Radiantec INCORPORATED
ENERGY EFFICIENT RADIANT HEATING SYSTEMS, SINCE 1979
PO BOX 1111, LYNDONVILLE, VT 05851 | P: 800-451-7593 | F: 802-626-8045

WITHIN SLAB RADIANT INSTALLATION

Installation Supplement 250

SLABS

Installing tubing in a concrete slab is the simplest, least expensive, and most effective way to install radiant heat. While it is simple to do, it is still very important to do it correctly. If it is not, you can have a floor heating system that is inefficient, costly to operate, and may not work at all. This manual gives you some general guidelines to follow. Keep in mind that these recommendations are general in nature and you should always consult with your code official for code compliance.

DEFINITIONS

1. Zone: A zone is an area controlled by a single thermostat. A zone can be a 30 sf bathroom or a 2000 sf shop. Not to be confused with circuit.
2. Circuit: A length of tubing within a zone. A zone, unless it's really small, will typically be made up of any number of circuits that will connect to a tubing manifold. Multiple, short circuits of tubing are required for system efficiency and even heating. If one long circuit of tubing is installed, the water will cool off too much by the time it reaches the end leaving one part of the room warm and another cool. Plus, the water heater will have to work extra hard to heat the water back up.
3. Tubing manifold: A copper apparatus with multiple tees and shut-offs that allows multiple circuits of tubing to be fed with one supply and one return line.

INSULATE THE SLAB FROM THE EARTH

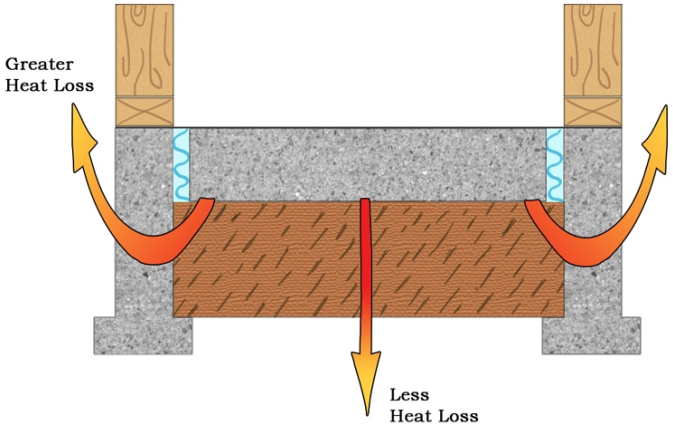
Vapor Barrier (optional)

On top of your compacted earth or sand, you should install a vapor barrier. 6 or 8-mil Visqueen plastic (polyethylene plastic) has always been the material of choice. A vapor barrier prevents ground moisture from entering the slab that could lead to moisture problems inside the building.

Insulating the Slab

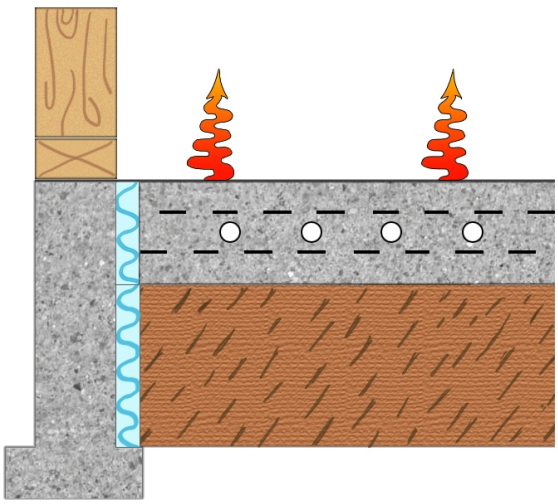
For maximum performance and efficiency, the slab should be insulated from the earth. It is helpful to understand the nature of heat loss to the ground so that we can plan good strategies to reduce it. Less heat is lost straight down with a slab on grade structure.

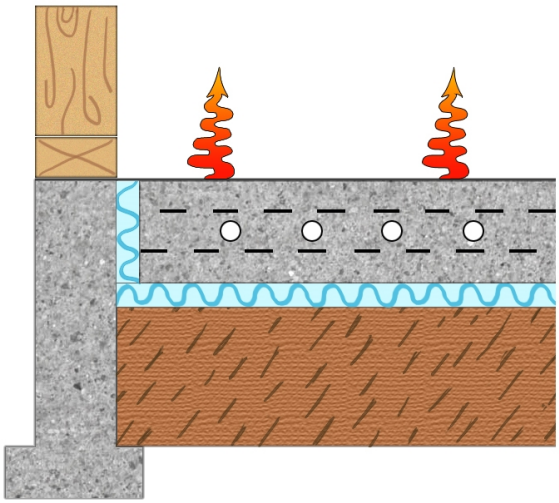
Earth is not a very good insulator, but there is a great thickness of it so that heat does not penetrate much more than 4 feet. Of equal concern is heat loss off to the sides. Slab edge insulation is extremely important and often overlooked.



