Radiantec INCORPORATED
ENERGY EFFICIENT RADIANT HEATING SYSTEMS, SINCE 1979
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WITHIN JOISTS RADIANT INSTALLATION

Installation

Supplement 260

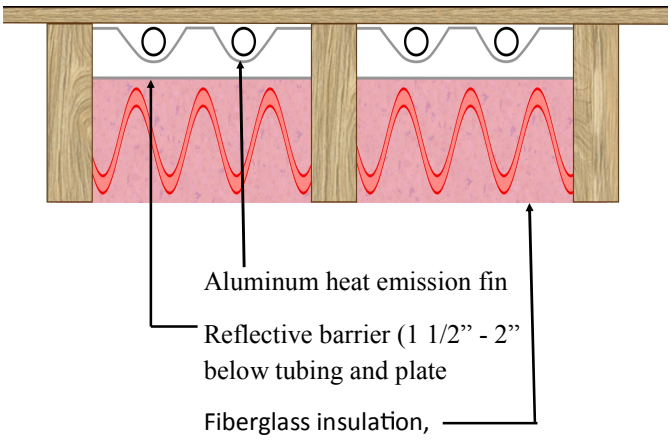
JOISTS

When tubing is installed between the floor joists, it is referred to as the staple-up system. In order to have an effective staple-up installation, 4 critical steps must be taken.

1. Installation of Pex tubing between the floor joists.
2. Installation of aluminum heat emission fins.
3. Installation of aluminum reflective barrier.
4. Installation of insulation

Many companies will tell you that some of these steps are not necessary, in particular, the installation of the aluminum heat emission fins. The system *may* provide you with enough heat but we feel that if any of these important details are left out, you will have a system that is inefficient, costly to operate, and will underperform in terms of total heat output.

To learn more about the benefits of the aluminum fins, please visit http://www.radiantec.com/pricing/heat_transfer_plates.php

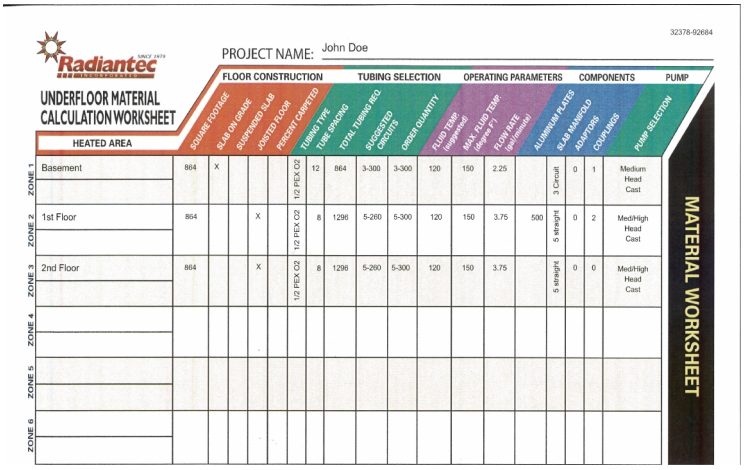


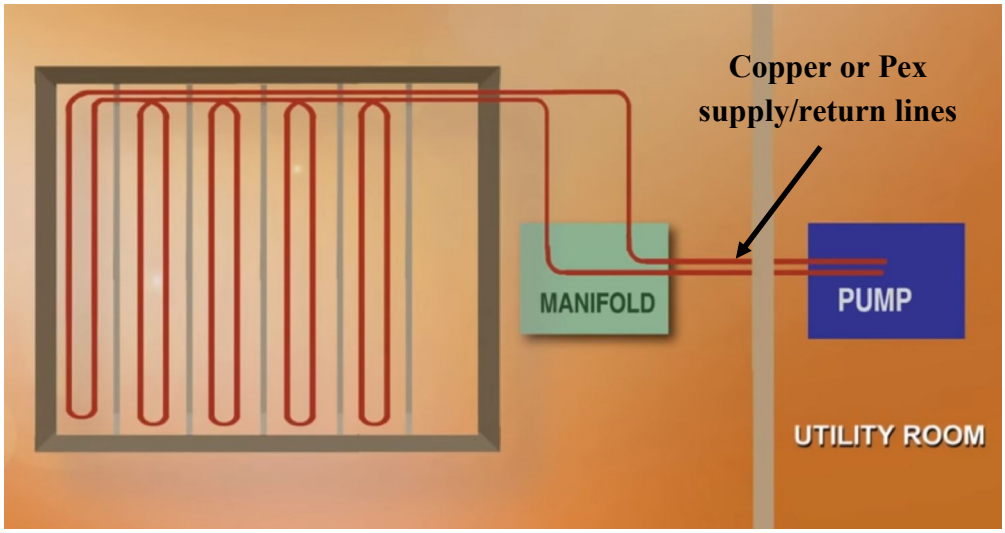
DEFINITIONS

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 that allows multiple circuits of tubing to be fed with one supply and one return line. Typically there will be one tubing manifold per heating zone.

