. Use tape to hold the pencil grip onto the cable until the glue sets.

Method 2: Insulators from alligator clip as replacement strain relief boots

Dome style strain reliefs are designed to protect the wire entering the equipment. They prevent the cord from rubbing against a rough or sharp edge where the cord passes through the equipment panel.

1. Remove the insulator part of alligator clips (see photo below).
2. Cut the insulator lengthwise. Sand the inside of the alligator clip insulator and the outside of the cable to improve adhesion.
3. Add glue to the inside of the insulator. In most cases, acrylic glue will work. Epoxy can be used if there is no other choice.
4. Wrap the insulator around the cable at the device end. The insulator must be at the end of the cable. Tape the insulator in place while the glue sets.



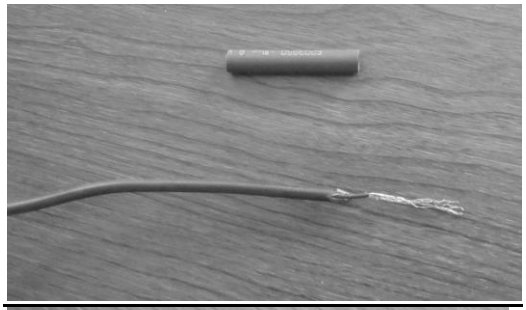
Method 3: Reuse strain relief boots

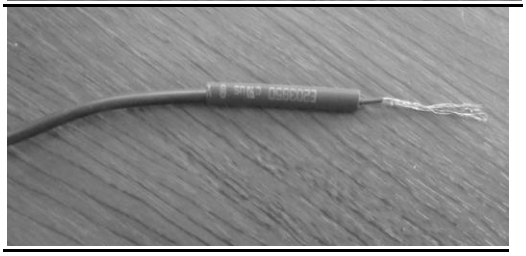
1. Strain relief boots can be taken from old cables. Cut the strain relief boot from the old cable. Drill a hole in the housing of the strain belief boot wider than the cable diameter.
2. If possible sand the cable and boot.
3. Add glue inside the hole and around the edges of the hole.
4. Pull the cable through the strain relief boot. If needed increase the friction of the cable by applying a small amount of epoxy around the cable at the end.

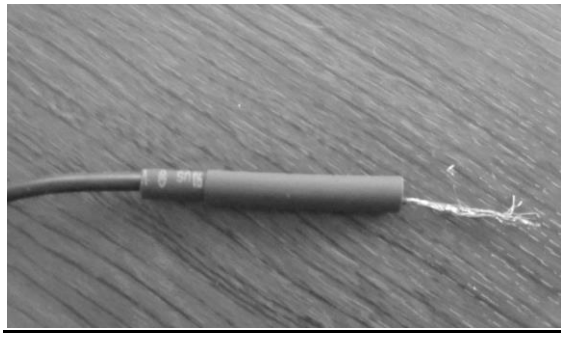
Method 4: Using Heat-shrink tubing

1. Cut a piece of heat-shrink tubing, slightly longer than the original strain relief boot you are replacing.
2. Insert the cable through the heat-shrink tubing. Pull tubing up to the edge of the cable that goes into the connector.
3. Refer to the BTA skill *Electrical-Connections-HeatShrinkTubing* for instructions on securing the tubing.
4. 2 layers of tubing can be used for increased effect.

See pictures below:





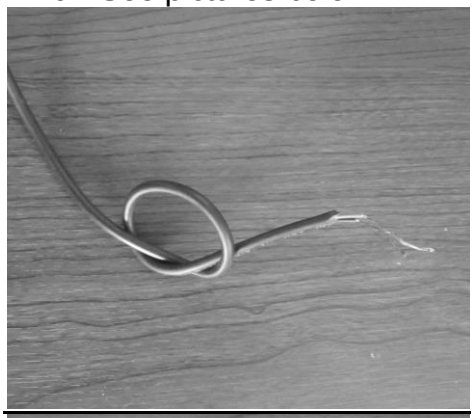


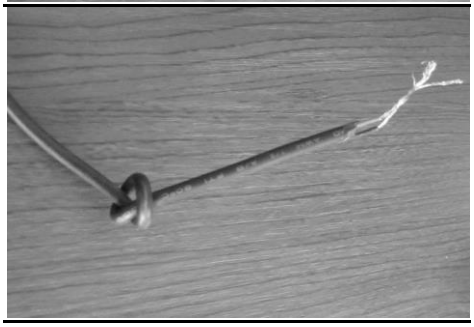
Method 5: Using buttons

1. Fine cables or wires can be strung through a series of buttons.
2. A button cannot be used to provide strain relief for thicker cables.
3. See picture below

Method 6: Tying a knot

1. If no other mechanism is available, simply twist the cable into a knot.
2. A simple overhand knot will be sufficient.
3. Insure the knot is at the end of the wire/cable going into the casing.
4. The knot method is especially suitable for thicker cables.
5. When possible, the knot can be contained in the casing holding the connector end of the wire. A larger sized plug may allow the knot to be contained inside the casing.
6. See pictures below:





Pull Test

After installing the cable and the strain relief and letting the glue set, conduct a pull test. Connect the cable to the device. Place the device on a table with the cable dangling over the edge vertically. Use electrical or duct tape to attach a small weight to the hanging end of the cable. The strain relief should protect the cable from bending at a sharp angle. The strain relief should form a curve instead of an angle. Remove the weight and check the cable near the strain relief for visible signs of damage.

Exercise

Your instructor will provide you with connector cables. Use available materials to try the different procedures to add strain relief. Then, perform the Pull Test to ensure that your modifications were effective. Evaluate the efficacy of different mechanisms.

Preventative Maintenance and Calibration

Check all cables for exposed wires every six months. Check the insulation for wear every six months. Replace the cables when needed.

Always calibrate every medical device before returning it to use.