

SAFETY INFORMATION



TC / TCM Thermal Storage Cable and Mats Systems



	DANGER	
ELECTRIC SHOCK OR FIRE HAZARD		
READ ALL WIRE SIZING, VOLTAGE REQUIREMENTS AND SAFETY DATA TO AVOID PROPERTY DAMAGE AND PERSONAL INJURY		

King's Thermal Storage Heating systems are designed to warm the concrete slab of a building, creating a heated thermal mass below the floor surface that radiates heat into the building throughout the day. Perfect for both commercial and residential heating applications, heating floors in an efficient manner. King's system runs during off peak hours, heating the floor to a comfortable and consistent temperature, and then shuts off during peak hours using the stored heat to keep costs down.







TCM Series Mats offers the easiest solution to in-concrete thermal storage, providing pre-fabricated mats at 12W/SqFt (6" spacing) that can be rolled out prior to the concrete slab being poured.

TC Series Cable offers a custom layout solution to in-concrete thermal storage, that can be installed to fit any individual application. Cable can be spaced to allow between 12W/SqFt – 17W/SqFt (4", 5" or 6" spacing) depending on the application.

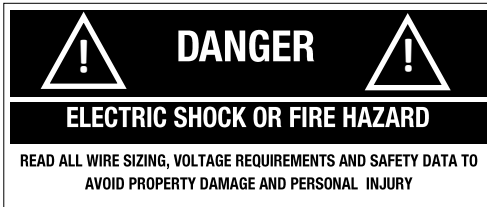
WARNING

READ CAREFULLY - It is important to read these instructions carefully before installing the TC Thermal Storage System. Installation must be performed by qualified personnel, in accordance with local codes and standards.

Read these important warnings and all installation instructions prior to installation. Failure to do so can result in fire, electrical shock, property

-  **WARNING** TC / TCM is a heating system usually intended to be the sole source of heat in the building.
-  **WARNING** King strongly recommends consulting with a building engineer, architect or qualified professional to ensure that the TC thermal storage system selected will be suitable for your intended application.
-  **WARNING** The installation shall be in accordance with the manufacturer's instructions and national and local electrical codes. The installation shall be in accordance with Part 426, American National Standard Institute / National Fire Protection Association (ANSI/NFPA70), National Electrical Code (NEC) and Canadian Electrical Code (CEC), Part 1. You must use a ground fault protection device (GFCI) or a Residual Current Device (RCD).
-  **WARNING** All local codes concerning buildings, electrical installations etc. must be adhered to regardless of instructions provided in this manual. If these regulations are in direct conflict with instructions stated herein, please contact the manufacturer.
-  **WARNING** It is important that this equipment is only installed by qualified electricians who are familiar with the proper sizing, installation, construction and operation of electric heating cable systems and the hazards involved. The TC system is only designed for installation in concrete or sand applications.
-  **WARNING** Metal structures or materials used for the support of or on which the Jiahong TC is installed must be grounded in accordance with CSA Standard C22.1, Section 10 and the NEC.

SAFETY INFORMATION



WARNING CONTINUED

- ⚠ WARNING** It is recommended to install the TC heating cables/mat with a controller that contains an integrated temperature limiter.
- ⚠ WARNING** Remember to check that the supply voltage matches the voltage required for your particular TC product.
- ⚠ WARNING** Extreme care must be used to ensure the TC cables are not damaged when using sharp tools, wheelbarrows, heavy machinery, shovels, rakes, or other implements. Avoid walking on the cables or mats during installation.
- ⚠ WARNING** **READ THESE INSTRUCTIONS BEFORE BEGINNING THE CONSTRUCTION OF THE FOUNDATION**
- ⚠ WARNING** **Never cut the heating cable.**
- ⚠ WARNING** **Do not install the TC cables in such a manner that two heating cables touch, cross or overlap.**

- ⚠ WARNING** Measure, verify and record the actual resistance throughout the installation process:
 - 1. Out of the box**
 - 2. During installation**
 - 3. After laying the sand bed (for sand bed installation)**
 - 4. After the concrete slab is poured (but not set)**
 - 5. After connecting thermostat and/or contactors**

- ⚠ WARNING** Record these values in the **TC Cable / TCM Mat Testing Log**. Failure to do so will void the warranty.

