Concrete System

Installation Manual

March 2009

Contents

SYSTEM ADVANTAGES AND BENEFITS - CHAPTER 1

1.1 Why Is Radiant So Comfortable

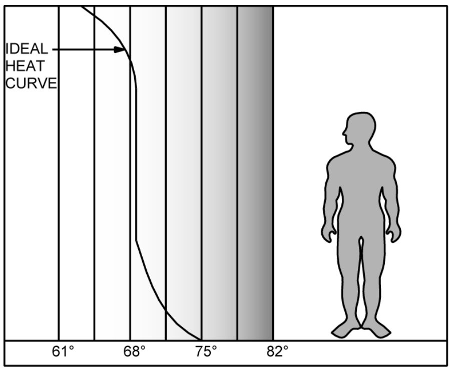


Figure 1.1a

Even Heat Distribution

Ideal Heating Curve

For maximum comfort, the warmest temperature is at floor level and cooler temperatures are at head and ceiling levels. By comparing the four main heat distribution systems (see below) one can easily see that in forced air, radiators, and convective baseboard heating patterns, heat becomes trapped at the ceiling level, causing an inversion of the ideal heating pattern.

Q: Is there energy being wasted from certain heating systems?

A: Yes, the area between the ideal heating curve and each specific heating system curve represents wasted energy, which causes higher monthly fuel bills.

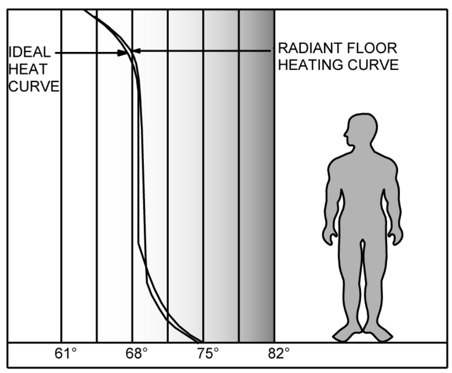


Figure 1.1b

Radiant Floor

- Entire floor surface area is in effect a low temperature radiator
- Warms other surfaces in that room and they, in turn, become heat emitters
- Has superior energy efficiency

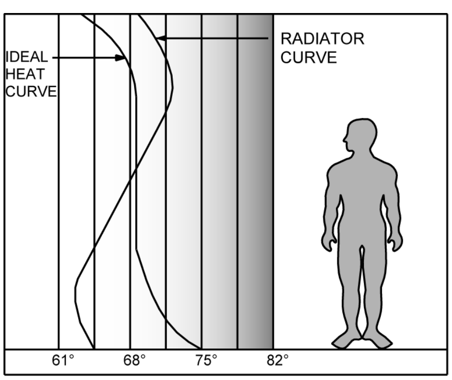


Figure 1.1c

Radiators

- Most of the heat is delivered by convection
- Operates at high water temperatures
- Creates convective warm air currents

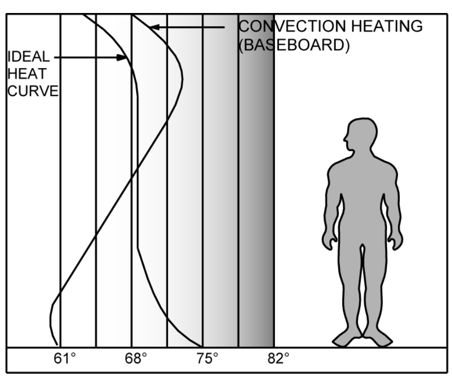


Figure 1.1d

Baseboard (natural convection)

- Has minimal surface area
- Operates at high water temperatures
- Tends to create uneven pools of warmth

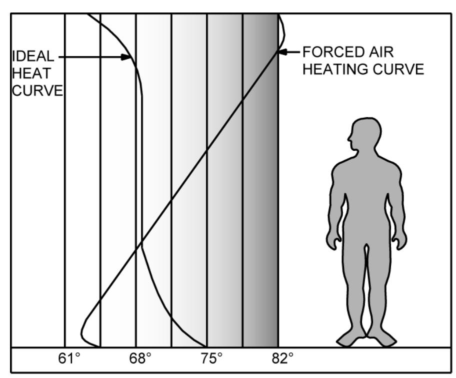


Figure 1.1e

Forced Air

- Drafts may occur
- High temperature air may be blown at occupants
- Exact opposite of the ideal heat curve, i.e. cold feet and hot head

1.2 Application Benefits

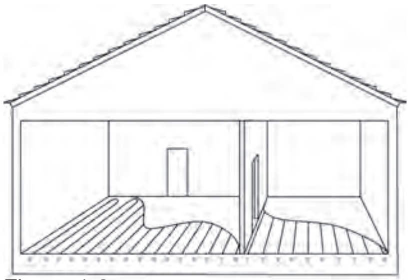


Figure 1.2a

Slab on Grade

Used in new single story slab houses

- Typical tubing spacing 9" on center.

Bathrooms/Foyers

A thin-slab (lightweight pour) is a good medium in some marble or ceramic tile finish floor applications. Thin-slabs may also be used over thick mud jobs.

- Typical tubing spacing 6" on center.

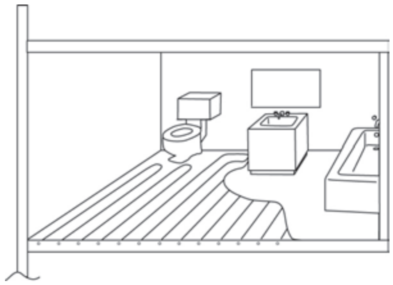


Figure 1.2b

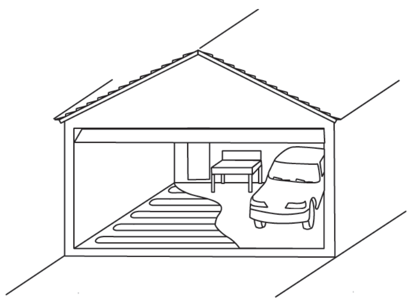


Figure 1.2c

Garages/Workshops

Ideal for heating garages. Makes working in the shop comfortable. Dries floors and cars in the wet winter weather. Helps prevent tracking unwanted snow and dirt inside in the winter.

- Typical tubing spacing 12" on center.

New Basements

Radiant heating in the slab makes a more comfortable basement. It also decreases the downward heat loss through the first floor.

- Typical tubing spacing 12" on center.

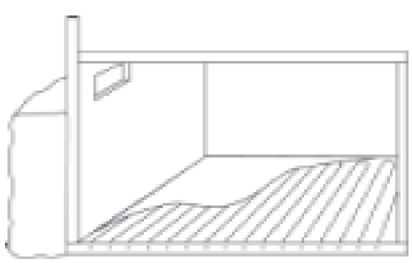


Figure 1.2d

SYSTEM DESIGN - CHAPTER 2

2.1 Creating a Concrete System Material List

- Calculate the net heated area.
- Use this chart to make an initial material list for the net area to be heated.

Note: This estimation does not include controls.

ViegaPEX Barrier / FostaPEX Tubing*	Net Heated Area	Multiplier	Estimated Amount
6" Spacing		2.2	
9" Spacing		1.6	
12" Spacing		1.1	

Table 2.1a * Sizes 1/2", 5/8", 3/4"

Fasteners*	Net Heated Area	Multiplier	Estimated Amount
6" Spacing		1.1	
9" Spacing		.75	
12" Spacing		.55	

Table 2.1b * Various fasteners available

Equation:
Net Heated Area x Multiplier = Estimated amount

Use this room accompanied with the chart to practice estimating.

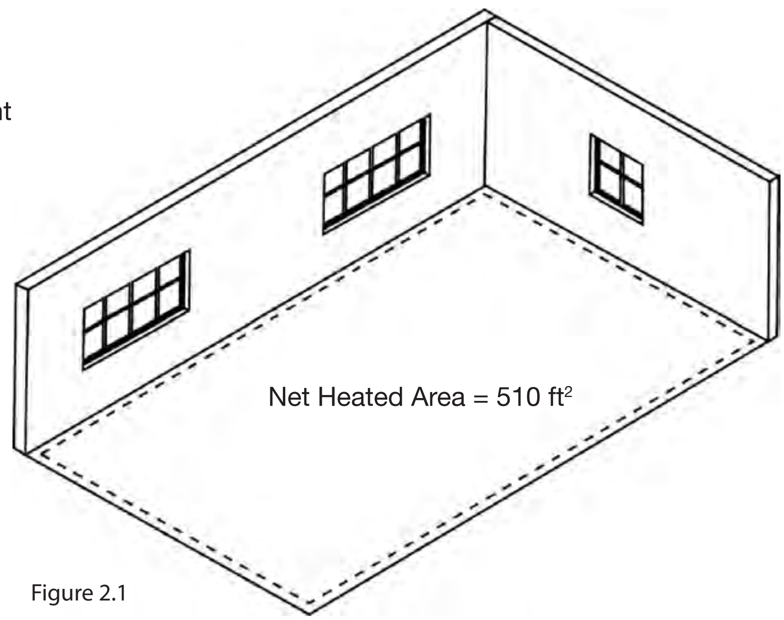


Figure 2.1

Solutions

Remember this chart is only for estimating. The number of circuits in the area will be covered in section 3.1 Layout Planning. Installer's preference determines choice of fasteners.

ViegaPEX Barrier / FostaPEX Tubing*	Net Heated Area	Multiplier	Estimated Amount
6" Spacing	510 ft^2	2.2	1,122 ft
9" Spacing	510 ft^2	1.6	816 ft
12" Spacing	510 ft^2	1.1	561 ft

Table 2.1c * Sizes 1/2", 5/8", 3/4"

Note:
Changing tubing size does not necessarily give you a higher heat output (remember the floor is the main heat emitter). The larger tubing allows for longer circuit lengths (Refer to section 3.1 for maximum circuit lengths).

Fasteners*	Net Heated Area	Multiplier	Estimated Amount
6" Spacing	510 ft^2	1.1	561 pc
9" Spacing	510 ft^2	.75	383 pc
12" Spacing	510 ft^2	.55	281 pc

Table 2.1d * Various fasteners available

Tubing is sold in coils and fasteners in packages

2.2 Heat Loss Calculations for Floor Heating Systems Using Radiant Wizard™

The easy-to-use Radiant Wizard program will calculate the heat loss of any building. Based on ASHRAE formulas, the Radiant Wizard will also perform a full, multi-temperature, detailed design and quote for your system. A step-by-step users manual is provided with the program.

Contact your local representative to receive a copy of the Radiant Wizard program.

