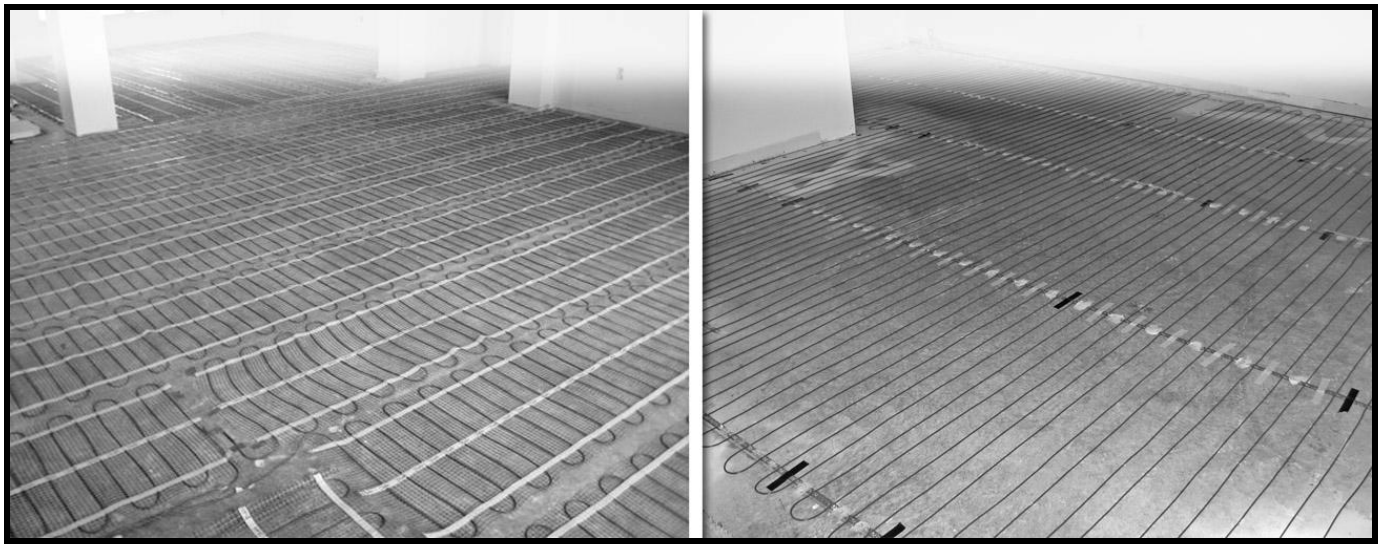
Electric Floor Heating Mats and Cable

Installation



Radiant heat is a simple, economical way to warm your floors. This manual provides instructions, tips, and safety precautions for installing an electric floor-heating system.

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General Installation Information

Local codes may require this product and/or the thermostat controller to be installed or connected by an electrician.

NOTE: *It is recommended that a qualified electrician install the wiring for this system.*

Floor Temperature Expectations

The floor heating system's effectiveness depends on several factors:

- The insulation of the floor.
- The temperature of the floor before startup.
- The heat loss of the underlying materials (in un-insulated concrete slab applications).
- Climate where installation is to take place.

The Three Most Common Installations

Insulated Concrete Slab on Grade - With the cables installed on an insulated concrete slab, and thin-set mortar and tile on top, most floors can be heated up to about 15°F warmer.

Un-insulated Concrete Slab on Grade - When the cables are secured on a concrete slab that is un-insulated, and thin-set mortar and tile is installed on top, the floor can typically be heated up to approximately 10° to 15°F warmer.

Wood framing - When the cable is secured on a well-insulated wood subfloor and thin-set mortar with tile is installed, most floors can be heated approximately 20°F warmer.

For pricing heat applications, a heat loss calculation should be performed by a qualified person.

Product and Warranty Information

⚠ To retain the limited warranty, you must follow the installation steps in this manual. (See the *Manufacturer Warranty* on page 18.)

- ⚠ Do not remove the nameplate label from the power leads.
- ⚠ Record the cable serial number, cable size, voltage, and resistance range printed on the label. Log the information for each cable and sensor in the *Heating Sensor and Cable Resistance Log* (Table V) provided in this manual.

Mechanical Installation Tips and Warnings

WARNING: As with any electrical product, care should be taken to guard against the potential risks of fire, electric shock, and injury to persons. The following guidelines must be observed.

MECHANICAL DON'TS

1. Never space the heat cables less than 2-inches apart (on center).
2. Never cut the heating cable. (The 10-foot black connection lead may be cut shorter if necessary.)
3. Never repair a damaged cable without consulting the factory.
4. Never cross the heating lead on the connecting lead or thermostat wire.
5. Never touch, cross or overlap the heating cable over itself. This could cause the cable to overheat, requiring replacement.
6. Never run the heating cables into closets or other confined areas.
7. Never run heating cables under permanent fixtures or boxed bottom cabinets such as kitchen cabinets, bathroom vanities, appliances, toilets, shower stalls, or tubs.
8. Never install the heating cables in or over walls or partitions.
9. Never install the heating cables below 5°F (-15°C) ambient temperature.
10. Never bang the cable with the edge of a trowel while removing excess thin-set or mortar from tool. Avoid damaging the heating cable
11. Never use solvent based adhesives or premixes, as they are not heat resistant.
12. Never embed the heating cable in adhesives intended for laminates or vinyl flooring.
13. Never run the heating cable beyond the room in which it originates.

MECHANICAL DO'S

1. Always use a plastic trowel while when applying the leveling pour / thin-set.
2. Always use thermal insulation to improve the system efficiency.
3. Always use a polymer-modified cement-based mortar or thin-set to embed the heating cable.
4. Always completely embed the heating cable **including the splice** in the leveling pour / thin-set.
5. Always install the heating cables using an even spacing between the heating wires so the system will provide an even heat. (Heat will radiate about 2-inches from the heating cable; therefore, consistent spacing is very important.)
6. Always measure the open area where you intend to install the heating cable. Use the formula listed under *Heating System Design* in *Section 1* to determine the spacing of your heating cables.

Electrical Tips and Warnings

Inherent dangers apply to all electrical products. Care should be taken to guard against the potential risk of fire, arcing and electrical shock; any of which can cause personal injury or loss of property.

The following guidelines are intended as a guide and by no means should the precautions taken to guard against injury or loss be limited to these guidelines. These guidelines do not supersede common sense or standard electrical industry safety or practice.