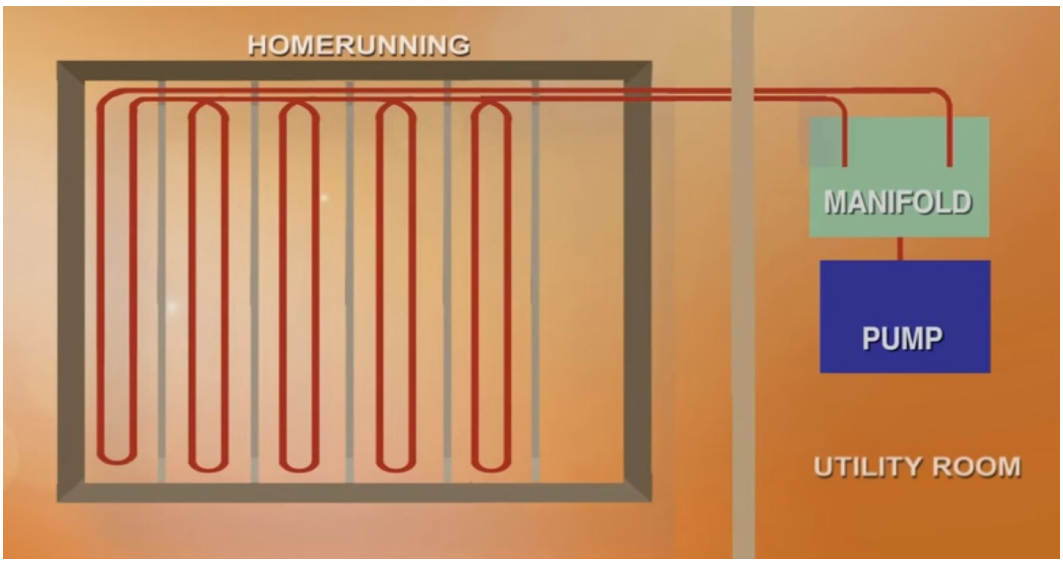
LOCATE THE MANIFOLD

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.





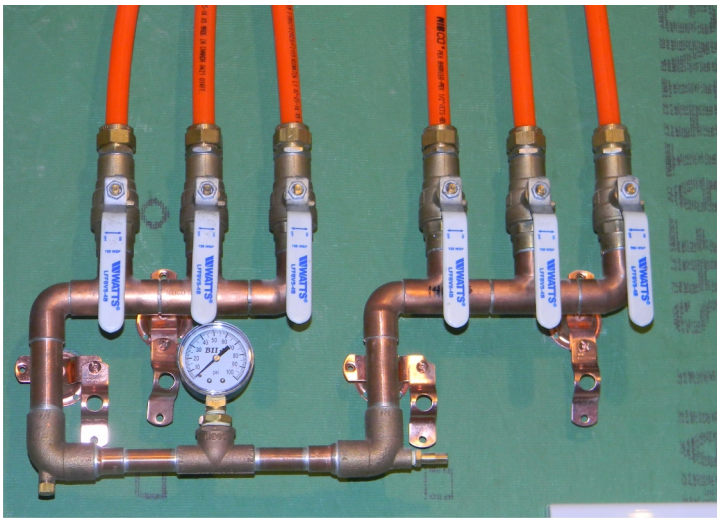
For ease of quoting a system, Radiantec only quotes the amount of tubing required to fill the zone and connect to a tubing manifold within that zone. This manifold is often centrally located within the zone but it doesn't have to be. We then anticipate that a copper or pex supply and return line will 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 first joist, you will use up 30' of tubing just to get out to the joist 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.

We will detail how to mount/install the tubing manifold a little later.

Still another option is to build what is called a long manifold. This is nothing more than a length of copper pipe that spans the entire zone and then tees off to the different circuits. For example, let's say you have a zone with two circuits of tubing. The first circuit starts in bay 1 and ends in bay 5. The second circuit starts in bay 6 and ends in bay 10. A long header would consist of a length of copper pipe (or pex) that comes out of the pump, travels out to the area, connects to circuit 1 in bay 1 by means of a tee, shut-off valve and adapter, then continues onto bay 6 to connect the second circuit. You then have a return line that does the same and brings the water back to the water heater.