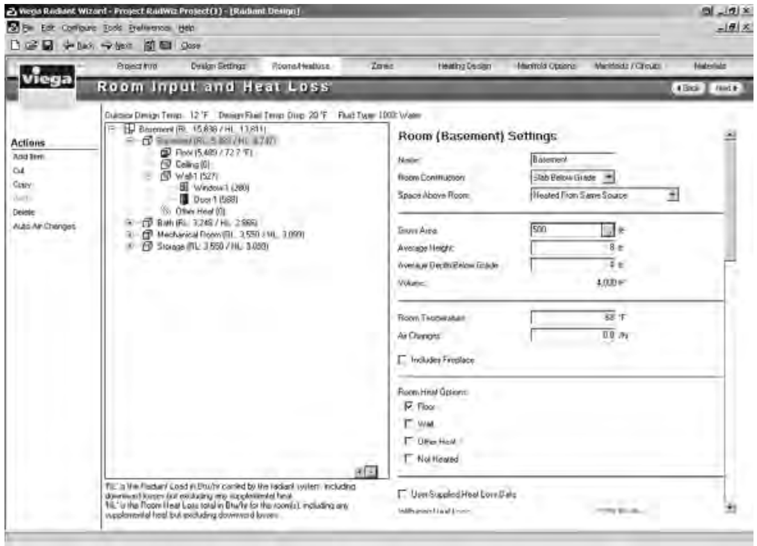


Figure 2.2

2.3 Calculating the Supply Water Temperature

4 Inch Slab on or Below Grade Application
9" Tubing Spacing

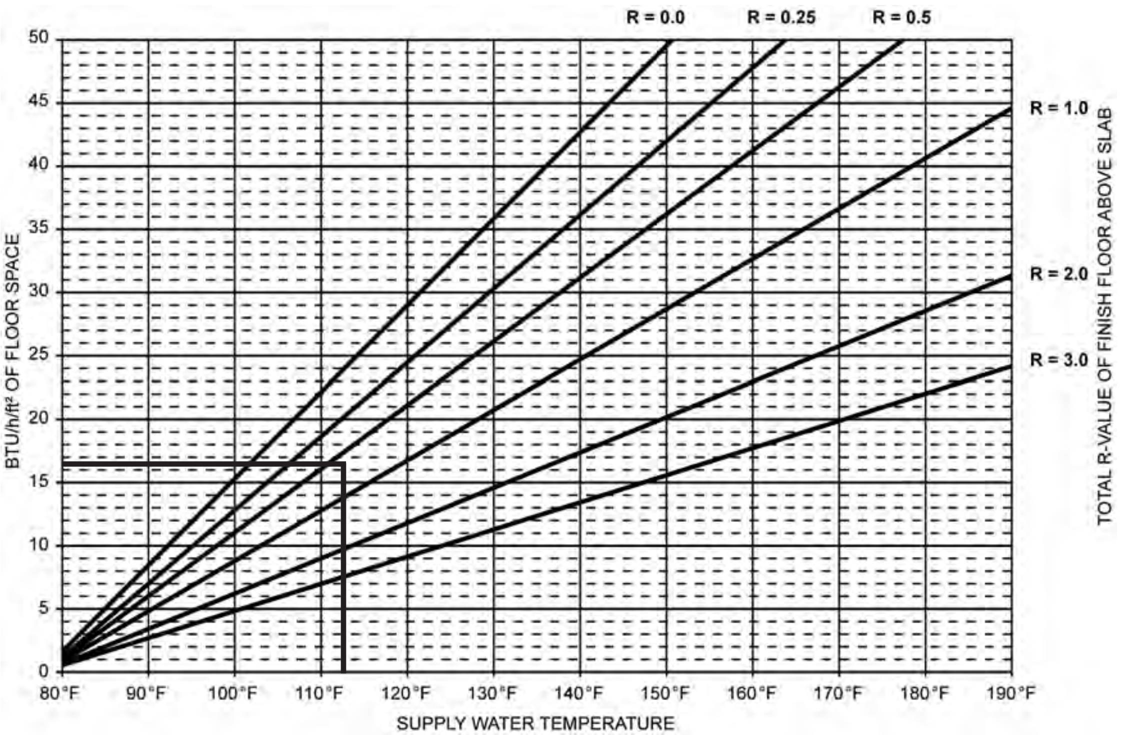


Figure 2.3

Based on 68°F room temperature with 1/2" Pex tubing and R5 insulation below the slab.

Procedure:

1. Locate desired BTU output (from Radiant Wizard) on left vertical axis.
2. Follow to the right until you reach the selected total R-value curve.
3. Then move down to the horizontal axis and read the supply water temperature.

Example:
Output needed: 20 BTU/h/ft^2
Finish floor R-value: 0.25
Supply water temperature: 112°F

2.4 Calculating the Floor Surface Temperature

This chart shows the relationship between room temperature and floor surface temperature for floor heating systems.

Procedure

1. Locate required output (from Radiant Wizard or other source) on left vertical axis.
2. Follow to the right until you reach the curve.
3. Then move down to the horizontal axis and read the ΔT between the room temperature and the floor surface temperature.
4. Add the room temperature and the ΔT to get the floor surface temperature.

Example

Output needed: 25 BTU/h/ft^2
Room temperature: 68°F
ΔT (from chart): ~ 12°F
Floor surface temperature:
68°F + 12°F = 80°F

The floor surface temperature will be 80°F with 25 BTU/h/ft^2 output and 68°F room temperature.

Floor Surface Temperature Chart

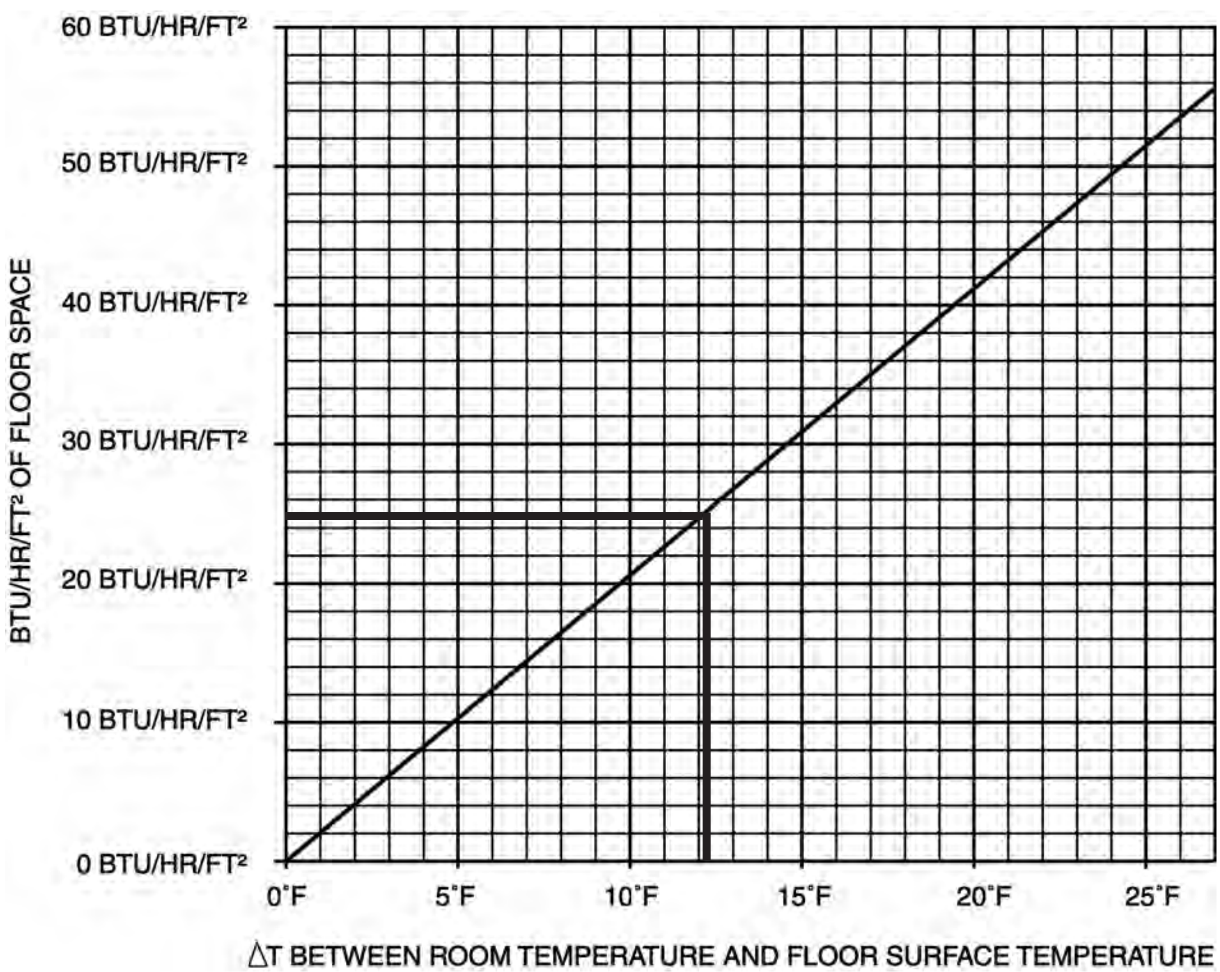


Figure 2.4

2.5 Calculating the Pressure Drop

In order to select the correct pump size for the system, the pressure drop must be calculated. Use the chart below to calculate the pressure drop.

Procedure

1. Locate desired flow rate for one circuit on the left vertical axis (receive circuit flow rate from the Radiant Wizard program).
2. Follow to the right until you reach the selected tubing size.
3. Then move down to the horizontal axis and read the pressure drop in feet of head per floor of tubing.
4. Multiply pressure drop per foot by length of longest circuit.

ViegaPex™ Tubing Data Table

Nominal Size (in.)	Outside Diameter (in.)	Inside Diameter (in.)	Water Content (in.)
5/16	0.430	0.292	0.004
3/8	0.500	0.350	0.005
1/2	0.625	0.475	0.009
5/8	0.750	0.574	0.014
3/4	0.875	0.671	0.018
1	1.125	0.862	0.030
1-1/4	1.375	1.053	0.045
1-1/2	1.625	1.243	0.063

Table 2.5

Example

GPM through 1/2" ViegaPEX Barrier: 0.7 GPM
Pressure drop per foot: 0.022 ft. of head / ft.
Total pressure drop: 0.022 x 350 total ft = 7.7 ft. of head

