

Knowledge Domain: Electrical Simple

Unit: Fabrication

Skill: Temperature Probe Cable

Tools and Parts Required:

- 1) 1.8 meter of copper electrical wires, 16-gauge stranded (x2)
- 2) 25.4mm of solid copper core conductor wires, 22-gauge (x2)
- 3) Phono-jack (or other connector in some cases)
- 4) NTC thermistor
- 5) PTC thermistor
- 6) Fixed resistor
- 7) Soldering iron
- 8) Solder
- 9) Heat shrink tubing
- 10) Electrical tape
- 11) Scotch tape (Transparent Tape)
- 12) Wire cutters
- 13) Potentiometer
- 14) Vice grips or pliers
- 15) Multimeter (Ohmmeter function)

Introduction

Temperature probes monitor the patient's temperature. Cardiac care devices are one type of equipment that uses temperature probes. Most medical devices sense temperature with a thermistor. Not all temperature measuring devices use thermistors.

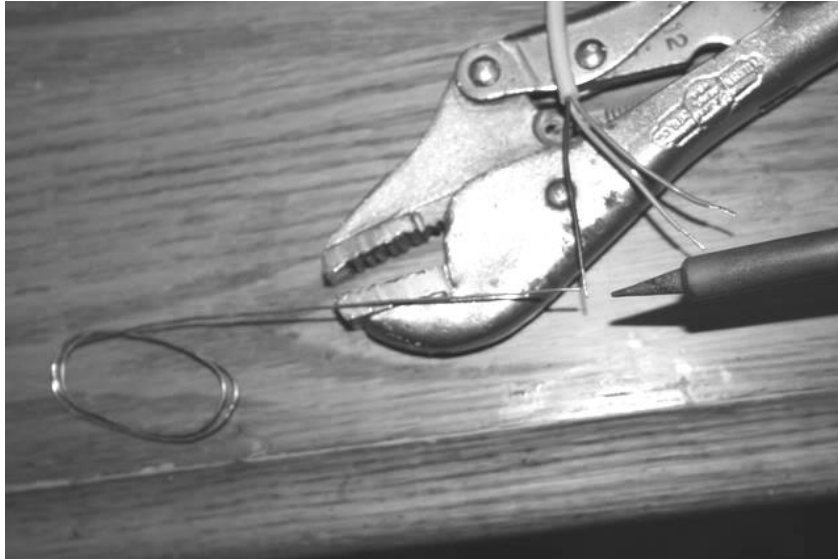
Some devices will not function without a temperature probe cable. You may be able to construct a replacement temperature probe cable using this skill. Or, you may be able to fashion a substitute that will allow the machine to function without a temperature probe. Only bypass the temperature probe if the medical staff agrees with your action.

Identification and Diagnosis

If a medical device is non-functional, check the connecting cables. Insure the cable is not frayed or torn. Use the BTA skill *Electrical-Connections-Broken Wires in Cables* to repair frayed or torn cables. The connector cable may not connect at the pin site. Use the BTA skill *Electrical-Connectors-Broken Housing* or *Electrical-Connectors-Loose Connectors* to repair the pins. Repair or replace broken cables. Fabricate a cable only if you cannot repair the original.

Procedure

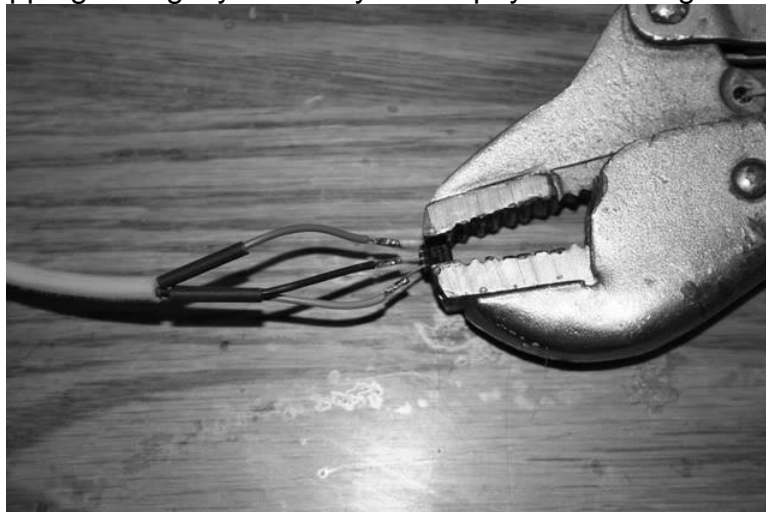
1. Cut the "male" end of the cable to the desired length. The male end should plug into the medical equipment. Strip the jacket back about 4 cm, being careful not to nick the conductors.