Wall-mounted manifold for zone located manifold or homeruns.

Long manifold

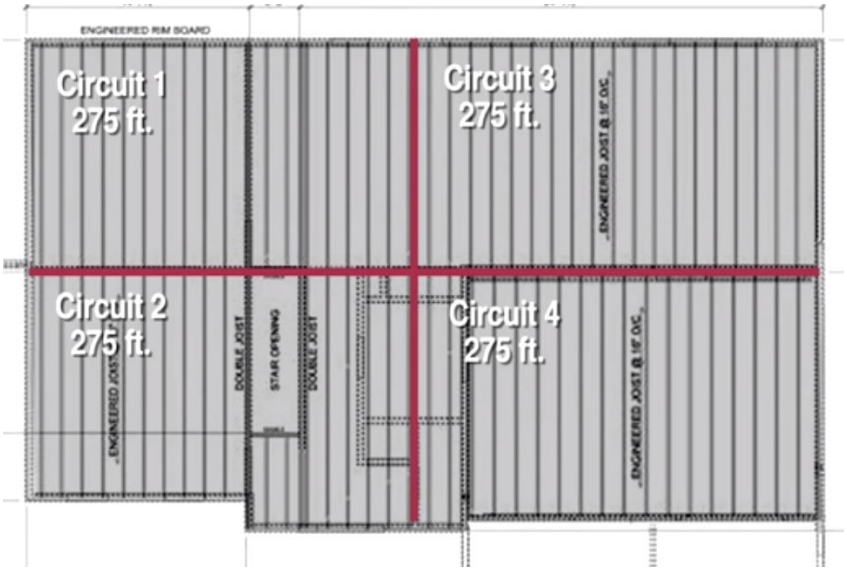
PLAN THE LAYOUT

Circuit lengths should be neither too long nor too short. If the tube length is too long, there will be a tendency for the water to lose too much heat before it reaches the end of tube. The result is tubing at the end of the circuit is exposed to water that has already lost much of its heat and the tubing is then "loafing." For this reason, the longest recommended circuit for ½" and 5/8" tubing is 300' while it is only 200' for the 7/8" tubing.

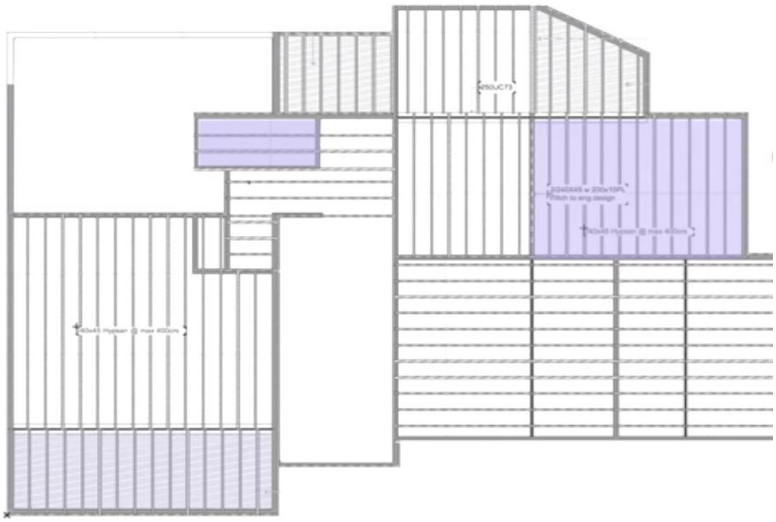
Many people prefer to come up with a layout on paper prior to the installation, which is a good idea. A detailed layout will make the physical part of the work go much easier because you've already done the "thinking" part of the job. Radiantec doesn't typically provide a tubing layout for joisted systems because the joists dictate the layout and there are usually site decisions that will impact the layout that we cannot see from a set of plans.

The simplest way to do the layout is to first find the zone information on your worksheet because most of the pertinent information you need to install your tubing is there; the name of the zone, the type of installation, the type of tubing, the recommended number of circuits, etc. Next, get a copy of your joist plan and break the zone down into equal sections based on the number of circuits on your worksheet. For example, if we recommended 4-circuits at 275', break the zone down into 4 equal sections. Each run of tubing will cover one section.