- ⚠ WARNING** The TC thermal storage heating system is most effective in single story buildings, with tiled or stone or concrete floors. If carpet, wood or other flooring materials are to be used, please consult with King.
- ⚠ WARNING** The TC mat or TC cable must be embedded in mortar or mortar mixture, concrete, sand or similar material. Ensure no air pockets exist in the concrete or sand. This can damage to the cable.
- ⚠ WARNING** The perimeter of the heated area should be insulated to 4 feet below grade with a minimum of 2 inches of rigid, closed cell foam insulation (styrofoam) or equivalent suitable for in-ground installation. Foamed urethane or polystyrene are not acceptable moisture reduced its insulation properties.
- ⚠ WARNING** Ensure that all sharp stones and debris are removed from the area where the heating cables are going to be installed.
- ⚠ WARNING** Make sure the cable is not subjected to excessive tension or strain, especially at the heating cable to power lead slice. It should not cross an expansion joint when installed in concrete. For two or more slabs, use separate cables in each slab.
- ⚠ WARNING** At low temperatures, the heating cable stiffens and may be difficult to work with. To overcome this, connect the cable to the mains for a brief period of time. Ensure the cable is fully rolled out when this is done.
- ⚠ WARNING** A minimum of 6 inches (15 cm) should exist between the cables and the perimeter of the foundation, and obstructions such as conduits and structural members and a minimum of 8 inches (20CM) should exist between the cables and any drains.
- ⚠ WARNING** There should be a minimum of 2 inches (5 cm) of concrete or sand above and below the heating cables.
- ⚠ WARNING** Allow the concrete to set for at least 30 days before the heating cables are turned on.
- ⚠ WARNING** **There should be no moving groundwater in the building area. Natural moisture in the soil is acceptable. If in doubt, contact King.**
- ⚠ WARNING** Please consult the King for any other questions, concerns or advice.

INSTALLATION INSTRUCTIONS

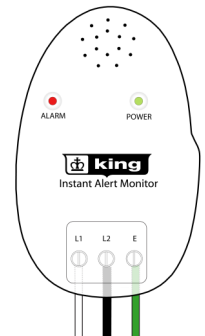
Measure The Resistance

- Use a digital multi-meter to measure the resistance between the conductors of the mat power leads. Record these resistances on the **Cable/Mat Testing Log** under section **“Test Record # 1 Prior to Installation”**. The resistance between the white and black lead wires should be within the resistance range on the nameplate label. If it is a little low, it may be due to low air temperatures or meter calibration. Consult the factory if you are in doubt.
- The resistance between the white and black leads and ground lead should be “open”, usually indicated by an “OL” or whatever your meter shows when the test leads and ground lead should be “open”, usually indicated by a reading. Record this information and contact the factory before installing. This could indicate damage, test lead problems, or a number of other issues. Try “pinning” the test leads to the cable/mat lead wires against a hard non-metal surface if your readings fluctuate.
- Your electrician should perform an insulation resistance test on the mat. A mega ohm meter adjusted to a minimum 1000 VDC should give a measured value at least 20 mega ohm (MΩ).

⚠ WARNING Mega Ohm meters apply high voltage and could shock or cause serious injury if improperly used. Follow mega ohm meter instructions for safe and proper use.

IMPORTANT! Use King’s Cable Alarm Monitor during installation.

- **It is recommended to use the King’s Cable Alarm Monitor (Model # FCS11) during installation. When connected, the device will constantly monitor the heating wire during the entire installation process. If the wire is cut or damaged during installation, this device sounds an alarm. The FCS11 will prevent burying a damaged wire below hardened concrete.**



Installing The Heating Cable

The TC cable must be laid out with even spacing over the entire area to be heated. To ensure an accurate and easy method of installing it is recommended to attach to rebar or wire mesh. The heating cable can be attached directly to the rebar or wire mesh using tie wraps. Secure the heating cable at the correct center-to-center distance. Do not secure the cable too tightly as this may damage the cable.

5.3 Center-to-center (C-C) Distance

To determine the approximate c-c distance of the TC cables, the following formula below can be used, or consult with the engineer responsible for the building construction. To determine the

$$Cable\ Length\ (ft) = \frac{Power\ (W)}{9}$$

Since the length will not exactly match a standard TC cable length, select an appropriate combination of cables. Then, proceed to calculate the c-c distance:

