

WattsRadiant™

Floor Heating & Snow Melting

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Heating Cable Repair Kit Installation Guidelines

Warranty Disclaimer: This repair kit and these installation guidelines are provided by Watts Radiant to assist in repairing a Watts Radiant heating cable damaged at the job site. Watts Radiant does not, in any way, warranty the repair or ensure proper function of the product following the repair. Only a qualified electrician should make repairs to the Watts Radiant heating cables. It is highly recommended that an experienced tile installer remove the tile over the damage. For further assistance, please contact Watts Radiant.

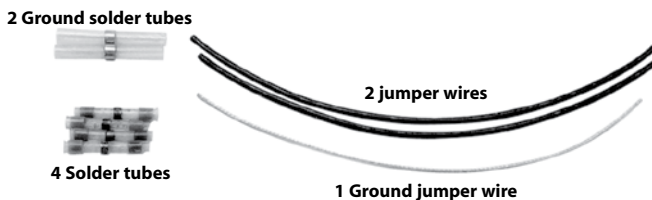
Watts Radiant does not qualify electricians, tile installers, or Watts Radiant installers to perform diagnostics, tile removal, or cable repair. It is the responsibility of the installing party or homeowner to contact a qualified person to follow these guidelines.

DO NOT USE this repair kit to splice different cables together. The kit is only for making a repair within a cable.

DO NOT USE this repair kit to repair a cable within a shower area or a cable that extends into a shower area.

Materials and Tools Needed

Heating Cable Repair Kit: Manufacturer order number 81007142.



This heating cable repair kit contains components for making a repair at one location. Certain components may not be used depending on the method of repair selected.

Repair Tool Kit: Manufacturer order number 81007201. Available for rent or purchase as a kit. NOTE: Items are subject to change.



Heat gun

- Must be able to heat to about 1000°F.
- Milwaukee Model 8975, shown with reduction nozzle.

Thermal wire strippers

- For stripping the heating wires.
- Omega Model TW-1.

Scoring tool

- For cable with an outside jacket.
- Ideal Model 45-403 with blade Part K-6502.

Wire strippers

- For cutting and stripping 16-AWG wire.
- GB Model GESP-55.

Small screwdriver

- To help separate heating wire from braid.
- Paper clip or similar pointed tool may also be used.

Special Note on Alternative Tool Options - When thermal strippers are not available, the heated tip of a soldering pencil is the best alternative tool for stripping the heating elements, and the "TPU" jacket on some floor warming cables.

If your heat gun does not have a factory reducer nozzle you can make one from an empty can, or aluminum foil can be fashioned to work with a piece of wire or a hose clamp to hold it on the end of the heat gun. The nozzle opening should be about 1/2" wide.

Other Tools

Digital multimeter

- Must measure up to 20k ohms or 20,000 ohms.

Hammer and chisel

- For removal of tile and mortar if needed, and for creating a "valley" in which to lay the splice.

Hot glue gun with standard stick adhesive

- For adhering splice into the "valley" chiseled into floor.

Scissors

Part 1. Getting Started

Step 1.1. Make sure the power is OFF!

Step 1.2. Two repair methods are shown in these guidelines. Choose the method that is best for the installation.

Direct splice: This method is used when the damaged cable has enough "play" to be cut and overlapped by about 3/4 of an inch. This also gives the best possible heating uniformity over the splice versus using the jumper splice, and has fewer soldered connections.

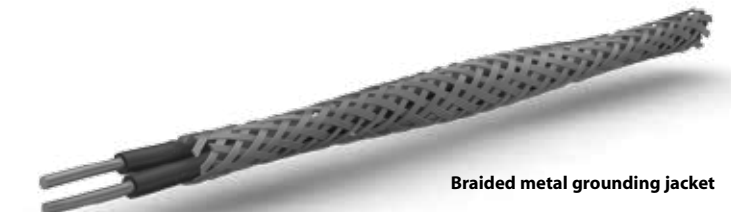
Jumper splice: This method is used when the damaged cable does not have enough "play" to be cut and overlapped. This also results in a splice section that will have very little heating directly over the splice.