ELECTRICAL DON'TS

1. Never apply 240 volts to the heating cable if it is rated for 120 volts.
2. Never touch or work on a live or powered circuit.
3. Never remove the white UL tag from the black cold lead of the cable (black connecting wire). If the cold lead is shortened, relocate the tag to a place where it will not be cut off.
4. Never violate local code, the National Electric Code (NEC), NFPA-70 in the USA or the Canadian Electrical Code (CEC) in Canada while installing our heating products. (See article 424 of the NEC or Part IX section 62 of the CEC.)
5. Never underrate the feeder wire for the heating system (the home run to the breaker panel).
6. Never overload the control device / thermostat.
7. Never place the heating system on a non-GFCI circuit.
8. Never perform the resistance or megger test on a live or powered circuit.
9. Never install the heating cable without performing the required resistance test.
10. Never apply power to the heating cable before the embedment is cured (fully dried), as this will reduce the system efficiency or compromise your heating system.
11. Never size the wiring in such a way as to cause the voltage drop to exceed 3 percent.
12. Never exceed 15 amps (1800 watts @ 120 volts or 3600 watts @ 240 volts) on any one thermostat or heating system control unless specified by the factory design team.
13. Never install the heating cable in exterior applications.
14. Never install the heating wire where there is a possibility of something sharp piercing the heating wire or cold lead.
15. Never continue your install if the wire test is bad at any given point in the install.
16. Never mix cable voltages in a room when multiple cables are required. You must select ether 120 volt or 240 volt.
17. Never install more than 12 amps on a 15 amp circuit, 16 amps on a 20 amp circuit or 24 amps on a 30 amp circuit.

ELECTRICAL DO'S

1. Always test for voltage before proceeding with your work.

WARNING: Do not proceed if voltage is present.

2. Always select controls that are rated for the voltage and current / load of the heating system being installed.
3. Always perform the required warranty test at the point of the install that they are required.
4. Always complete all connections in a workman like manner and conform to local code, the National Electric Code (NEC), NFPA-70 in the USA or the Canadian Electrical Code (CEC) in Canada while installing our heating products. (See article 424 of the NEC or Part IX section 62 of the CEC.)
5. Always use the continuity alarm to insure the cable is not damaged during the embedment.
6. Always call technical support if any questions arise during the install of our heating products.
7. Always install the thermostat remote sensor prior to embedment of the heating cable.
8. Always install the sensor using one of the following methods.
   a. The sensor may be installed directly in the thin-set.
   b. A conduit may be installed to house the remote sensor. (This is so the sensor can be changed in the unlikely event it is defective.)
9. Always locate the conduit or sensor in such a way as to be centered between two of the heating wires (no closer than 1-inch to the heating wires) at least 18-inches in from the wall in the heated floor.
10. Always install the heating cable in interior floors only.
11. Always wait until the floor is cured before powering the heating cable to insure the cable is not damaged or the efficiency of the heating system compromised.
12. Always perform the steps in *Section 1* to select the cable model / length.

SECTION 1:
Pre-Installation – For Spool Cable

Read the *Mechanical* and *Electrical Installation Tips* prior to proceeding with this section.

If this is to be primary heat for the building, a heat loss calculation on the building must be performed to determine the required amount of heat loss in Watts per square foot or BTU's per square foot per hour. (This is the sole responsibility of the installer or home owner / purchaser of this heating system.)

NOTE: *If the exact length of cable calculated is not found in the spool selection tables starting on page 14, it may be necessary to adjust the warming area(s) or select a slightly smaller spool size.*

Remember, the cable must never be cut shorter to fit; therefore, avoid selecting a spool that is too large.

Tools Required:

- Measuring tape
- Calculator
- Pencil
- Paper

Part A: Planning Your Project

1. Measure the room to be covered.
2. Draw a sketch of the floor to be heated. Draw in any toilets, vanities, cabinets, appliances, shower stalls or bath tubs that may occupy some of the floor.
3. Add the dimensions of the room and all of the above mentioned appointments.
4. Calculate the total square footage of the room and subtract the square footage of the installed appointments. This is the open square footage or the net square footage in which the heating system can be installed. (Heat loss must be based on the total square footage.)

Part B: Selecting the Correct Heating Cable and Control Device

To determine the length of the heating wire required for a given square footage, take the net square footage calculated in *Part A* (above) and plug it into the following formula:

Net square feet x 12 ÷ spacing on center (in inches) = Length of the heating wire required (in feet). Refer to *Example 1*.

or:

Net square feet x 12 ÷ the total length of the heating cable (in feet) = On center spacing (in inches). Refer to *Example 2*.

Example 1:

The following is an example for determining the cable length for a 50-square foot room using 3-inch spacing (which will provide 12 watts per square foot of heat).

50 x 12 ÷ 3 = 200-feet of heating wire

So, as the installer you would select the 120 or 240 volt, 195', 600-watt cable for this room.

Example 2:

Assume that you have already purchased a 600-watt (195') cable. To determine the spacing of the cable for this same 50-square foot room, use the following formula:

50 x 12 ÷ 200 ~ 3-inch spacing (on center)

So as the installer you would then space this cable ~3-inches from center to center.

FORMULA ASSUMPTION:

The installer must install the heating wire so that it is 3-inches from all walls and from obstructions where the heating cable is not going to be run.

1. Select where your thermostat is going to be in the wall and mark your diagram. (Make sure the floor sensor will reach under the floor where required.)
2. Select the thermostat / control device for the cable. Make sure the total heating cable amperage is below 15. (If the amperage exceeds 15 amps, use slave relays to make up the required amount.)

Example 3:

Assume you have a room with a net square footage of 425-square feet.

425 x 12 ÷ 3 = 1700-feet of wire

However, because heating cable does not come in 1700-foot lengths, multiple cables would have to be used to make the length required. Two 851-foot 240 volt heating cables that draw 11 amps each would need to be selected.

The total amperage is 22 amps, so the two loads would need to be on two separate control devices; a master thermostat and one slave thermostat. Both devices may be fed from the same 30 amp source or from two separate 20 amp sources.

SECTION 2:
System Installation

Tools Required:

- Broom
- Chalk line
- Tin snips (metal shear)
- Drill motor
- ½-inch drill bit
- Chisel
- Wire stripper
- Diagonal cutters (wire cutter)
- Phillips screw driver bit with No.2 tip
- Flat screw driver with No.2 tip
- Straight dry wall saw (key hole saw)
- Plastic trowel
- 1000 volt megger
- Volt ohm meter
- Plus any tools required to complete the finish floor.

Materials Required:

- The heating cable(s) selected in *Section 1*.
- Cable straps (for spool cable)
- Thermostat / control device
- The correctly sized circuit breaker. (1 pole for 120 volt; 2 pole for 240/220 volt.)
- A deep, single gang old work box (for old construction).
- Or a deep single gang new work box (for new construction).
- Cable clamps (new construction)
- Flexible or EMT conduit
- The proper sized wire to go from the circuit breaker panel to the control / thermostat.
- Nail plates (for new construction)
- Wire nuts if a J-box is required.