$$c - c\ (in) = \frac{Area\ (ft^2) \times 12}{Cable\ Length\ (ft)}$$

INSTALLATION INSTRUCTIONS

Planning

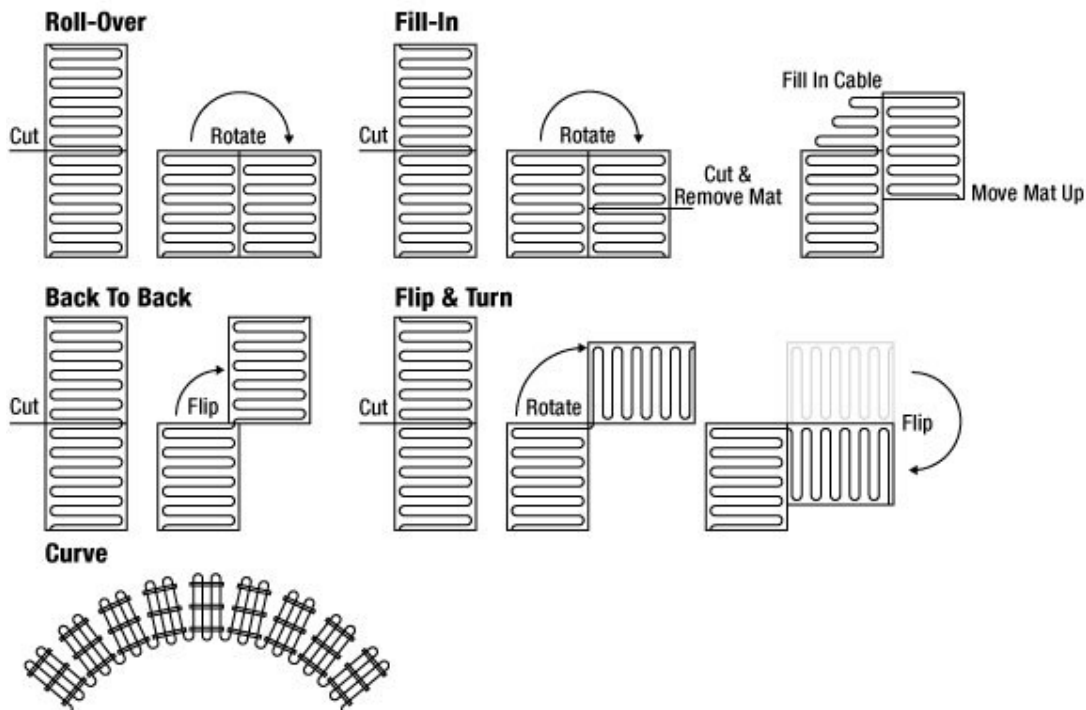
Prior to installation, It is recommended to sketch a plan of the layout of the heating system. Cable/Mat locations, sensor placement, junction boxes, conduits and the location of drains and other obstructions should be noted.

Installing the Cable / Mat

Begin by fastening the heating cable or mat to the mesh reinforcement or rebar using tie-wraps. Do not fix the heating cable or the mat in such a way that it is compressed or strained - it must be able to move. Unroll the mat up to the point at which it is to be flipped and turned. Use the figure above for suggestions on how to alter the mat.

Cut the tape using scissors and rotate the mat so that it can be unrolled to cover the area next to the already unrolled mat.

Do not cut the cable! The cable can be carefully detached from the tape and then placed as free cable. This feature can be very useful for curves and around drains or other obstructions.



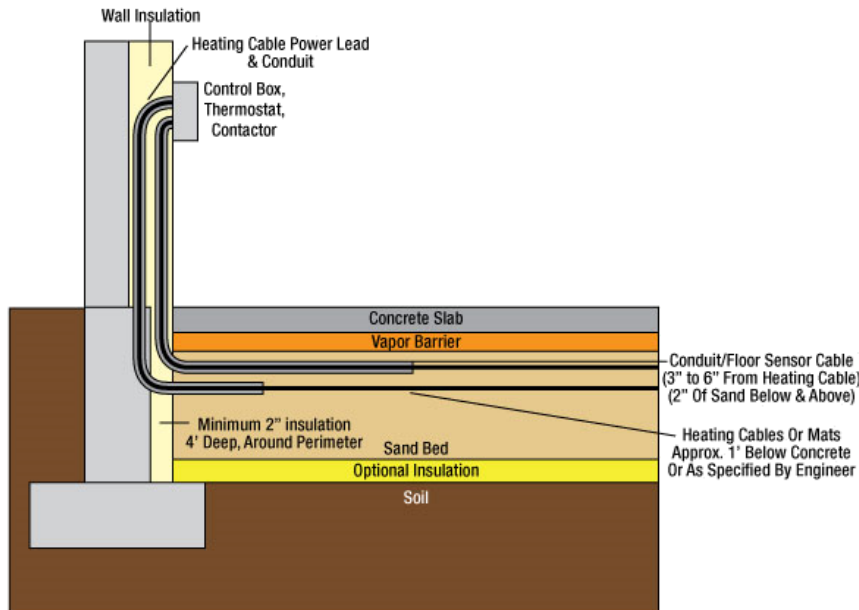
Mat Alterations

The TC heating mats can be altered to accommodate drains, obstructions or bends in the layout. By carefully cutting the mat, many patterns and designs can be created. The figure below illustrates this.

