Installation Guide

Hydronic Flooring

A better approach to radiant Heating systems

Radiant Heating and Snowmelting products

ComfortPro® Systems

AquaHeat

System Design and Installation

The Mains

PEX pipe mains are recommended to reduce labor and architectural impact. For a slab-on-grade installation, the mains can be buried below or within the slab. For below slab installation refer to insulated supply and returns like ComfortPro Systems Microflex product range. For a wet or dry on plywood application, the mains can be installed within the joist cavity. Always allow for the expansion and contraction of the mains, as the temperature fluctuates. It is recommended that the pipe be allowed free movement and is not fastened directly to the floor joists.

Requirements of a hydronic control system

The intent of a hydronic heating control system is to achieve heating comfort, system protection, energy saving and ease of use.

Heating comfort is achieved by:
- keeping proper system temperatures
- directing the right amount of heat when and where you want it

System protection is achieved by:
- protecting the primary heat source (e.g. boiler) from corrosion and thermal shock
- reducing equipment cycling

Energy saving is achieved by:
- running the system at the lowest water temperature possible
- turning off the system when no heat is demanded
- minimizing boiler short cycling.

Ease of use is achieved by:
- running automatic functions in lieu of manual settings
- providing easy and consistent wiring and installation procedures

AquaHeat Installation Guide Philosophy

A hydronic system can get quiet complicated and with the rapid introduction higher integrated solutions keeping up is challenging more than ever. To keep the basic installation order we have build this series of guides to reflect the typical steps in the implementation of a project. Please note that references to other guides out of the series are reflecting chapters:

Chapter 1 - Hydronic floor installation

Chapter 2 - Manifold installations

Chapter 3 - Boiler room installations

Chapter 4 - Control system installation

Chapter 5 - General Heating System Considerations, System start-up, and Maintenance

ComfortPro Systems

AquaHeat

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Chapter 1 - AquaHeat Hydronic Floor Installation

System Selection

The first determining factor will be the type of system installation.

Wet (poured) systems - (primary heating)

Of primary concern at this stage is the selection of the type of installation you require. When making your decision, take into account the highest efficiency versus the easiest installation method versus the least structural impact. With the use of either concrete or gypsum, the thermal mass of the floor will bring the most fuel efficiency and greatest comfort. While there may be slower recovery times, the high mass ensures a more even heat output, and in turn the floors retain their heat longer. This is caused by the large inertia that is stored in the slab. Other things to bear in mind are:

- concrete versus gypsum pours on plywood subfloor (i.e. main and second floor)
- fastening of pipe for the basement pour utilizing tie-strap mesh versus tracking, and
- the addition of full versus partial cover of insulation, and the requirement for expansion stripping.

Dry (staple-up) or Dry above (staple-down) - primary heating

Radiant heating is often dismissed as an option when there is a concern about the load bearing ability of the structure. However, it is still possible to have radiant heating in these circumstances, by either placing the pipe within the joist cavity (using the staple-up method), or dry above floorpanel system on top of the subfloor. In the staple-up method, you will require the addition of AquaHeat heat transfer plates. These plates aid in the heat transfer process by distributing the heat over a wider area (than the area directly above a narrow pipe), and also increase the heat transfer from pipe to floor as the plate draws heat from the entire circumference of the pipe.

- Dry staple-up
- Dry above (Floorpanel)

Partial systems - secondary or supplemental heating

It is becoming more common to see a combination of heating systems used in buildings. In some situations, the radiant portion of a heating system is used as a heating supplement to another system (such as radiant in the basement floor with forced air, and baseboard on the other levels). In other circumstances, a floor-warming supplement might be used to address human comfort issues instead of actually heating the home. An example would be under a tile or slate floor where the purpose is to remove the chill from the surface, with a minimal effect on the room temperature.

Heatloss/Design

Proper plans
Architectural plans, with all dimensions including elevations with window and door specifications, insulation specifications and grade/ below grade information, are required.

Floor coverings
Ascertain that all floor coverings allow for specific heat load calculations, i.e. carpet versus tile or hardwood.

Carpet
Use only brand name products where the manufacturer has confirmed the suitability for floor heating. Choosing products with a minimal thermal resistance will help ensure that feedwater temperatures remain within an acceptable range. In order to maximize the heat transfer characteristics of a product, it is preferable to glue carpet instead of stretching it. All adhesives used must be suitable for floor heating. Under no circumstances should adhesives made of bituminous material be used. Needle-felt carpets and carpets with jute backs have proven to be acceptable.

Quarry tile/Ceramic tile
All tile work should be installed according to industry standards. Expansion joints and control joints in the floor topping should continue through into the tile floor. Under no circumstances are tiles to cross over these joints. The expansion/control joints in the tile floor need to be permanently elastic.
At a joint between a wall tile and a heated floor, ensure that the wall tile terminates at 1/4" (6 mm) above the top surface of the finished floor. This joint may be filled with permanently elastic material.

Vinyl/Plastic flooring
All vinyl/plastic flooring should be installed according to industry standards.
All expansion and control joints should continue through the flooring to reduce damage caused by movement of floor slab. All joints are to be permanently elastic. All adhesives used must be expressly approved for floor heating applications. Adhesives with a bituminous base are not to be used for any purpose.

Hardwood flooring
- All hardwood flooring should be installed according to industry standards and as per manufacturer instructions. Shrinkage can and will occur in most hardwood regardless of the heating system chosen. However, due to the presence of a low temperature heated mass in direct contact with the hardwood, the normal shrinkage that may take place over a 6 to 24 month period can be greatly accelerated with a radiant floor heating system if the proper installation techniques have not been followed.
- There are many types of hardwood flooring available including solid planks as well as laminates. In most regions of North America laminate flooring is gaining acceptance as more types/brands and finishes become available. (Laminate flooring has several advantages over other types of hardwood flooring especially when used in conjunction with a radiant floor heating system. Due to the layers being manufactured at right angles to each other (i.e. similar process as plywood sheathing), shrinkage is nearly eliminated.
- If solid hardwood stripping is desired, and an acceptable laminate flooring cannot be used, it is imperative that the hardwood has been "acclimatized" to the region where it is being installed. Sometimes a flooring supplier will receive a shipment of hardwood from a manufacturer and then send it out to a job site within several days or weeks. This may not be sufficient time for the hardwood to acclimatize to the particular region, especially in a "dry" climate area. Hardwood must not exceed 6% to 8% moisture content at the time of installation. It is our recommendation that all hardwood be placed on site and the floor temperature increased before flooring installation to ensure the proper moisture content is achieved.
- Control selection is especially critical for installations with hardwood to ensure that proper modulation of the supply water temperature is possible. Modulating controls will provide the lowest possible supply water temperature for the given outside temperature. As well, maximum floor surface temperature should not exceed 85°F to 90°F (30°C to 32°C). With the variance in humidity levels through the various seasons in a given year, supplemental humidification may have to be provided to ensure relative humidity can be maintained at 40% to 45%. For further information and clarification for your particular project, please contact your ComfortPro Systems representative.

- In all cases of using nail-down hardwood, the installer must be aware of the potential for pipe damage. Pipe locations must be marked to ensure against nails being hammered into pipes.

Shortages

Where the heatloss has indicated a shortage in a particular room, an alternative heat source should be selected to make up for the shortage. This could be as simple as a towel warmer in the bath, or as complex as a fan with heat coil.

Site Preparation

Cleanup

Clear the floor of debris whether it is a dry or wet install. In the case of a staple up, this could also mean grinding off any nails that penetrate through the floor into the work area.

Manifolds

Choosing the manifold

Residential and light commercial applications will usually require the Promix #2013, #2015 or ProLock #76000 manifolds, while for heavy commercial and snow melt installations the Promix #2016 manifold is recommended. This selection will be made automatically in the ComfortPro AquaHeat Heatloss calculation and material list.

Location

Select a central location, which will allow for permanent access to the manifold location, (a closet is common), however with the use of custom enclosures it may be possible to use a wall in a hallway or room. The key consideration is to allow for the concentration of the uncontrolled heat from the leader pipes.

Support

The quantity of modules (loops) will determine the width of the wall cavity. ProMix as well as ProLock manifolds can be extended after the product selection if needed. Sufficient space should be allowed for any future extra loops that might be added. While installing, place the manifold high enough to allow for easy access to the pipes. Also, leave 8" of clearance above the top of the manifold for control wiring.

Option 1:
Install a 1/2" plywood strip (notched into the back of a 2×4) in the stud wall.

Option 2:
Install a prefabricated metal rough-in enclosure. There are several sizes available, depending on the required number of loops.

Manifold assembly

- Secure the brackets to the backing support.
- Make sure that the work area is completely clear of dust and debris.

Manifold connection

The end of the PEX pipe must be cut squarely to ensure it seats tightly against the flange of the insert fitting. Disassemble the outlet of the module being connected, then slide the nut, cone ring, and split ring ferrule onto the pipe. Place the insert fitting into the pipe and ensure that it seats correctly. Clean and lubricate the O-ring before inserting it into the manifold.

PEX Pipe Installation

- Install AquaHeat PEX pipe 3/8", 1/2", 5/8", 3/4", and 1" according to the manufacturer's recommendation.
- All pipes should be kept in their original packaging material until installation and must not be exposed to direct sunlight. All pipe is produced with a UV stabilizer but this instruction should still be followed.
- PEX pipe should be installed at temperatures higher than 32°F (0°C). At or below this temperature, construction heating is required.
- Please take care that a minimal bending radius of 6 times the diameter is obtained. For example, at 68°F or 20°C, there should be a:
    - 2-1/4" (57 mm) radius for 3/8" PEX,
    - 3" (77 mm) radius for 1/2" PEX,
    - 3-3/4" (95 mm) radius for 5/8" PEX,
    - 4-1/2" (115 mm) radius for 3/4" PEX, and
    - 6" (153 mm) radius for 1" PEX.
- For under-floor double loop installations where the piping is being run in the joists (through, not underneath), it is important to crossover the piping to ensure it does not kink or collapse (see dry below section).
- Sharp kinks in the pipe wall can be repaired using hot air by heating the pipe to transparency and allowing the thermal memory to return the wall to its original shape and diameter. A flame or torch must never be used to repair kinks.
- Care should be taken during installation not to damage the pipe with sharp objects such as nails or wires. The use of binding wires for tying pipe to rebar or wire mesh in not allowable, only plastic straps should be used.
- Pipes must not be connected directly to a boiler or hot water tank. Allow for a minimum of 12" to 18" (30 to 50 cm) of solid piping before the transition to PEX.