If the zone is fairly straightforward with equal lengths of joists and void of stairways, and if you will centrally locate the manifold within that zone, you can simply add up the number of joist bays and divide by the number of circuits. For example if you have 24 joist bays and 4 circuits of tubing, you know each circuit will cover 6 bays (24 bays/4 circuits=6 bays per circuit).



There may be other scenarios in which this isn't possible, like the plan at right. If some of the bays are shorter than others (because of stairwells or the zone could be L shaped) then you may have to add up the length of tubing that will be installed in each bay (be sure to add 2' to every bay for the bends) and break up the zone according to equal tubing runs. See chart below.



Always be aware that our goal is to equalize the circuits as closely as we can; a 25'-30' variation is acceptable. Keep in mind, though, if one circuit ends up being much longer than the others, the zone can be "balanced" by tweaking the ball valves on the legs of the tubing manifolds.

If you are "homerunning" the tubing back to a utility area, the first circuit of tubing will fill fewer bays because of the added distance going back and forth. Now that you've broken the zone into sections, you can begin drawing the tubing runs on your plan. Since your drawing is scaled, you will know precisely the length of tubing in each bay and the length of the circuit.

Length of Each Bay: 21' x 2 (for 2 lines in each bay)= 42'

Distance to Manifold: 15' x 2 (for going out and back)= 30'

Length of Tubing Roll: 300'

Subtract Manifold Distance from Roll: 30' - 300' = 270'

Divide Bay Length by 270': 42/270' = 6.43

Number of Bays a 300' Roll of Tubing will Cover = 6

TUBING INSTALLATION

DRILL THE HOLES

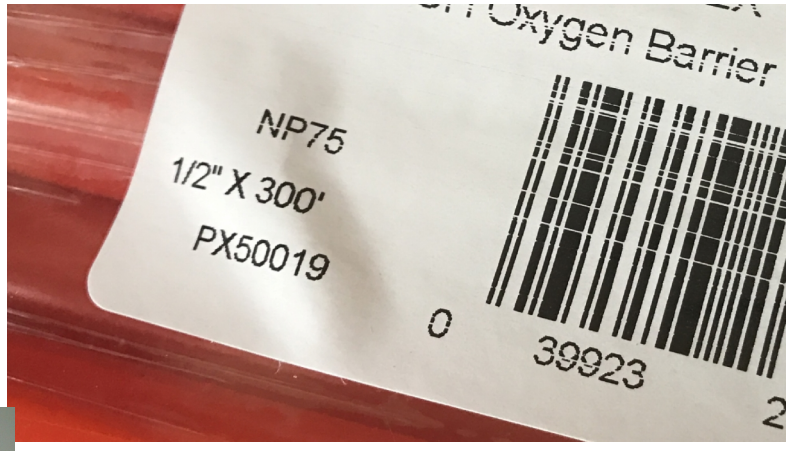
Before you can install the tubing, you must drill holes in the joists. We typically recommend that at least a 1 ½" hole (2" is better) be drilled in order to do the work in the easiest way possible. **You should always check with your local codes to find out if there are any restrictions on drilling holes in your joists.** **BE SURE TO WEAR EYE PROTECTION!**

When installing ½" and 5/8" tubing, there will be 2 runs of tubing in every bay assuming joist spacing of 16" on center. This means that all of the holes will be drilled on the same side of the zone.

The ideal location for the hole is 6"- 8" in from the rim joist and 3" down from the top (to the top of the hole). If you are able to plan well enough in advance, the ideal time to drill the holes is before the joists are installed. If you were not able to do this, you will need to get a drill with a right-angle bit in order to do the work.

INSTALL THE TUBING

While there are many ways to install the tubing, we've found that this method is the easiest for most of our customers. For other ideas you can always do an internet search for videos of "pex tubing installed in joisted floors." We also have a video of this install. Just go to YouTube and type in Radiantec in the search bar; all of our videos will come up.



Before you start, make sure you check the labels on the tubing to be sure you're using the right rolls. It is common for some zones to call for 250' rolls while others may call for 300' rolls. Next, be sure to tape up the ends so you keep dirt and shavings out of the system.

