

Radiant Panel Heating Basics

The trend is: Radiant!

In a previous article we looked at the amazing benefits of Radiant Panel Heating Systems using Crosslinked Polyethylene (PEX) tubing. Considering the major advantages over other conventional systems, we may wonder why the usage has not exceeded the current pace of 25-30% per year. When forced air systems became the standard many years ago, the people familiar with hydronic (water carried) heating became difficult to find. This article will provide some highlights about how these systems work and how they are installed.

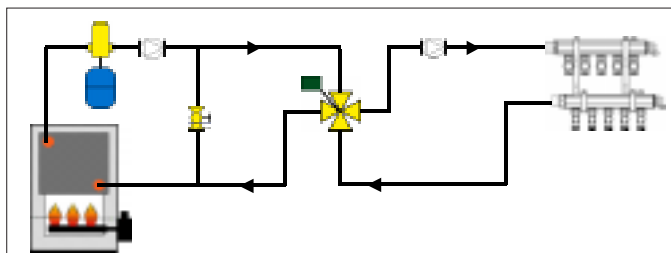
So how does it work?

The basic principle is actually quite easy to understand. Since radiant panel heating requires comparatively low water temperatures, hot water from a boiler is mixed with return water from the tubing loops by means of a mixing valve. The mixing valve setting should be adjusted for each season so that water is distributed at the correct temperature. The mixing valve may be equipped with an electronically controlled motor which automatically provides the right water temperature for the current outdoor conditions.

A small circulator pump pushes the mixed water through the manifolds that serve as headers for 2 - 10 pipe loops. The length of each tubing loop is normally between 150 and 350 ft., and, since the most common center distance between the pipes is 1 ft., each loop serves an area of about 150 to 350 sq. ft. ≈ a typical room size. Supply and return manifolds are centrally located in a closet or in a wall cavity, serving adjacent areas. The manifolds include valves for balancing the water flow because short tubing loops need less water flow than long loops. However, most buildings have floor covering materials such as carpets, hardwood, tile, or vinyl that differ in each room. The heat flow through each floor will differ as well, and balancing this by adjusting the flow is not sufficient. For this reason, most systems include individual room thermostats controlling small electrical (24 Volt) valve heads that automatically shut off the flow at intervals. The result is an evenly warm floor and a maintained, set room temperature.

Easy Installation into Concrete Floors

There are huge benefits that should warrant the installation of radiant heat in every building project. If the builder or first owner does not select radiant heat, future owners of the building will see the added value of having it available. With tubing already installed in the floor, the house will be prepared to utilize any future alternative energy source - the heating system will only require lukewarm water. It is essential to install tubing before pouring any concrete floor - after pouring it is not possible to retrofit pipes into that floor and the radiant heating option is gone forever.



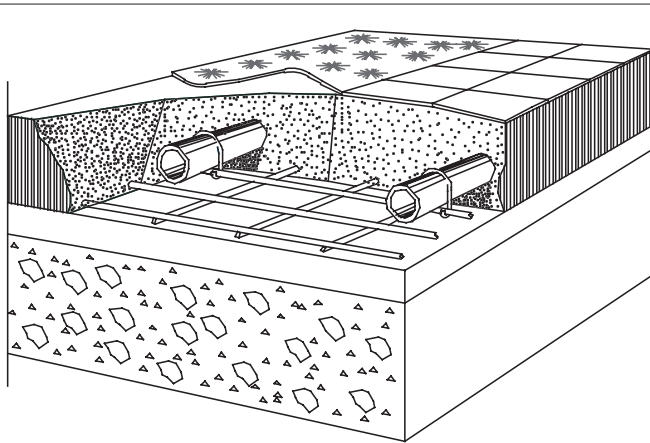
A typical radiant panel heating system schematic. The boiler water temperature is typically around 180°F. A circulating pump for the boiler circuit (often called the “primary circuit”) pushes the water around through the mixing valve and back to the boiler. After leaving the boiler, the water passes through an air scope that traps possible air bubbles and vents them out. Also shown is an expansion tank. This is a chamber partly filled by water and partly by air. Since air is easily compressible, this tank will absorb the water’s expansion and contraction caused by temperature variations in the system. There is a boiler bypass valve before the water reaches the 4-way valve. The reason is that many boilers need adequate flow and fairly high return water temperatures. By adjusting the bypass valve, any suitable bypass flow can be achieved. (Some 4-way valves have a bypass built-in).