Heating pipe expansion joint crossings

When PEX heating pipes cross expansion joints their flexibility must be ensured by appropriate measures such as, the use of pipe sleeves made of closed cell pipe insulation, polybutylene, PVC or ABS. The sleeve must be approximately 1' (30 cm) long, split open and pushed over the top of the PEX heating pipe. Coverage should extend 6" on either side of the joint.

Entering/Exiting concrete slabs

When entering or exiting a concrete slab the PEX pipe should always be protected by a conduit elbow (AquaHeat 86000 Series), or a pipe sleeve.

Couplings

Should a joint be required in a heating loop, exercise care to ensure the coupling is installed correctly. The end of the PEX pipe must be cut squarely to ensure it seats tightly against the flange of the insert fitting. Disassemble the coupling to be used. Slide a nut and a split ring ferrule onto each pipe end. Place the insert fitting into the pipes and ensure that both pipes are seated correctly. Tighten both nuts. For Wet installations only, wrap all couplings with PVC tape or compatible material before the topping-pour, to prevent any possible corrosion. (See Wet Installation.) Another method of highly reliable coupling comes from using the Pinchlock clamp and tool with either a plastic or brass double sided barb. Place the appropriate size clamp over each piece of PEX, insert either a plastic or brass barb in the PEX. Move clamp to the correct distance from barb and complete with the pinchlock tool. Now do the same on the other side of the PEX covered barb.

Pressure test

For the pressure test, use at least 80-100 psi (550-690 kPa) hydrostatic pressure or 60-80 psi (415-550 kPa) air pressure. This test must be performed for a minimum of 12-24 hours before the placement of the topping. Special care must be taken to check and retighten all joints and connections. During the pouring of the topping, the pipe must be left under pressure so that possible damage to the pipe can be immediately detected. (In cold environments, a hydrostatic test must be properly freeze protected before testing. A test pressure of 80 psi for a minimum of 24 hours before, during and after the enclosure is required.)

DESIGN CHECK LIST

1. Complete room by room heat loss analysis
2. Calculate room by room upward load
3. Determine surface temperature
4. Select tube size and spacing
5. Select temperature differential
6. Determine water supply temperature
7. Complete back losses anaiysis
8. Select tubing layout and pattern
9. Determine manifold (s) location (s)
10. Determine flow rate requirements
11. Determine loop lengths and number of loops required
12. Calculate pressure drop for individual loops
13. Determine pressure drop for entire system
14. Size and select circulating pumps
15. Determine expansion tank requirements
16. Select heat source
17. Select system controls
18. Develop material list

Wet Installation

A Wet Installation requires the pipe to be immersed in a wet mass, or topping-pour. Some recommended topping-pours include: concrete, light-weight concrete, and gypsum.

Below are some points to consider when commencing a Wet installation:

- For a Wet install on plywood, AquaHeat tracking should be spaced at:
  - 40" apart for concrete, and
  - 30" apart for gypsum.

- When fastening pipe to mesh or rebar, plastic tie straps should be used to secure the pipe every 2' to 3'.Loop bends must be supported with a tie at each end and the top of the bend. Usage of any other tie material (e.g. wire ties) requires pre-approval from ComfortPro Systems.

- If the pour exceeds 3", it is recommended that the pipe be raised or chaired up into the top 2" of the pour. Note: if the design requirements specify lowering the pipe below 3", pre-approval/calculations are needed (e.g. warehousing where bolts are to be drilled/inserted into the floor).

- When installing pipe in a bathroom floor, ensure that the pipe is not too close to the toilet flange and seal.

- Ensure that all pipes are kept clear of floor space below cabinets, refrigerators and stoves. Large objects above a floor-heated space will interfere with efficient heat transfer. In some cases, appliances above, or food products within cabinets, could be overheated.

Expansion stripping

For Wet installations (excluding gypsum pours), ensure expansion stripping is fastened against the base of all interior and exterior walls. For residential applications where there is a concrete foundation, expansion stripping can be omitted for basements only.

Ground insulation/Vapor barrier

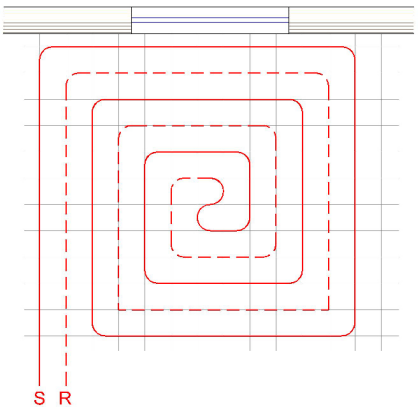
It is highly recommended to include a full coverage of 1" to 2" (25 to 50 mm) closed-cell high-density ground barrier insulation for all slab-on-grade or basement projects. In addition to reducing the amount of downward heatloss that could occur in such floor heating projects, there is a substantial benefit in utilizing a ground barrier insulation for any projects where response times or night set-back thermostats are desired. By reducing the amount of downward heat loss (and consequently the amount of additional thermal mass being created by heating of the soil below the slab), both the heating-up periods and cool-down periods will be greatly reduced.

- For projects where there is a concern of wet soil conditions, a minimum 6-mil vapor barrier must be installed, in addition to a full coverage of ground barrier insulation. This is imperative as any water movement, or the presence of a high water table, can trigger the transfer of the majority of the heat output downward, with only a minimum of heat being discharged upwards into the heating space.

- Snow melting projects require a minimum of 2" (50 mm) of closed-cell high-density insulation.

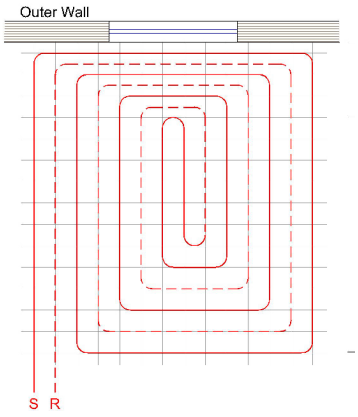
Counter Floor Loop

Perimeter border zone (tighter spacing), and inner zone (wider spacing).



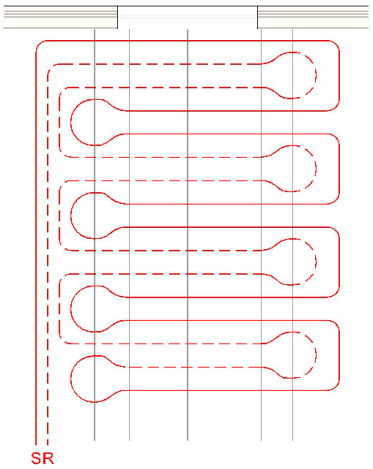
Border Counter Floor Loop

Perimeter border zone (tighter spacing), and inner zone (wider spacing).



Double Counter Floor Loop

This is the recommended installation method for tracking.

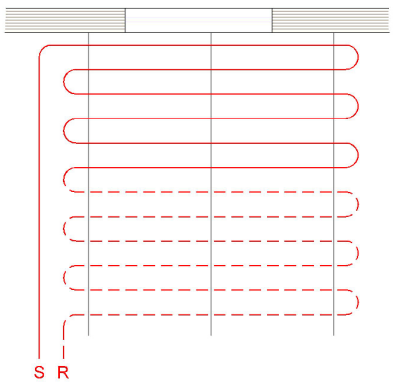


Note:

- Allow for sloppy or large radius turns where piping makes a single spacing pass, especially for any spacing less than 6" (150 mm) (see examples).
- For pipe spacing of 4" (100 mm) or less, an additional track at the loop end is recommended to ensure even spacing.

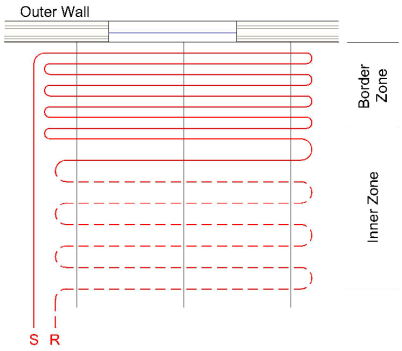
Serpentine Loop

Only recommended for floor surface areas where the temperature drop from supply to return piping transition is not critical (i.e. low occupancy areas).

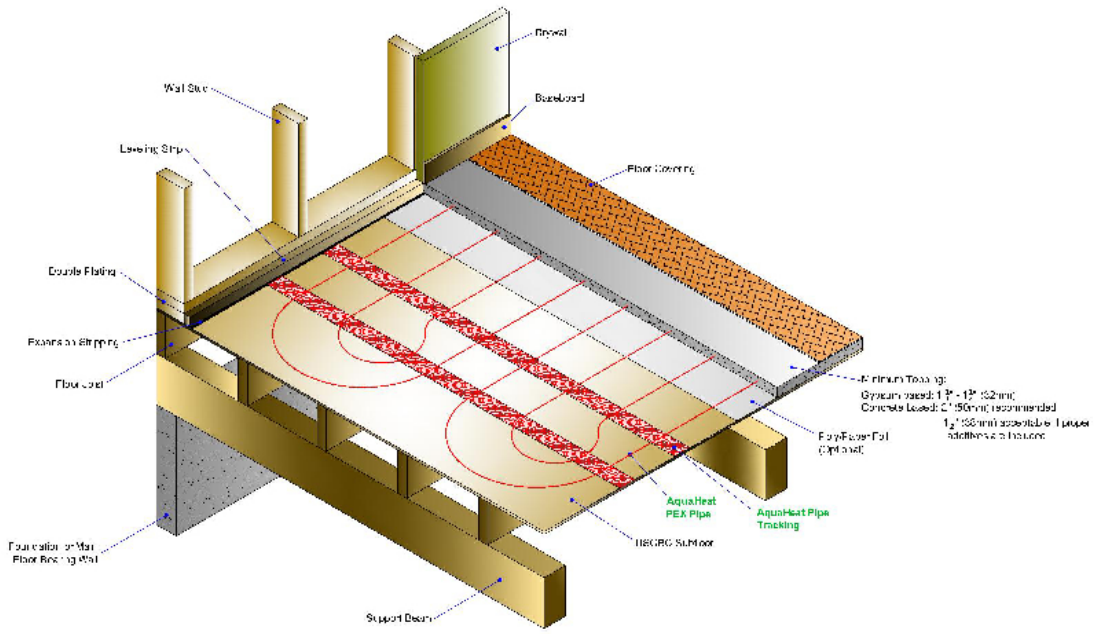


Border Serpentine Loop

Perimeter border zone requires tighter spacing, and the inner zone requires wider spacing. This is recommended for areas of high heat loss on perimeter, and where a floor surface temperature drop in the inner zone is not critical (i.e. carpeted areas or low occupancy areas).