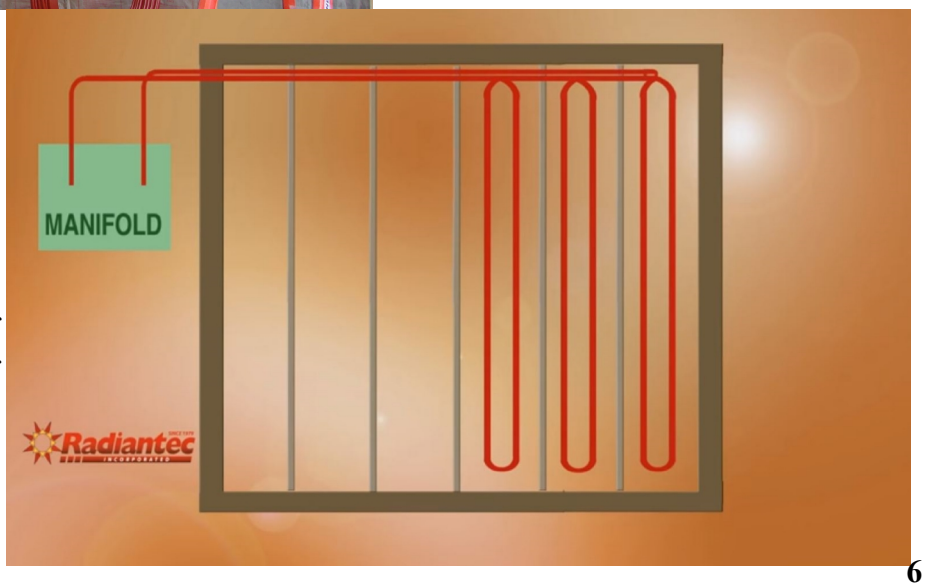
1) In each bay that 1 roll of tubing will cover, start by putting in a 4-5' loop that will hang down towards the floor. When all bays have a loop, continue with the end of the tubing to the manifold location.

A video of this process can be seen on our YouTube channel. Go to YouTube and search "Radiantec" and our videos will pop up. Or, enter this into your web browser: https://www.youtube.com/watch?v=YESpHAvf0yI

2) Next, with one person uncoiling tubing from the roll, start feeding the tubing into the bay closest to the roll. Uncoil enough tubing so that the loop hangs down to the floor. Then, feed that loop into bay 2 and continue this process until the tubing is transferred into the last bay. Completely fill the last bay and install a couple of aluminum heat emission fins to hold the tubing up to the floor. Now do the same process for the rest of the bays. The picture to the left shows the worker getting ready to feed slack into the bay on his left.

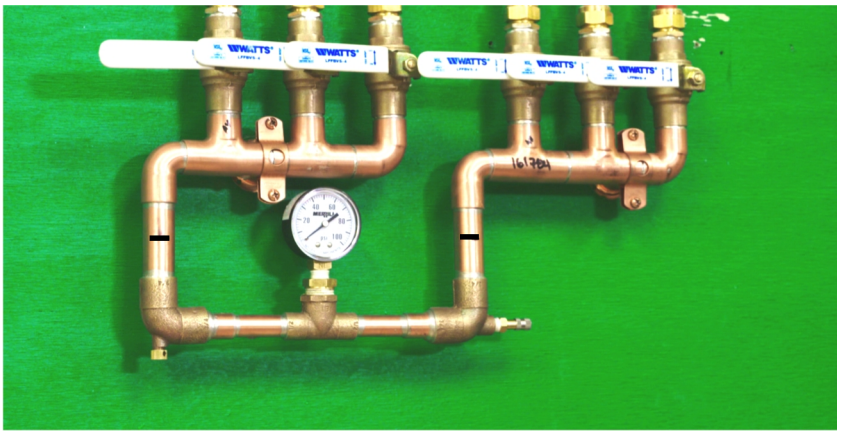
3) Once all of the bays have been filled, uncoil the rest of the tubing and feed the end back and connect to the manifold.

It is possible during the installation that you may kink the tubing. If the tubing just has a small dent then you can wrap the tubing with a rag and with a pair of channel lock pliers, round it back out. If there is a sharp crease, however, you will need to cut the tubing and put in a repair coupling. If in doubt, always put in a repair coupling.