WARNING: DO NOT CUT THE HEATING CABLE.

INSTALLATION—SAND BED APPLICATION

Installation Diagram:



TC / TCM Installation in Sand Bed - Step by Step

STEP 1: PLAN YOUR LAYOUT

Make a sketch of the area to be covered with heating TC / TCM cables/mats. Determine the location of fixtures such as drains, pipes, electrical conduits, structural members. Remember to keep a distance of 12 inches (30cm) around such obstacles. All obstacles that shall be in the concrete slab should be installed prior to TC / TCM cables/mats installation to avoid damaging the cable.

STEP 2: STARTING THE SAND BED

Ensure that the ground below the sand bed is well compacted, free of organic materials, and generally suitable for a stable for laying a suitable foundation. Proceed to fill the area with washed masonry sand. The sand should be free of organic material, stones, debris or any other object that could damage the cable. Moisten, and compact the sand. Raise the sand to a level of 12 inches below the bottom of the concrete slab, or as specified by the engineer. The layer of sand should be at least 2 inches thick.

STEP 3: INSTALLING THE FLOOR SENSOR AND CONDUIT

A floor sensor for high temperature protection must be installed in rigid conduit. The conduit protects the sensor and facilitates its replacement in the unlikely event of failure.

The sensor and the conduit may be installed during the initial construction work and then connected at a later date. Please observe:

1. Ensure that the conduit is sealed before the sand is poured.
2. The conduit must be positioned between the heating cables. This is usually 12 inches below the bottom of the concrete slab.
3. Keep the conduit as short as possible and to minimize the number of bends in the conduit. This will ease the installation of the sensor.
4. Place the sensor inside the tube until it reaches the end of the conduit.
5. Sensor & conduit should be placed within 3 to 6 inches of the heating cables and with at least 2 inches of concrete or sand above and below.
6. The floor sensor should be installed at least 3 feet (1m) into the heated area.
7. The floor sensor has a standard 10 foot (3m) lead that may be extended with 20 AWG wire.

INSTALLATION—SAND BED APPLICATION

STEP 4: MEASURE THE RESISTANCE OF THE HEATING CABLE

Using a digital ohm-meter, measure the resistance of the TC cable. Compare the measured value with the resistance listed on the label of the power lead.


Remember to record the measured resistances on TC Cable / TCM Mat Testing Log under the section “Test Record # 1 Before Installation”. Documenting the resistance at each stage of the installation is required for warranty purposes.

STEP 5: INSTALLING THE TC/TCM CABLE/MAT

Install the TC/TCM cable/mat according to the sketch made in Step 1. The cable/mat should be secured to prevent movement in subsequent steps. Follow instructions under section “Installing the Cable / Mat” on page 4.

At least 12 inches (30 cm) of the power lead must be embedded in the mass material. The remainder of the power lead should be in a conduit that extends to the thermostat or contactor. The power lead may be extended if required.

Measure the resistance once again, and record in the **TC Cable / TCM Mat Testing Log under the section “Test Record # 2 During Installation”**.

 **IMPORTANT TIP:** It is recommended to take a picture of the cable/mat layout and conduit placement during installation. This can help in the unlikely case that the cables/mats need repairs.

STEP 6: FINISHING THE SAND BED

Continue raising the sand bed with washed masonry sand, to approximately 1 inch below the base of the future concrete slab. Once again sand should be free of organic material, stones, debris or any other object that could damage the TC cables. Gently wet the compacted sand until completely saturated with water.

Ensure that the contractors are careful not to damage the cable with tools, heavy machinery, etc.

Install a vapor barrier over the sand bed with 6 inches of overlap for adjacent sheets. Finish the sand bed with an additional 1 inch of compacted sand. This will help to prevent movement of the vapor barrier when during subsequent steps.