Pressure Drop Chart

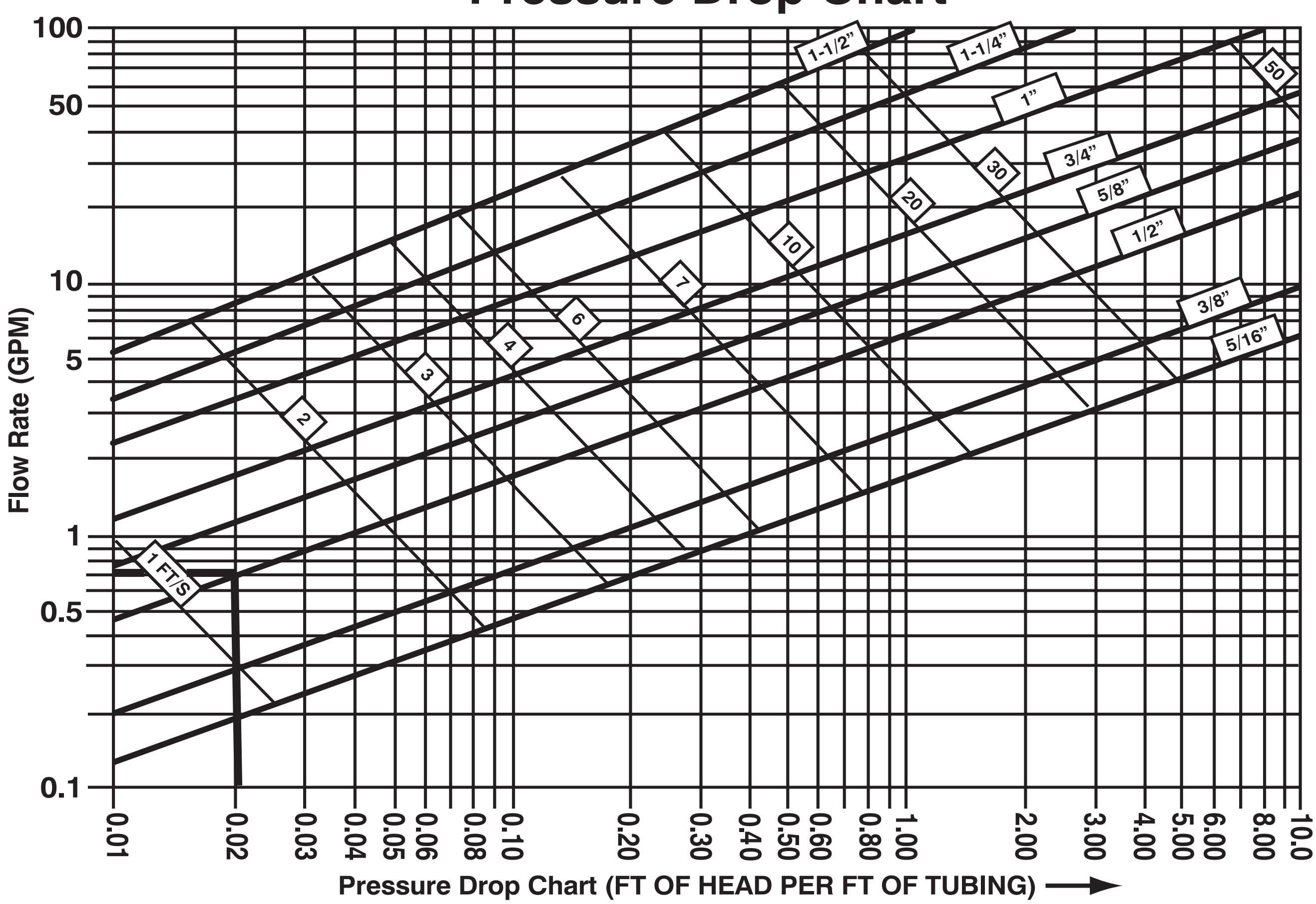


Figure 2.5

2.6 Selecting the Circulator Pump

The pump must have a capacity equal to the system flow rate and a head equal to the system pressure loss. These two system characteristics are the primary ones in selecting a pump. Flow rates come from the Radiant Wizard program. Pressure drop comes from section 2.5 (Calculating the Pressure Drop) or from the Radiant Wizard program. Remember that for pressure drop, use the highest pressure drop of all the circuits fed by their circulator. If the circulator can overcome that pressure drop, then it can overcome all the others.

Procedure

1. Locate the pressure drop on the left vertical axis.
2. Locate the total system flow rate on the bottom horizontal axis.
3. Follow to the intersection of both variables.
4. Select the pump with a curve higher than this point.

Example (see below)

Total GPM through 1/2" ViegaPEX:
5 GPM

Longest circuit pressure drop:
10 ft of head

Pump selected:
Low Head Pump

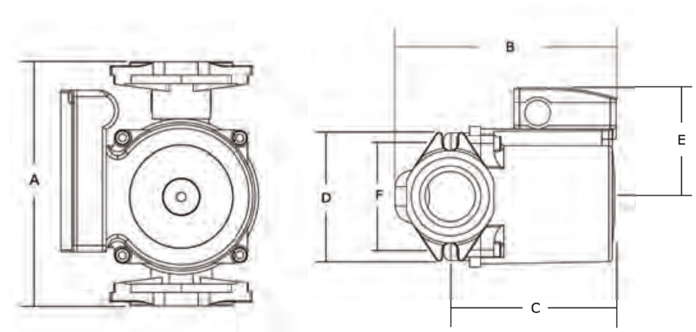
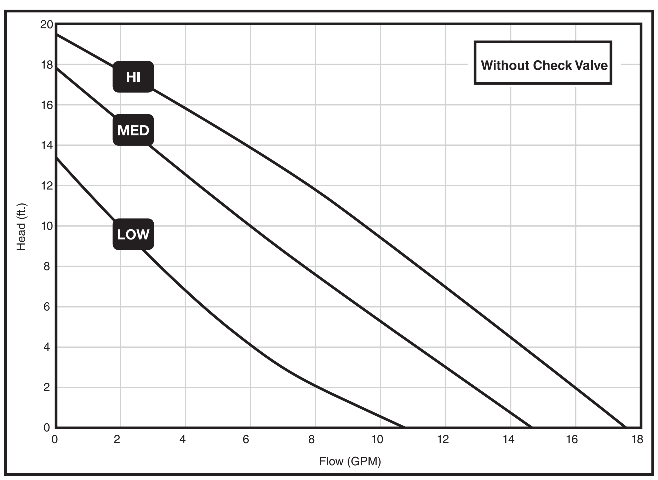
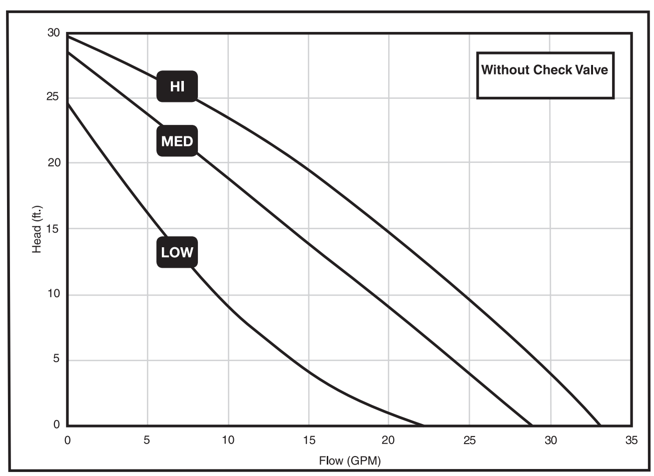


Figure 2.6a

Stock Code	A	B	C	D	E	F
12126	6-1/2"	5-1/4"	4"	4-3/16"	3"	3-5/32"
12127	6-1/2"	6"	4-7/8"	3-1/2"	3-7/16"	3-5/32"



Stock Code	Speed	Amps	Watts	HP
12126	HI	0.75	87	1/25
	MED	0.66	80	1/25
	LOW	0.55	60	1/25



Stock Code	Speed	Amps	Watts	HP
12127	HI	1.8	197	1/6
	MED	1.5	179	1/6
	LOW	1.3	150	1/6

Figure 2.6b

2.7 Typical Cross Sections

SECTION THROUGH SLAB ON OR BELOW GRADE INSTALLATION USING SNAP PANEL®

- Install insulation (R-5 minimum)
- Push PEX tubing into Snap Panel in any direction

Note:
A good general building practice is to install a vapor barrier (polyethylene film) on top of the gravel; with Snap Panel this is not needed.

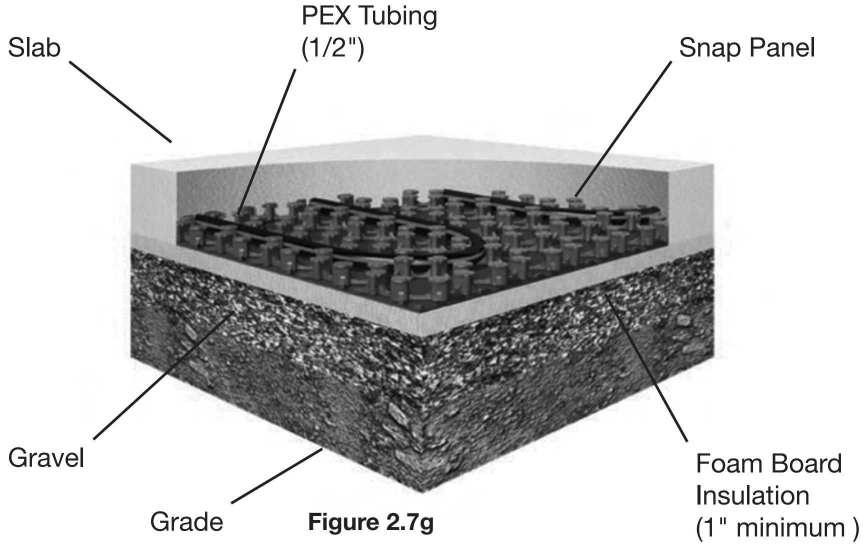


Figure 2.7g

SECTION THROUGH THIN-SLAB INSTALLATION USING SNAP PANEL

- Push PEX tubing into Snap Panel in any direction
- Allow minimum 3/4" height of thin-slab over top of PEX tubing
- Plywood staples recommended (U-clips may be substituted)

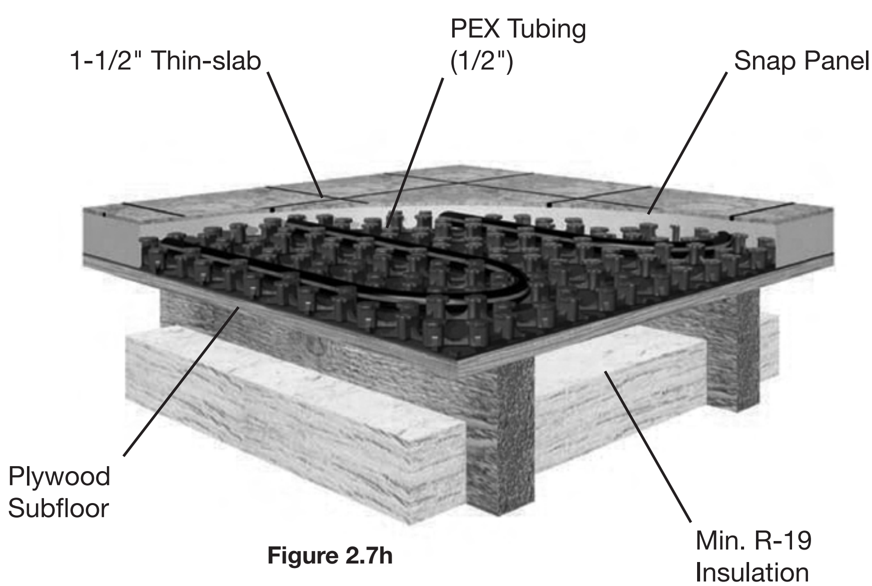


Figure 2.7h

SECTION THROUGH SLAB ON OR BELOW GRADE INSTALLATION USING WIRE MESH CLIPS

- Install insulation (R-5 minimum)
- Install wire mesh
- Fasten PEX tubing to wire mesh using Wire Mesh Clips
- Chairs/bricks may be used to raise the wire mesh and tubing to the mid point of the slab

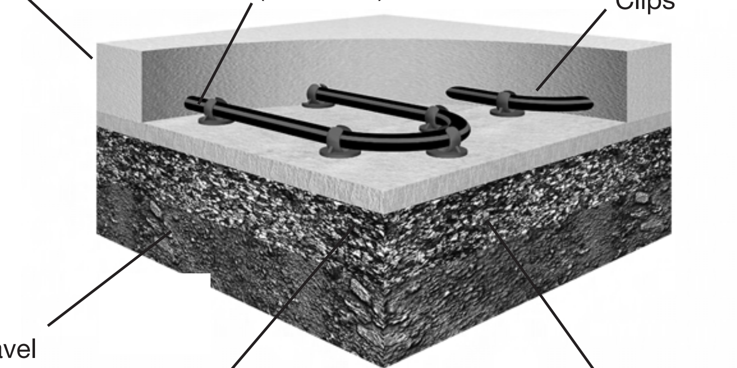


Figure 2.7c

Note:
A good general building practice is to install a vapor barrier (polyethylene film) on top of the gravel

SECTION THROUGH SLAB ON OR BELOW GRADE INSTALLATION USING PLASTIC ZIP TIES

- Install insulation (R-5 minimum)
- Install wire mesh
- Fasten PEX tubing to wire mesh using plastic zip ties. Cut end of zip ties
- Chairs/bricks may be used to raise the wire mesh and tubing to the mid point of the slab