Part A: Floor Area Preparation

1. Remove all construction debris and trash from the room and sweep the floor.
2. Locate the white UL tag on the cold lead and record the cable model number and the serial number in Table V.
3. Remove your heating cable/mat from the box. Do not unroll the cable at this time.
4. Strip 3-inches of the outer jacket off the cold lead.
5. Strip ¾-inch of insulation from the cold lead wires.
6. Perform the first of the required resistance and insulation tests for the warranty.
7. Record this information in Table V.
8. If a continuity alarm is used, install it onto the cold lead at this time.
9. Check for any visible damage to the cable. The shielded leads coming out of the spool of cable are the power leads. These are simply power supply cables that do not heat. The power leads are approximately 10 feet long and are used to connect the heating cable to the controller.

SKIP TO PART C IF YOU ARE INSTALLING MATS.

Part B: Installing the Cable Straps

The cable is secured by straps that are usually placed every 3½ to 4 feet. Select enough straps to secure the cable to the floor. (One box contains 25 feet of strap, enough to prepare about 50 square feet of floor.)

1. Refer to your sketch that was completed in *Section 1* and determine which walls the heating cable loop ends are going to be near.
2. Measure the spacing dimension from the wall at each end of the wall and strike a chalk line between those two points.
3. On non-concrete floors set the metal cable strap along the chalk line and screw or nail it down on one end. (Use galvanized flat head screws.)
4. On concrete floors use a hammer drill and plastic anchors or a ram set gun to set the strap. **(Ram set guns are dangerous and should only be used by trained individuals.)**
5. Roll out the strapping and cut it to length.
6. Making sure the strapping lays flat, nail or screw it to the floor every 6 to 10 inches.
7. Measure the spacing dimension from the opposite wall at each end of the wall and strike a chalk line between those two points.
8. Install the second strap along this chalk line using the methods previously described.
9. If the room is a large one you will need to install more straps between the first two that have been installed. The strap row should be 4 to 5 feet apart.

PART C: Electrical Rough-in and Wiring

WARNING: To avoid personal injury, make sure the power to the circuit that is being worked on is turned off.

NOTE: *Follow all National Electric Codes (NEC), NFPA70, or the Canadian Electrical Code (CED) and all other local electrical code requirements when installing this system.*

CAUTION: The floor-warming system should be installed on a dedicated circuit, direct from the circuit breaker panel.

TIP: If you are connecting one or two cables to the control, install an extra-deep single-gang wall case. If connecting three cables, use a deep, 4-inch square box with a single cover. (Extra room is needed for the wire, wire nuts, and control.)

Existing Construction

1. Locate the point in the wall you wish to place the thermostat. (Make sure it is at a hollow point in the wall.)
2. Use the front of the box as a template and mark the wall with a pencil following the outline of the box.
3. Cut a hole using the key hole saw. (Follow the lines you traced in Step 2 and cut on the pencil line.)
4. Fish your home run from your electrical panel using copper 12 awg Romex or "NM Wire" to the thermostat hole, leaving about 10-inches hanging out of the hole.
5. Install a circuit breaker 1 pole for 120 volt and 2 pole for 240 volt into your circuit breaker panel. (Voltage is determined by the heating cable you purchased.)

   NOTE: *Do not connect the home run to the circuit breaker at this time.*
6. Take the molding off of the wall at the bottom of the wall.
7. Cut a fishing slot at the bottom of the wall.
8. Chisel out enough of the 2 x 4 bottom wall plate to fish the wiring up to the thermostat.
9. Fish the thermostat temperature bulb down to the floor. Mount it so that it is centered between two heating wires. Use duct tape to secure the temperature bulb lead so it does not drop down the wall.
10. Feed the power wire from the home run into the old work wall case at the top.
11. Clamp the wire into the box.
12. Fish the cold lead up the wall to your thermostat location and feed it into the bottom of the box.
13. Feed the temperature bulb wire into the old work wall case (deep outlet box, single gang) from the bottom.
14. Tighten the wire clamps onto the Romex NM feeder and the heating cable cold lead.
15. Slide the old work box into place and tighten up the old work ears until the box is tight in the wall.
16. Skip to "*Wiring at the Circuit Breaker Panel*"

New Construction

1. Locate the point in the wall where you will place the thermostat.
2. Attach the deep, single gang work box to a stud.
3. Fish your 12 awg Romex NM wire home run from the circuit breaker panel to the deep single gang new work box that has been mounted for your thermostat. (Make sure you attach your home run to the stud per code.)
4. Fish it into the top of the deep single gang new work box and clamp the Romex NM wire using the built in NM cable clamps.
5. Chisel out enough of the 2x4 bottom wall plate to fish the wiring up to the thermostat.
6. Install the proper sized circuit breaker 1 pole for 120 volt and 2 pole for 240 volt into your circuit breaker panel. (Voltage is determined by the heating cable you purchased.)

   NOTE: *Do not connect the home run to the circuit breaker at this time.*
7. Fish the cold lead of the heating cable up to the bottom deep single gang new work box. (Make sure you secure the cold lead to the stud per code.)
8. Clamp the heating cable cold lead wire in the wire clamp in the deep single gang new work box.
9. Make sure 6-8 inches of wire is left sticking out of the box to satisfy code.

Wiring at the Circuit Breaker Panel

1. Skip to Step 6 for 120 volt; otherwise proceed to Step 2.
2. For 240 volt wiring, connect the black from the Romex NM wire to the top output pole on the 2 pole circuit breaker.
3. For 240 volt wiring, connect the red wire from the Romex NM to the bottom output pole on the 2 pole circuit breaker.
4. For 240 volt wiring, connect the bare copper wire from the Romex NM to the grounding buss in the circuit breaker panel.
5. For 240 volt wiring, proceed to Step 11.
6. For 120 volt wiring, connect the black wire from the Romex NM home run to the output pole of a single pole circuit breaker.
7. For 120 volt wiring, connect the white wire from the Romex NM home run to the Neutral buss in the circuit breaker panel.
8. For 120 volt wiring, connect the bare copper wire from the Romex NM home run to the grounding buss in the circuit breaker panel.

9. Close the circuit breaker panel covers and make sure the circuit breaker is turned off, locked out and labeled.

Thermostat Wiring: (Perform this Section After the Heating Cable/Mat Install)

10. For 120 volt, skip to Step 15; otherwise proceed to Step 11.
11. For 240 volt wiring of the thermostat, connect the black from the Romex NM home run wire to terminal 2 (L1).
12. For 240 volt wiring of the thermostat, connect the red from the Romex NM home run wire to terminal 3 (L2).
13. For 240 volt wiring of the thermostat, connect the bare copper wire from the Romex NM home run wire to the braid of the heating cable. ***NOTE: If a metal box is used, ground the box.***
14. For 240 volt wiring, proceed to Step 18.
15. For 120 volt wiring of the thermostat, connect the black wire from the Romex NM home run to terminal 2 (L1).
16. For 120 volt wiring of the thermostat, connect the white wire from the Romex NM home run to terminal 3 (L2/N).
17. For 120 volt wiring of the thermostat, connect the bare copper wire from the Romex NM home run wire to the braid of the heating cable. ***NOTE: If a metal box is used, ground the box.***
18. Use the small screw driver to loosen the screw that holds the front cover to the thermostat back plate.
19. Fish the temperature bulb sensor wire though the hole provided in the back plate.
20. Connect the temperature bulb red and green wire to terminals C and D.
21. Mount the back plate into the deep single gang "work box" using the screws that were provided with the thermostat. Accordion the wires into the box so as to not pinch them while installing the back plate.
22. Mount the thermostat front display onto the back plate by hooking the tabs at the top and levering the faceplate down to the bottom seating it into its' socket. Tighten the screws at the bottom.