Step 1.3. Depending on the product used, the heating cable is constructed in one of the two following ways:

Jacketed heating cable: This cable is comprised of two insulated heating wires, covered by a metal braid, which in turn is covered by an outer covering. Each heating wire consists of at least one heating element that must be kept intact and undamaged.



Non-jacketed heating cable: This cable is comprised of two insulated heating wires covered by a stainless steel braid. Each wire consists of at least one heating element that must be kept intact and undamaged.



Part 2. Tile and Mortar Removal



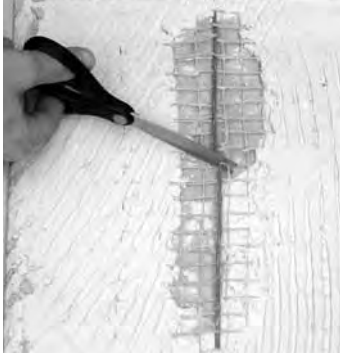
Step 2.1. If not done so already, carefully remove the tile/stone/marble floor covering over the damaged cable area. Removal of the grout around the affected tile(s) must be done with a blunt instrument such as a hand-held grout-removal tool. **DO NOT USE A KNIFE!** Gently break out the tile with a small hammer, removing the fragments as the tile is broken up. See wattsradiant.com for additional instructions and tips regarding tile removal.



Step 2.2. Remove enough mortar and tile to expose about **4" to 5" of free wire on both sides of the damaged portion**. Part of the wire may be visible so that the mortar can be removed carefully around the damaged wire using the hammer and/or chisel. Mesh can be cut with scissors in order to free the wire.

Part 3. Installing a Direct Splice

To install a jumper splice (please see Step 1.2), skip to Step 4.1.



Step 3.1. Cut out the damaged wire location, creating two ends or leads. **If the cable being repaired is not the jacketed heating cable, skip to Step 3.6.**

Step 3.2. For a heating cable with an outer jacket: Strip off approximately 2.5 inches of the outer jacket. **DO NOT USE standard wire strippers!** The out of round character of the cable makes it very difficult to strip with a common wire stripper tool, using one could damage the cable. There are two types of jacket compounds, "XLPE" and "TPU" (TPU see Step 3.3.b).

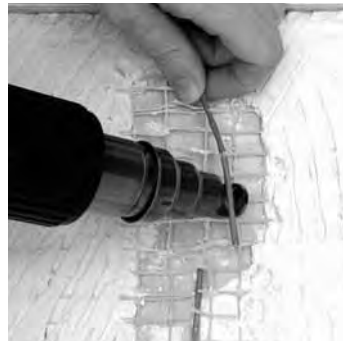


Some of our products have an "XLPE" jacket that is a somewhat hard material that can be lightly "scored" with a scoring tool or sharp blade. Use the scoring tool to carefully score the jacket about 2.5" from the end of each lead. Do this by placing the cable lead into the V-notch of the tool and rotating the tool only one or two revolutions around the cable. Do not place any additional pressure on the tool head to cut deeper. Let the tool apply its own spring-loaded pressure.

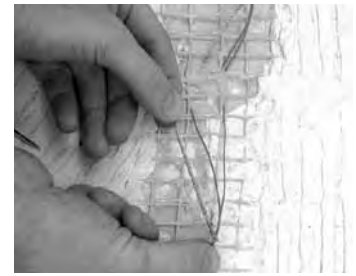


Step 3.3. Gently bend the cable at the score to break through the jacket all the way around the cable, then pull off the slug

Step 3.3.b. If the jacket is the softer "TPU" material, you'll find it is easier to use thermal wire strippers or the tip of a soldering pencil to melt a narrow ring around the outer jacket of the cable, then pull the slug off. The TPU jacket has a lower melt point than the insulation on the heating elements, but you must still be very careful to avoid overheating the heating elements during this step.