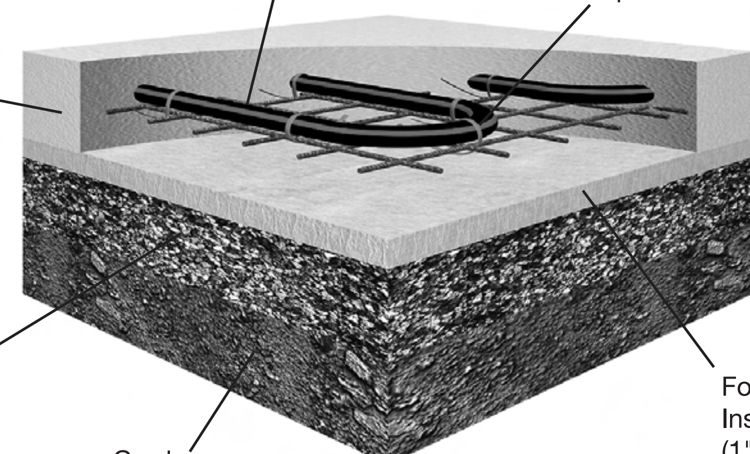


Figure 2.7d

Note:
A good general building practice is to install a vapor barrier (polyethylene film) on top of the gravel

SECTION THROUGH SLAB ON OR BELOW GRADE INSTALLATION USING U-CHANNELS

- Install insulation (R-5 minimum)
- Snap PEX tubing into U-Channel (tubing insertion points are every two inches)

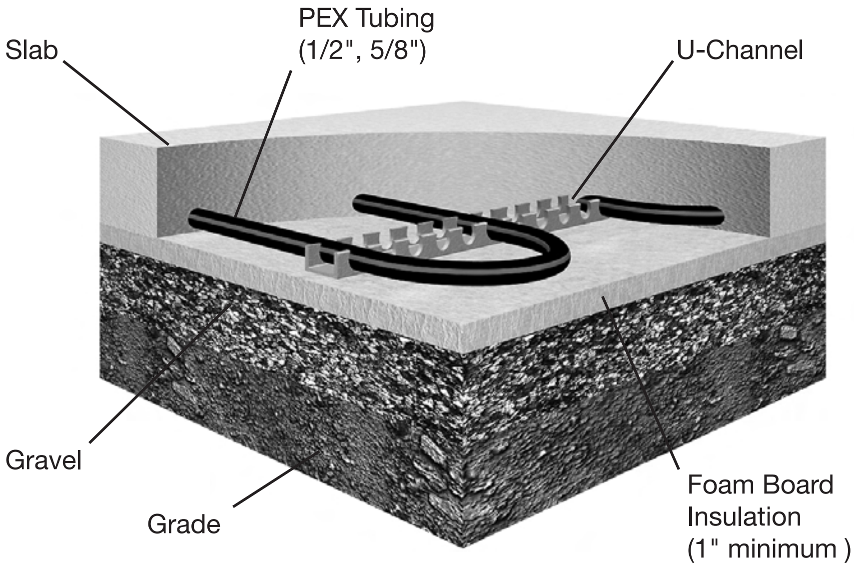


Figure 2.7e

Note:
A good general building practice is to install a vapor barrier (polyethylene film) on top of the gravel.

SECTION THROUGH THIN-SLAB INSTALLATION USING PLYWOOD STAPLES

- Use the Viega Pneumatic Staple Gun to staple PEX tubing to plywood subfloor with plywood staples. The Pneumatic Staple Gun will leave a consistent 1/8" space above tubing.
- Allow minimum 3/4" height of thin-slab over top of PEX tubing.
- Plywood staples recommended (U-clips may be substituted).

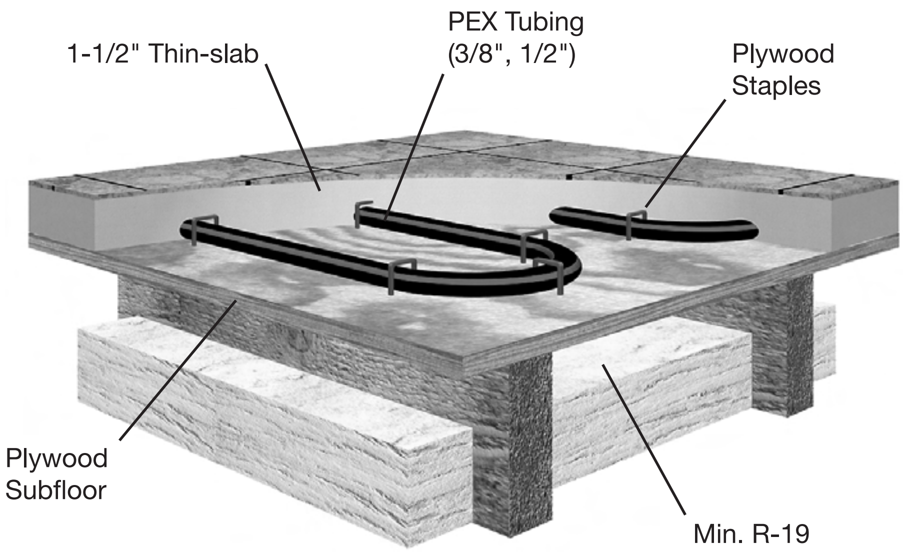


Figure 2.7f

2.8 Typical Schematics

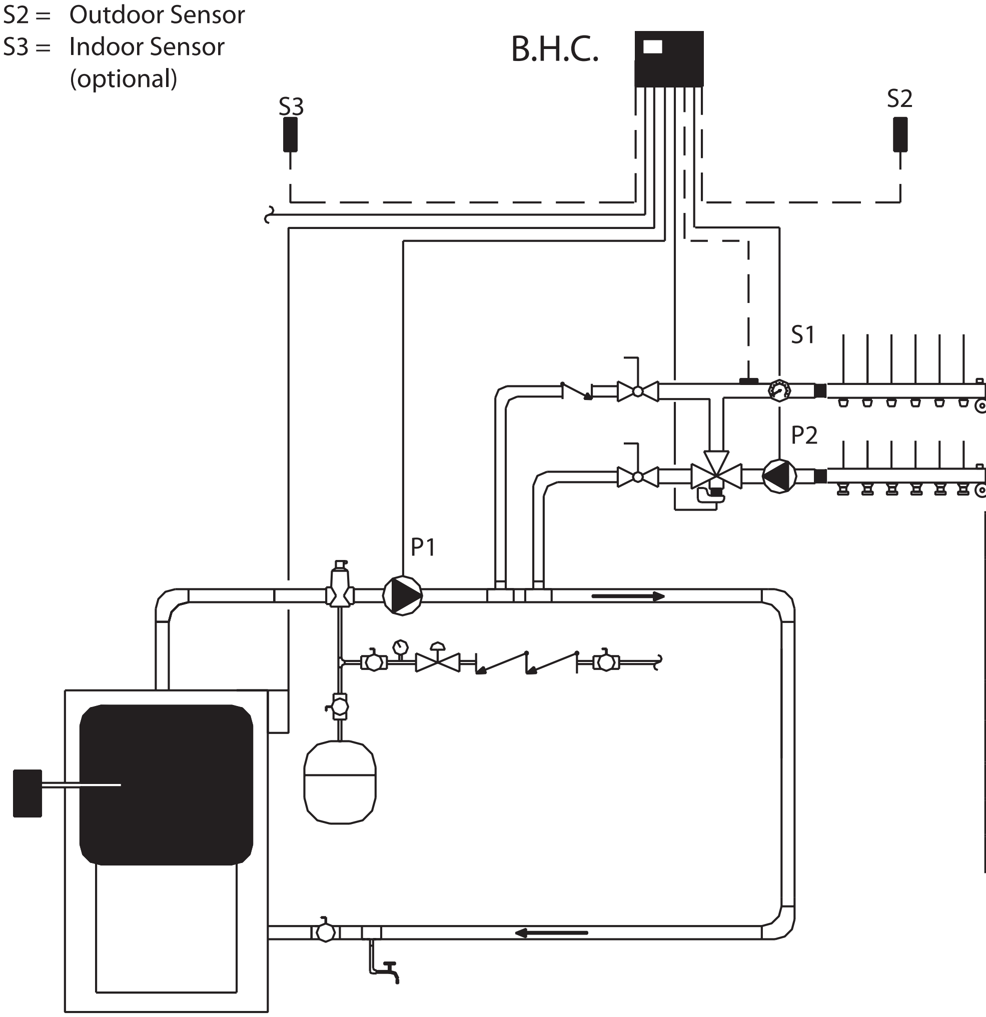
Single Temperature Radiant System

The Basic Heating Control is selected to modulate system water temperature as the outdoor temperature fluctuates. Multiple zones may be incorporated by adding Thermostats and a Zone Control.

Material	Quantity	Stock Code
Mixing Station	1	12120 - 12125
Basic Heating Control	1	16015
Indoor Sensor	1	16016
Three Position Actuator	1	18003
Stainless Manifold, Shut-Off/Balancing/ Flow Meter, # Outlets*	1	15900 - 15910

*Based on job requirements

Mechanical
P1 = Primary Loop Pump
P2 = System Pump
S1 = Mixing Supply Sensor
S2 = Outdoor Sensor
S3 = Indoor Sensor (optional)



Primary Loop Sizing*		
Copper Pipe Size (inches)	Flow Rate (GPM)	Heat Carrying Capacity (BTU/h)
3/4	4	40,000
1	8	80,000
1-1/4	14	140,000
1-1/2	22	220,000
2	45	450,000

*Flow Rate and Heat Carrying Capacity calculation based on a 20°F temperature drop across the system.

Note: All schematics are conceptual. The designer must determine whether this application will work in the system and must ensure compliance with national and local code requirements. Boiler trim (expansion tank, fill valve, relays, etc.) supplied by others.

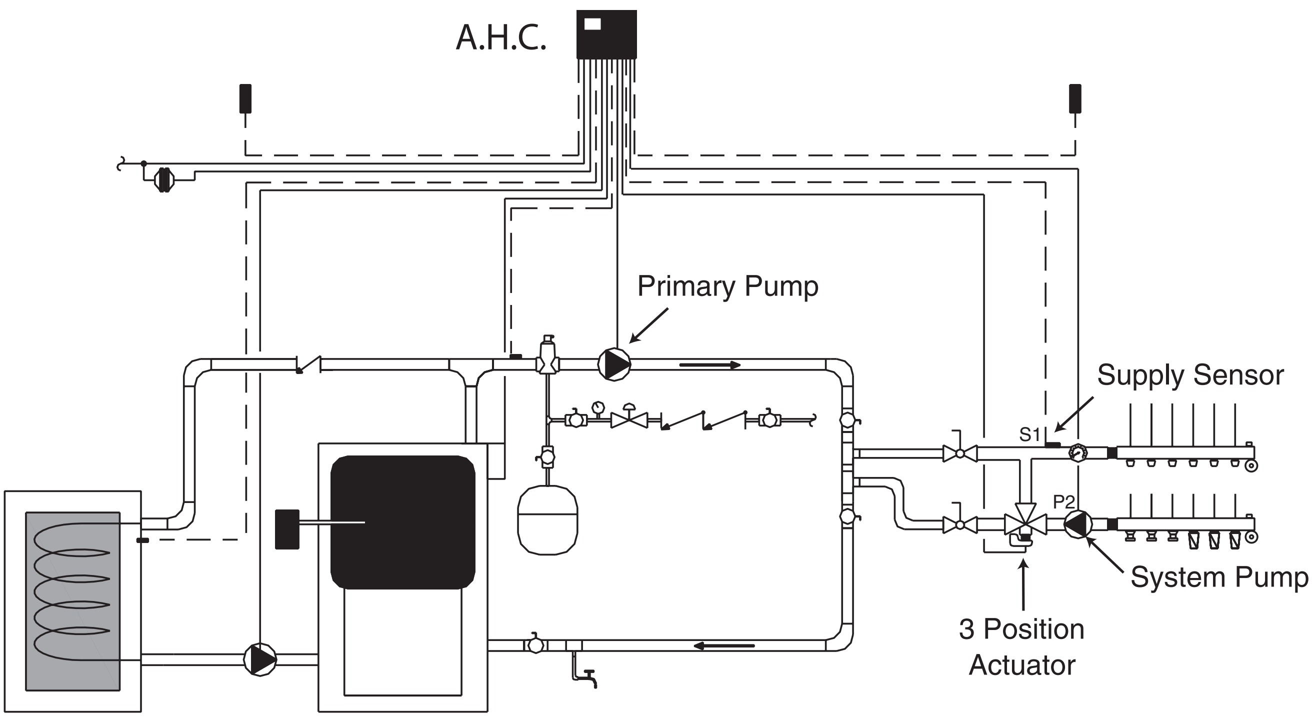
Single Temperature Radiant System With Boiler Modulation and Optional DHW Control