Measure the resistance once again, and record in the **TC Cable / TCM Mat Testing Log under the section “Test Record # 3 After Installation”**.

It is not recommended to power the cable at this time.

STEP 7: POUR THE CONCRETE SLAB

Pour the concrete slab. Ensure that the contractors are careful not to damage the cable with tools, heavy machinery, etc. Once the slab is poured but concrete is still wet, measure the resistance once again, and record in the **TC Cable / TCM Mat Testing Log under the section Test Record # 3 After Installation”**.

It is not recommended to power the cables/mats for until the concrete has cured (approximately 30 days). Check with the concrete manufacturer for exact curing times. Doing so can affect both the integrity of the slab, and the subsequent proper operation of the TC/TCM cables/mats.

STEP 8: CONNECT POWER SUPPLY AND THERMOSTAT

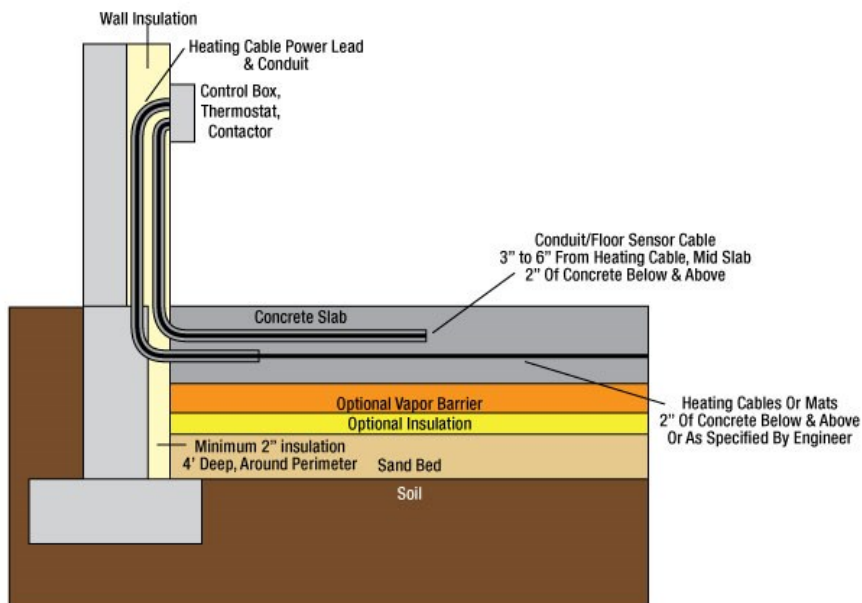
The connection of the thermostat must be done by a qualified electrician familiar with heating cables and in accordance with the National Electrical Code (NEC) and the Canadian Electrical Code (CEC). Remember to properly ground the heating cable braid.

If this is not already done, the sensor should be installed in the conduit. Remember that the sensor should reach the sealed end of the conduit. Connect the thermostat and sensor according to the wiring diagram in appendix A.

A final resistance reading of the cables should be carried out, and recorded in the **TC Cable / TCM Mat Testing Log under the section “Test Record # 4 Final Commissioning”**.

INSTALLATION - CONCRETE APPLICATION

Installation Diagram:



TC/TCM Installation in Concrete Slab - Step by Step

STEP 1: PLAN YOUR LAYOUT

Make a sketch of the area to be covered with heating TC/TCM cables/mats. Determine the location of fixtures such as drains, pipes, electrical conduits, structural members. Remember to keep a distance of 12 inches (30cm) around such obstacles. All obstacles that shall be in the concrete slab should be installed prior to TC/TCM installation to avoid damaging the cable.

You should also plan the location of the thermostats, floor sensors locations and their conduit's location. The start of cables/mats should be as close as possible to the thermostat's final placement. Follow instructions under section "Installing the Cable / Mat" on page 4.

STEP 2: INSTALLING THE FLOOR SENSOR AND CONDUIT

A floor sensor for high temperature protection must be installed in a rigid conduit. The conduit protects sensor and facilitates its replacement in the unlikely event of failure.

The sensor and the conduit may be installed in connection with the actual construction work and connected at a later date. Please observe the following:

1. Ensure that the conduit is sealed before the concrete is poured.
2. The conduit must be positioned between the heating cables. This is usually at approximately the mid-point of the concrete slab.
3. It is recommended to keep the conduit as short as possible and to minimize the number of bends in the conduit. This will ease the installation of the sensor.
4. Place the sensor inside the tube until it reaches the end of the conduit.
5. Sensor & conduit should be placed within 3 to 6 inches of the heating cables and with at least 2 inches of concrete or sand above and below.
6. The floor sensor should be installed at least 3 feet (1m) into the heated area.
7. The floor sensor has a standard 10 foot (3m) lead that may be extended with 20 AWG wire.