Step 3.4. With either type of jacket, if it doesn't easily pull off you may need to use your heat gun to gently warm the slug, which should soften and loosen it for you. Use the heat gun (set to about 500°F) and move the gun back and forth under the jacket slug for about 3 or 4 seconds, or until it can be easily removed.



Step 3.9. Pull the braid straight out to make it into a pigtail.

Step 3.5. Use a glove or other protective cloth to pull off the loosened jacket slug. **Do not touch** the hot jacket slug with bare fingers. The slug will be very hot and will burn!



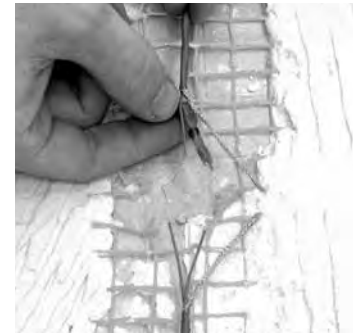
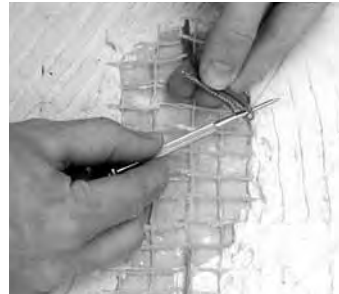
Step 3.10. Use the thermal wire strippers to carefully strip off exactly 1/2" of the insulation from the heating wires. Count the little heating elements to make sure none were cut off and thereby cause a hot spot or possible failure. A fiber strand may also be found among the heating elements. There is no need to separate or remove this fiber strand.

Step 3.6. Loosen the braid by pushing back on the braid about 1/2" and cause the ends of the heating wires to be exposed.



Step 3.11. Use the digital multi-meter and TDR at this repair location before proceeding. Check for any additional damage locations in the heating cable by "looking" in both directions. For assistance in using these instruments, consult the instructions that came with them or contact Watts Radiant.

Step 3.7. Bend the cable back onto itself.



Step 3.8. Use the small screwdriver, paper clip, fingernail, or similar blunt instrument to pry between the braid and make an opening through which to pull the heating wires. Pull each wire through the braid.

Step 3.12. Slide the solder tube over one of the heating wires.



Step 3.13. Pull the heating wires together to overlap the heating elements of both leads. Lightly twist the elements together to better join them. Slide the solder tube over the twisted elements, centering the elements between the gray adhesive bands. If this is not done correctly, the elements may pull out and cause the splice to fail.



Step 3.14. Use the heat gun (set to HI temperature, about 1000°F) to carefully heat the solder tube. First, heat directly under the solder ring in the middle of the tube. **IMPORTANT!** When the solder completely melts and flows into the wires, continue heating for another 3 seconds. If the heat is removed too soon, an incomplete solder connection will result, causing connection failure later. When the solder is completely melted, begin moving the heat gun back and forth under the rest of the solder tube to shrink the tube and cause the adhesive bands at the ends to melt and flow onto the wire insulation. After the tube is completely shrunk and the adhesive bands are fully melted, stop heating the tube. Additional heating will not help and may cause either scorching of the tube or splice failure. Allow the solder tube to cool for about 1 minute.



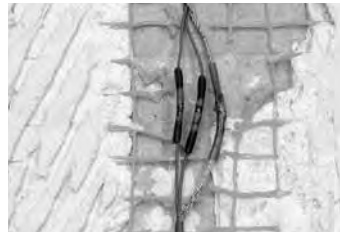
Step 3.15. Repeat Steps 3.12 through 3.14 for the other heating wire splice. Make sure to avoid reheating or scorching the first splice while working on the second. It may require a heat shield like a wet cotton rag or a piece of tin to protect the first splice and the insulation of the heating wires.