The proper material for below grade insulation is 2-3" (check local codes) of either expanded or extruded polystyrene, as long as it is designed for below grade use. Other materials are prone to absorb moisture or do not have enough compressive strength or stability over time. Some promote a very thin sheet of air-bubbles with foil. ***This is not an acceptable substitute for rigid expanded or extruded polystyrene.*** There is no substitute at present in our opinion.

You can insulate either vertically down the side of the building or you can insulate horizontally under the slab. The methods are about the same as far as reducing heat loss is concerned. But the choice of insulation method can make a big difference in the ability of the building to store heating or cooling energy.



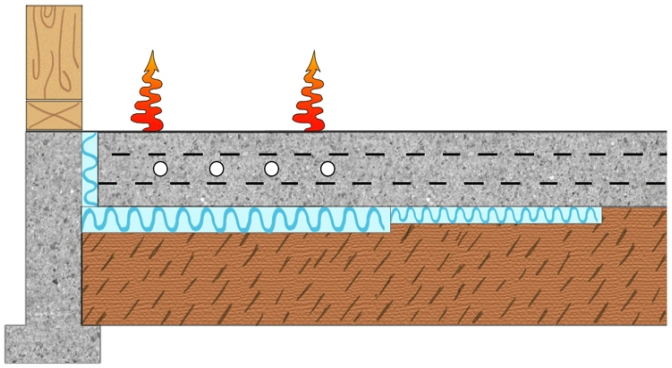


If the insulation is placed vertically, the heat storage ability of the earth is incorporated into the building down to an effective depth of about 3 feet. This results in a building that can store large quantities of heating or cooling energy. Such a building can "coast" through the Spring and Fall seasons without large amounts of heating or cooling energy inputs. Such a building can also be designed to store alternative energies such as solar in an efficient and cost effective way.

On the other hand, the building with vertical insulation will not be as responsive to changes in energy inputs as compared to the building with a horizontal placement under the slab. There will be less benefit from nighttime or weekend temperature setbacks. Larger sized slab on grade buildings can benefit from a special detail with the benefits of both insulation methods.

Larger sized slab on grade buildings can use this detail.

Insulation of decreasing thickness is placed from the perimeter of the slab in towards the middle of the building. It is common to use 2" thick extruded polystyrene for 4 ft and then 1" thick for another 4 ft and then no insulation at all under the center of the slab (diagram at right).



These recommendations come from our 40+ years of experience in the industry but do not supersede building codes. As with any construction project, be sure to check your local codes for recommendations and restrictions.

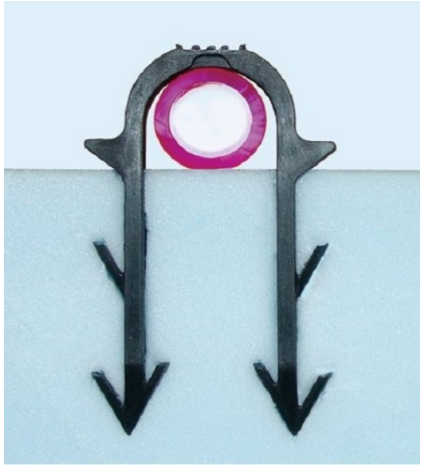
Lay Out the Reinforcing Steel

Many will ask us what they should use for the reinforcing steel. This really isn't a radiant heating question and the radiant system will perform the same with wire-mesh, rebar, or fiber-filled concrete. Rather, this is an answer for the concrete contractor, architect, or engineer involved with the project. The type and amount of steel for a concrete slab is dependent upon how the slab will be used and what will go on it for heavy vehicles.

If you are using rebar, the contractor will layout the appropriate grid and the rebar will be propped up with rebar chairs. The tubing can be attached directly to the rebar using wire ties, nylon or plastic zip ties, twine, or whatever works for you. Most use plastic ties.

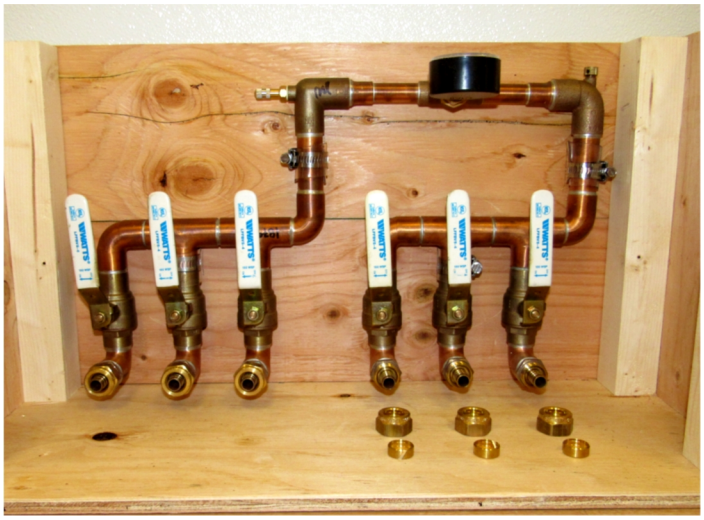
Another popular method is for the contractor to put in wire mesh for reinforcement. In this case, we prefer to see one layer of mesh put down and have the tubing tied to it. Some will then add another layer of mesh over the top which will help prevent damage to the tubing in the unlikely event that it floats up during the pour.