Heat Cable and Mat Installation

Perform the element resistance test and the insulation test in *Section 3* and document the reading.

Always position the power leads near the thermostat. If this is not possible, then route the power lead through a wall or floor to the location of the thermostat. (Be sure to follow all electrical/building codes using electrical conduit and boxes.)

If you are using an electronic cable monitor, attach it to the heating cable at this time. (This does not eliminate the resistance readings required; it merely facilitates the discovery of a problem with the heating cable while the installer is occupied with the install.)

CAUTION: Do not space the cable less than 2-inches apart. Never install mats whereby the heating wires are closer than 2-inches from each other.

CAUTION: When installing in a bathroom, keep the heat cable 6 to 10-inches from the wax ring seal of your toilet.

CAUTION: Never cut the heating cable.

Heat Cable Installation

NOTE: *This method assumes the thermostat is located in the middle of the room.*

1. Clear the floor of dust and debris.
2. Starting at the thermostat, run the heating cable to the furthest extent of the room. Serpentine the cable back and forth, maintaining the spacing that you calculated in *Section 1*.
3. Lock the heating cable in place using the metal tabs on the fastener straps installed in *Section 2*.
4. Once you get back to the thermostat, run the heating cable to the other extreme of the room and serpentine back to the thermostat again.

   NOTE: *Make sure the heating cable remains 3-inches from the walls, vanities, cabinets or any other obstruction.*

   NOTE: *If installing spool cable, observe how much cable is being used and the area that is being covered so that you can judge if the cable is going to be long or short.*
5. If the cable is too long or short, re-space the cable over the remaining area, using the spacing calculation (square footage x 12 ÷ length of cable).
6. Once the floor is covered and evenly spaced, fish the cold lead (the black non-heating wire) up to the J-box for the thermostat.

NOTE: *To protect the heating cable from being damaged prior to the floor covering being installed, place raised wooden planks, carpet or other material over the mats (Figure 1).*

Figure 1: *Create a walkway over the unprotected heating cables.*

Heating Mat Installation

In all applications, double-sided tape can be used to affix the heating mat to the substrate. If installing over backer board or plywood, pneumatic stapling is also an option.

Heat radiates approximately 1 to 2-inches from the heating wire, so avoid leaving gaps between the mats. The heating mat should be installed continuously across the floor.

CAUTION: Proceed slowly and be very careful not to staple the heating wire.

1. Clear the floor of dust and debris so that the adhesive tape on the mats will stick.
2. Roll out the mat accordingly. At each turn or bend, stop and stretch the mat tightly to eliminate any slack. Keep the heating mat approximately 3 to 6-inches from walls, showers, tubs, drains, etc.
3. To create turns in the heating mats, carefully cut the woven mesh backing and then direct the cable as desired. **DO NOT** cut or damage the heating cable.

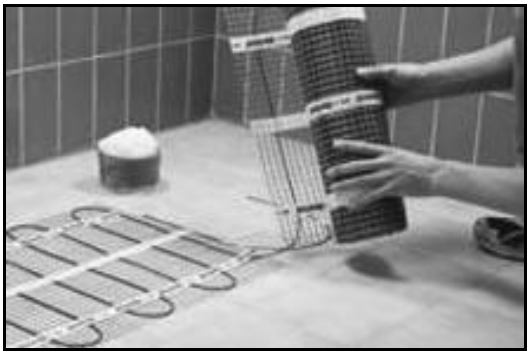

Figure 2: *Cut mesh backing to turn the heating mat for the desired layout.*

4. Affix the mat to the floor using double-sided tape or staples. When using double-sided tape, apply it to the floor on 2-foot centers or more, as necessary, depending on the jobsite conditions. Applying the thin-set will be easier if the mat is secured tightly. Cover about 10-square feet at a time. Use short pieces as necessary at the corners.
5. When using pneumatic staples, use ⅜ x ¼-inch chisel point staples. Attach the mat every 2 to 3 feet on either side of the mat in the gaps between the heating wires when you initially lay it down. This will make it easier to reposition the mat later – if necessary.
6. After laying out all the mats, staple on 1-foot centers at either side in the areas between the heating wires.
7. Once the floor is covered and evenly spaced, fish the cold lead (the black non-heating wire) up to the J-box for the thermostat.

NOTE: *To protect the heating cable from being damaged prior to the floor covering being installed, place raised wooden planks, carpet or other material over the mats (Figure 1).*

Shower Installation

Heating cables can be installed to operate safely in shower areas; however, it is imperative that you follow the precautions outlined in this manual.

1. Install the heat cable only under surfaces as approved in this manual (i.e., tile, stone, brick, or other masonry surfaces), and make sure the mats are embedded in cement-based mortar.
2. Do not install heating mats in shower walls.

WARNING: Never make a field splice to mats installed in a shower. Do not attempt to repair or modify the mat in any way, as serious hazard could result.

3. The connection between the power lead and the heating wire must be fully embedded in mortar and located at least 1-foot away from shower openings and other areas that are normally exposed to water. DO NOT BEGIN THE MAT IN THE SHOWER.
4. Never install the controls for the floor heating system less than 4-feet away from shower openings to avoid being exposed to water or touched by anyone exiting the shower.

NOTE: *The UL Listing for this product covers use in wet locations for CANADA only. Wet location installation in United States shall be in accordance with the National Electric Code, NFPA 70 and any other applicable jurisdictional code and final acceptance is to be made by the Authority Having Jurisdiction (AHJ).*

Section 3:
Testing the Heating Wire

Checking the Cable Heating Element Resistance

The following readings must be taken in this order:

1. Before the heating cable is unrolled.
2. After the heating cable is mounted to the floor.
3. After the finished floor is installed or the product is embedded.