Step 3.16. Slide a ground solder tube over a ground braid lead. Overlap the braid ends and twist them to help hold them together. Slide the ground solder tube over the twisted braid ends, centering them under the ring of solder.



Step 3.17. Be sure to avoid reheating or scorching the heating wires or splices, using a heat shield again if needed. Heat the tube to shrink it completely and cause the solder to flow into the twisted ground wires completely. When it cools, the connection should be secure.



Step 3.18. The connection should now be complete and ready to test. Go to Step 5.1 under "Testing the Repair."

Part 4. Installing a Jumper Splice



Step 4.1. Cut out a 2"- to 3"-long section of the heating cable around the damaged area, creating two ends or leads.

If the cable is not a jacketed heating cable, SKIP to Step 4.6.

Step 4.2. For a heating cable with an outer jacket: Strip off approximately 2.5 inches of the outer jacket. **DO NOT USE** standard wire strippers! The out of round character of the cable makes it very difficult to strip with a common wire stripper tool, using one could damage the cable. There are two types of jacket compounds, "XLPE" and "TPU" (TPU see Step 4.3.b).



Some of our products have an "XLPE" jacket that is a somewhat hard material that can be lightly "scored" with a scoring tool or sharp blade. Use the scoring tool to carefully score the jacket about 2.5" from the end of each lead. Do this by placing the cable lead into the V-notch of the tool and rotating the tool only one or two revolutions around the cable. Do not place any additional pressure on the tool head to cut deeper. Let the tool apply its own spring-loaded pressure.



Step 4.3. Gently bend the cable at the score to break through the jacket all the way around the cable, then pull off the slug.

Step 4.3.b. If the jacket is the softer "TPU" material, you'll find it is easier to use thermal wire strippers or the tip of a soldering pencil to melt a narrow ring around the outer jacket of the cable, then pull the slug off. The TPU jacket has a lower melt point than the insulation on the heating elements, but you must still be very careful to avoid overheating the insulation on the elements during this step.



Step 4.4. With either type of jacket, if the jacket slug doesn't easily pull off you may need to use your heat gun to gently warm the slug, which should soften and loosen it for you. Use the heat gun (set to about 500°F) and move the gun back and forth under the jacket slug for about 3 or 4 seconds, or until it can be easily removed.



Step 4.5. Use a glove or other protective cloth to pull off the loosened jacket slug. Do not touch the hot jacket slug with bare fingers. The slug will be very hot and will burn!



Step 4.6. Loosen the braid by pushing back on the braid about 1/2", causing the ends of the heating wires to be exposed.



Step 4.7. Bend the cable back onto itself.

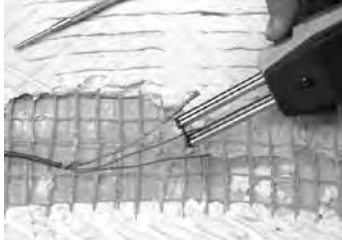


Step 4.8. Use the small screwdriver, paper clip, fingernail, or similar instrument to pry between the braid and make an opening through which to pull the heating wires. Pull each wire through the braid.

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Step 4.9. Pull the braid straight out to make it into a pigtail.



Step 4.10. Use the thermal wire strippers to carefully strip off exactly 1/2" of the insulation from the heating wires. Count the little heating elements to make sure none were cut off and thereby cause a hot spot or possible failure. A fiber strand may also be found among the heating elements. There is no need to separate or remove this fiber strand.



Step 4.11. Use the digital multi-meter and TDR at this repair location before proceeding. Check for any additional damage locations in the heating cable by "looking" in both directions. For assistance in using these instruments, consult the instructions that came with them or contact Watts Radiant.



Step 4.12. Cut the jumper wires shorter, if necessary, so that they overlap the stripped ends of the heating wires.



Step 4.13. Use the 16 AWG setting on the wire strippers to strip off exactly 1/2" of the insulation from both ends of the jumper wires.