The mixing valve mixes the hot water from the boiler with return water from the Radiant Panel Heating System. Some of that water goes back to the boiler to be reheated, but most of it recirculates to the manifolds. After the mixing valve there is another pump which provides constant water flow through the manifolds and the PEX tubing connected to it. (This part of the system is called the “secondary circuit”).

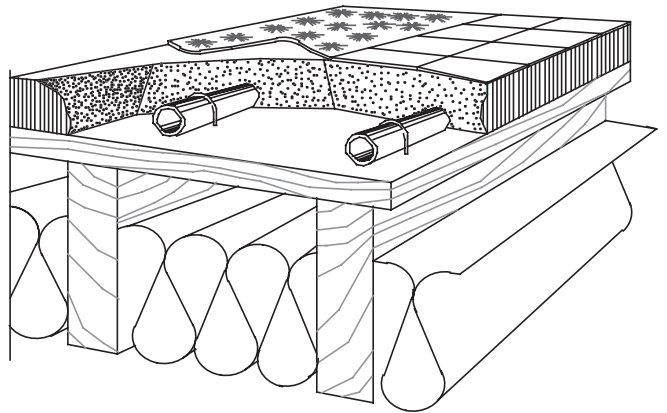
This figure displays a supply and return manifold that can serve 5 PEX tubing runs that may be looped in the floors of 5 different rooms. The flow may be shut off and on by built-in loop valves controlled by room thermostats, so that room temperature remains constant at the set temperature.

Radiant heating projects should be properly designed prior to installation, but if a design is not available, tubing should still be placed in the floor. The predominant tubing is 1/2" PEX with an oxygen barrier that prevents corrosion of system components. They are typically installed 12" on center. If tubing is tied to mesh or rebar over slab insulation, and tubing loop lengths do not exceed 250 ft., the floor is prepared for radiant heating, right away - or in the future. As long as the tubing is in the concrete floor, a post-installation design can be adapted and the system made to work. Start by hooking one pipe end up to the secured manifold while the pipe coil is placed in a tubing uncoiler outside the working area. Then loop the pipe close to the outside walls and work inwards. After the room is done the tubing is cut and this end attached to the return manifold. Simple!

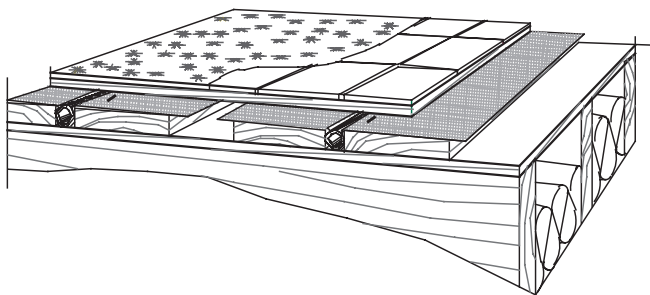
Radiant Panel Heating Basics



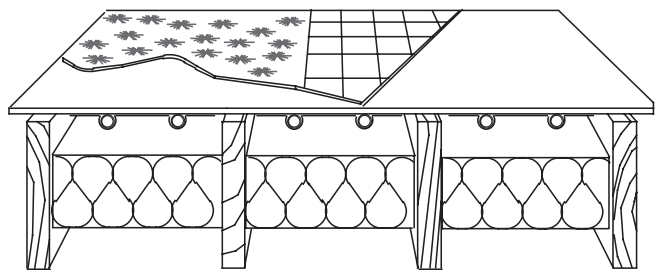
PEX Tubing in Concrete Floors over insulation board and compacted base.



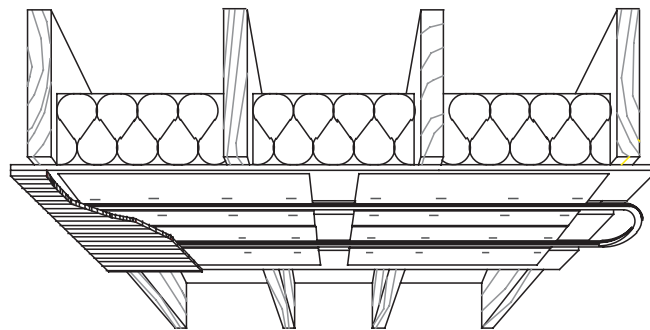
PEX Tubing in Gypsum Overpour on top of suspended floor



PEX Tubing with Alu Panels over suspended floor



PEX Tubing installed from underneath in suspended floor



PEX Tubing in Ceiling Heating

applied over slab floors or wood joist floors. The efficiency of these constructions is very similar to in-slab installations with low heating water temperature requirements.