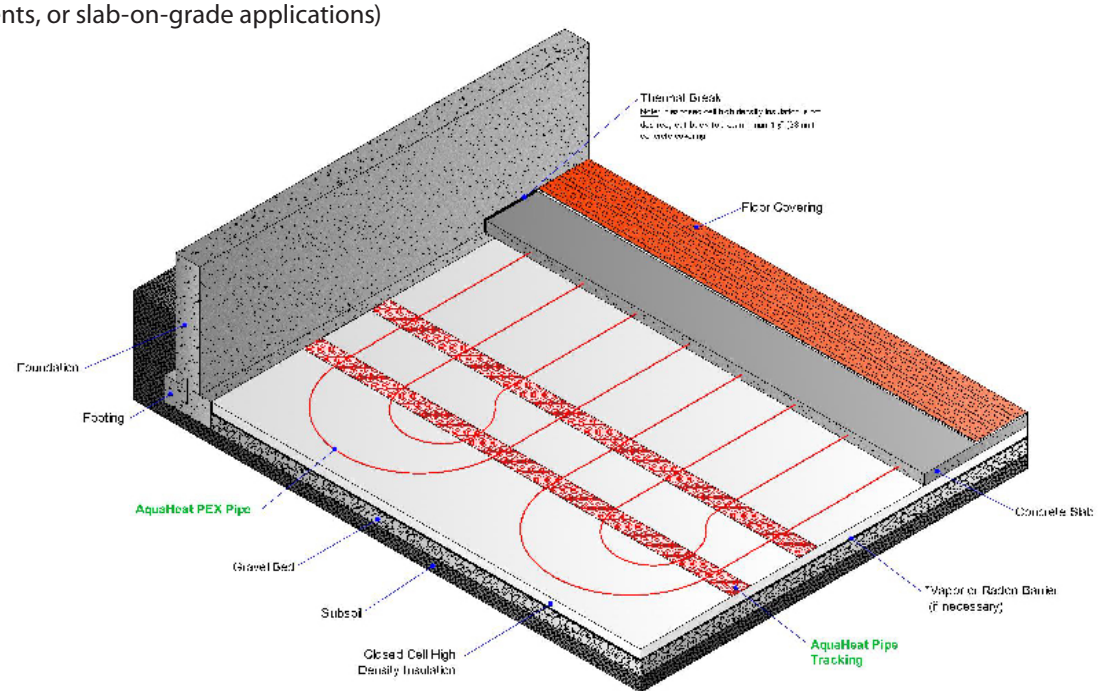


AquaHeat Wet Installation on Top of Subfloor (i.e. upper stories)



* Insulation is recommended where the space below should not receive any heat. (e.g. wine cellars).

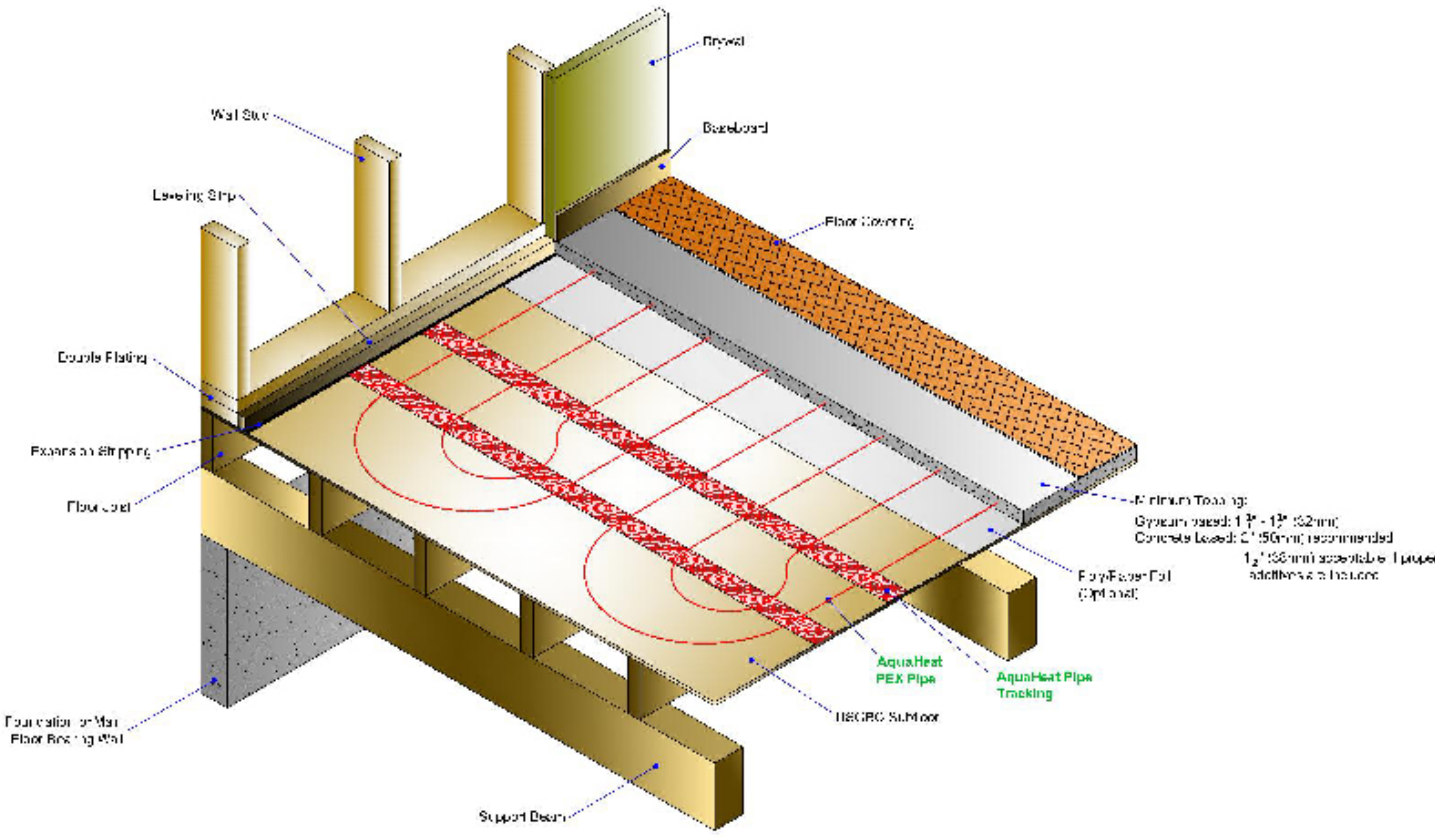
Wet Installation for Ground Floor
(i.e. basements, or slab-on-grade applications)



Note: If piping is to be placed directly on the gravel bed without a layer of closed cell high density insulation, wire mesh or rebar and plastic tie straps should be used instead of pipe tracking and track staples.

* For applications where a high water table or soil moisture content is present, an insulation layer plus vapor barrier must be provided!

Wet Installation on Top of Subfloor with Sleepers for Solid Hardwood Flooring (i.e. upper floors)



Note: Sleepers should be added after laying the pipe to maintain the pipe spacing.

* Insulation is recommended where the space below should not receive any heat. (e.g. wine cellars).

Dry below Installation

Heat transfer plates

Fasten plates by stapling them to the underside of the subfloor. Ensure gap spacing does not exceed 6" (150 mm). At the end of each joist space (at the pipe bend), set the first two plates well back (heat transfer plates must be installed 12" (310 mm) from loop ends and crossovers), and fasten on a slight diagonal. This will ensure there is minimal tension on the pipe wall from any expansion or contraction of the piping. Adjust plate gap spacing between 3" to 6". Gap spacing can be manipulated to eliminate the need for trimming the plates.

Foil-backed insulation

Fasten a minimum of 1-1/2" (40 mm) foil-backed insulation with foil facing piping and heat transfer plating directly under the subfloor (a high insulation R-Value of R-20 or higher is recommended to prevent downward heatloss). Install foil-backed insulation in the optimal reflecting distance for a radiant barrier from a heat emitter between 1/2" and 1" away from the pipe and plate assembly.

An alternate method is to fasten only the foil to underside of the subfloor (foil face against piping and plates), and then place some batt insulation against the foil. If this method is used, ensure that the batt insulation is fitted securely to the bottom of the foil and will not fall to the bottom of the joist space (thereby creating an air cavity).

Dry below installation guidelines

- The tightest bend radius for PEX is 6 times the outside diameter.
- Use protective sleeves when penetrating floors, laminated wood, or metal studs.
- Drill holes at least 1/4" (5 mm) larger to provide free movement of pipe.
- Protect pipe with steel plate if it is within 2" (50 mm) of a stud, plate or nailing surface (see Figure 1).
- When running AquaHeat PEX be sure to install at least 6" (150 mm) from any gas appliance vent piping, or 12" (300 mm) from any recessed light fixtures (see Figure 2).
- If AquaHeat PEX piping is notched or cut, section of PEX must be cut out and replaced.
- Beneath cabinets, refrigerators and stoves, insulation should be placed between the subfloor and pipe to prevent overheating those areas.