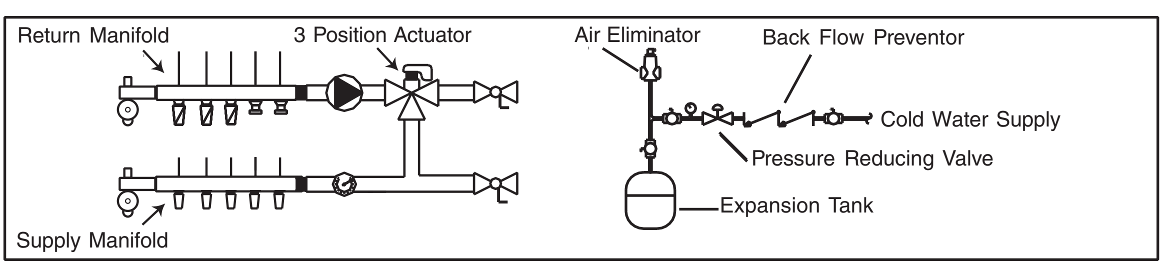
The Advanced Heating Control incorporates low temperature mixing, provides boiler modulation, and the option of domestic hot water control with priority.

Optional DHW sensor may be in tank or on outlet piping. If boiler and DHW control is not needed, refer to Basic Heating Control diagrams.

Material	Quantity	Stock Code
Mixing Station	1	12120-12125
Advanced Heating Control	1	16014
Indoor Sensor	1	16016
Three Position Actuator for Station	1	18003
1-1/4" Stainless Manifold, # Outlets*	1	15700 - 15710
Thermostats	*	18002
Powerheads	3	15061
Optional DHW Sensor	1	16018
Transformer 24V	1	18008, 18020

*Based on job requirements



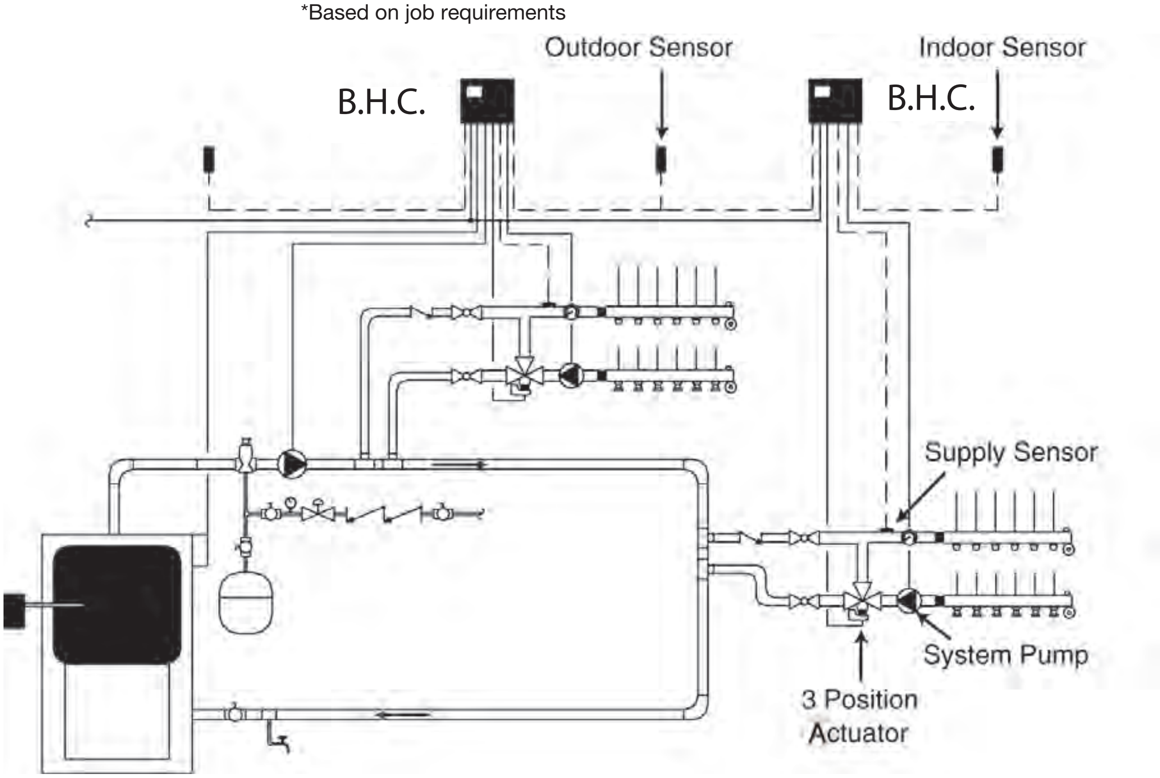


Multiple Temperature Radiant System With Boiler Modulation

Note: If the heat loss and required water temperature varies throughout a building, a multiple water temperature system may be required. To add an additional temperature system, pipe in another Mixing Station with the necessary controls.

Material	Quantity	Stock Code
Mixing Station	2	12120 - 12125
Basic Heating Control	2	16015
Indoor Sensor	2	16016
Three Position Actuator for Station	2	18003
1-1/4" Stainless Manifold, # Outlets*	2	15900 - 15910
Zone Control	2	18032
Thermostats	*	18029 - 18031
Powerheads	*	15061
Optional DHW Sensor	1	16018
Transformer 24V	1	18008, 18020

*Based on job requirements



Primary Loop Sizing					
Copper Pipe Size [inch]	3/4	1	1-1/4	1-1/2	2
Flow Rate* [GPM]	4	8	14	22	45
Heat Carrying Capacity [BTU/h]	40,000	80,000	140,000	220,000	450,000

*Based on 6 FPS

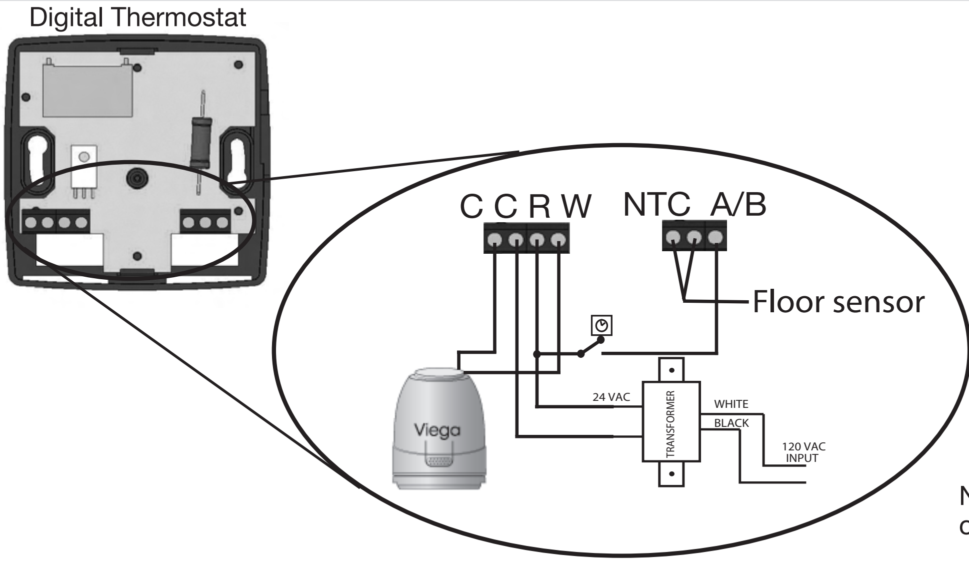
2.9 Zone Wiring

A manifold system allows any one or more of the circuits to be adapted for control by a thermostat. The following are typical zone wiring schematics.

Detailed wiring diagrams are provided with products.

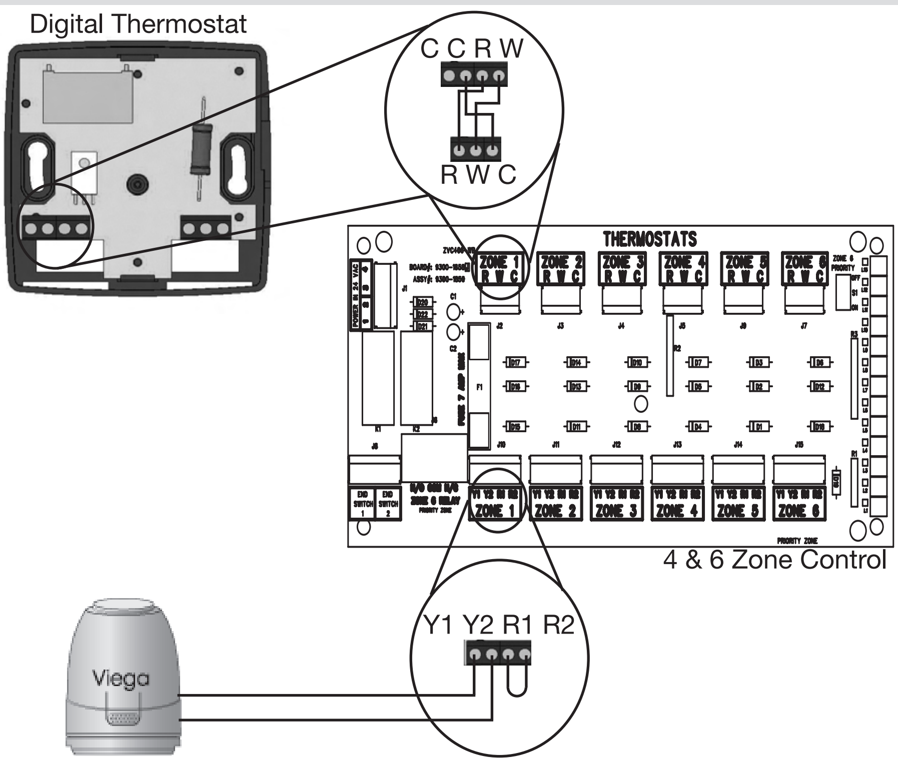
Important Note:
Installation by a licensed electrician is recommended. Installation and use of this equipment should be in accordance with provisions of the U.S. National Electric Code, applicable local code, and pertinent industry standards.

Wiring Schematic: One-Zone Application

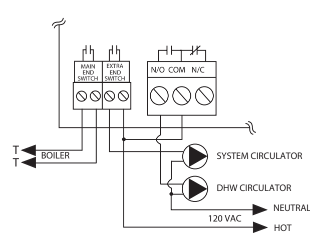


Note: Digital Thermostats can control up to 4 powerheads.