Another alternative is to make room for tubing by nailing 1 x 4 boards 6" on center across floor joists or on top of a subfloor. Tubing may then be fitted in special Alu Panels (with a groove for tubing) to spread the heat. Finish the floor with a 1/2" conventional flooring board. Tubing with Alu Panels may also be stapled to flooring boards from below. Although this method requires additional labor, it has become quite popular because it does not interfere with the height of the finished floor. When installing tubing in wood floors some contractors eliminate the Alu Panel. This saves on cost, but there's a corresponding decrease in system efficiency. Also, water temperatures need to be quite high, so the benefits of having a versatile low temperature system adaptable to various kinds of heat sources is lost when compromising the system in this way.

And Don't Forget the Ceiling Heating Option

Ceiling heating is a feasible alternative method to wood joist floor installations. Wood battens nailed across ceiling joists provide adequate openings for PEX Tubing with Alu Panels in tight contact with the sheetrock finish. Because sheetrock boards have good heat conduc-

Some building codes require that the pipes be pressurized while the concrete is poured. PEX tubing is made for rough handling at a building site, so it can be virtually ignored (walked on, etc.) during the pour. 1/2" PEX tubing is flexible, installs quickly and easily, and the installed cost is a fraction of its value as a lifelong insurance towards future energy crises and the resale value of the building.

Suspended Floors Can Also Radiate.

Although radiant floor heating in a concrete slab is most common and cost-effective, there are other options. These are also feasible retrofit alternatives. Tubing can be put in concrete or lightweight aggregate overpours

Radiant Panel Heating Basics

tivity, the ceiling temperature will be even and water temperatures can be kept low. The restriction of heat transfer by carpeting or other floor covering materials does not exist here, and most of the ceiling is normally available for installation of radiant heat panels. Additionally, when the wood joist floors constitute the upper level(s) of a house, there is no cold floor problem to care of (there is a warm room underneath). But also: heated ceilings radiate heat down to the floor surface below making it comfortably warm.

Installation into ceilings is cost-effective, can give high heat output, and provides excellent comfort. Also, by running the circulation during the summer, the cooler tempered lower level slab can draw heat out of upper level ceiling panels helping to even out the building temperature. So, there are many reasons to not forget the ceiling when talking about radiant panels!

There is a Limit to What Radiant Heat Can Provide.

The radiant panel heating floor temperature should normally not exceed 84°F (but, an occasional temperature of 89°F may be acceptable in some areas) to provide maximum comfort. This limits the heat output to about 35-40 Btu/h. sq. ft. at normal room temperature (lower room temperatures allow for higher heat output). However, this is hardly a limit since the energy saving codes of today are pushing for heat requirements of less than 25 Btu/h. sq. ft.

In exceptional cases where there is wood joist floor construction, high heat requirements, and thick carpet and padding, unacceptably high water temperatures may be needed to provide sufficient heat. On those rare occasions we may recommend lessor thickness of carpet/padding, or that an additional heat source is used during the coldest winter days.

How Do I Get My Radiant Panel Heating System?

The above system description and installation hints are provided to give a basic understanding of the systems; not to actually design and build it. A contractor with experience should do this. There are several suppliers of complete radiant panel heating systems, including PEX tubing, manifolds, fittings, valves, controls, fasteners, accessories, and tools along with instructions as how to use or apply them. By selecting such a system approach you can rely on receiving compatible components. The system suppliers also provide installation handbooks, design methods, even computer design software, and warranties. Wholesalers and system suppliers in cooperation are providing training to contractors and installers to make appropriate designs and correct installation. For areas where it is difficult to find experienced contractors, the system suppliers may provide the design of your system and their representatives may assist a local installer as necessary.

A proper design starts with a room-by-room heat loss analysis followed by a system layout where floor construction and floor covering materials are considered. That means that you have to provide drawings to the system designer, including a description of your selection of floor materials. You will also need to indicate your preference regarding individual room temperature control (for maximum energy saving and flexibility) or a more basic zoning. Should your garage be heated (providing warm and dry garage floors) and are there special requirements for any area?

Since radiant panel heating systems have become quite popular over the last decade, pricing is competitive in most areas. Your heating system may initially cost somewhat more than a "conventional" system, but with heating bills for the first 5 years included, the radiant system is always the economical alternative. And after that you can enjoy it's added benefits and the outstanding comfort for free!