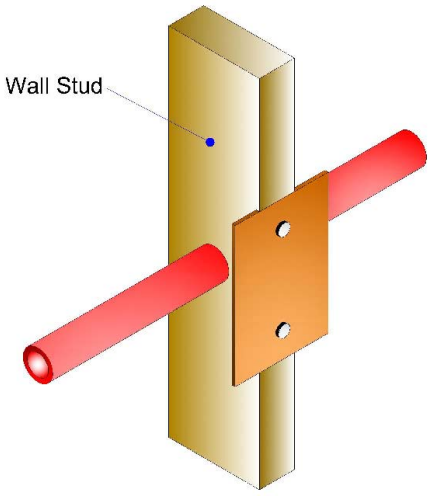


Fig 1

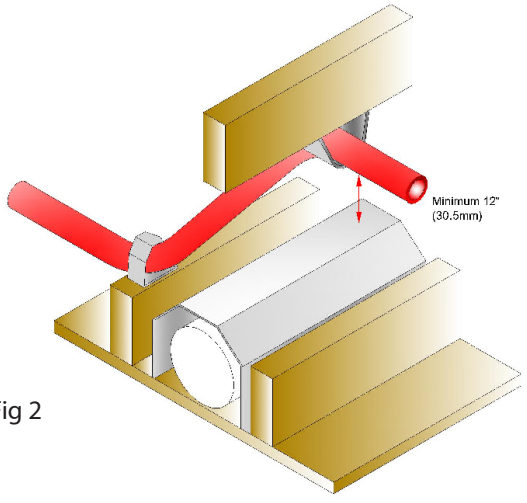
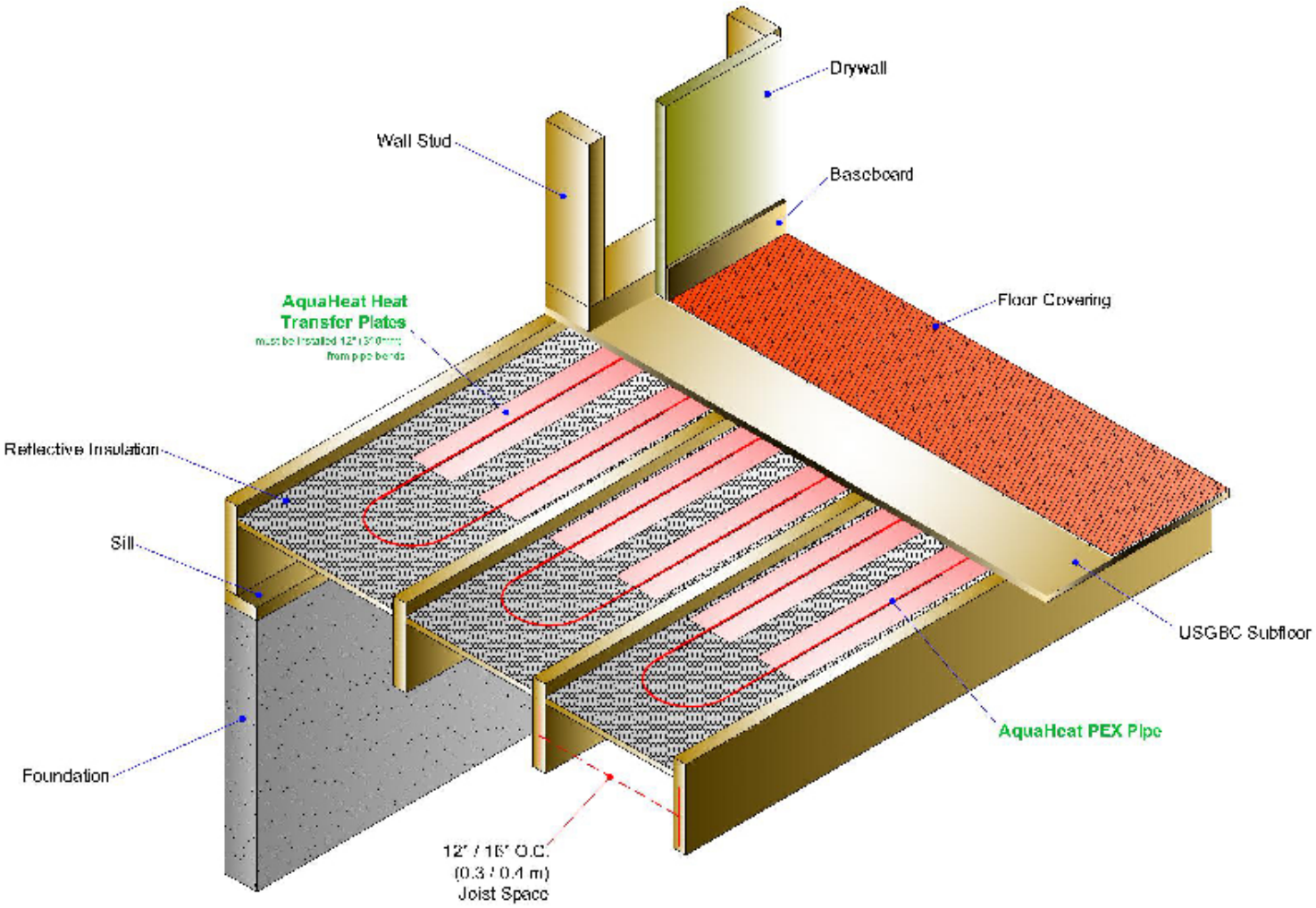


Fig 2

Dry below Double Loop Installation for Under Subfloor Applications
(i.e. between the floor joists)



Notes:

- Foil should be fastened with the optimal reflecting distance for a radiant barrier from a heat emitter between 1/2" and 1" directly under the subfloor.
- Non-Barrier PEX pipe is preferred to ensure elimination of expansion/contraction noises. If AquaHeat O_2 Barrier PEX Pipe (#94000/98000 Series) is required, then a modulating indoor/outdoor controller is required. (Alternatively, a silicon based adhesive can be placed between the plate and pipe.)

Two pipes per joist space

1. Spooling pipe from the dispenser, go first through the hole furthest from the beam to the last joist cavity being supplied by the loop. Then lead the pipe directly back to the distribution manifold. Attach pipe to distribution manifold, and secure.

2. Pull the pipe into the first joist space. (Note: There is no pipe crossover in the first space only.)

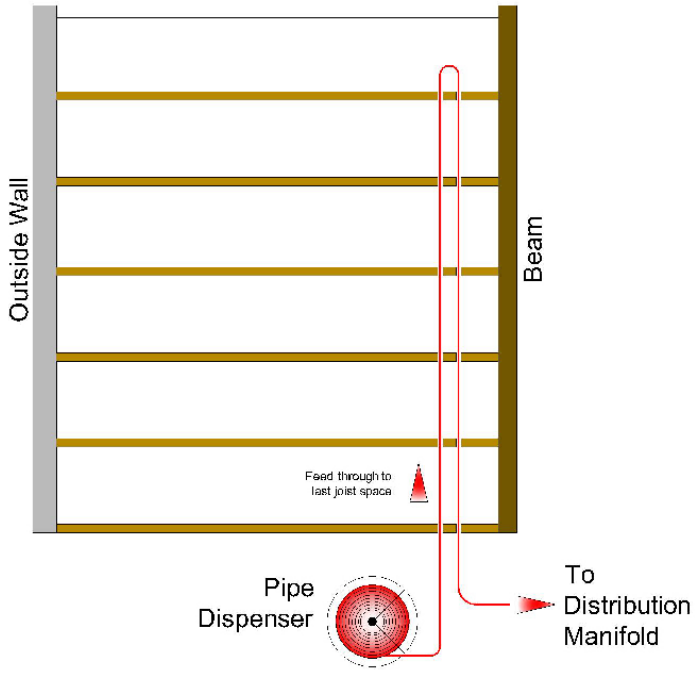
3. Using J-Clips, temporarily attach the pipe to the bottom of the subflooring. The J-Clips remain in place until the heat transfer plating is installed.

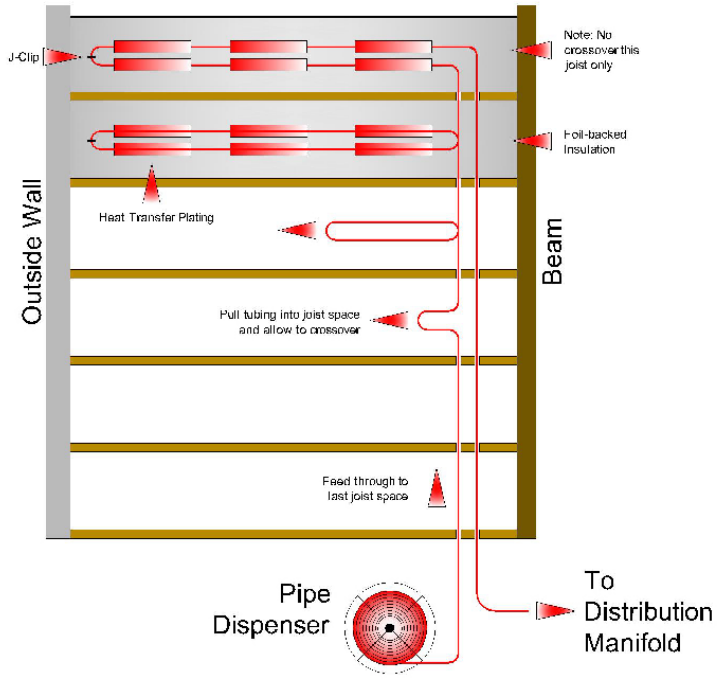
4. Proceed to pull the pipe into each remaining joist space. (Note: Allow pipe to crossover as shown to prevent kinking.)

5. Pulling the pipe into the joist spaces, proceed with the installation of heat transfer plating.

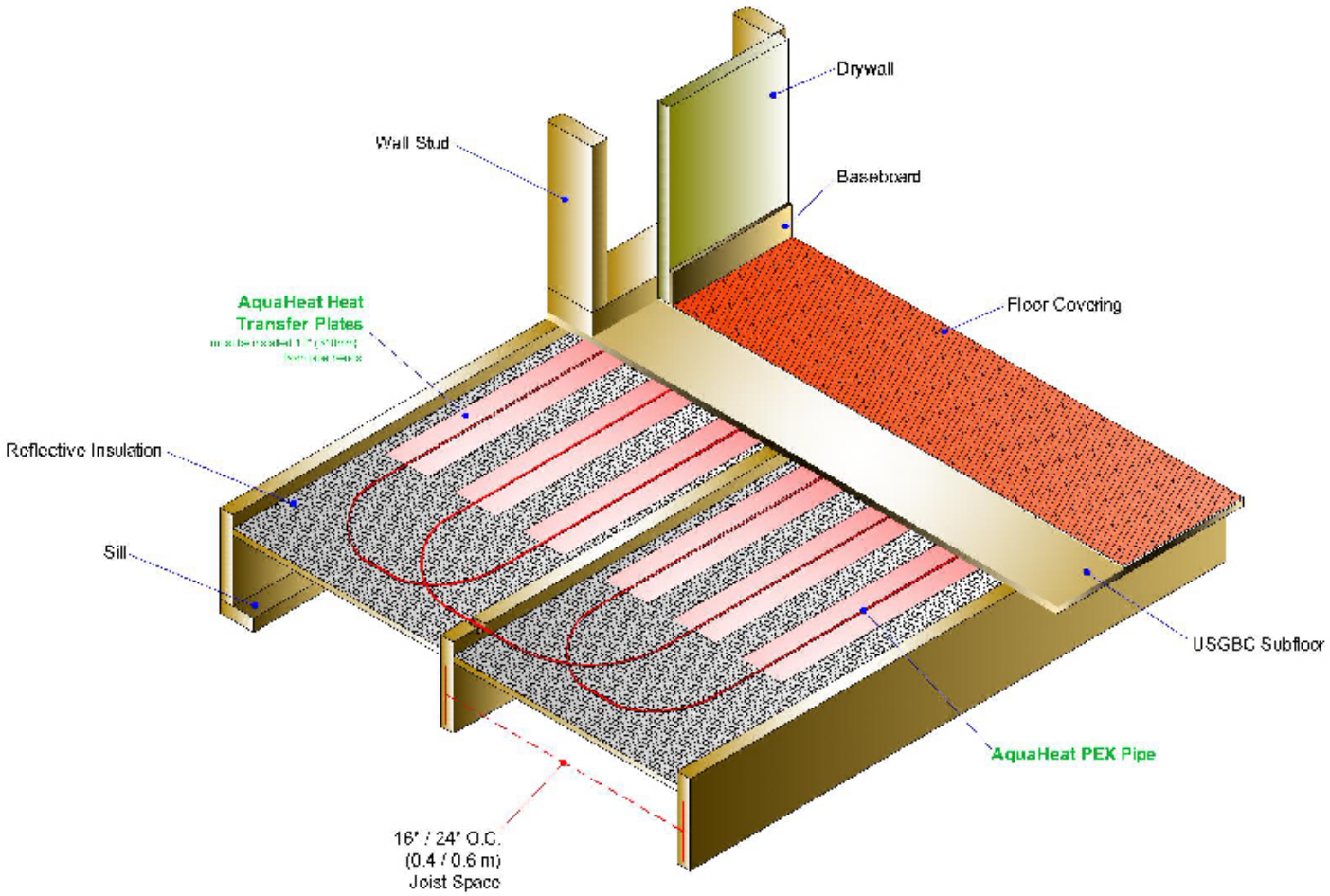
6. Begin plating on one row of one joist. After completing the first row of plates, plate gap spacing can be adjusted from 3" to 6" (75 to 150 mm) for the second row, to ensure that the last plate in a joist cavity does not have to be cut.