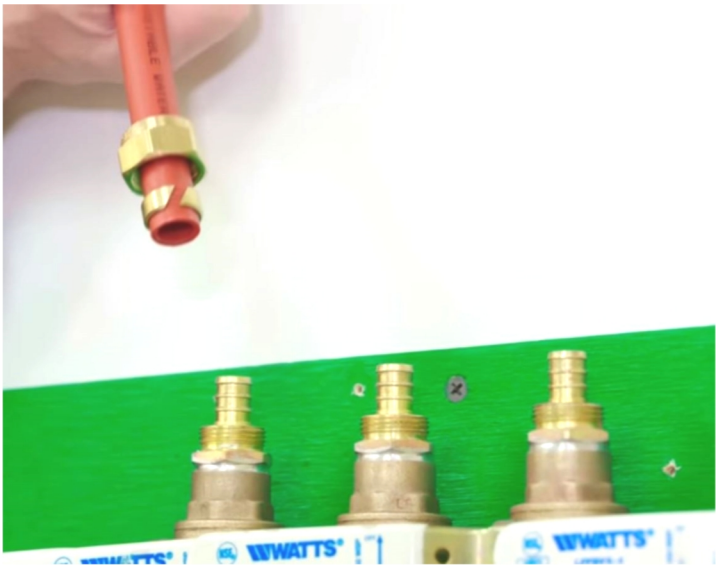


INSTALLING THE TUBING MANIFOLD

The tubing manifold is easily installed by first securing the bell hangers onto the wall. Next, the tubing manifold fits onto the bell hangers. Be sure to use a level for a professional appearance. We usually supply (sold separately from the manifold) 4 bell hangers per manifold but larger manifolds (6 circuits or more) may get at least 6.



ATTACH THE TUBING TO THE MANIFOLD

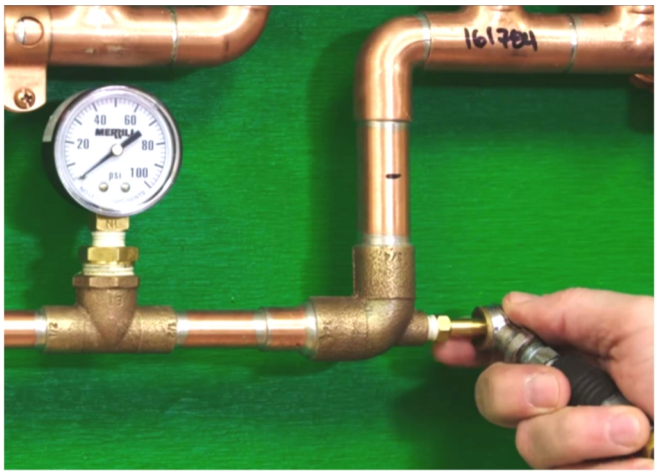


Radiantec uses nut and ferrule style fittings which are also called compression fittings. We use these so that our DIY customers don't have to go out and by a special and expensive tool for a one time use. With these fittings all you need is an adjustable wrench.

To install the tubing onto the fitting, first unscrew the nut from the manifold and a ferrule (compression ring) will come off with it. Slide the nut and then the ferrule over the tubing. Slide the tubing onto the ribbed fitting on the manifold and tighten the nut. We usually go 2-3 turns past "hand-tight."

PRESSURE TEST THE TUBING

An attractive feature of all Radiantec manifolds is that they come fully assembled with an easy to use pressure-testing kit. It's wise to pressure test your tubing before you get too far into the process. The time to find any potential issues is *before* you put in all of the plates, barrier, insulation and sheetrock!

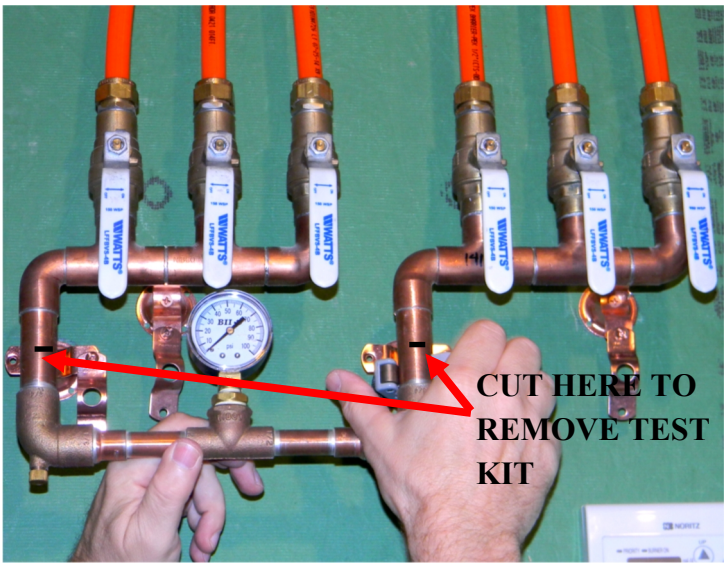


We use a regular valve stem so any air compressor with an attachment that will blow up a tire will work. We recommend pressure testing up to at least 50 psi. Some codes require a 100 psi pressure test and that is perfectly acceptable. All Radiantec equipment can easily handle 100 psi.