Wiring Schematic: Multi-Zone Application



Note: 4 Zone Control (18060) can operate 8 powerheads.
6 Zone Control (18062) can operate 16 powerheads.



CONCRETE SYSTEM INSTALLATION - CHAPTER 3

3.1 Layout Planning

To avoid waste and to have equal circuit lengths, a carefully planned layout should be done. First, determine where the manifold should be installed. Remember the manifold must be accessible. When calculating the number of circuits, always round up. Keep the length of each circuit in the same room equal.

Maximum Circuit Length		
Tubing	≤ 25 Btu's / (hr x ft²)	≥ 25 Btu's / (hr x ft²)
3/8"	300'	250'
1/2"	400'	350'
5/8"	500'	450'
3/4"	600'	750'

Calculating number of circuits:
Total amount of tubing ÷ Maximum circuit length = # of circuits

Table 3.1

CIRCUIT LAYOUT PATTERNS FOR HYDRONIC RADIANT FLOOR HEATING

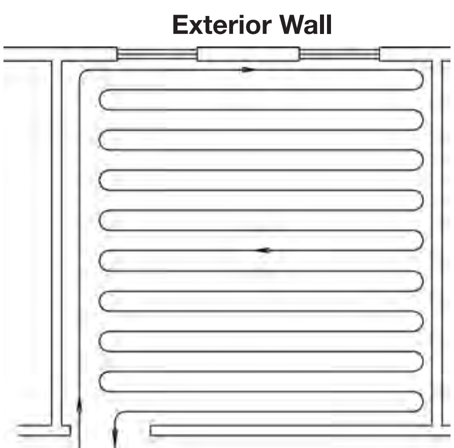


Figure 3.1a
One Wall Serpentine
Room has one exterior wall

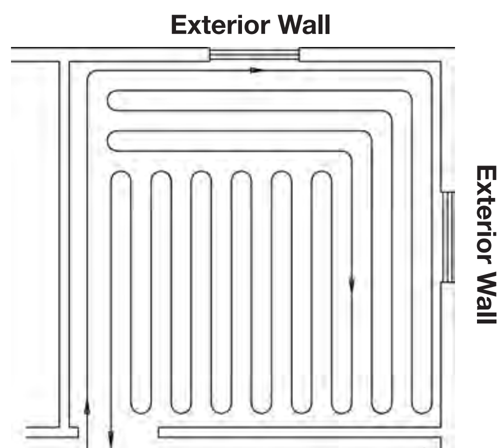


Figure 3.1b
Two Wall Serpentine
Room has two exterior walls

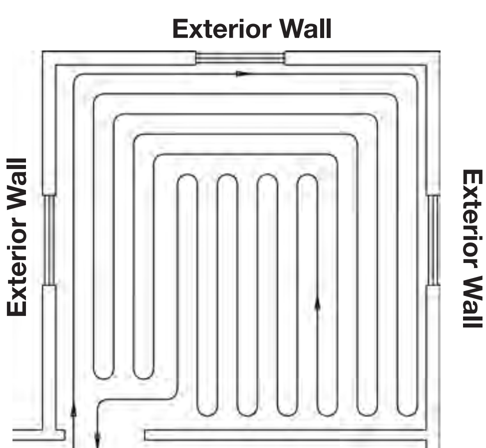


Figure 3.1c
Three Wall Serpentine
Room has three exterior walls

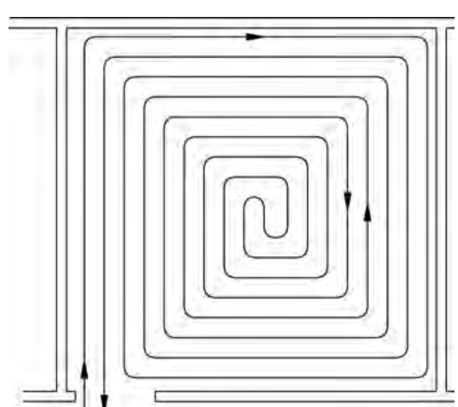


Figure 3.1d
Counter Flow
Room has no exterior walls

Continue serpentine pattern.

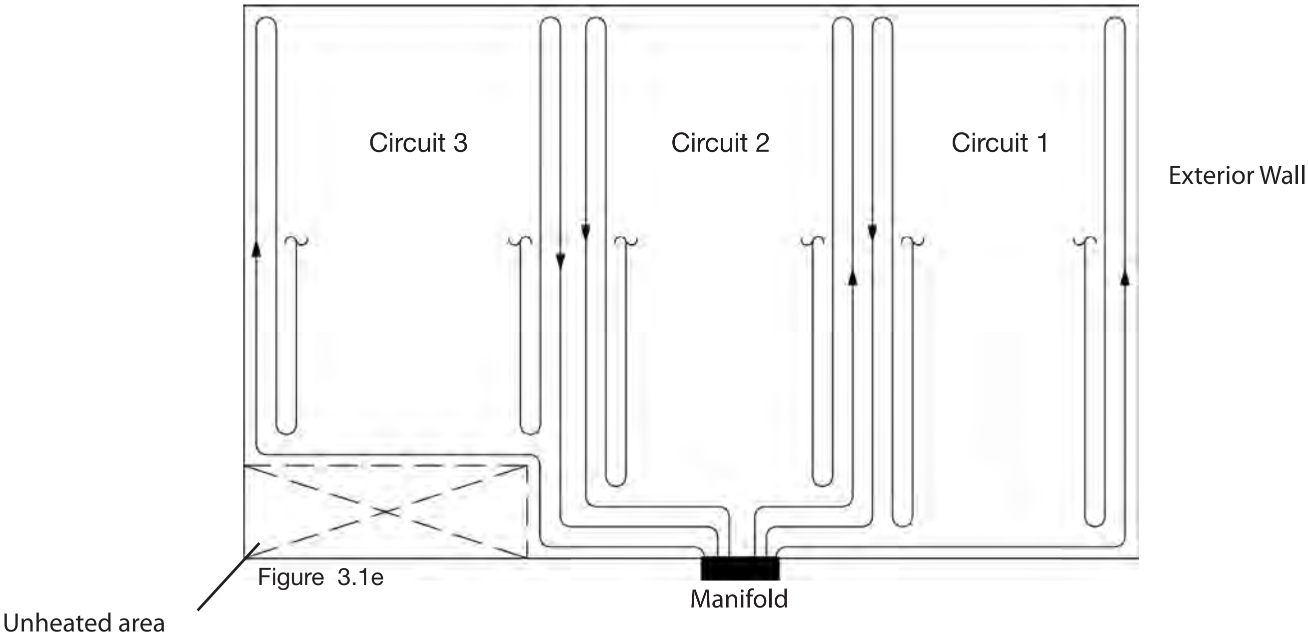


Figure 3.1e

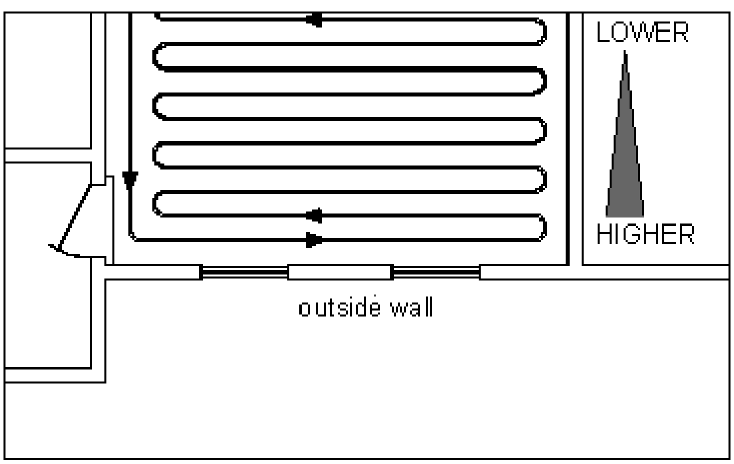


Figure 3.1f

Run supply tubing from red manifold valves into high heat loss areas first (i.e. closest to exterior walls, windows, sliders, etc.) and then into the interior of the room.

Higher water temperatures at the outside wall will provide more BTU output where it is needed.

Continue the circuits, laying them out in the same direction toward the interior of the room.

TUBING LAYOUT AROUND JOINTS

Concrete has very little flexibility and will almost always crack. Jointing is one of the best ways to control the inevitable. Joint location, which influences the radiant heating piping design layout is generally specified by the architect.

Typical Joint Locations

- Edge of thermal mass
- Side length 18'
- Sides less than 1:2 ratio
- Doorways
- Bays in L-shaped rooms

Isolation Joints
When installed against the concrete foundation at the perimeter of the slab, the joint material prevents the slab from bonding to the walls. It also allows the slab to expand without cracking during temperature fluctuations.

Control Joints
Control joints force cracks to follow the path of the joint. Without them, random cracks will ruin the appearance and sometimes the usefulness of the slab.

Slabs With Isolation And Control Joints

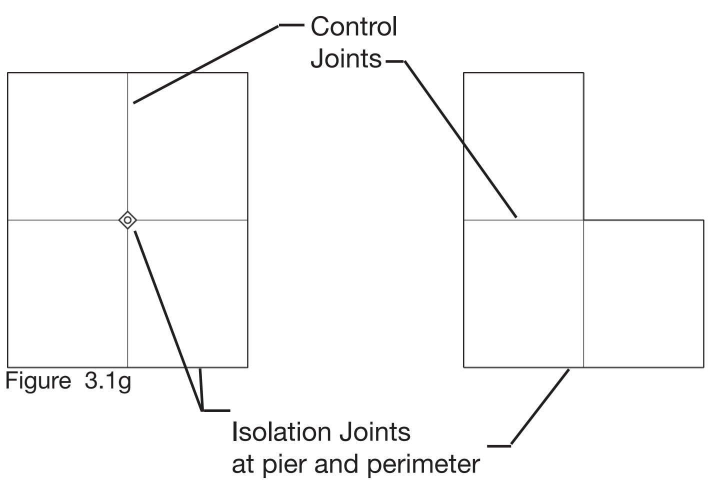


Figure 3.1g

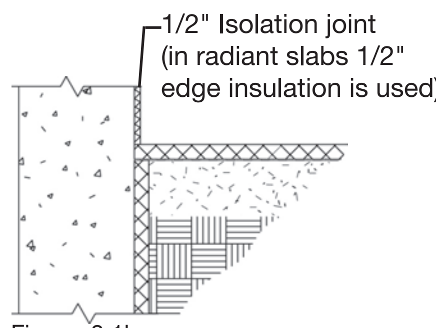


Figure 3.1h

Note:
Building or masonry supply companies sell 1/2" thick isolation joint material that is precut to the thickness of the slab.

Minimize Penetration of Joints

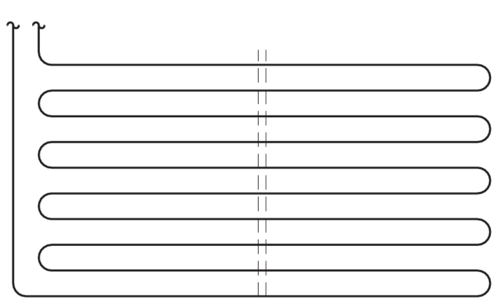


Figure 31i

Incorrect

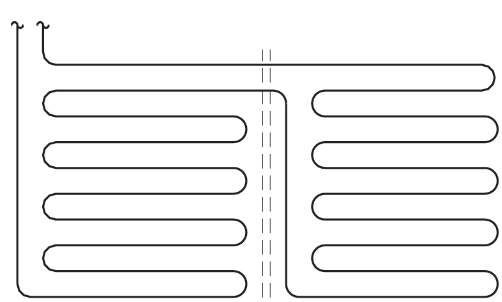


Figure 3.1j

Correct

3.2 Concrete System Installation

Step 1

Installing The Insulation

- Final grade should be accurately leveled.
- Cover grade with a polyethylene film (6 mill minimum).