7. Place a minimum of 1-1/2" (40 mm) foil-backed insulation in the optimal reflecting distance for a radiant barrier from a heat emitter between 1/2" and 1" tight against the pipe and plate assembly, or alternatively staple a foil to subfloor and then add some minimum R-12 (R-20 recommended) batt insulation.





Dry Below Triple Loop Installation for Under Subfloor Applications
(i.e. between the floor joists)



Note: Foil should be fastened in the optimal reflecting distance for a radiant barrier from a heat emitter between 1/2" and 1" under the subfloor. (Foil face should be facing the pipe and heat transfer plating.)

Three pipes per joist space

1. After drilling holes in the joist; pull the pipe off the dispenser and through the holes in the joist to the manifold.

2. Fasten pipe in the manifold (See chapter 2)

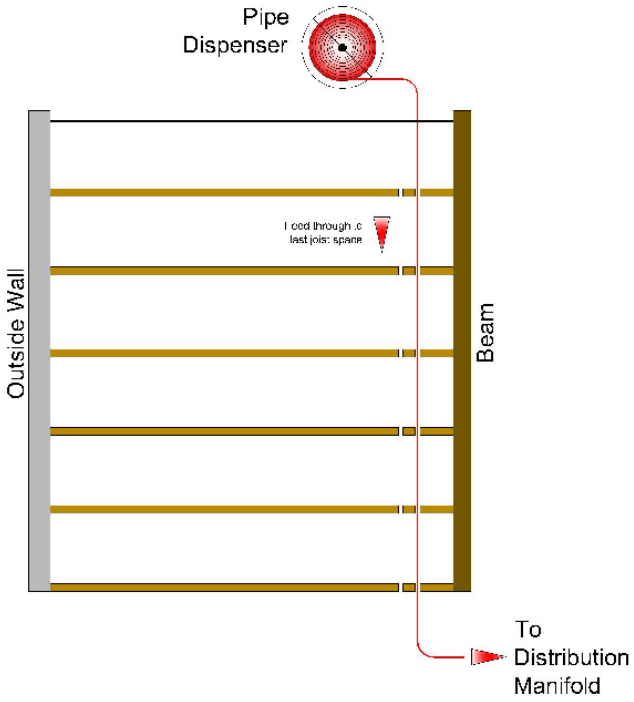
3. Pull pipe into the joist space, allowing for the pipe to cross over. Continue to pull pipe into the length of the joist space.

4. Once all the cross over loops have been pulled, measure the total distance of all joist spaces in the loop, plus any additional piping from the loop back to the manifold.

5. Pull the corresponding amount of pipe off the pipe dispenser and cut the pipe.

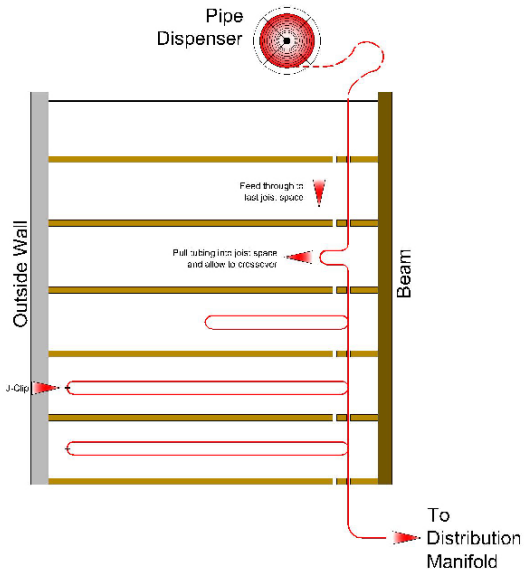
6. Begin feeding the cut end of the pipe through each length of the joist to create the third line.

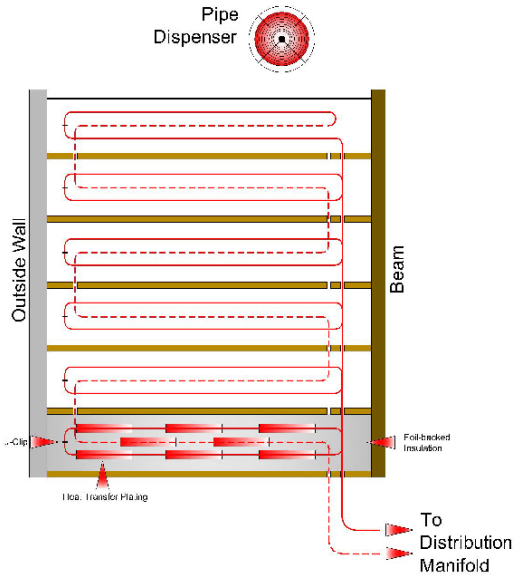
7. String the third line through all the joist spaces and return to the manifold.



8. Begin plating on one row of one joist. After completing the first row of plates, plate gap spacing can be adjusted from 3" to 6" (75 to 150 mm) for the second row, to ensure that the last plate in a joist cavity does not have to be cut.

9. Place a minimum of 1-1/2" (40 mm) foil-backed insulation in the optimal reflecting distance for a radiant barrier from a heat emitter between 1/2" and 1" under the pipe and plate assembly, or alternatively staple a foil to subfloor and then add some minimum R-12 (R-20 recommended) batt insulation.



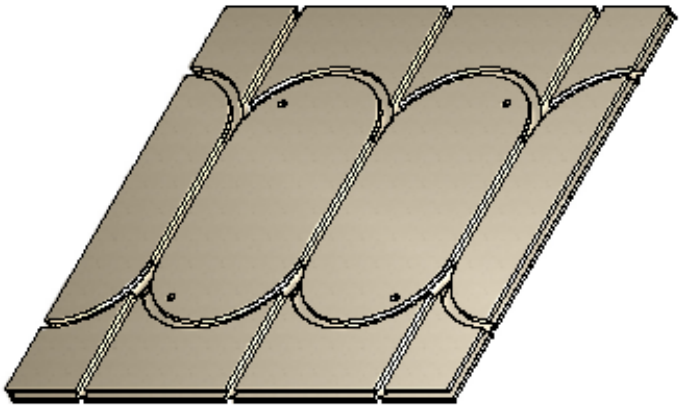


AquaHeat

Introduction

Outstanding for both new construction and retrofit, AquaHeat FloorPanel allows for the fast and effective installation of PEX tubing in virtually every application. No longer does one have to deal with expensive or impractical lightweight concrete pours or time consuming between floor joist installations.

- Unique single panel design secures 3/8" PEX tubing @ 8" on center spacing in any direction; straight, turns, or both.
- 24" x 24" dimensions allows for straightforward material calculations (sq.ft./4).
- Adds only 5/8" to existing/planned floor height.
- Open channel design leaves tubing fully visible and accessible during installation.
- Tongue and groove edges allows for quick interlocking installation and maximum surface continuity.
- Pre-drilled countersunk mounting holes provide for ease of installation.
- Moisture resistant MDF construction offers protection against high levels of humidity and occasional wetting of the installation area (basements, baths, kitchens,…)
- Lightweight — 5 times lighter than concrete.



RADIANT DESIGN: The following steps are provided as a guide in designing a radiant floor heating system. Please consult with your PEX tubing manufacturer for specific design criteria.

Determining Your Heating Requirements

The room or area heating requirements must be determined using a radiant design calculation or adjusted conventional heat loss calculation. System suppliers, local product representatives, and wholesale distributors can all assist you in determining your heating requirements.

Required Heat Output

The heat loss of any given area must be replaced with the heat output provided by the radiant source (floor). It is important that only "open" floor area (Net Area) be utilized in determining the Required Heat Output. The Net Area is established by subtracting from the total square footage all cabinets, fixtures and other non heat producing areas.

$$\text{Required Heat Output} = \frac{\text{Heat Loss}}{\text{Net Area}}$$

Supply Water & Surface Temperature

Using the Floor Output Chart the system Supply Water Temperature and Surface Temperature can be determined.

1. Find the Required Output on the left side of the chart and read across to the right to determine the Surface Temperature.

2. Calculate the Total R-Value of the floor covering material and extend a line up from this point to where it intersects the Required Output. The Supply Water Temperature can be read at the point of intersection.

3. If the Water Temperature is above 150°F or the Surface Temperature is above 85°F.

a. Check the heat loss for accuracy. Has it been determined for radiant heat?
b. Choose a floor covering with a lower R- Value.
c. Reduce the heat loss of the area (I.E. increased insulation, new windows)
d. Include supplemental heating for the area.

Required Output [BTU/squ. ft]	0.5	1.0	1.5	2.0	2.5	3.0	Surface Temperature [°F]
45	145	159					90
40	138	150	168				87
35	130	142	157				85
30	123	132	144	159			83
25	114	122	133	145	160		81
20	107	113	122	131	143	165	78
15	102	106	111	118	128	143	76
10	93	97	100	104	112	123	73
5	87	89	91	93	97	102	70

R-Value of Floor Covering

Fig Floor Output Chart

AquaHeat FloorPanel & PEX Tubing Requirements

FloorPanel: To estimate the number of panels needed, divide the square footage of the area by 4 (each panel is 4sq.ft.). Example: A 20ft. X 20ft. room = 400sq.ft., dividing 400 by 4 = 100 panels. For standard room configurations, (square, rectangle) include 5% additional panels to allow for waste. For rooms with angled walls, multiple corners, or bump outs, include 10% additional panels.