Once you fill the tubing with air, watch for 30 minutes. There should be no drop in pressure. If there is, mix up a bottle of soap and water and spray all of the fittings including the ball valves. Almost always if there is a leak it is found at the fittings and you simply have to tighten them more. Once in awhile the packing nut behind the ball valve handle comes lose during shipping and has to be tightened.

Keep the tubing under pressure overnight and check again. There could be a 4-6 psi drop due to temperature change and that is acceptable.

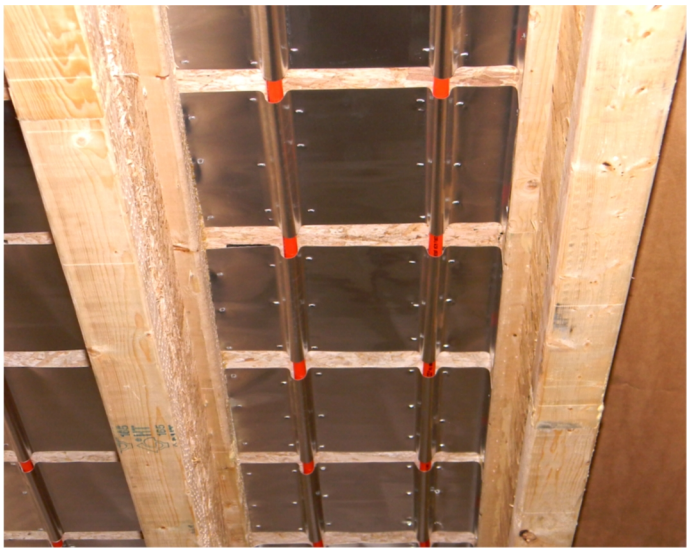
The pressure testing kit will be removed when you are ready to hook up the mechanicals by cutting on the 2 black marks. Then you are ready to connect your supply and return lines. One side is the supply and the other the return, you pick which is which.



INSTALL ALUMINUM HEAT EMISSION FINS (aluminum plates)

Now that you've passed the pressure test, it's time to put up the rest of the aluminum heat emission fins. People use either a hand, electric, or a pneumatic stapler. If using a hand or electric stapler we recommend using 3/8" staples. If using a pneumatic stapler we recommend using 1/2" staples. If you have Advantech subflooring, chisel point staples work the best. The plates have sharp edges so be careful! We also advise that you use hearing protection.

Our rule of thumb spacing of the plates is to space them in continuous coverage in baths, carpeted areas, and areas with high heat loss (leave a 2" gap). In all other areas you can space them every 6-8". Keep in mind that it is ideal to cover the tubing completely with plates for maximum heat transfer, but it is not mandatory.



Plates in continuous coverage.

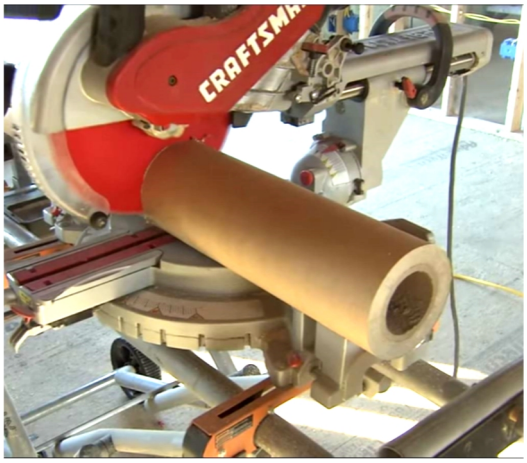
Plates spaced 6" apart.

INSTALL THE ALUMINUM REFLECTIVE BARRIER

About 1-2″ below the radiant tubing and plates, you should install aluminum reflective barrier. This is nothing more than a craft paper with an aluminum facing. It has fibers that run through it so it doesn't rip or tear but it can be cut with a pair of scissors. The reflective barrier comes on a roll that is 50″ wide and must be cut so that it can fit between the joists.

Assuming the joists are 16” on center, you can cut the roll into thirds using a sharp hack saw or a chop saw as shown. You will be left with 3 rolls that are approximately 16 1/2” wide which will leave you about a 1” tab to staple to the side of the joist.

The purpose of the reflective barrier installation is to reflect the radiant heat waves back up towards the sub-floor. We are also trying to create a small dead air pocket that further helps to equalize the heat transfer. Some will argue that the reflective barrier isn’t necessary and that it will become covered up with dust and lose its effectiveness over the years. We still feel it’s an important piece and since it’s relatively inexpensive, it should be installed.