There are some circumstances where reinforcing steel is not used like when fiber reinforced concrete is poured. This concrete has tiny fibers in it that are the reinforcement. In this case, you still need a way to secure the tubing. Some will go ahead and put in the wire mesh anyway for tying purposes and not for reinforcement. Another option is to use staples that are inserted into the foam and hold the tubing in place.



INSTALL THE TUBING FOR A "SLAB ON GRADE PROJECT

The manifold is the place where the main supply line that comes from the heater connects to one or more circuits of plastic tubing. Radiantec projects will use either a "slab manifold" or "wall manifold".



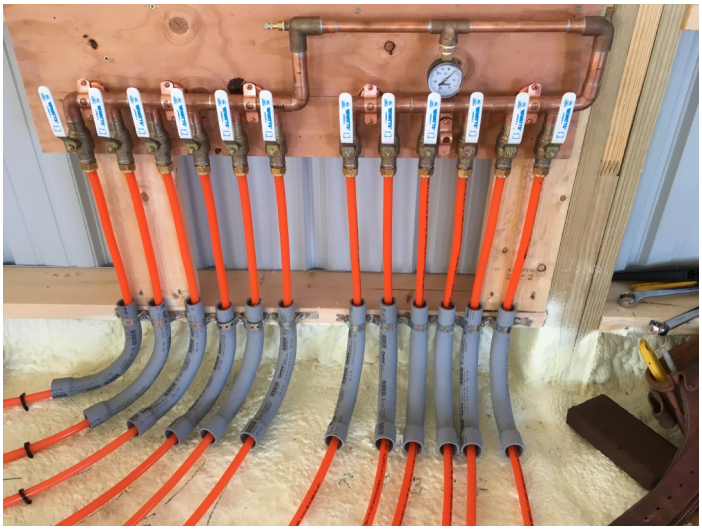
SLAB MANIFOLD

WALL MANIFOLD

The slab manifold is a design of ours where the manifold is shipped inside of a wooden box. The entire manifold, including the plywood box, is then cast into the floor. The plywood box serves to protect the manifold during construction and it also serves as a concrete form. The box can be knocked completely apart after the concrete has set. The manifold now sits in a hole in the floor (called a manifold well). The plastic tubing does not come out of the floor where it could be damaged during the construction process or at any time in the future. Concrete does not come in contact with the copper manifold which would cause corrosion. Access to the fittings is preserved if necessary. If you want to conceal the manifold, fill the hole with sand and lay a skim coat of mortar over it.

Slab manifold fully installed with box broken apart

When the pressure testing equipment is removed, two pipes (one supply, one return) is all that is visible. Arrange for a partition to fall over these two pipes. You can also locate the manifold in a place where it will not be seen, such as a closet.



Some people prefer to have the manifold mounted up on a wall and have the tubing sweep up out of the concrete. This is a perfectly acceptable application and one needs to take measures to protect the tubing where it exits the slab. A PVC sweep will be sufficient.

LOCATE THE MANIFOLD

Radiantec Company provides a worksheet with design recommendations that comes with each price quotation (if you've misplaced your copy, simply contact us for another). Check with Radiantec if you make changes to our recommendations because any changes could affect the size of the pump required. On this worksheet you will find that for each zone we specified the total amount of tubing required and the number and length of the circuits.

For ease of quoting a system, Radiantec only quotes the amount of tubing required to fill the zone and connect to a tubing manifold within that zone. This manifold is often centrally located within the zone but it doesn't have to be. We then anticipate that a copper or pex supply and return line will be run from the pump in the utility room to the tubing manifold and back again.

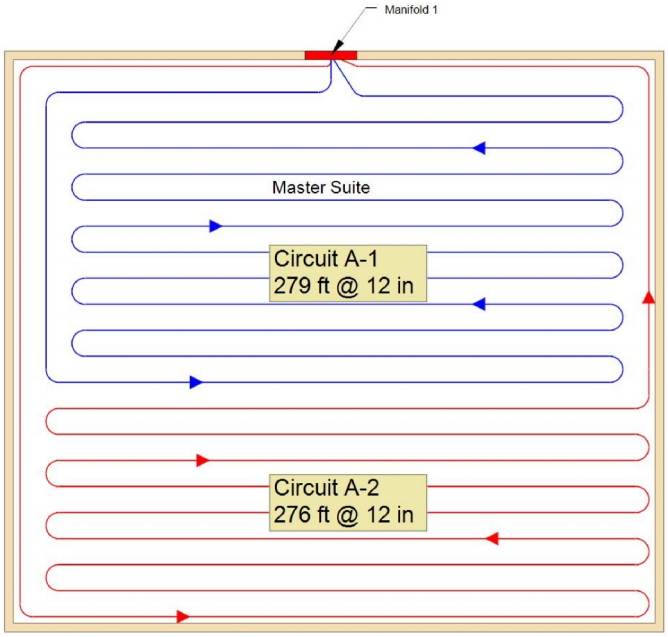
Another option is to place the tubing manifold in the utility room and have each run of tubing start and return there which is called a "homerun." This is an acceptable practice but depending on the distance between the utility room and the zone, there can be a lot of wasted tubing going back and forth. For example, if the tubing manifold is 30' away from the slab, you will use up 30' of tubing just to get out to the slab before you even start making any loops. If "homerunning" the tubing to the utility room is what you want to do, this installation will more than likely require more tubing than what was originally quoted and possibly larger pumps.