INSTALLATION - CONCRETE APPLICATION

STEP 3: MEASURE THE RESISTANCE OF THE HEATING CABLE

Using a digital ohm-meter, measure the resistance of the TC/TCM cable. Compare the measured value with the resistance listed on the label of the power lead.


Remember to record the measured resistances on TC Cable / TCM Mat Testing Log under the section "Test Record # 1 Before Installation". Documenting the resistance at each stage of the installation is required for warranty purposes.

STEP 4: INSTALLING THE TC/TCM CABLE/MAT

Install the cable/mat. The cable and mat is usually installed attached to the rebar or wire mesh of the foundation. Install the TC/TCM cable/mat according to the sketch made in Step 1. The cable/mat should be secured to prevent movement in subsequent steps. Follow instructions under section "Installing the Cable / Mat" on page 4.

The power lead to heating junction and at least 12 inches (30 cm) of the power lead must be embedded in the mass material. The remainder of the power lead should be in a conduit that extends to the thermostat or contactor. The power lead may be extended if required.

Measure the resistance once again, and record in the **TC Cable / TCM Mat Testing Log under the section "Test Record # 2 During Installation"**.

 **IMPORTANT TIP:** It is recommended to take a picture of the cable/mat layout and conduit placement during installation. This can help in the unlikely case that the cables/mats need repairs or for warranty claims.

STEP 5: POUR THE CONCRETE SLAB

Pour the concrete slab. Ensure that the contractors are careful not to damage the cable with tools, heavy machinery, etc. Once the slab is poured but concrete is still wet, measure the resistance once again, and record in the **TC Cable / TCM Mat Testing Log under the section "Test Record # 3 After Installation"**.

It is not recommended to power the cables/mats for until the concrete has cured (approximately 30 days). Check with the concrete manufacturer for exact curing times. Doing so can affect both the integrity of the slab, and the subsequent proper operation of the TC/TCM cables/mats.

STEP 6: CONNECT POWER SUPPLY AND THERMOSTAT

The connection of the thermostat must be done by a qualified electrician familiar with heating cables and in accordance with the National Electrical Code (NEC) and the Canadian Electrical Code (CEC). Remember to properly ground the heating cable braid.

If this is not already done, the sensor should be installed in the conduit. Remember that the sensor should reach the sealed end of the conduit. Connect the thermostat and sensor according to the wiring diagram in appendix A.

A final resistance reading of the cables should be done and recorded in the **TC Cable / TCM Mat Testing Log under the section "Test Record # 4 Final Commissioning"**.

STEP 7: RECORD INFORMATION AND AFFIX LABELS

- Ensure that all resistances measured in steps 3 to 6 are recorded on the warranty card.
- The eight digit product code found on the TC cable/mat power lead must be recorded on the warranty certificate.
- Install the electrical panel label at the electrical panel, indicating the location of the cable.
- Install the Warning label in a visible area of the floor, for the duration of the construction.

It is also recommended that the label be kept in a suitable location on a permanent basis.

STEP 8: BEGIN USE OF TC/TCM

The TC/TCM thermal storage heating system is now ready to use. Increase the temperature gradually and adjust it until it reaches a level that suits your personal preferences.