Tubing: FloorPanel is designed to secure 3/8" ASTM F876 PEX tubing. Based upon the FloorPanel provided 8" on center spacing a tubing factor of 1.5 should be used. To determine the required amount of tubing, multiply the square footage of the area by 1.5. The result is the amount of tubing required to be installed into the panels. In addition, supply/return leader lengths must also be added depending upon the manifold/system connection location.

Where required heat outputs are 25 BtuH/ft^2 or greater, circuit lengths should be limited to aproximately 200ft. (including supply/return leaders). For heat outputs less than 25 BtuH/ft^2, circuit lengths should be designed around 250ft.

Number of Circuits: To determine the number of individual circuits of tubing required, subtract the supply/return leader length from the desired total circuit length (200ft, 250ft.). Divide the resulting circuit length into the total calculated tubing requirement (sq.ft. x 1.5) to determine the number of circuits for the project.

Example:
250ft. circuits minus a 25ft. supply and 25ft. return leader (50ft.) = 200ft. The total calculated tubing requirement is known to be 1200ft. (an 800sq.ft. area x 1.5). Divide 1200 by 200 to determine 6 circuits will be required.

Required Installation Equipment

The following are recommended for the installation of FloorPanel products:

- Table or skill saw with a high quality carbide or better blade.
- Drill Gun (electric or cordless) with No. 2 Phillips bit.
- 3/4" drill bit for supply/return leader access locations.
- Screws (min. 1-1/4").
- Rubber or similar soft mallet.
- Chalk line
- Carpenter Square
- Short (aprox. 6") lengths of 3/8" PEX Tubing for panel groove alignment.
- Vacuum cleaner for subfloor and groove preparation.

Subfloor Preparation

All subfloors must be structurally sound, level, and free of voids or defects. High and/or low spots must be addressed prior to panel installation. Sags and/or creaking may be signs of a larger problem. These, and all, structural deficiencies will need to be repaired in order to assure satisfactory panel installation. The entire floor area should be swept and vacuumed prior to installation.

Moisture Content: The moisture resistant properties of FloorPanel provides greatly increased resiliance to the damaging effects of moisture and humidity over standard wood products. However, excessive or continual moisture can cause adverse effects on subfloors, framing, finish flooring and, if left uncorrected, eventually to FloorPanel.

Wood subfloors should have a stable moisture content below 10% before panel installation. Due to environmental, shipping, and storage conditions, FloorPanel should be placed in the room that it is to be installed and allowed to acclimate to the environment (48-72 hrs.). It should be maintained at the same temperature (>50°F) and have a moisture content within 4% of that of the subfloor. This also holds true for any finish wood flooring that is to be installed over FloorPanel.

Concrete slabs will require special consideration. All slabs will release moisture regardless of their location (below, above, or on grade). In most cases, for new slabs, it will take 60 days or more before the slab is dry enough (cured) to proceed. After fully curing, moisture levels should be checked. Due to the specific procedures for properly testing concrete moisture content, and that slab moisture conditions can change as environmental conditions change, testing should be done by an experienced professional. If using a calcium chloride moisture test, the allowable amount of moisture emission is 3.0 pounds per 1000sq.ft. per 24 hours. If moisture conditions are questionable or inconsistent, slabs should be sealed with an appropriate moisture barrier.

Securing Panels

Four pre-drilled countersunk mounting holes are provided in each panel. In the event that it is necessary to field cut panels, 12" on center screw spacing should be maintained. Construction adhesive should be applied to each board. Using an 1/8" bead, apply the adhesive around the perimeter of the panel approximately 1" from the edge. Complete the adhesive coverage by applying an "X" from corner to corner. *Take care to ensure that adhesive does not come into contact with PEX tubing.

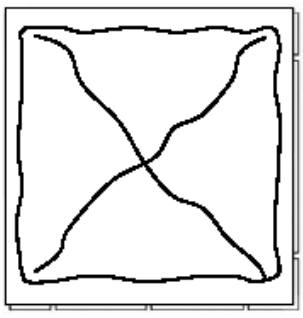


Fig. Adhesive Layout

Check with USGBC and/or LEED for Sub-floor adhesives outgassing criteria to achieve max. credits

Floating Panel Installation

FloorPanel may also be installed without physically attaching it to the subfloor. This application is typically used for installation over a concrete slab or where subfloor penetrations are not desired. A floating panel installation is not recommended for tile or stone finish floors. Note: It is important in a floating panel installation to stagger the seams between rows of panels. This will provide for a more stable floor. At the start of the second row, cut 8" off of the first panel. Continue to cut the first panel on every other row making sure that the surface grooves line up with previous rows.

There are two methods for installing "floating" panels. First, panels may be edge glued similar to laminate flooring installation. Use a quality construction adhesive and follow the manufacturer's instructions. Wipe all excess adhesive from the grooves and joints taking care to ensure that adhesive will not be in contact with the PEX tubing. The second method is to apply a plywood cover sheet overtop of a "dry" fit (not edge glued) FloorPanel installation. After the PEX tubing has been installed (see Install PEX Tubing), the cover sheet should be glued and screwed to the panels. Apply construction adhesive to the panels maintaining at least a 2" clearance from all surface grooves. After gluing, screw the cover sheet to the FloorPanel using 12" on center screw spacing.

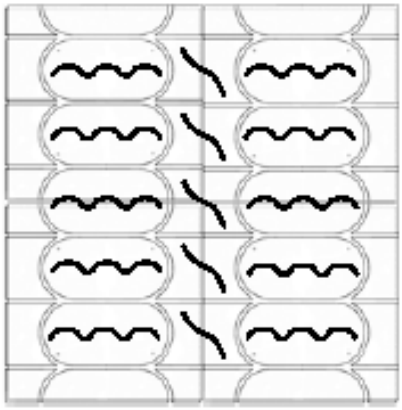


Fig. Adhesive Layout

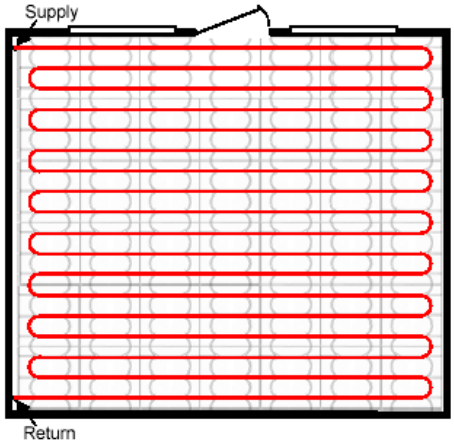


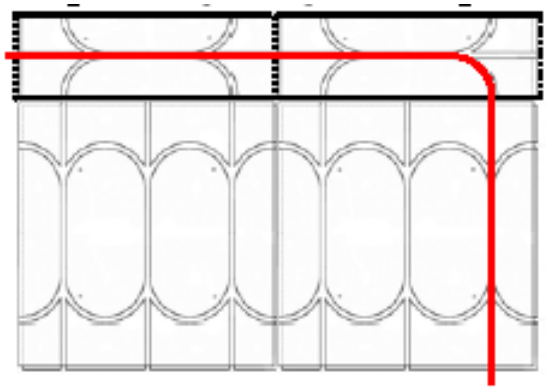
Fig. FloorPanel Layout

It is best to utilize a floor plan to determine the optimum panel layout. Using a carpenters square, determine if the room itself is square. If necessary, snap a chalk line to follow. In general, the first panel should be placed in a far exterior corner of the room so that the straight runs of tubing will be parallel to the exterior wall of highest heat loss. This and all other panels should be maintained aprox. 1/4" from the walls. *Place temporary 1/4" spacers between the wall and FloorPanel. These will be removed after installation is complete. The two "tongue" edges should be facing the two walls. This leaves the recessed "groove" edges exposed towards the room. As you continue to place down the panels, the grooved edges will now remain exposed for easier tapping of the panels (using a rubber or other soft mallet) into final alignment. Care should be taken to not tap or otherwise hit the tongue of the panels as they can be easily damaged. If a tongue does happen to become damaged, and will no longer interlock with a groove, simply snap or cut off the damaged section.

Short (6") lengths of 3/8" PEX tubing can be very useful in aligning adjoining panels. Simply place the tubing into the grooves between two panels to assure groove alignment. Slight variations in either subfloor or panels may result in panel edges not always being perfectly aligned. *Do not assume that panel edge alignment will guarantee groove alignment.

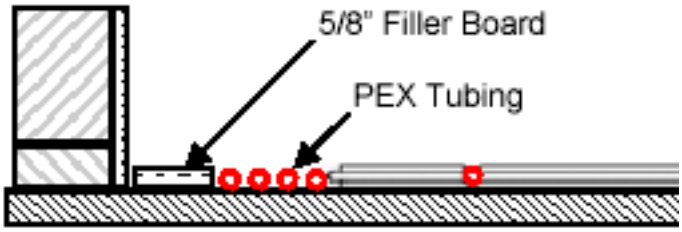
In almost all installations it will be necessary to cut a small number of panels to finish out a room. In addition, if the final panel in a row will place the PEX tubing within 2" of the finished wall, make an adjustment by cutting off and inch or two from the first panel in the row. Always make sure that the surface grooves line up with all previous rows. Panels can also be cut in order to change direction of the tubing. This may be necessary if there is limited access in where tubing may enter or exit an area.

Custom cut Panels can be used to change tubing direction



Panels may be cut with either a table or skill saw with a high quality carbide blade. *Cutting should be done with adequate ventilation and while wearing a protective mask. Cuts should be made so that the tongue edges continue to match up with the grooved edges. If two tongue edges do end up facing each other, you may simply cut off the tongue edges (not applicable for floating panel installations). Cut panels may also be used as filler boards, with no tubing installed, to create a uniform floor height in an area.

During panel layout it will also be necessary to determine the location where the PEX tubing will enter the first panel and exit the last panel in a circuit. This tubing is called the supply and return leaders and will run from the panels to a manifold or main piping location. Holes (typically 3/4") should be drilled in the floor, or base of the wall, to accommodate the leaders. PEX bend supports are available to provide a tight 90° turn into the floor or up a wall. In areas that require several circuits of tubing (see AquaHeat FloorPanel & PEX Tubing Requirements) it will be necessary to drill holes for each supply and return leader. Leaders may also be run along the subfloor to a common entry/exit location without being installed into panels. If necessary, a leveling compound, or 5/8" sleepers (filler boards), may be installed between or along the tubing to provide a sound base for floor coverings.