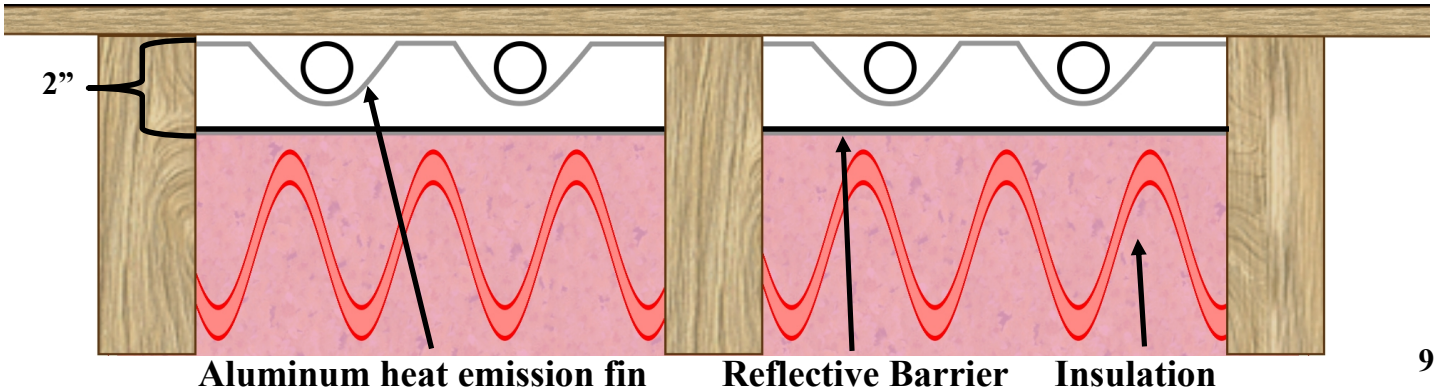
Reflective barrier installed

INSTALL INSULATION

Many people ask us if it’s necessary to also install insulation below the radiant tubing, heat transfer plates, and reflective barrier. If you can only do this once because the ceiling will be finished then the answer is absolutely yes. The amount of insulation is dependent on what is above and below. If there is carpeting or a high heat loss area above then you should put in R-19. If not, you can probably get away with R-13 but R-19 is better. The type of insulation doesn’t really matter all that much.

If the ceiling will not be finished, some will wait and see how the system performs and then add the insulation after, if necessary. What can happen if you don’t insulate? Since radiant heat will go in all directions, the heat can just as easily go downward. The basement will get too warm and you won’t get enough heat into the space above.

If there is an unheated basement below then you should use R-19. Most people don’t mind if they lose a little bit of heat downward in this scenario. If the heat loss downward is entirely wasted to a crawl space, for example, then your insulation method should be extensive. You should try to get in a minimum of R-30. Some will insulate between the joists with fiberglass and then seal the entire underside with rigid foam.



WILL A RADIANT FLOOR SYSTEM WITHOUT ALUMINUM HEAT EMISSION FINS WORK?

We get this question a lot because let's face it, people want to save money. Aluminum is expensive. We get it! Radiantec considers itself to be an "energy efficiency" company. Everything we do and everything we quote is for the sole purpose of creating the most energy efficient system possible.

We also adhere to the "keep it simple" approach so we only quote components that we believe are truly necessary. This in turn will save you money every single day that you operate the heating system. So, in our opinion, it's foolish to save a little bit of money up front and forgo an essential element that will save you money forever.

Will a radiant system without aluminum plates work? The best answer is "maybe." If plates are not used then you are relying on air and the few locations where tubing is in contact with the floor to transfer the heat. The problem is, air is an insulator and Pex directly in contact with wood is a poor conductor. In order to make up for this poor heat transfer, the water temperature must be raised significantly. In some cases, as high as 180 degrees F.! Even then, on a cold day, the floor may not put out enough heat to heat the room if the home is older and not energy efficient.

In new construction and with today's well insulated structures, a system without plates will more than likely work. But, it **won't work as well or as efficiently as it could**. Also, you may not be able to use a water heater as the heating source because the system requires much warmer water to make up for the poor heat transfer. In turn, your project may not be a great candidate for a solar hot water assist, either. What makes more sense, to install a system that can operate at lower temps (around 120-130 degrees F.) or to eliminate components that make you run the system at high temps (around 180 degrees F.)? It's also easy to tell which system will cost less to operate.

We get calls on a daily basis from people with existing systems (not ours) that are looking to improve the performance. They complain of not getting enough heat on cold days and/or high energy costs. We're thrilled when they call back later and rave about how well their system works after installing plates!

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

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