Step 4.14. Slide a solder tube over one of the heating wires on one lead of the heating cable, or position it on the jumper lead if that makes joining the wires easier.



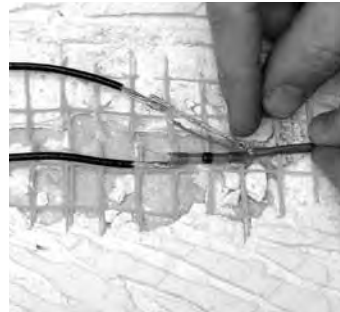
Step 4.15. Place the heating elements and jumper wire ends alongside each other. **Lightly** twist the elements together to better join them. Slide the solder tube over the twisted elements and over the edge of the insulation on the jumper wire. Make sure the twisted wires are fully inside the solder tube and located between the adhesive bands at the ends of the solder tube. If this is not done correctly, the elements may pull out and cause the splice to fail.



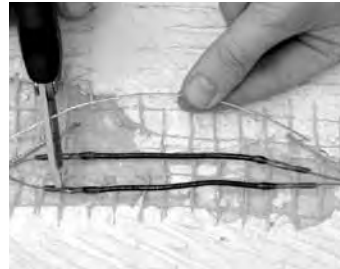
Step 4.16. Use the heat gun (set to HI temperature, about 1000°F) to carefully heat the solder tube. First, heat directly under the solder ring in the middle of the tube. **IMPORTANT!** When the solder **completely** melts and flows into the wires, continue heating for another 3 seconds. If the heat is removed too soon, an incomplete solder connection will result and cause connection failure later. When the solder has completely melted, begin moving the heat gun back and forth under the rest of the solder tube to shrink the tube and cause the adhesive bands at the ends to melt and flow onto the wire insulation. After the tube is completely shrunk and the adhesive bands are fully melted, stop heating the tube. Additional heating will not help and may cause either scorching of the tube or splice failure. Allow the solder tube to cool for about 1 minute.



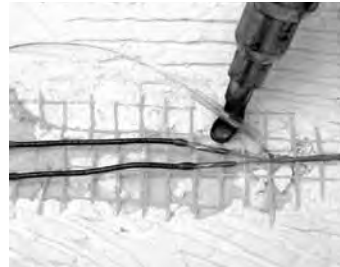
Step 4.17. REPEAT Steps 4.14 through 4.16 for the other heating wire. Be sure to avoid reheating or scorching the first heating wire splice, using a heat shield like a wet cotton rag or a piece of tin if needed.



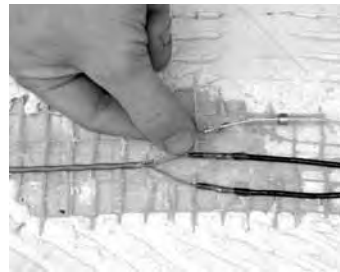
Step 4.18. At the other end of the jumper wires, slide a heating element solder tube over a heating wire or its jumper wire, whichever is easier for you to position the tube out of the way and allow for easy access to the ends of the wires. REPEAT Steps 4.14 through 4.17 to complete the heating element jumper wire connections.



Step 4.19. If necessary, cut the ground jumper wire shorter so that it overlaps the ends of the ground braid lead wires by about 1/2" to 3/4".



Step 4.20. Overlap the ends of a ground braid lead and the ground jumper wire by about 1/2" and twist them together. Slide a ground solder tube over the twisted ends, centering the ends under the solder ring. Heat the tube to shrink it completely and cause the solder to flow into the wires completely. Be sure to avoid reheating or scorching the heating wires or splices, using a heat shield like a wet cotton rag or a piece of tin if needed. When it cools, the connection should be secure.



Step 4.21. At the other end of the ground jumper wire, slide a ground solder tube over the wire. REPEAT Step 4.20 to complete this connection. Be sure to avoid reheating or scorching the heating wires or splices, using a heat shield again if needed.