NOTE: *It is highly recommended that the cable be monitored throughout the install so that the installer will discover any problem and make repairs before the cable is embedded to avoid ripping up a finished floor.*

Tools Required:

- 1000v megger with a low ohms scale, or a volt ohm multi-meter that will read down to 2 ohms.
- Diagonal cutters
- Strippers

1. Using the diagonal cutters strip off 2-inches of the black jacket from the non heating wire connected to the heating wire, hereafter called “cold lead”.
2. Using the strippers strip ½-inch of the insulation from black and the yellow wire (black and red for 240v) of the cold lead.
3. Twist the ground braid together, making a tight bundle of wire.
4. Connect the black wire of your meter to the black wire of the cold lead.
5. Connect the red wire of your meter to the yellow wire (red for 240v) of the cold lead.
6. Place your meter on the low ohm scale, R x 1 scale or the 200 ohm scale.
7. Measure the resistance and record it in Table V.
8. Repeat for all heating cables.

Checking Heating Cable Insulation (Optional)

Tools Required:

- 1000v megger
- Diagonal cutters
- Strippers

WARNING: Do not allow yourself to become part of the circuit while using a megger. Electric shock may result.

1. Using the diagonal cutters strip off 2-inches of the black jacket from the non heating wire connected to the heating wire hereafter called “cold lead”.
2. Using the strippers strip ½-inch of the insulation from black and the yellow wire (black and red for 240v) of the cold lead.
3. Twist the ground braid together making a tight bundle of wire.
4. Take the black lead of the 1000v megger and connect it to the ground braid of the cold lead.
5. Take the red lead of the 1000v megger and connect it to both the black and yellow wires (black and red wire on 240v) of the cold lead at the same time.
6. Select 1000v on your megger and push the TEST/Measure button on your megger. (If your megger has a crank rapidly turn the crank).
7. On digital meggers: “1” with the rest of the display blank or “OL” is infinity (infinite resistance). If your megger reads something other than infinity please call the factory.
8. On an analog 1000v megger look for the infinity symbol (∞). The needle should be pointing to that symbol while you are measuring. If the megger indicates any other reading, please consult the factory immediately.
9. Record your readings in Table V.
10. Repeat for all heating cables.

Alternate Insulation testing Method

NOTE: *It is strongly recommended to use the digital megger method. The alternate testing method will not catch high resistance shorts which will trip the ground fault in your thermostat.*

CAUTION: This method will not catch high resistance shorts which will trip the ground fault in your thermostat.

Tools Required:

- A volt ohm multi-meter that will read up to 200 megohms
- Diagonal cutters
- Strippers

1. Using the diagonal cutters, strip off 2-inches of the black jacket from the non heating wire connected to the heating wire hereafter called “cold lead”.
2. Using the strippers, strip ½-inch of the insulation from black and the yellow wire (black and red for 240v) of the cold lead.
3. Twist the ground braid together making a tight bundle of wire.

4. Connect the black wire of your meter to the black and yellow wire (black and red wire on 240v) of the cold lead.
5. Connect the red wire of your meter to the ground braid of the cold lead.
6. Place your meter on the highest ohm scale your meter has. It is very important that you do not touch the test probe metal or the wires being tested. Doing so will cause a false low reading.
7. Measure the resistance and record it in Table V.
8. Repeat for all heating cables.

Appendix 1:
Install the Floor Coverings

For optimum results, it is recommended to work with professional flooring installers to make sure proper materials are used and proper installation techniques are followed.

Final Cable Inspection

Prior to embedding the cable, carefully inspect the work after the cable installation.

1. Make sure that all the cables and sensor(s) are undamaged.
2. Check that the cable is secured and that all the tabs are clamped down (over the spooled cable).
3. Make certain that the cable spacing is correct.
4. Check that no cables overlap.
5. Check that all areas to be heated are covered with cable.
6. Select the ideal thin-set, thick-set, or self-leveling mortar method for the application. Consult with building professionals and/or the factory if assistance is required.
7. Check the resistance of the cable and sensors with a digital ohmmeter before, during and after the installation of the floor covering. Record the readings in the *Mat and Sensor Resistance Log* (Table V).

Appendix 2:
Insulation and Installation Mediums

To optimize the performance and efficiency of the floor heating system, insulate under the subfloor.

Insulation

For new slab applications, it is important that foam insulation is installed around and under the slab to prevent heat loss.

In existing construction where insulation under the slab is absent, it is strongly recommended that a layer of insulating material be attached to the slab prior to the installation of the cable.

There are several ground insulation options, such as cork or Insul-Tarp. Cork possesses a minimal R value that will help keep the radiant heat at the floor surface. Consult the manufacturer regarding proper application and attachment of the cork to the concrete slab.

Placing insulation in the joist spaces dramatically enhances the performance and efficiency of a radiant floor-warming system.

Insulation with an R value of 19 will be satisfactory for most regions, while in more temperate areas R-11 will be sufficient.

NOTE: *Do not install rigid insulation layers directly above or below backer board or mortar.*

Anti-fracture Membrane

An anti-fracture membrane is a flexible layer that can be installed directly on the surface of the slab or self-leveling mortar layer that the tile will be installed on. The membrane reduces minor stress and fracturing in tile by uncoupling the tile from the building structure. Always install the heat cable above the membrane unless directed otherwise by the membrane manufacturer.

Framed Floor Construction and Applications

In wood subfloor construction, the primary concerns are insulation and floor rigidity. Without proper insulation, radiant heat escapes through the joist spaces. If a plywood subfloor is not properly reinforced, the slight flexibility can cause the tile floor and grout joints to crack.

Options for Reinforcing the Subfloor

Option for strengthening and leveling the floor are:

1. Add ¾-inch thick plywood to the top of the existing subfloor.
2. Install a quality concrete backer board or fiber cement underlayment over the subfloor.
3. Lay a 1¼ to 2-inch mudbed, reinforced with plastic lath, directly onto the optional anti-fracture membrane.

For leveling, pour a ¼ to ½-inch thick layer of self-leveling mortar over the existing subfloor.

Mortar Beds

Heat cable can be installed in three types of mortar beds:

1. Thin-set ½ to 1-inch thick
2. Thick-set mortar beds ½ to 1-inch thick
3. Self-leveling mortar beds ½-inch thick

Thin-set Mortar Beds

If backer board or plywood reinforcement is used on a plywood subfloor, or if the cable is to be placed directly onto the slab, first install the cable and then apply the thin-set mortar bond coat (using a plastic trowel) directly over the cable and lay the tile.

Thick-set Mortar Beds

If a thicker mortar bed is used to strengthen the floor, the cable can be installed under either the mortar bed (also known as "dry-set") or under the mortar bond coat directly below the tile or stone. In a thick-set application, the cable is generally installed above the mortar bed, but before the thin- set bond coat. Thick mortar beds of this type require the use of a reinforcing mesh or lath.

If plastic lath is used instead of the typical metal lath, the cable can be installed before pouring the self-leveling mortar bed. (Plastic lath is recommended.)

CAUTION: If metal lath is used in the mortar bed, do not allow the cable to come in direct contact with the lath. Damage to the cable could result.