ARRANGE THE TUBING ACCORDING TO THE LAYOUT

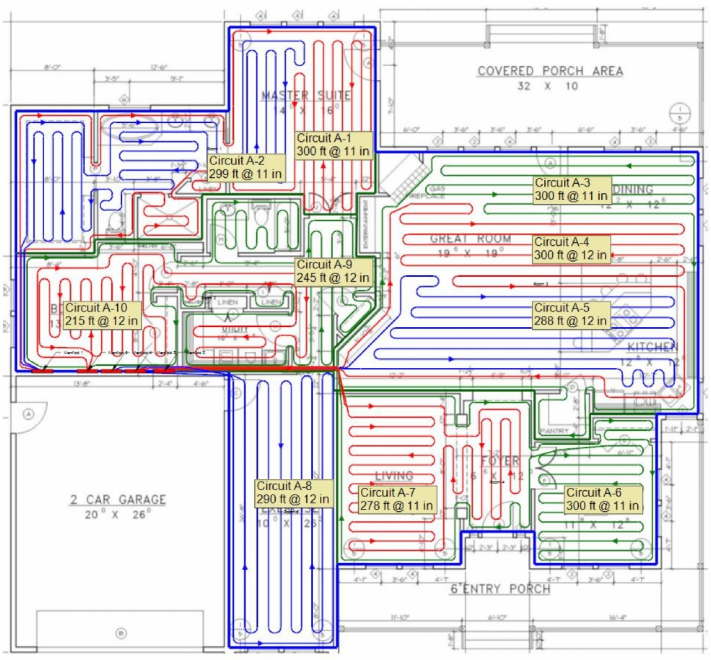
One of the many advantages of working with Radiantec is that we provide a custom tubing layout for free when you purchase the tubing from us. Keep in mind that an exact and perfect layout typically isn't necessary but having something on paper certainly gives you a good idea of how the work can be done.

Not all projects will require a layout because of their simplicity. A square footprint with only 1 or 2 runs of tubing is easy enough to figure out. You simply lay out the tubing by going around the perimeter of the slab and then weaving back and forth until you can make it back to the manifold. The tubing is marked so you'll be able to tell just how much tubing you have left and when you should be making your way back to the manifold.

Here is an example of a simple, 2 circuit layout as well as a more complex layout.



Simple layout



Complex layout

Here are some general guidelines for laying out the tubing:

1. Inspect the tubing as you lay it out. Manufacturing defects in the tubing are uncommon, but they can happen. Shipping damage is also possible. Minor scratches or abrasions are permissible but deep gouges are not.

2. Do not kink the tubing. Refer to the minimum bending diameter of the tubing that you are using (12" for ½", 14" for 5/8" and 24" for 7/8")

3. Tubing may be concentrated in bathrooms and other areas where added heat is wanted.

4. Tubing may be placed closer together around the outside perimeter walls, beneath picture windows, and other high heat loss areas if you want. Any improvement in the evenness of the heating, however, will be insignificant if the building is energy efficient.

5. Work with the tubing at room temperature whenever possible. Keeping the tubing in a heated vehicle, for example, will make the install a little easier on a cold day.

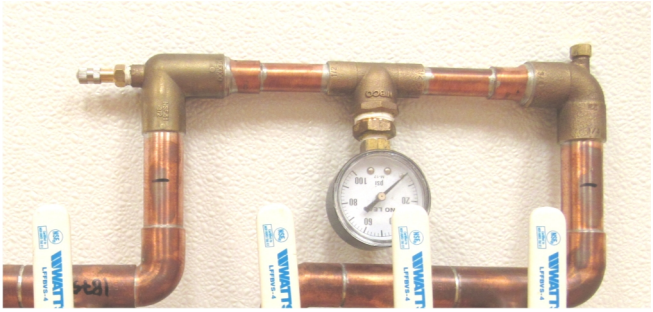
6. Tie the tubing to the reinforcement steel with whatever you want. Inexpensive twine, wire ties, and plastic/nylon zip ties are all acceptable. Tie the tubing very well (approximately every 2 ft) to prevent floating if the concrete mix will be very soupy and if the tubing will not be covered with another layer of steel.