Install PEX Tubing

Vacuum the surface and grooves of all panels to assure that there is nothing present that may damage the PEX tubing and to provide for a satisfactory fit into the grooves.

Starting with the first panel (supply leader hole location), leave sufficient excess tubing to reach the manifold location. Next, begin rolling the tubing out from the coil and "snap" it into the grooves. A rubber or other soft mallet is recommended to assist with this step. The grooves are designed to provide a tight fit for the PEX tubing in order to hold it firmly in place. Please note, due to tolerances in both the tubing and the panels, it is normal for varying degrees of force to be required to fully seat the tubing into the grooves. Continually check the length of tubing remaining in the coil to ensure sufficient length for the return leader to reach the manifold location. After completing the installation of each circuit of tubing, confirm that the entire length is fully seated into the grooves. The tubing MUST sit below the surface of the panels in order to provide a sound base for the finished floor.

Insulation

Insulation should be installed below all FloorPanel installations. Failure to provide insulation will decrease the heating efficiency of the PEX tubing and may not allow for sufficient heat output. Local Building Codes will specify the minimum required floor insulation over an unheated space. For other applications, a minimum R-19 insulation is recommended.

Finish Floor Covering Applications

Care should be taken wherever tubing may be at risk from nails or other penetrations associated with the finish floor installation (saddles, carpet tack strips, molding, ect.). Always be sure to maintain adequate clearance from the tubing. Nail guards, such as those used to protect electrical wiring, should be installed as necessary. If an adhesive is to be used to secure the finish flooring (I.E. carpet or vinyl) a backer board (1/4" luan plywood) and high temperature latex adhesive must be utilized. Do not allow adhesive to come into contact with the PEX tubing.

Carpet

1/4" luan plywood should be applied over the panels prior to pad and/or carpet installation. However, if carpet is installed directly over FloorPanel, a leveling compound should be used to fill all unused surface grooves and level all areas. It is important to know the R-value of the pad and carpet that will be used and its effects on the obtainable heat output of the radiant system. A thin high density rubber pad and short high density carpet will provide lesser resistance to heat transfer than other pad/carpet combinations.

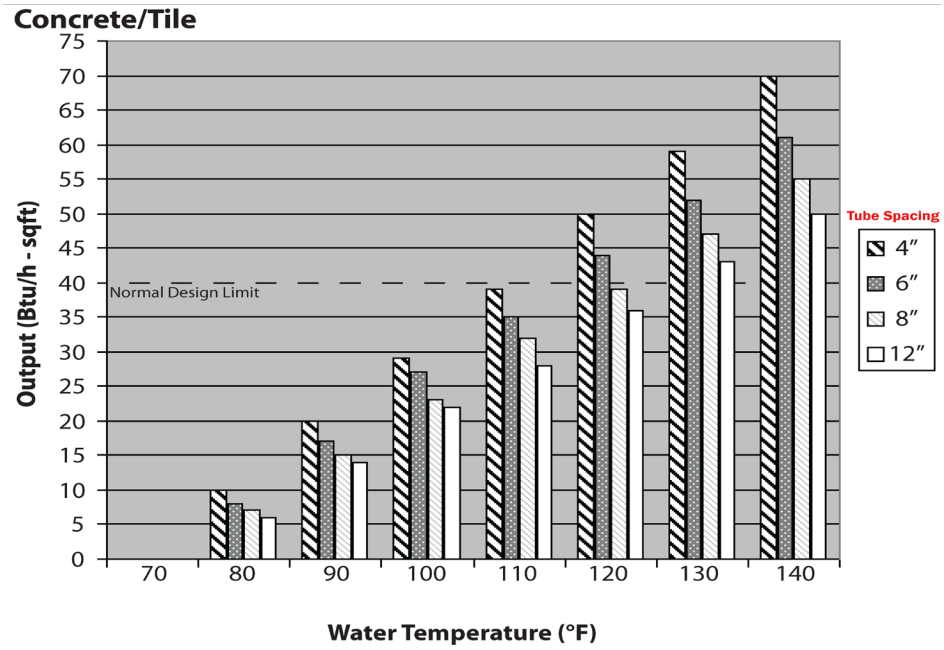
Hardwood

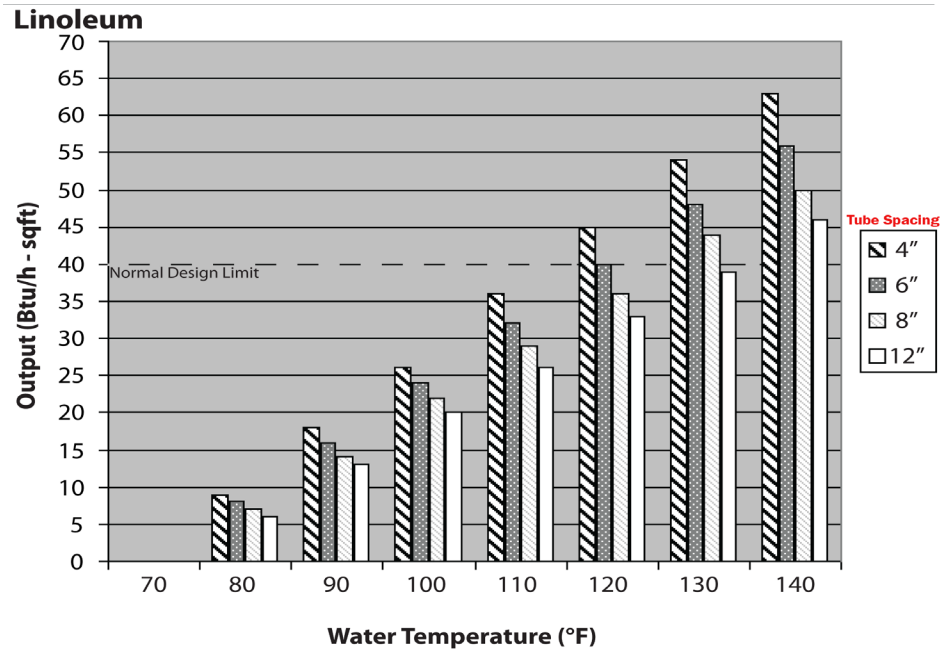
Conventional nailed hardwood flooring may be installed directly over the panels. The primary direction of the tubing runs in the panels should be perpendicular to the direction of the hardwood flooring strips. Red rosin paper (do not use asphalt felt) should be placed over the panels. Chalk lines showing the tubing runs may then be snapped on top of the rosin paper and used as a guide to avoid the tubing. The nails selected should be of sufficient length to penetrate through the panels and into the subfloor below. If installing a clip style floating floor systems, care must be taken so that the clips do not come into contact with the PEX tubing. All wood floors will expand and contract as temperature and humidity levels change. This can result in gaps between flooring strips that may be present at certain times of the year and not others. A properly designed and operated radiant floor heating system should not increase these natural occurrences. Be sure to allow the flooring to acclimate to the area and follow the wood floor manufactures instructions for installation over radiant heat. Do not design or operate a system with a floor surface temperature in excess of 85° F. In general, narrow (<3" wide) hardwood flooring will provide the least expansion and contraction. Softer woods (pine, fir), higher moisture levels, and wide plank style floors will increase the potential for expansion and contraction both with and without a radiant floor heating system. Because of its dimensional stability, laminated flooring is an excellent choice.

Tile/Stone/Vinyl

For ceramic tile and stone, a tile backer board should be used over the panels. Care should be taken to avoid all tubing runs when screwing down the backer boards. A crack isolation membrane is recommended on top of the backer board. Conventional mortar bed or thinset installations may then be used.

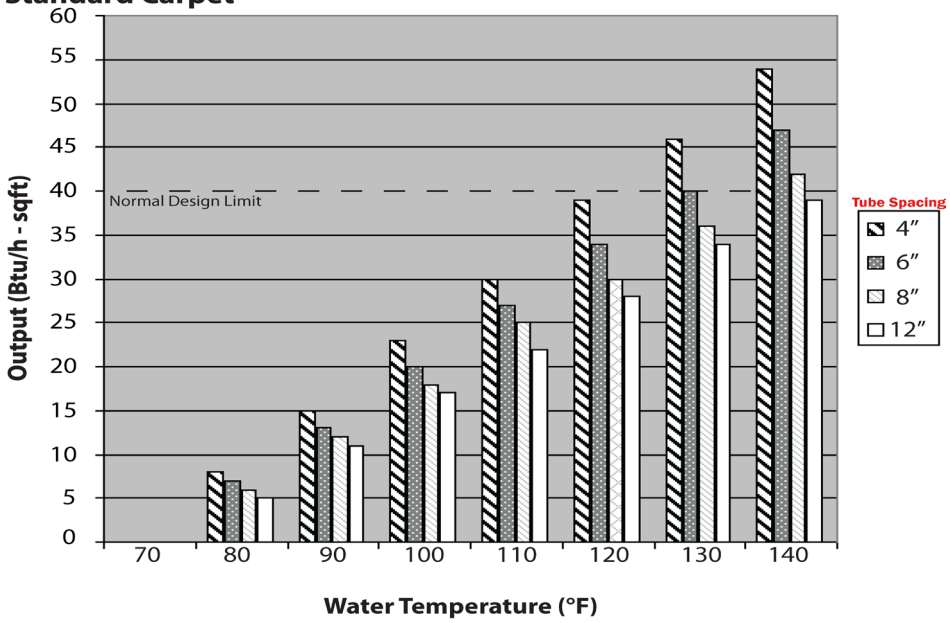
For vinyl floors, a minimum 1/4" plywood backer board is required and the flooring and adhesive material checked for temperature limitations.