Self-leveling Mortar Beds

If a non-masonry floor covering such as engineered wood, vinyl, laminate, or carpet is being installed, self-leveling mortar can be used. Simply attach the cables to the slab or subfloor and pour a ½-inch thick layer of self-leveling mortar over the cables according to manufacturer's specifications. Install the flooring after the mortar has cured.

Regardless of the type of mortar bed used in any particular application, always make sure the cable is secured to the subfloor prior to covering it with the mortar or cement. Do not attempt to lay or work the cable in a previously-poured layer of wet mortar.

NOTE: *Install tile and stone flooring according to manufacturer's recommendations, Tile Council of North America (TCNA) guidelines, and ANSI specifications. Always follow the industry and manufacturer's recommendations when installing non-masonry floor coverings, such as hardwood, vinyl, laminate, or floating floors.*

Expansion joints

In slab or mortar applications, do not install the cables through an expansion joint unless an appropriate anti-fracture membrane is installed per TCA recommendations. If not using an anti-fracture membrane, install the cables right up to the joint, if necessary, but not through the joint.

Mosaic Tile (Typically ¼-inch tile with mesh backing.)

When laying mosaic tile, first embed the cables in the appropriate mortar bed and allow curing per manufacturer's instructions. Apply the thin-set and place mosaic tile according to typical practice.

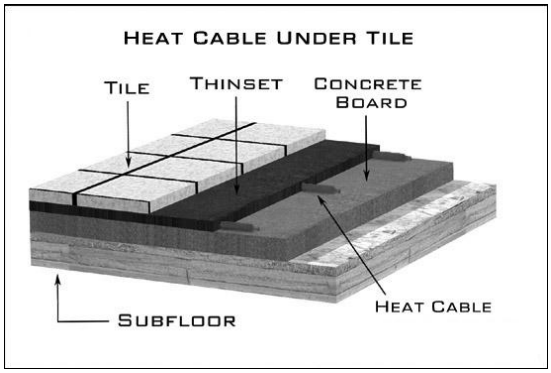

Figure 3: *Heat cable installed under mosaic tile.*

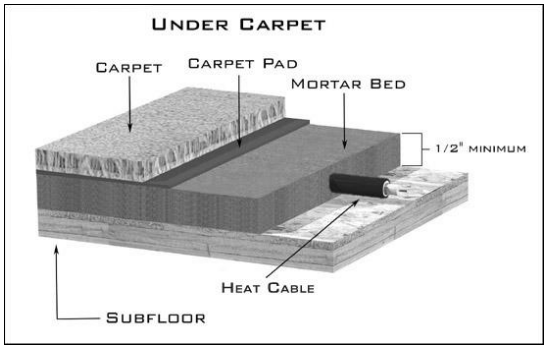

Figure 4: *Example of heat cable installed in slab under carpet.*

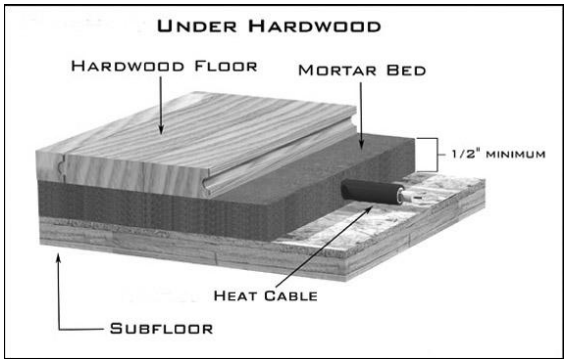

Figure 5: *Heat cable installed under hardwood.*

Appendix 3:
System Startup

Maximum limit of the temperature setting on the thermostat should not exceed 86°F (30°C). Be sure to program the control accordingly. Consult the manufacturer regarding recommended floor temperatures for the flooring being installed.

Energize the system and briefly test the operation of the components for **no longer than 10 minutes**. (Operate the controls so that the system turns on the floor-warming cable.) Using a clamp-type ammeter pull the control out of the wall and determine whether the cables are pulling current, thus indicating they are working as intended.

Do not put the system into full operation until the tile or concrete installer verifies these cement materials are fully cured. (This is typically one to four weeks. See thin-set manufacturer's instructions for recommended curing time.)

Appendix 4:
System Multimeter Test of Heating Cable/Mats

Heating Element Test

1. Using a razor knife, very carefully strip off 2-inches of the outside jacket of the "Cold Lead" (connection cable).
2. Strip the insulation from the black wire and the yellow (red for 240v) wires.
3. Plug the black test lead into the left hand socket labeled "COM" (common).
4. Plug the red test lead into the center socket labeled "V Ω MA"
5. Turn the knob on the multimeter to the "200" Ω (or lowest setting)
6. Touch the red and black test lead probes together. Note the reading here: _____
7. Attach the black test lead to the black wire of the heating cable/mat.
8. Attach the red test lead to the yellow wire (red for 240v) of the heating cable/mat.
9. Read the multimeter and note the reading here: _____
10. Read the white tag on your heating cable /mat and note the desired resistance here: _____
11. Subtract the reading in Step 6 from the reading in Step 9 note answer here: _____
12. The reading in Step 11 should be ±10% of the desired resistance noted in Step 10.

Insulation Test

1. Connect the black test lead to the ground wire of the heating cable/mat.
2. Connect the red test lead to both the black and the yellow (red for 240v) wire of the heating cable/mat at the same time.
3. Turn the function dial to the 2000K position and note the reading here: _____
4. If the reading is something other than 1_ _ _ (infinity), call technical support with the reading.

TIP: Do not touch the test probes with your fingers. If you do the meter will read your body resistance.

Appendix 5:
Heating Cable/Mats

Table I: 120 VAC Spools

Cable Length (feet)	Wattage	2-inch spacing (18 watts/sq.ft.)	3-inch spacing (12 watts/sq.ft.)	4-inch spacing (9 watts/sq.ft.)	Amps
19.5	60	3	5	7	0.5
38.9	120	6	10	13	1.0
58.4	180	10	15	19	1.5
77.8	240	13	19	26	2.0
97.3	300	16	24	32	2.5
116.7	360	19	29	39	3.0
136.2	420	23	34	45	3.5
155.6	480	26	40	52	4.0
175.1	540	29	44	58	4.5
194.5	600	32	49	65	5.0
233.5	720	39	58	78	6.0
272.4	840	45	68	91	7.0
311.3	960	52	78	104	8.0
339.2	1050	57	85	113	8.8
369.4	1140	62	92	123	9.5
391.7	1210	65	98	131	10.1
425.9	1310	71	106	142	10.9
443.6	1370	74	111	148	11.4
461.1	1420	77	115	154	11.8