Insulation Recommendations

- When high water table - required
- Perimeter insulation - required
- At the thermal break - required (Between heated and unheated slabs)
- Edge insulation - required
- In high heat loss conditions
- For small residential slabs (<2000 ft)

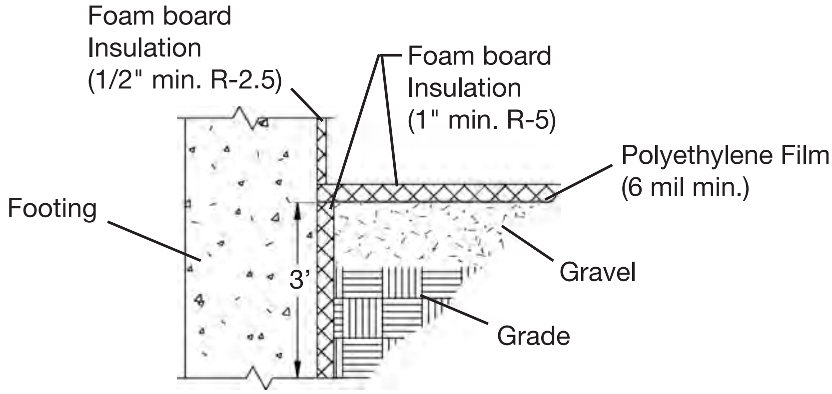


Figure 3.2a

Insulation Benefits

- Increased response time
- Increased energy savings
- Improved thermal conductivity
- Decreased downward heat loss

Note: Weigh down the foam boards to prevent wind uplift. In some jobs this can be done by installing wire mesh as soon as foam boards are placed.

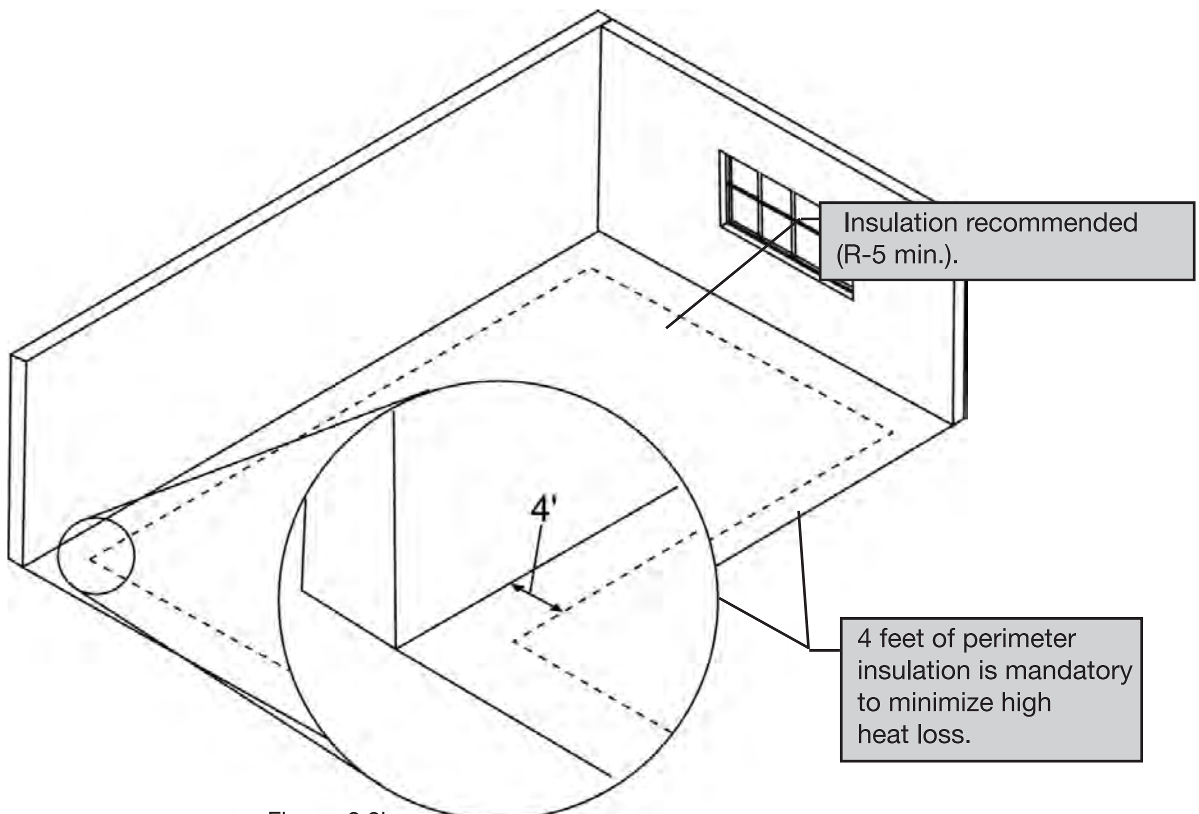


Figure 3.2b

Note: Check with local codes for requirements related to insulation.

Step 2

Installing the Tubing

Fasten tubing every two feet and three times at each u-turn to hold down any return bends or other shapes created.

It's helpful to mark out portions of each circuit directly on the insulation using spray paint.

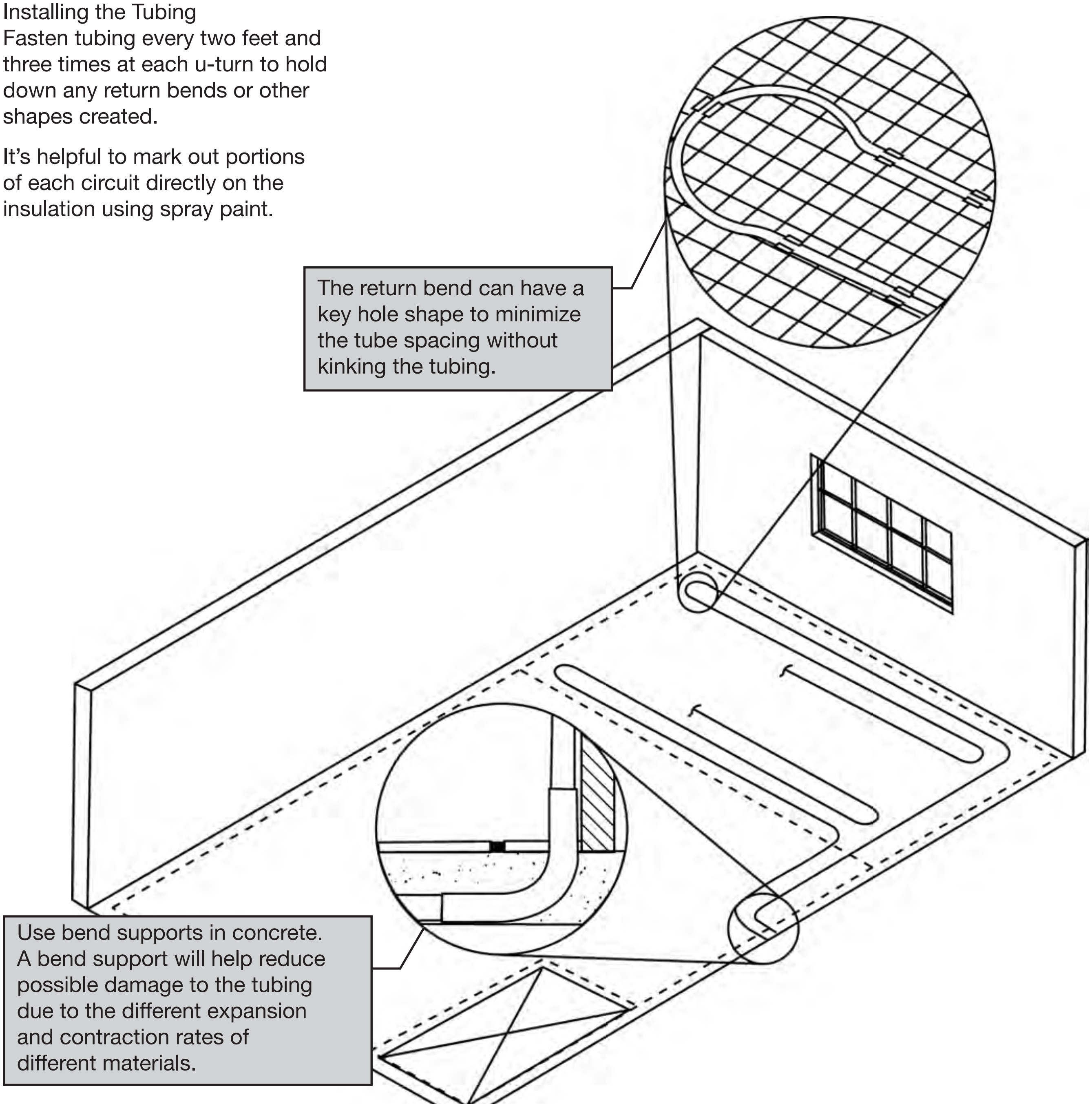


Figure 3.2c

Step 3

Pressurizing the Tubing

Pressurize tubing to 80 psi 24 hours before pour and leave pressurized until slab is cured.

Re-tighten any tubing couplings located in the slab area after at least 12 hours of system pressurization.

Step 4

Warming Up the Slab

It is best to warm the thermal mass up slowly during start-up to help prevent possible shock to the slab. In accordance with DIN 4725 section 4, Viega recommends:

- Start warm up after concrete has reached its final set (curing complete).
- Set supply water temperature to 77°F for the first three days.
- Increase supply water temperature to the set point in gradual increments for the next four days (maximum of a 50°F increase in a period of 24 hours).
- Slab warm up should follow the concrete manufacturer's recommendations.

Step 5

Testing the Concrete for Excessive Moisture

The polyethylene film test: tape a one foot square of 6 mil clear polyethylene film to slab, sealing all edges with plastic moisture resistant tape. If, after 48 hours, there is no "clouding" or drops of moisture on the underside of the film, the slab can be considered dry enough for finish floor applications.

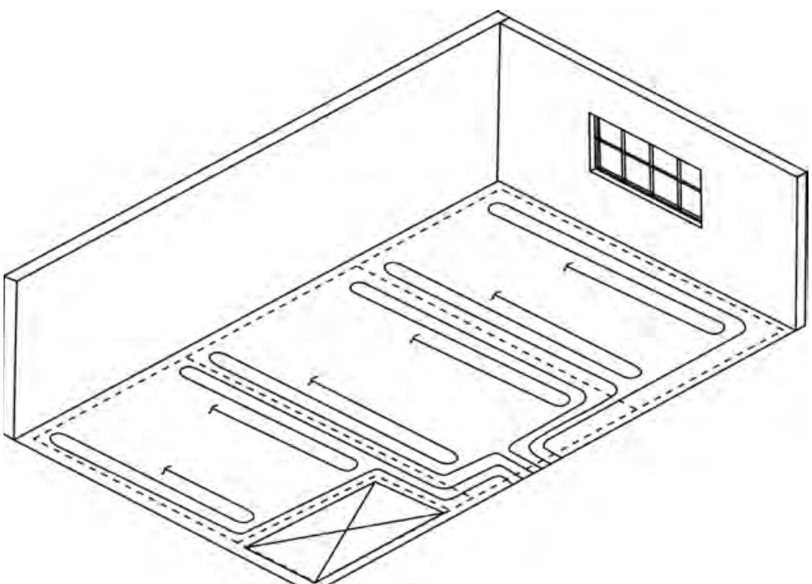
Drying times vary considerably with location, season, interior temperature/ humidity, etc. Follow the finish flooring manufacturer's recommendations.