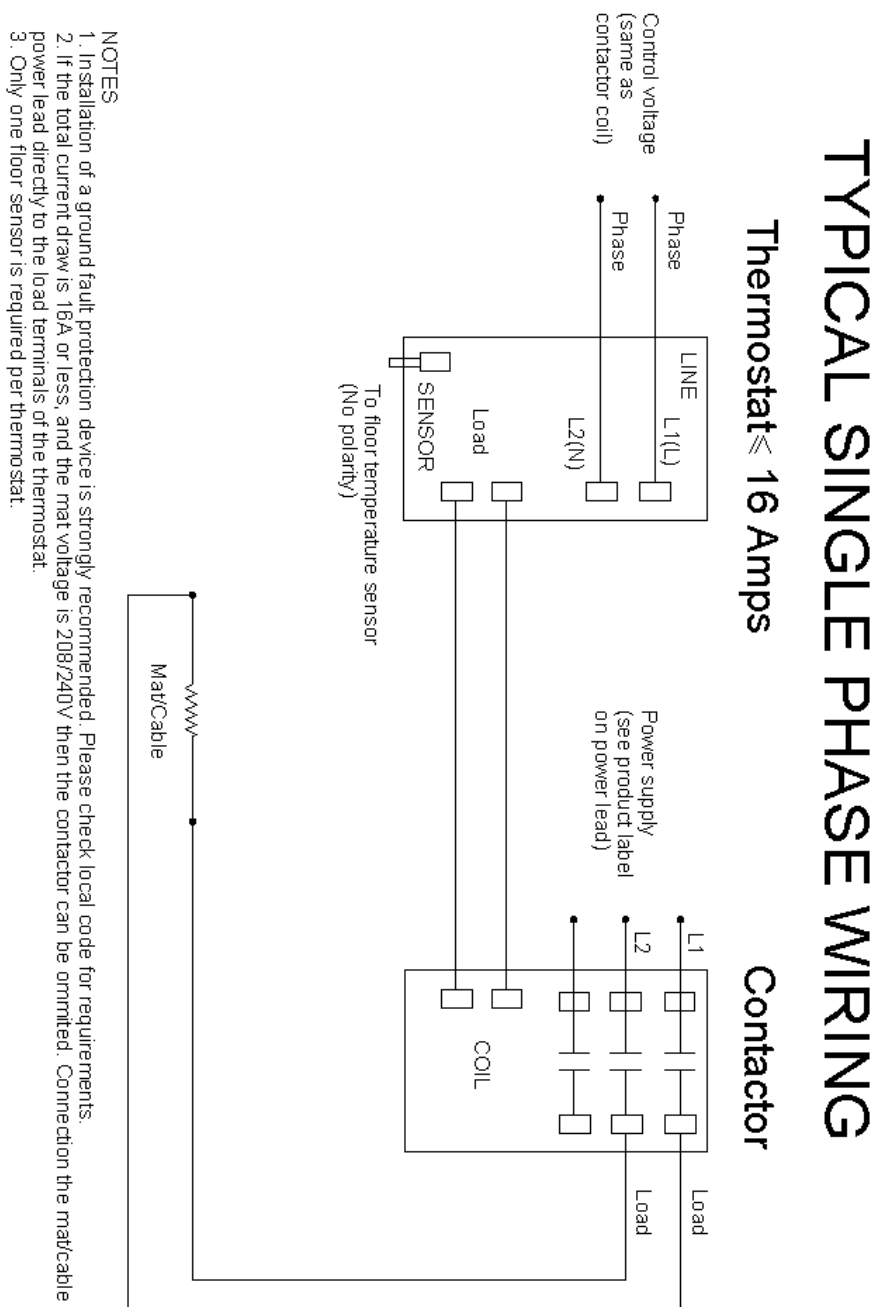
Note that it may take several hours for the thermal mass to heat up the first time the system is powered, or after extended periods of inactivity.

INSTALLATION - CONCRETE APPLICATION

STEP 9: RECORD INFORMATION AND AFFIX LABELS

- Ensure that all resistances measured for Before, During, After and Final Commissioning are recorded in the **TC Cable / TCM Mat Testing Log**.
 - The six digit product code found on the TC cable/mat power lead must be recorded in the **TC Cable / TCM Mat Testing Log**.
 - Install the electrical panel label at the electrical panel, indicating the location of the cable.
 - Install the Warning label in a visible area of the floor, for the duration of the construction.
- It is also recommended that the label be kept in a suitable location on a permanent basis.