Step 4.22. The connection should now be complete and ready to test. Go to Step 5.1 under "Testing the Repair."

Part 5. Testing the Repair

After completing the splice connections and letting them cool, test the repair as follows:

Step 5.1. Gently tug on each wire separate to make sure they do not pull apart.

Step 5.2. Use a digital multimeter to measure the resistance of the heating cable. This measurement should fall within the resistance range specified for this heating cable. There should also be infinite resistance between the heating cable power leads and the ground wire. For this test, your multimeter should have the same display you see when not touching anything with the meter's test leads. If assistance is needed with these tests, follow the steps shown in the installation manual for this cable, or call Watts Radiant.

Step 5.3. Properly connect the repaired heating cable to the power source through a GFCI, such as the Watts Radiant thermostat. Operate the cable for a few days or at least for ten to fifteen 5-minute heating cycles. If the GFCI trips or the cable does not heat, the cable will need to be checked for additional damage, or else the repair may have failed.

Step 5.4. After the repair work is complete and you are confident the floor warming cable is in good working condition, make sure power to the system is turned off. Power should not be supplied to the floor warming cable again until the new mortar and grout have had a minimum of 2 to 3 weeks to cure out. Turning on the system before the mortar bed is fully cured can cause GFI trips when there may be nothing wrong with the floor warming cable.

Part 6. Final Steps

Make sure the splice is protected and lays flat on the floor before installing floor coverings.

Step 6.1. If necessary, use a chisel to carefully carve a "valley" into the sub-floor under the splice.

Step 6.2. Use the hot glue gun and place a bead of adhesive into the valley. Press the splice into the adhesive to recess it in the valley.

Step 6.3. If floor coverings are not being immediately installed, temporarily cover the splice and surrounding heating cable with a loose tile or similar hard material to protect them against damage.

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ADDITIONAL TIPS

V.1 5/24/05

Disclaimer: The following are tips and techniques provided by Watts Radiant, Inc. to assist in discovering and uncovering damage made on-site to an electric radiant heating system product made by this company. Watts Radiant does not, in any way, guarantee the tips presented here nor have any responsibility for damage or other problems incurred by following these tips.

Finding damage within floor warming systems

Experience has shown a few things that can help in troubleshooting the radiant heating cables and tips for the work that follows. Here are a few things to consider when looking for a damage location:

- The power supply leads or heating cable can be penetrated by a nail or screw while installing baseboard trim, sheetrock, or other things that were installed after the wires were put in place. Be aware of all subsequent work done in the area of the heating cable, and consider the possibility that such things may have contributed to the problem you have experienced.
- Plumbers have been known to run the water supply line to a toilet after the tile has been set. Drilling the hole for the water line has been known to cut heating cable wires if they were placed in that area.
- Simply dropping a hammer, or some other heavy object on the heating cable can damage the insulation of the heating cable. The cable might work for quite a while before this kind of damage becomes evident.
- It is important that you exercise extreme caution while removing the mortar or grout around a tile. We do not recommend using a knife or chiseling for this, you could cut a wire.
- On a few occasions, the LoudMouth™ monitoring device has given the installer a false "damage" signal, primarily due to the moisture content of recently applied very wet thin-set mortar, or self-leveling compounds. If your LoudMouth has sounded, but you don't find any evidence of damage with your digital ohmmeter, call our technical support staff for assistance, 888-432-8932.