Table II: 120 VAC Mats

Mat Length (feet)	Wattage	Coverage (sq.ft.)	Amps
3.3	60	5	0.5
6.7	120	10	1.0
10.0	180	15	1.5
13.3	240	20	2.0
16.7	300	25	2.5
20.0	360	30	3.0
23.3	420	35	3.5
26.7	480	40	4.0
30.0	540	45	4.5
33.3	600	50	5.0
40.0	720	60	6.0
46.7	840	70	7.0
53.3	960	80	8.0

Table III: 240 VAC Spools

Cable Length (feet)	Wattage	2-inch spacing (18 watts/sq.ft.)	3-inch spacing (12 watts/sq.ft.)	4-inch spacing (9 watts/sq.ft.)	Amps
38.9	120	6	10	13	0.5
77.8	240	13	19	26	1.0
116.7	360	19	29	39	1.5
155.6	480	26	39	52	2.0
194.5	600	32	49	65	2.5
233.5	720	39	58	78	3.0
272.4	840	45	68	91	3.5
311.3	960	52	78	104	4.0
350.2	1080	58	88	117	4.5
389.1	1200	65	97	130	5.0
466.9	1440	78	117	156	6.0
512.0	1580	85	128	171	6.6
580.1	1790	97	145	193	7.5
626.8	1930	104	157	209	8.0
678.4	2,090	113	170	226	8.7
738.8	2280	123	185	246	9.5
783.3	2420	131	196	261	10.1
851.8	2,630	142	213	284	11.0
887.2	2740	148	222	296	11.4
922.2	2,840	154	231	307	11.8

Table IV: 240 VAC Mats

Mat Length (feet)	Wattage	Coverage (sq.ft.)	Amps
6.7	120	10	0.5
13.3	240	20	1.0
20.0	360	30	1.5
26.7	480	40	2.0
33.3	600	50	2.5
40.0	720	60	3.0
46.7	840	70	3.5
53.3	960	80	4.0
60.0	1080	90	4.5
66.7	1200	100	5.0
80.0	1440	120	6.0

Appendix 6:

Table V: Heating Cable and Sensor Resistance Log

	Mat/Cable 1	Mat/Cable 2	Mat/Cable 3
Cable serial number			
Cable size			
Cable voltage			
Factory cable resistance range			
Prior to Installation (ohms)			
Cold Lead (black to yellow (red 240v))			
Cold Lead Black Cable (ground braid)			
Cold Lead Yellow (Red 240v) Cable (ground braid)			
Sensor wire			
After being secured to the floor (ohms)			
Cold Lead (black to yellow (red 240v))			
Cold Lead Black Cable (ground braid)			
Cold Lead Yellow (Red 240v) Cable (ground braid)			
Sensor wire			
After floor covering is installed (ohms)			
Cold Lead (black to yellow (red 240v))			
Cold Lead Black Cable (ground braid)			
Cold Lead Yellow (Red 240v) Cable (ground braid)			
Sensor wire			
	Mat/Cable 4	**Mat/Cable 5**	**Mat/Cable 6**
Cable serial number			
Cable size			
Cable voltage			
Factory cable resistance range			
Prior to Installation (ohms)			
Cold Lead (black to yellow (red 240v))			
Cold Lead Black Cable (ground braid)			
Cold Lead Yellow (Red 240v) Cable (ground braid)			
Sensor wire			
After being secured to the floor (ohms)			
Cold Lead (black to yellow (red 240v))			
Cold Lead Black Cable (ground braid)			
Cold Lead Yellow (Red 240v) Cable (ground braid)			
Sensor wire			
After floor covering is installed (ohms)			
Cold Lead (black to yellow (red 240v))			
Cold Lead Black Cable (ground braid)			
Cold Lead Yellow (Red 240v) Cable (ground braid)			
Sensor wire			

NOTE: *Make sure to include the information in this table with your Warranty Registration Card and submit it to the manufacturer within 14 days after the date of the completed installation.*

Store this log, all instruction sheets and warranty information in a safe area for future reference.

Appendix 7:
Troubleshooting

WARNING: Any electrical troubleshooting work should be performed by a qualified, licensed electrician, and with the power removed from the circuit unless otherwise noted.

Problem	Possible Cause	Solution
Cable resistance measurement is outside the range printed on the name-plate label.	An analog ohmmeter (using a moving needle) was used to take the reading.	Use a digital ohmmeter that is able to read 0 to 20,000 ohms and re-measure the resistance.
	If measurement shows an open or short circuit, the heating wire has been damaged.	Record resistance between all wires and contact the manufacturer.
	If measurement is just a little low or high, room temperature has affected the resistance.	Make the room temperature 75°-85°F, or contact the manufacturer.
	The resistance measurement could be from more than one mat wired in series, or wired in parallel. Either will provide false resistance readings.	Make sure resistance measurements are for only one mat at a time. When connecting more than one mat to the control, multiple mats must be wired in parallel (i.e., black to black, white to white).
	The ohmmeter may be set to the wrong scale. For instance, the 200 K ohms scale measures up to 200,000 ohms.	The ohmmeter should typically be set to the 200 ohms scale, with the exception of mats having a rating above 200 ohms on their nameplate label. If the resistance reading is outside the range printed on the nameplate label, contact the manufacturer.
Floor is not getting warm.	The cable has been damaged.	Measure cable resistance. If damaged, record resistances between all wires and contact the manufacturer.
	GFCI has tripped, indicated by a light on the control. Light may be labeled "GFI", and below the words "Stand by" or on the button labeled "Test".	Check for loose wire connections. Reset the GFCI on the control or circuit breaker. If it trips again, check for a short circuit in the mat as detailed earlier in this manual. If mat is damaged, record resistance between all wires and contact the manufacturer. If mat is not damaged, replace the GFCI control. Also see "GFCI conflicts" below.
	Incorrect voltage supplied, or mismatched electrical components used.	Measure "line" voltage. 120V cable has black and yellow leads. 240V cable has black and red leads.
	Concrete slab floor	Surface temperatures rise slowly in a slab. If, after 5 to 8 hours of heating, the floor is not warmer to the touch, check for cable damage (see *The cable has been damaged* above). Measure "load" voltage/amperage to cable.
	Cable are wired in "series" or "daisy chained" (end-to-end).	Multiple cables must be connected in "parallel" (black-to-black, white-to-white, etc.).
Floor heating system runs continuously.	Sensor is loose or broken. If control has a digital display, it may indicate "LO".	The system controls have a floor sensor. Pull the sensor wires loose from the control and reinsert them. If this does not solve the problem, measure resistance across the sensor wires. For this system's control, the resistance should be between 17,000 ohms (at 55°F) and 8,000 ohms (at 85°F).
	The system was wired incorrectly. The control may have been bypassed when it was wired to the power supply.	Make sure wiring connections are correct. Consult the wiring diagram on the back of the control, the instructions that came with the control, or the wiring diagram in this manual.
	Defective controller.	Return control to dealer for replacement.
Floor temperature reads "HI" or shows temperature over 100°F.	Floor sensor is not wired properly, or is located incorrectly.	Make sure only one floor sensor is connected to the control. Also see *Sensor is loose or broken* above.
Control is not working correctly.	If a programmable control, the programming may be incorrect.	Carefully read and follow control programming instructions.
	Incorrect voltage supplied, or mismatched components used.	Test voltage, verify parts. See *Incorrect voltage supplied* above.
	Floor sensor is not wired properly, or is not working properly.	Make sure only one floor sensor is connected to the control. Also see *Sensor is loose or broken* above.
	Loose connection(s) on line side and/or load side of control.	Remove and reinstall the wire nuts at each connection. Make sure the wire nuts are tight. Check all connections back to the breaker.
Control is not working.	No power is supplied.	Check circuit breaker. Measure voltage at the control. Check all connections between breaker and control.
	Floor sensor is not wired properly, or is not working properly.	Make sure only one floor sensor is connected to the control. Also see "Sensor is loose or broken" above.
	Defective control.	Return control to dealer for replacement.
GFCI conflicts and false-trips	More than one GFCI on the circuit.	GFCI units will sometimes trip when there is nothing wrong with the equipment on the circuit, but when there is more than one GFCI. Reroute power to avoid having more than one GFCI on the circuit.
	An electric motor or a ballasted light source is sharing the circuit with the mat.	Electric motors and other electrical devices can cause a GFCI to false-trip. Run a dedicated circuit to the floor-warming system.