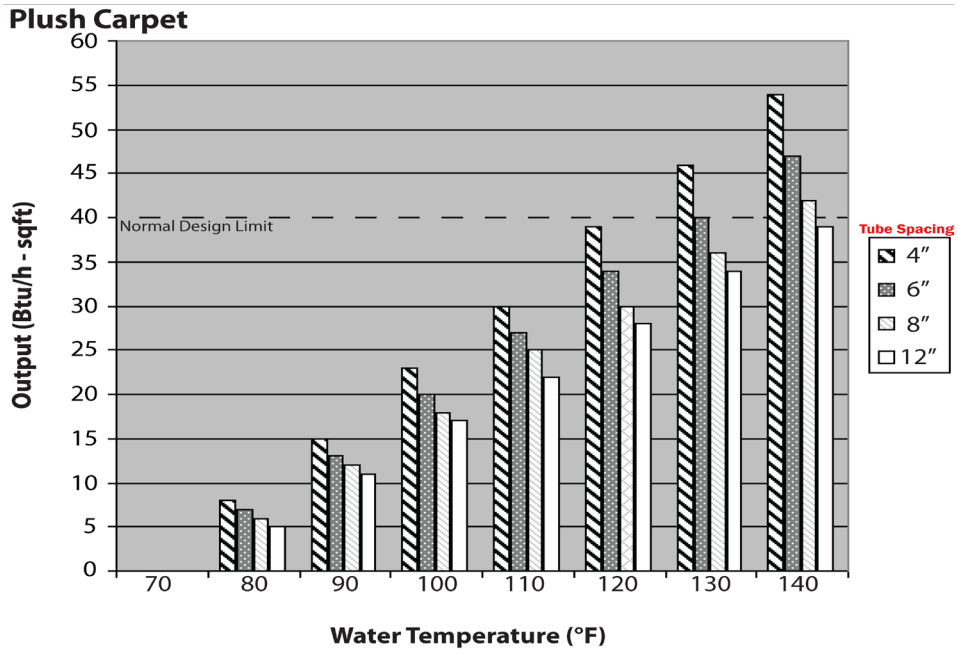


Notes:
1. Based on 20°**F temperature differential supply / return at full output.**
2. Top of tubing must be 1 3/8" to a maximum of 3"from finished surfaces.
3. Conventional construction - excessive R values or material should be individually designed.
4. 3/8", 1/2" and 5/8" tubing only. Loops should not exceed maximum recommended length for size selected.
5. Floor surface temperature should not exceed 85°F.
6. Loop flow (GDM) = Area Covered (ft²) X BTU/ft²
10,000 BTUH/GPM

Standard Carpet



Plush Carpet



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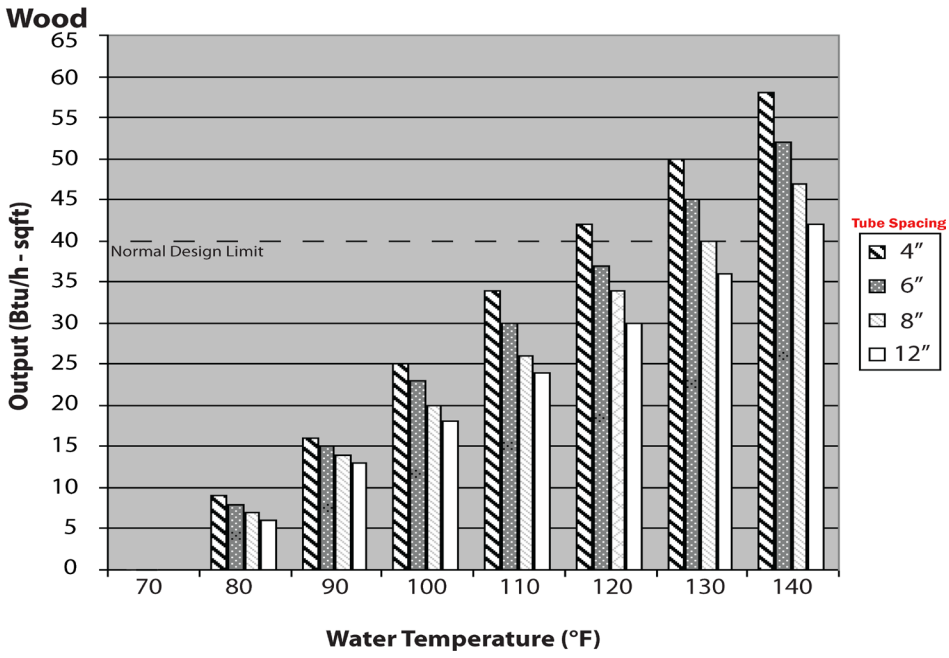

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10,000 BTUH/GPM

Convert From	into	Multiply by
VELOCITY		
Feet per second	Meters per second	0.3048
Meters per second	Feet per second	3.281
LENGTH		
Inches	Feet	0.0833
Inches	Centimeters	2.54
Inches	Meters	0.0254
Feet	Inches	12
Feet	Centimeters	30.48
Feet	Meters	0.3048
Centimeters	Inches	0.3937
Centimeters	Feet	0.0328
Centimeters	Meters	0.01
Meters	Inches	39.37
Meters	Feet	3.281
Meters	Centimeters	100
AREA		
Square Inches	Sq. Feet	0.0069
Square Inches	Sq. Centimeters	6.452
Square Inches	Sq. meters	0.00065
Square Feet	Sq. Inches	144
Square Feet	Sq. Centimeters	929.03
Square Feet	Sq. Meters	0.0929
Sq. Centimeters	Sq. Inches	0.155
Sq. Centimeters	Sq. Feet	0.0011
Sq. Centimeters	Sq. Meters	0.0001
Square Meters	Sq. Inches	1550
Square Meters	Sq. Feet	10.764
Square Meters	Sq. Centimeters	10000
VOLUME FLOW RATE		
Gallons / minute	Cubic Ft. / Sec.	0.0022
Gallons / minute	Liter / Sec.	3.786
Cubic Ft. / sec.	Gallons / Min.	448.86
Cubic Ft. / Sec.	Liter / Sec.	28.32
Liter / Sec.	Gallons / Min.	0.264
Liter / Sec.	Cubic Ft. / Sec.	0.0353
WEIGHT		
Pounds	Kilograms	0.4536
Pounds	Grams	453.6
Kilograms	Pounds	2.205
Kilograms	Grams	1000
Gallons of Water	Pounds*	8.26
Gallons of Water	Kilograms*	3.743
Liters of Water	Kilograms*	0.988
Liters of Water	Pounds*	2.18
ENERGY		
Calorie	BTUH	0.00397
Calorie	kWh	0.000001163
BTU	Calorie	252
BTU	kWh	0.000293
kWh	Calorie	860100000
kWh	BTU	341.3

Convert From	into	Multiply by
VOLUME		
Cubic inches	Cubic feet	0.00058
Cubic inches	Cubic meters	0.00002
Cubic inches	U.S gallons	0.0043
Cubic inches	Liters	0.0164
Cubic Feet	Cubic Inches	1728
Cubic Feet	Cubic Meters	0.0283
Cubic Feet	U.S. Gallons	7.481
Cubic Feet	Liters	28.33
Cubic Meters	Cubic inches	61024
Cubic Meters	Cubic Feet	35.31
Cubic Meters	U.S. Gallons	264.13
Cubic Meters	Liters	1000
U. S. Gallons	Cubic Inches	231
U. S. Gallons	Cubic Feet	0.1337
U. S. Gallons	Cubic Meters	0.0038
U. S. Gallons	Liters	3.786
Liters	Cubic Inches	61.01
Liters	Cubic Feet	0.0353
Liters	Cubic Meters	0.001
Liters	U.S. Gallons	0.264
POWER		
Horsepower	Kilowatt	0.746
Horsepower	BTUH	2546
Kilowatt (KW)	Horsepower	1.34
Kilowatt (KW)	BTUH	3413
BTUH	Kilowatt	0.000293
BTUH	Horsepower	0.00039
PRESSURE		
Atmospheres	Feet of Water*	34.28
Atmospheres	mm of Mercury	760
Atmospheres	Pounds / Sq. Inch	14.7
Atmospheres	Pascals	101300
Feet of Water	Atmospheres*	0.0292
Feet of Water	mm of Mercury*	22.17
Feet of Water	Pounds/ Sq. Inch*	0.4286
Feet of Water	Pascals*	2956
mm of Mercury	Atmospheres	0.00132
mm of Mercury	Feet of Water*	0.04511
mm of Mercury	Pounds/ Sq. Inch	0.01934
mm of Mercury	Pascals	133.32
Pounds/ Sq. Inch	Atmospheres	0.06805
Pounds/ Sq. Inch	Feet of Water*	2.333
Pounds/ Sq. Inch	mm of Mercury	51.71
Pounds/ Sq. Inch	Pascals	6895
Pascals	Atmospheres	0.00000987
Pascals	Feet of Water*	0.000338
Pascals	mm of Mercury	0.007501
Pascals	Pounds/ Sq. Inch	0.000145
TEMPERATURE		
Fahrenheit = (Centigrade X 1.8) + 32		
Centigrade = (Fahrenheit X .555) - 17.8		

* at 120 degrees F

Warranty Requirements for AquaHeat Floor Installations

Pressure test

For the pressure test, use at least 80-100 psi (550-690 kPa) hydrostatic pressure or 60-80 psi (415-550 kPa) air pressure. This test must be performed for a minimum of 12-24 hours before the placement of the topping. Special care must be taken to check and re-tighten all joints and connections. During the pouring of the topping, the pipe must be left under pressure so that possible damage to the pipe can be immediately detected.

Corrosion protection

For all systems it is suggested that inhibitors, approved for closed loop hydronic heating systems, be added to the heating fluid for corrosion protection. For calculation of system water content in the particular PEX piping chosen for your project, please see chapter 5 - corrosion protection.

Freeze protection

It is recommended for all systems exposed to freezing temperatures that glycols with built-in inhibitors (that are approved for hydronic heating systems) be added to the heating fluid. A minimum of a 30%-35% (maximum 50%) glycol/water mixture for combination system corrosion, plus freeze protection, is needed. For a calculation of the system water content in the particular PEX piping chosen for the project, please see chapter 5 -freeze protection.

System fill / Air purge (loop-by-loop fill)

It is suggested that an isolation valve be installed at each supply/return manifold header. To fill the system you will need to have a minimum of 40 psi water available. As well, obtain a 5 gallon pail and 5' of hose, complete with a hose connection end. Each loop must be filled individually!

Step 1 Isolate the supply and return piping with valves installed in front of each manifold header.

Step 2 Connect the hose to the hosebib on the return manifold and drop the end into a 5 gallon pail.

Step 3 Hand tighten the red caps on the supply manifold modules and close all the blue return module valves, closing all the loops.

Step 4 Open the isolation valve on the supply pipe to allow water pressure into the supply header. (Note: return valve remains closed.)

Step 5 Open the first return module valve. Open the first cap to allow water to flow into the loop . Watch the hose in the pail until you observe a steady stream of water (no air or spitting). Close cap on loop #1.

Repeat Step 5 for each loop until all loops are filled with water, and air is purged from pipes. Purging is complete when there is no more air and/or spitting.

ComfortPro Systems LLC
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