APPENDIX A: TYPICAL TC/TCM WIRING DIAGRAM

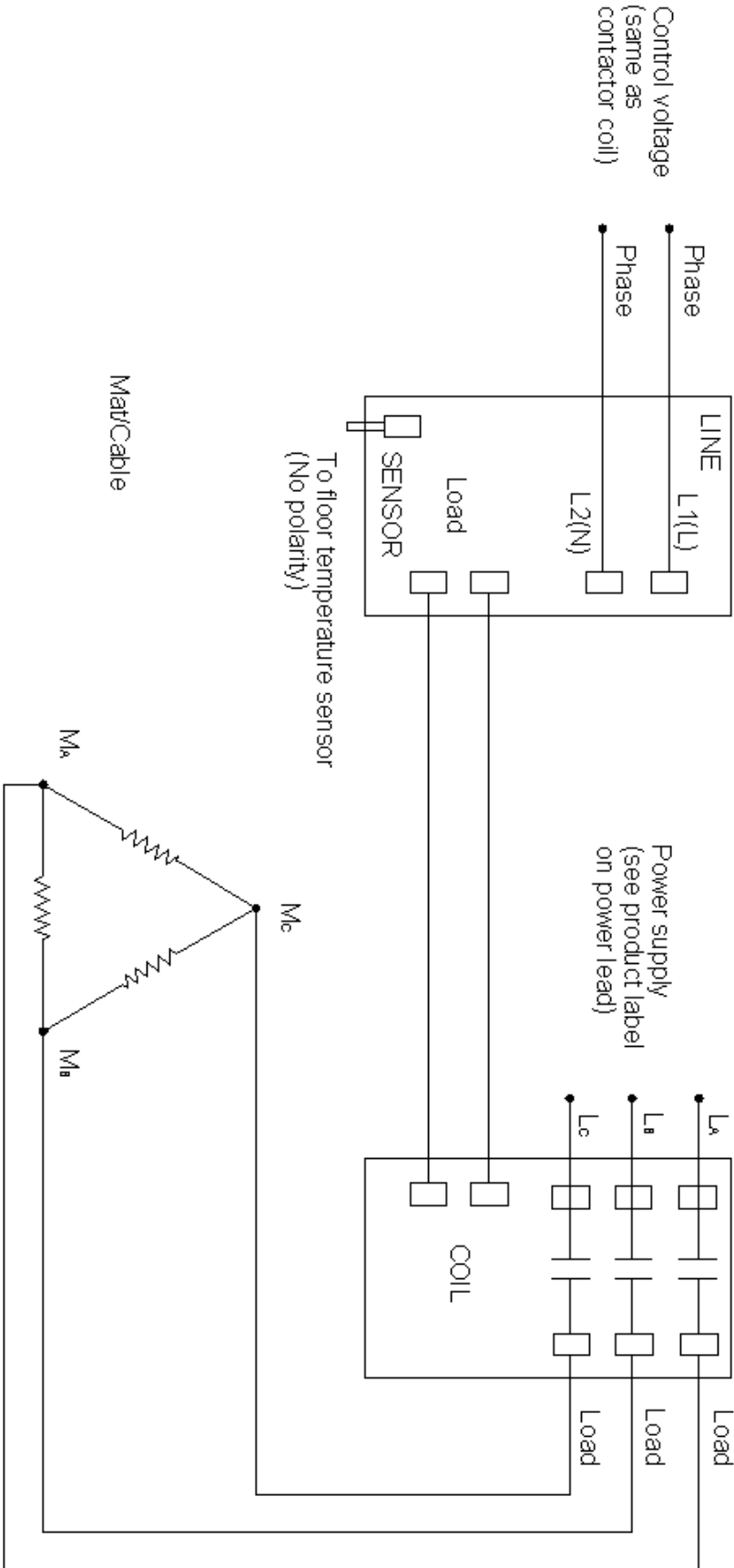


APPENDIX A: TYPICAL TC/TCM WIRING DIAGRAM (CONTINUED)

TYPICAL THREE PHASE WIRING

Thermostat \leq 16 Amps

Contactor



NOTES

1. Installation of a ground fault protection device is strongly recommended. Please check local code for requirements.
2. A minimum of 3 mats/cables is required for this wiring. The mats on each segment should have similar current draws to if a balanced load is desired.
3. Only one floor sensor is required per thermostat.

TC Cable / TCM Mat Testing Log

Customer: _____

Contractor: _____

Address: _____

Address: _____

Phone No: _____

Phone No: _____

Project Reference: _____

Record 1: Before Installation

Cable Type: _____

Cable Length: _____

Cable Model No: _____

Insulation Resistance M Ohms: _____

Tested By: _____

Date: _____

Witnessed By: _____

Date: _____

Record 2: During Installation

Insulation Resistance M Ohms: _____

Tested By: _____

Date: _____

Witnessed By: _____

Date: _____

Record 3: After Installation

(Sand Bed) Insulation Resistance M Ohms: _____

(Concrete Slab) Insulation Resistance M Ohms: _____

Date: _____

Tested By: _____

Date: _____

Witnessed By: _____

Record 4: Final Commissioning

Panel Number: _____

Breaker Number: _____

Volts: _____

Ambient Temperature (deg. F): _____

Recorded Amps: _____

Tested By: _____

Date: _____

Witnessed By: _____

Date: _____