Use multiple parallel circuits instead of just one long one. Refer to and comply with maximum circuit lengths for the tubing that you are working with. Also refer to the worksheet provided with your initial quote. Multiple circuits require less pump work and the fluid will not cool off too much. Because concrete is a decent conductor of heat and today's newly constructed buildings are so energy efficient, an exact and perfect tubing arrangement can waste a lot of time and it is generally not required. It is acceptable if the tubes cross one another as long as the concrete has adequate thickness but you will want to avoid multiple runs crossing each other.

The important points are:

- Put in the linear amount of tubing that is required.
- Space out the tubing reasonably well using our recommended spacing as an average. If we recommend 11" spacing, it is perfectly acceptable for it to be 8" in some areas and 13" elsewhere.
- Do not kink the tubing.

CONNECT TUBING TO THE MANIFOLD AND PRESSURE TEST



The manifold consists of a supply header and a return header that is connected across the top by the pressure testing equipment. At a later time, the headers will be separated for hookup to the heating unit and the pressure testing equipment will be discarded. At this time, however, the equipment will stay together so that the tubing may be pressure tested prior to the concrete pour.

The pre-installed pressure testing kit is an excellent feature of all Radiantec tubing manifolds. We're amazed at the number of installations we see that are done without pressure testing the tubing before pouring.

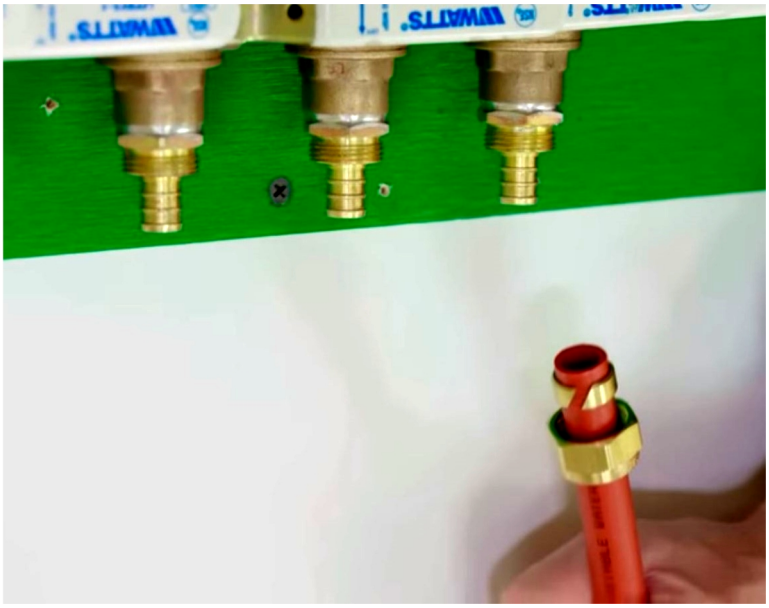
If using the slab manifold, take the top and two face plate boards off so that the manifold is accessible. Most will then simply set the box on top of the foam or whatever reinforcement steel that's being used. Others will secure the partly disassembled box with stakes so that it does not become crooked during the work.

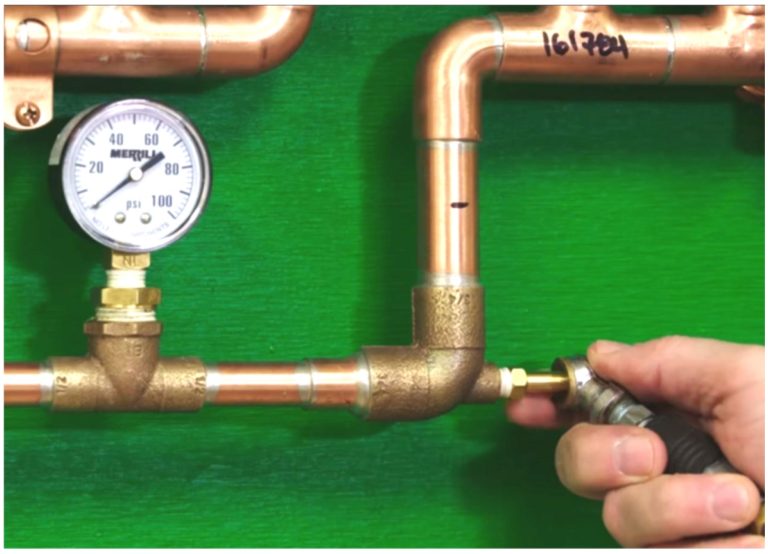
If using a wall manifold, you can attach it to a wall using bell or copper hangers. If there are no walls in place, attach the manifold to a piece of plywood and then to staked rebar or wood to hold it temporarily.

Designate one side as the supply header and the other as the return header (it doesn't matter which). Connect each circuit of plastic tubing to a supply outlet on one side and to a return outlet on the other side. It's a good idea to label each run of tubing so you or someone working on the system in the future will know which supply runs correspond with which return runs. Run the tubing into the box through the opening at the bottom. The tubing should come straight into the plywood box to avoid strain on the fitting. Excessive strain on the fitting may cause it to leak.