Wire locating equipment

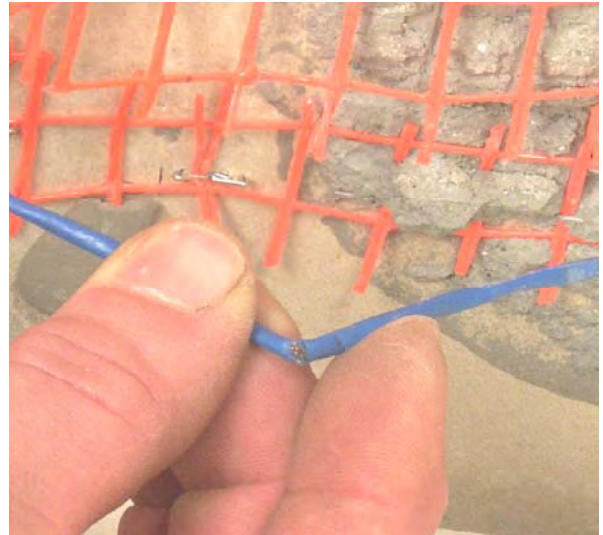
We've found the Fluke Corporation brand "Cable Fault Finder" works well for our products, but many electricians have used some other brand of "fault finder". Electricians in your area may have a test instrument in their own bag of tricks that may be helpful in pinpointing the damage in your heating cable. Please let our staff know about any successful damage location methods or tools, so we can pass on that information in the future.

Removing Tile

CAUTION! Power for this circuit must be turned off at the breaker panel before you start to remove tile. Verify that it has been turned off.

- It is important that you exercise extreme caution while removing the mortar or grout around a tile. A knife or chisel is generally not the best tool for removing grout, you could end up cutting a wire.
- The first picture below shows a hand held grout removal tool, use this to remove about half of the grout from the seams. This should reduce the chances of a crack spreading from the tile you are removing, to an adjacent tile.
- Don't use a chisel, knife, screwdriver or similar tool to pry up the tile(s). The best tool for safely removing ceramic tile over a heating cable is a small hammer, shown in the second picture below. Use it gently, to gradually break up a single tile at a time. Use a "shop-vac" frequently to remove the loose material as you proceed, pic. # 3.
- After you are able to clearly identify the spacing and layout of the heating cable, you will know where you must be extremely careful while you continue to remove the tile and mortar. In the areas between the heating cables you don't have to be as cautious as when working directly over or around a heating cable.





Spotting the damage

CAUTION! Power for this circuit must be turned off at the breaker panel before you handle the cable. Verify that it has been turned off.

- A lot of the damage that occurs during installation is from the edge of a metal trowel cutting into a cable. This may leave a place of obvious damage where wires are exposed, or it may look like a dent or a crease in the insulation.
- Don't gouge the wire further by probing a "crease" in the blue insulation with a knife or similar tool. Gently bending the cable to see if a crease will "open up" is a much better method of inspection, pictured above, on the right.
- The damaged area of the wire may have rolled to the bottom and may now face the floor, it is important to thoroughly inspect all sides of the cable for damage.
- If the outer blue insulation has been mildly damaged, but the extent of the damage is unknown, leave yourself some kind of marker indicating this point may require further inspection, and then continue to inspect the rest of the heating cable in this area for more significant signs of damage.
- The power supply leads and heating cables have occasionally been punctured by a nail or a screw from installation of sheetrock, shower door hardware, or baseboard trim. Any of these types of materials being installed after the floor heating system has been put in place, have the potential to damage a wire in your system. Pulling that nail or screw may temporarily "fix" the problem, but the wire should be repaired and reinsulated properly with the appropriate splice kit.
- A cable that has been damaged by a penetration from a staple is generally not too difficult to find, though the hole may be very small. Removing the staple will not really fix the damage. You will need to splice the cable at this point with the appropriate splice kit.
- Hammers and other heavy objects have been known to crush heating cables. The damage may look like an abrasion of the outer blue insulation or an abnormally thin or flat spot in the cable. This type of damage also requires the use of the appropriate splice kit.

After the repair has been made

We recommend that the floor coverings not be replaced over the repair location until after the system has been turned back on, and has had a chance to cycle on and off for at least a day or two. This is typically enough time to verify the integrity of your splice connections. If the repair location is in a high traffic area, extra care must be taken to ensure that your repair is not damaged by the traffic, and to ensure that it does not become a trip hazard.