2. Strip the conductor wires about 5 mm. Tin the conductor wires with solder using the soldering iron.
3. The cable may have two or three conductor wires. If there are three wires, the third wire is the shield. You do not need to connect the third wire to anything.
4. Locate the temperature-sensing end of the device or another identical device. The temperature-sensing end connects to the patient. Solder the two exposed wires from the male connector end to the two exposed wires from the patient end. It does not matter which wire from the male end is connected to which wire from the patient end for a thermistor. A thermistor has no polarity.
5. If you cannot locate the temperature sensing end, you will need a new thermistor or you will need to bypass the thermistor.
 - a. Determine the thermistor you need. A thermistor is described by its **coefficient** (Positive Temperature Coefficient -PTC or Negative Temperature Coefficient - NTC), **sensitivity** (α), **characteristic temperature** (β), **base temperature** (T_0) and **base resistance** (R_0). In order for your repaired device to work, these parameters must correspond to the device requirements.
 - b. Determine the parameters of the thermistor: Temporarily replace the thermistor with a 1Mohm potentiometer. Then, plug the temporary cable into the temperature-sensing device. As you vary potentiometer value, you should see the temperature-reading change.
 - c. For three different values of resistance, record three values of resistance, R_{meas} from the potentiometer using an ohmmeter. You

must unplug the temporary cable to record the potentiometer resistance. Also, measure three values of temperature, Temp, from the machine.

- d. You need a thermistor that will give the three values of resistance for the three values of temperature measured. You may call a manufacturer or look at manuals to determine the thermistor needed
 - e. You can also solve this equation:
 - i. $R_{\text{meas}} = R_0 * \exp [\beta * (1/\text{Temp} - 1/T_0)]$
 - ii. This equation has three unknowns. You have three measured values for each of the unknowns. Solve the system of three simultaneous equations to find R_0 , T_0 and β . Knowing R_0 , T_0 and β , you can purchase a new thermistor. Thermistors cost less than US\$1.
 - f. If you cannot find a thermistor in your country or shop: Sometimes you may only need the device to turn on but do not need it to sense temperature. In devices like an infant warmer which are used to monitor more than one baby per crib, measurement of temperature may not be required. Then, you can replace the potentiometer with a fixed resistance of any value you recorded earlier. Select the value that turns on the device. Check with your medical staff before bypassing the thermistor.
 - g. In some cases, the thermistor from one device may function in another device.
6. Once you have a replacement thermistor or a fixed resistance, connect the thermistor to the cable. Cut 2 pieces of heat shrink tubing about 16mm long and slip it over each conductor. Take care to slide the tubing on before you start soldering. Use a pair of vice-grips as a combination vice and work-piece holder. Clamp the temperature sensor GENTLY. Avoid gripping too tightly as it may cause physical damage to the sensor.

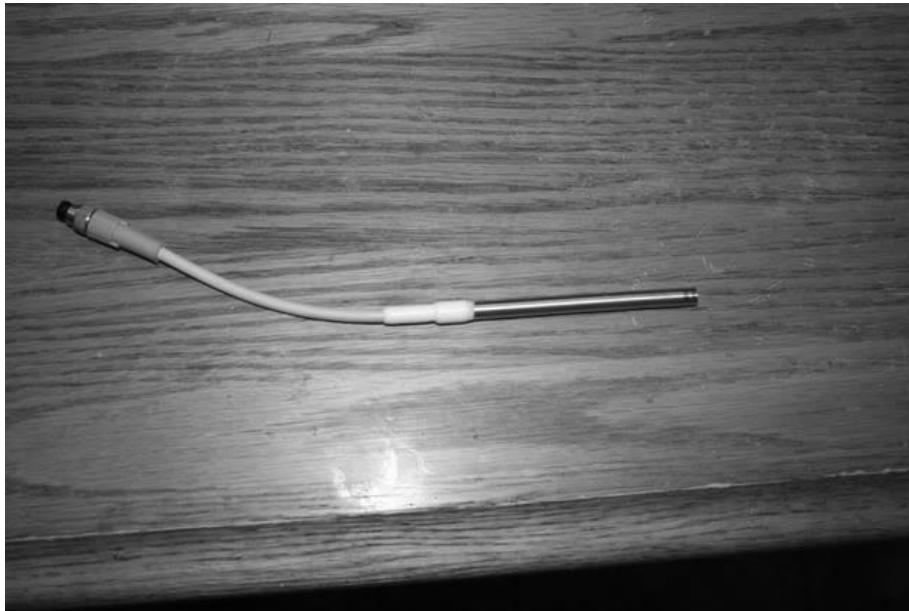


7. One at a time, lay each conductor alongside its respective pin and apply just enough heat with the soldering iron to melt the solder that was already on the wire.

8. After you finish soldering, slide the shrink tubing into position and apply heat.
9. If you wish, you can place the sensor into a metal housing.



End-product:



Exercise

Construct a replacement temperature cable. Your instructor may have a specific device to build the cable for. Or, build a cable to bypass the thermistor.

Preventative Maintenance and Calibration

Most temperature probes require replacement because they are lost. Label the probes in your hospital with the name or number and location of the corresponding device. Check cables frequently for frayed and broken insulation. Repair insulation before the conductor wires break.