Fittings used by Radiantec are of the compression type and no special crimping/expanding tools are necessary. To use these fittings:

1. Cut the end of the tubing with a pipe cutter so that it's square and not at an angle.
2. Take the nut and split ring off of the fitting.
3. Slide the nut and then the split ring over the end of the tubing.
4. Insert the tubing all the way onto the fitting.
5. Tighten the nut onto the fitting snugly with an adjustable wrench.





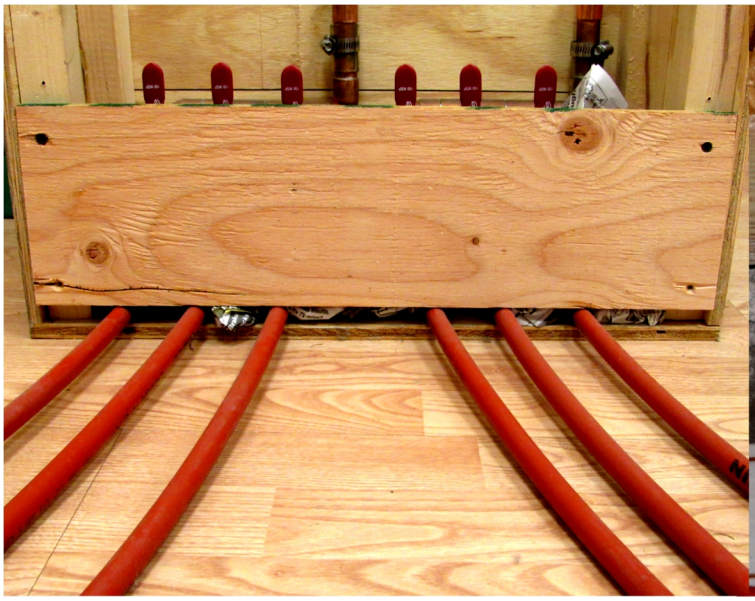
PRESSURE TEST

Charge with air up to 50 psi. Wait two hours. There should be no drop in pressure. If there is, tighten up the fittings and try again. If necessary, you can mix up a bottle of soapy water and spray the manifold connections to locate a leak. Check the pressure the following day. You may notice a 4-6 psi drop due to temperature change.

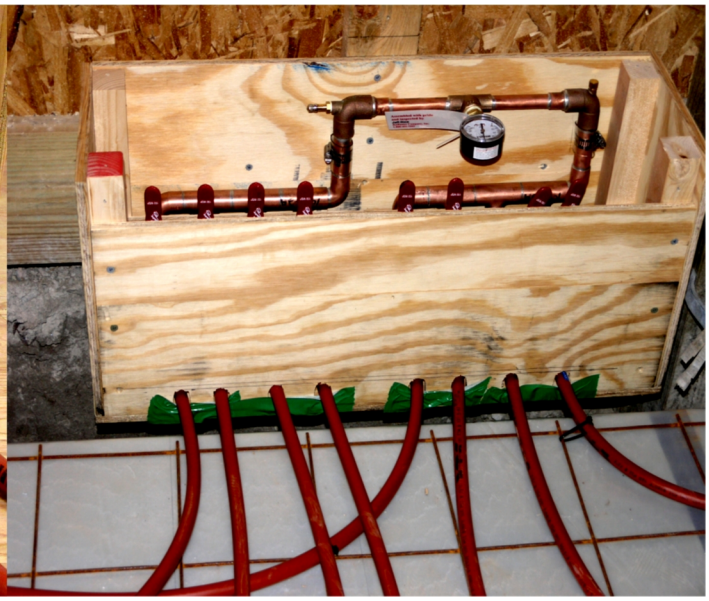
Some code officials may want to see a 100 psi pressure test and this is perfectly acceptable. All Radiantec tubing and fittings are designed to withstand that type of pressure.

GETTING READY TO POUR

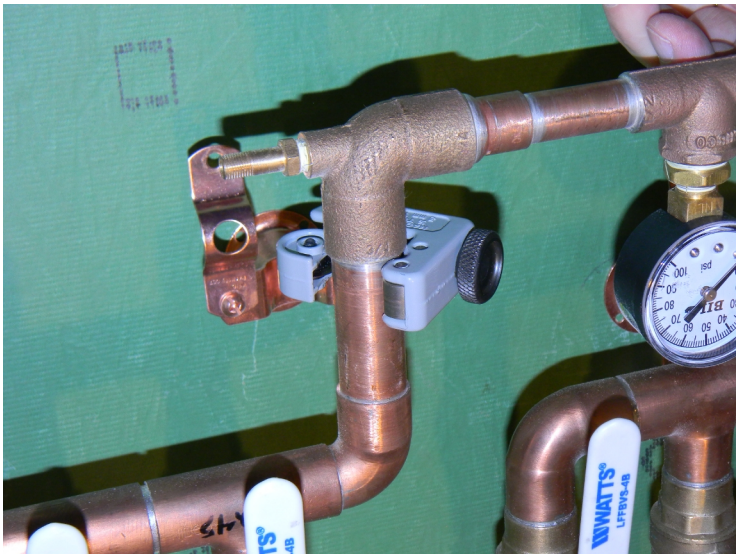
If using a slab manifold, drop the lowest plywood panel down so that it's resting on top of the tubing. You can now fill the bottom of the box with newspapers or rags so that concrete doesn't enter the box during the pour. You can also mark the bottom panel and cut slots for the tubing if you prefer. Here are a couple of examples:

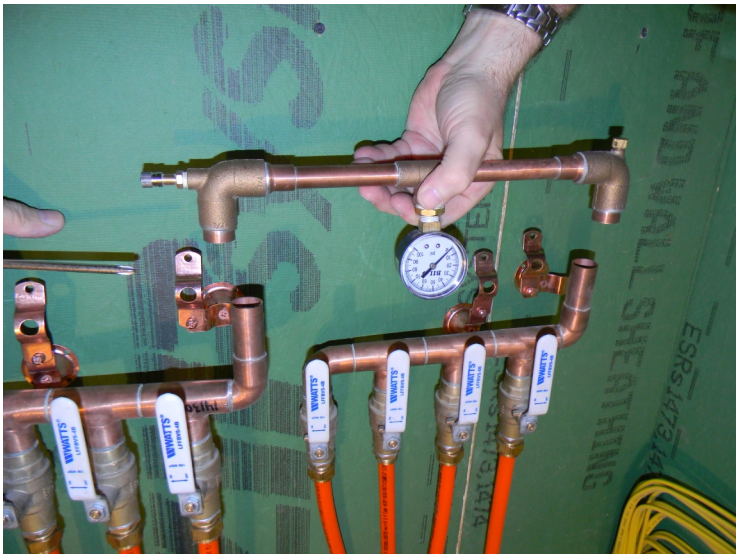


NEWSPAPER STUFFED IN BOTTOM



SLOTS CUT IN BOTTOM





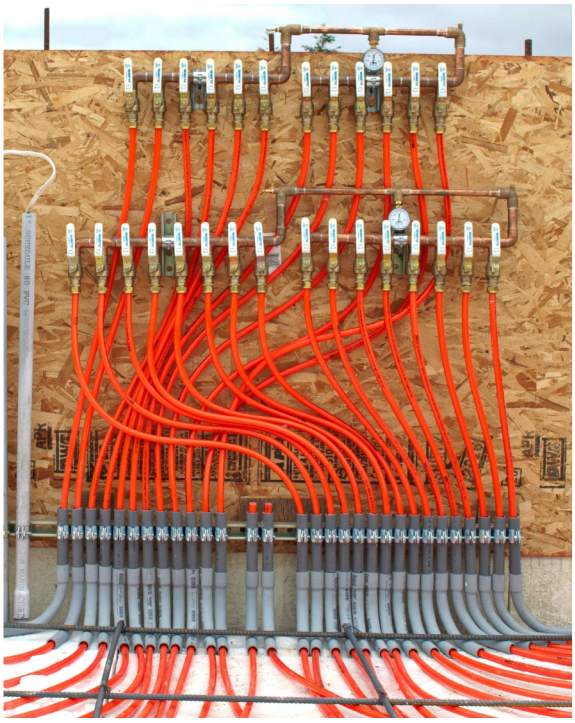
HOOKING UP YOUR SYSTEM

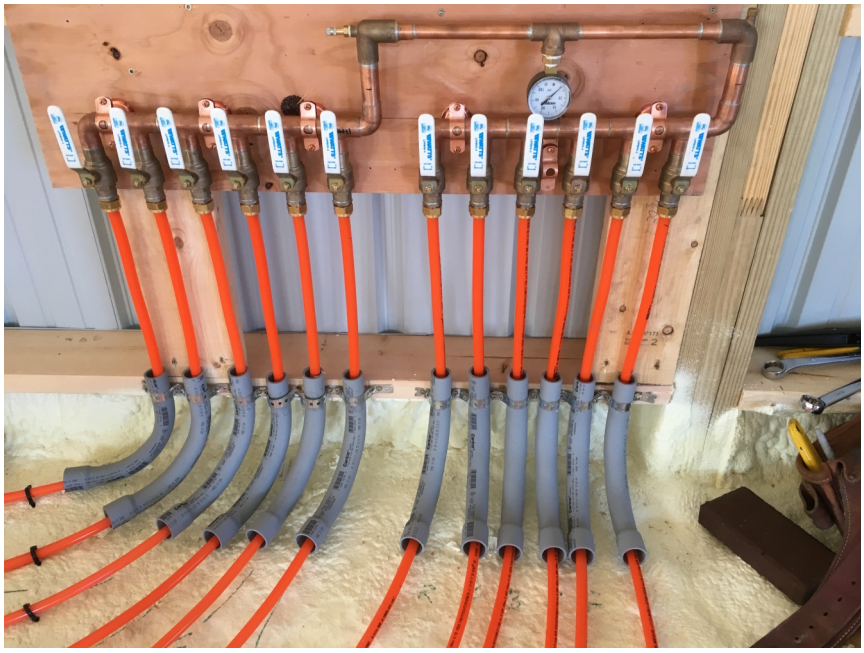
The tubing can remain charged with air until you're ready to hook it up to the heater. The pressure testing kit can be removed by putting heat to both elbows simultaneously and sliding the entire assembly off.