Manufacturer Warranty

For a period of twenty-five (25) years from the date of manufacture, Manufacturer warrants that the electric floor-warming mats and cables ("Product") are free from defects in materials and workmanship under normal use and maintenance, provided the Product is installed in accordance with the accompanying installation manual, any special written design or installation guidelines for a particular project, the National Electrical Code (NEC) or the Canadian Electrical Code (CED), and all applicable local building and electrical codes. The limited warranty is valid only if the warranty certificate has been properly completed and mailed within 14 days of installation. Warranty is for Product only and does not cover thermostats, controls or any other equipment.

Under this Limited Warranty if the Product is determined by Manufacturer to be defective in materials and workmanship, has not been damaged as a result of abuse, misapplication, misuse, modification, neglect, alteration or improper installation, operation, maintenance, repair or testing, the Manufacturer will repair Product or supply replacement Product or refund the purchase price of the Product on Product covered by this Limited Warranty whichever Manufacturer may elect at its sole discretion.

In order to receive the remedy set forth above, you must return the product during the warranty period and include sufficient details relating to the nature of the defect, the installation, the history of operation, and any repairs that may have been made, including:

1. Provide Resistance readings taken by installer, Ohms measurement: within 4 hours before installing Product, after installing Product, and after floor covering is installed over Product.
2. Provide proof that Product was installed in accordance with the installation manual, any special written design or installation guidelines, the National Electrical Code (NEC) or the Canadian Electrical Code (CED), and all applicable local building and electrical codes.
3. Provide dated proof of purchase.

This Limited Warranty does not cover and Manufacturer shall in no event be liable for:

1. Any direct, indirect, incidental or consequential damages, including inconvenience, loss of time, loss of or damage to or loss of use of facilities or other property, loss of revenue, loss of anticipated profits or loss of income.
2. Any labor or materials required to repair or replace the Product that is not authorized in writing by Manufacturer
3. Any labor or materials required to remove, repair or replace flooring materials.
4. Any freight or delivery costs related to the Product, or any related flooring or electrical products.

Manufacturer assumes no responsibility under this warranty for any damage to the Product caused by any persons; including any trades people or owners or visitors to the job site or damage caused as a result of pre or post-installation work.

MANUFACTURER DISCLAIMS ANY WARRANTY NOT PROVIDED HEREIN, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. MANUFACTURER FURTHER DISCLAIMS ANY RESPONSIBILITY FOR SPECIAL, INDIRECT, SECONDARY, INCIDENTAL, OR CONSEQUENTIAL DAMAGES ARISING FROM OWNERSHIP OR USE OF THIS PRODUCT, INCLUDING INCONVENIENCE OR LOSS OF USE. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE FACE OF THIS DOCUMENT. NO AGENT OR REPRESENTATIVE OF MANUFACTURER HAS ANY AUTHORITY TO EXTEND OR MODIFY THIS WARRANTY UNLESS SUCH EXTENSION OR MODIFICATION IS MADE IN WRITING BY A CORPORATE OFFICER.

DUE TO DIFFERENCES IN BUILDING AND FLOOR INSULATION, CLIMATE, AND FLOOR COVERINGS, MANUFACTURER MAKES NO REPRESENTATION THAT THE FLOOR TEMPERATURE WILL ACHIEVE ANY PARTICULAR TEMPERATURE, OR TEMPERATURE RISE. AND AS SUCH, USERS MAY OR MAY NOT BE SATISFIED WITH THE FLOOR WARMTH THAT IS PRODUCED. MANUFACTURER DOES WARRANT THAT PRODUCTS WILL PRODUCE THE RATED WATT OUTPUT LISTED ON THE PRODUCT NAMEPLATE WITHIN +/- TEN PERCENT, WHEN OPERATED AT THE RATED VOLTAGE.

Some states do not allow the exclusion or limitation of implied warranties or liability for incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may have other rights, which vary from state to state.

Incoming materials should be inventoried and a resistance reading taken immediately for completeness and for possible shipping damage. Any visible damages or shortages must be noted prior to accepting the material. Any discrepancy concerning type or quantity of material shipped or Ohms measurements, must be brought to the attention of Manufacturer or Manufacturer authorized agent within 14 days of the shipping date entered on the packing slip for the order.

Warranty Registration

Please include the Warranty Registration Card (below) with a copy of your readings documented in the *Heating Cable and Sensor Resistance Log* (Table V, provided on page 16 of this manual) to ensure that your warranty remains valid.

WARRANTY REGISTRATION CARD

WARRANTY REGISTRATION

Please provide the information requested below and submit with a copy of the readings recorded in the Resistance Log (provided in this manual).

1. Name: _____
2. Address: _____
3. Telephone: _____
4. Email: _____
5. Purchase date: _____
6. Purchase from: _____
7. Date installed : _____
8. Installer's name _____
9. Installer's phone: _____
10. Electrician's name : _____
11. Electrician's phone: _____
12. Please include a copy of your Resistance Log readings (Table V)

MAIL TO:

Manufacturer
PO Box 1268
Riverton, UT 84065

ATTN: Warranty Registration

This limited warranty is valid only if the warranty registration card has been properly completed and mailed within 14 days after the date of the installation. The system must be installed in accordance with the instructions provided in the Installation Manual.

Disclaimer
Warranty subject to terms as described in the Limited Manufacturer Warranty.

MAIL: Manufacturer
PO Box 1268
Riverton, UT 84065

PHONE: 801.948.7566
FAX: 801.948.7599