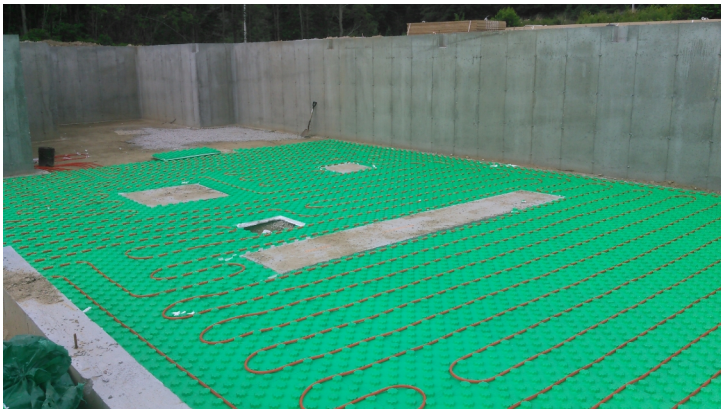
Or, you can use a small pipe cutter and cut just below each elbow. One elbow is the air vent and the other has the air stem. If using a slab manifold be sure to release the manifold from the box by undoing the hose clamps that are holding it. Then, you should be able to tilt the manifold forward just enough to fit the pipe cutter in.

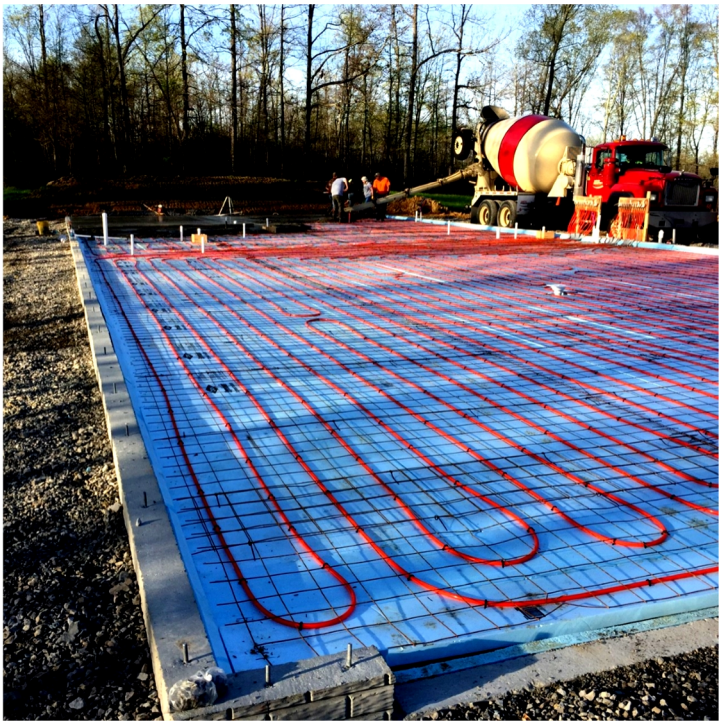
Now that the pressure testing kit is off, you can hook up your copper or pex supply and return lines. Simply choose one side as the supply and the other as the return, it typically doesn't matter which is which.

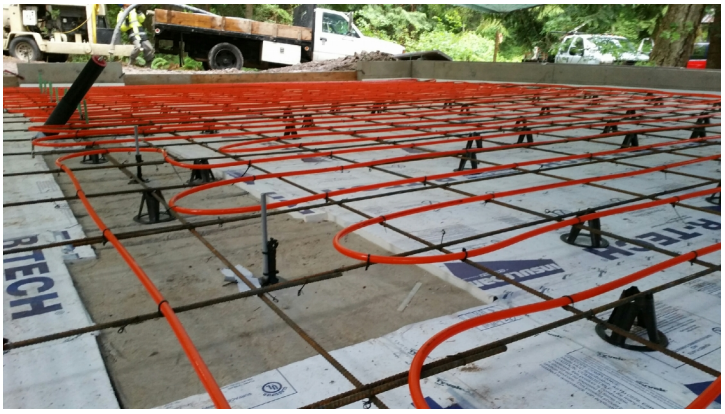
VARIOUS INSTALLATION PICTURES











QUESTIONS? PLEASE DO NOT HESITATE TO CALL US AT 800-451-7593 OR SEND US AN EMAIL AT INFO@RADIANTEC.COM