Concrete Thin-Slabs

The following may be added to the mixture for flowability, and reduced shrinkage to minimize cracking; super plasticizer, water reducing agent, fiberglass reinforcing.

Gypsum Thin-Slabs

Gypsum Thin-Slabs are usually installed after the walls have been closed in with drywall or other finish materials. The highly flowable Gypsum mix fills in any gaps between the dry wall and the subflooring reducing air leakage and sound transmission under walls.



Note:
Some installation methods call for the Thin-Slab to be constructed before any exterior walls or interior partitions are erected.

To prevent bonding, all edges of the base plates that will be in contact with the concrete slab should be coated with a suitable release agent compatible with PEX tubing.

Use a minimum of R-19 insulation under the plywood subfloor (refer to section 2.7 Typical Cross Sections).

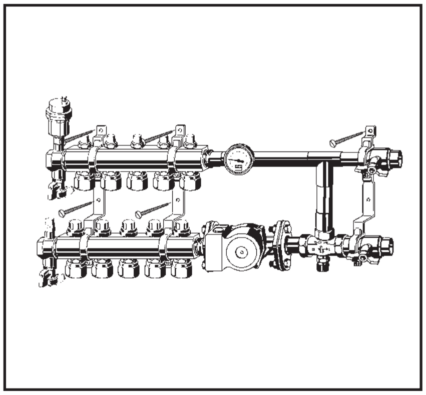
Note: All tubing must be pressure tested prior to and during pour (Refer to section 4.2 Pressure Testing)

CONCRETE SYSTEM STARTUP - CHAPTER 4

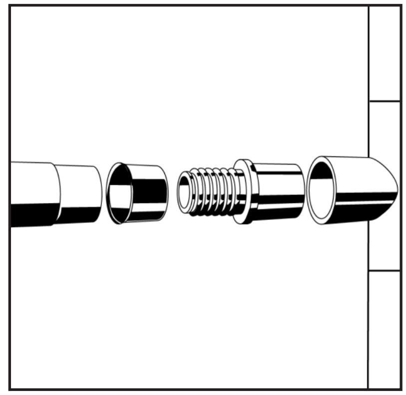
4.1 Station and Actuator Installation

Material	
Product	**Qty**
Mixing Station	1
Three Position Actuator	1
Stainless Manifold, # outlets*	1
Basic Heating Control	1
Indoor Sensor	1
FostaPEX	*
Press Adapters	4
Compression PEX Adapters	*

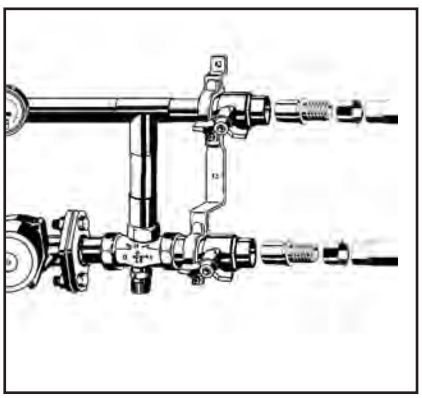
*Based on job requirements



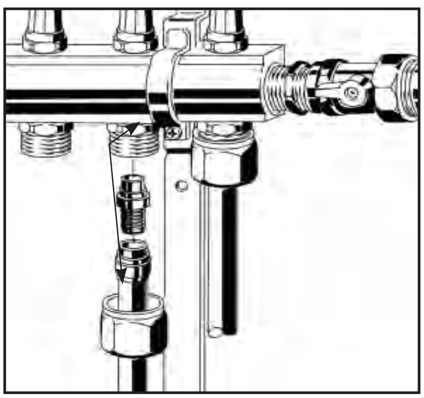
1. Mount the Mixing Station using the mounting brackets.



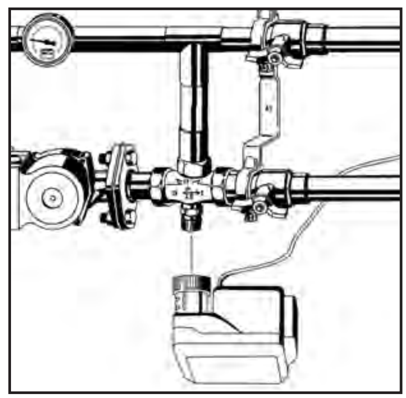
2. Make the press connection for the supply and return lines to the Mixing Station on the copper tee. Install tees as close as possible to keep pressure difference at a minimum.



3. Connect the supply and return lines by soldering on a ViegaPEX™ Press adapter, then pressing on ViegaPEX Barrier or FostaPEX®.



4. Use the SVC Compression or PEX Press Adapters to connect the ViegaPEX Barrier lines to the manifold.



5. Remove the grey cap from the diverting valve on the Mixing Station and screw the actuator on hand tight*.

*Perform step 5 after the system has been filled and purged; refer to section 4.2 for procedure.

5.2 Purging and Pressure Testing the System

Operation

Purging

1. Attach drain hose to purge valve hose connection on return header and open valve.

2. Close all but one balancing valve on supply header (under red caps, turn with 5mm allen key). Close isolation ball valve on boiler return line. Remove plastic dust cap or temperature controller from diverting valve and make sure that high-limit kit is fully open.

3. Open boiler fast fill valve to purge circuit. After purging first circuit, close red balancing valve and open next one. Continue with one circuit at a time until all circuits have been purged.

4. Close purge valve and open all balancing and boiler valves. Reset high-limit kit, and reinstall actuator onto diverting valve.

5. Any remaining air pockets in the system will be eliminated through the automatic air vent after a few hours of constant circulation.

NOTE: If the system must be purged again in the future for any reason, the high-limit kit must be reopened during purging for full flow.

Pressure Testing

Before the finish floor is installed the radiant system must be pressure tested. Air or water may be used as the medium.

The following procedure is recommended by Viega. Check the local building codes for compliance or additional test requirements.

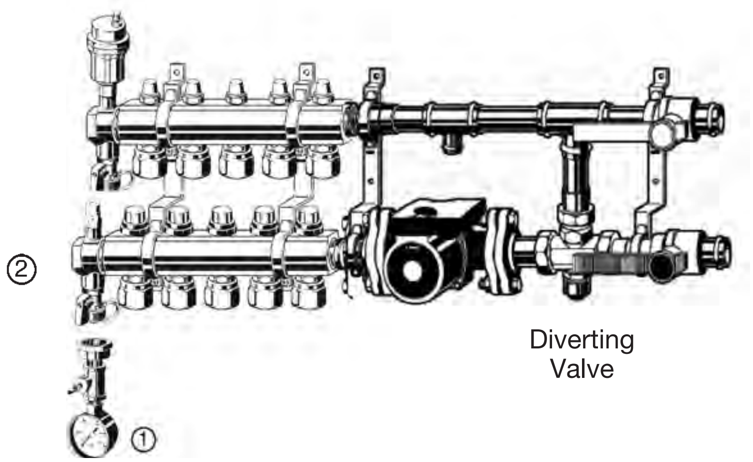
Procedure:

1. Double-check all connections to manifold to ensure proper seal.

2. Connect manifold pressurization kit (1) to any purge valve (2).

3. Pressurize the system to 80 psi to detect potential nail or screw penetrations.

4. The system should hold the 80 psi for a minimum of 24 hours.



Contractor: Maintain pressure during the installation of the finish floor to simplify leak detection if tubing is damaged.

Note: If the tubing is damaged, repair punctured section with a compression coupling.

4.3 Initial Balancing

Many times it is not possible to design the system using equal circuit lengths, so the system must be balanced in order to ensure adequate flow to each circuit on a manifold.

(Refer to your Radiant Wizard design program for detailed balancing.)

Procedure:

1. Start with all valves wide open.

2. To decrease flow, turn the balancing valve clockwise in small increments.

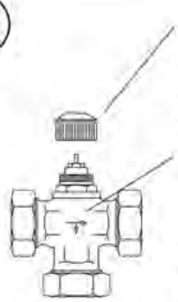
Note: Remove red caps and turn balancing valves with included allen key. Valves are hidden to prevent tampering.

4.4 Adjusting the High Limit Kit

Operation

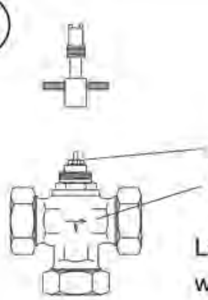
The Mixing Station is provided with a preinstalled temperature high-limit kit. This kit is installed into the 3-way valve to allow a maximum supply water temperature to be set. This kit must be unscrewed when purging the system, and should then be set according to the instructions below.

1



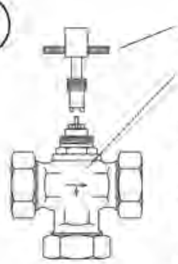
Remove grey plastic cap from valve body.

2



Loosen up hex lock nut with brass key tool.

3



Use opposite side of brass key tool and turn inner adjustment screw (slotted) in clockwise until valve spring resistance is felt.

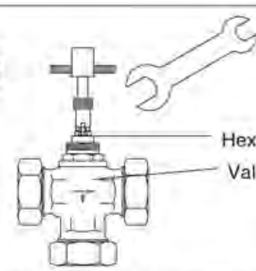
To lower water temperature turn key clockwise; turn counterclockwise to raise it.

4

Note: This calibration must be done with the boiler at its highest temperature, the circulator running and all zones open.

Turn adjustment screw further clockwise until desired supply water temperature is obtained and count quarter turns for reference. This has to be done carefully and slowly because each quarter turn of the adjustment screw will result in approximately 15°F temperature reduction. Wait until desired water temperature stays consistent.

5



Tighten hex lock nut with wrench.
Do not overtighten!
To secure high limit adjustment, hold slotted adjustment screw with brass key while tightening lock nut.

4.5 Choosing a Finished Floor

There are three common types of finished floors used in residential construction; wood floors, tile/vinyl, and carpet.

When picking a finished floor, the lower the R-value, the better radiant heat will work. When using tile, the R-value will be low and therefore will work very well with your radiant system. Vinyl flooring is another common choice for kitchens and baths and has a low R-value.

Using carpet over radiant heating requires careful planning. Viega's recommendation for a covering over a radiant system is to not exceed a total of a 2.5 R-value (the carpet pad plus the carpet itself). Remember that the pad and the carpet are insulators and will restrict the heat from getting into the room, so keeping the R-value of the pad and the carpet low is a must. It may be necessary to add supplemental heat or install hydronic baseboards in rooms with heavy carpeting (see Viega's Combiflex System).

There are many questions regarding hardwood flooring over radiant heating. Armed with knowledge and a few precautions, hardwood floors and radiant heat will work well together. There are two important issues:

1. Floor surface temperatures
2. Moisture

Floor Surface Temperatures

For many builders, a reluctance to install hardwood floors over radiant heat stems from problems associated with incorrect control of the floor surface temperatures.

- Today, modern insulation and building techniques allow a radiant floor to stay cooler than the floor of the average sunroom.

- The floor surface temperature should not exceed 85°F (refer to section 2.4 to calculate the floor surface temperature).

Also be careful when using multiple or high R-value area rugs over hardwood flooring. Your radiant heating system must be designed with this additional R-value taken into account in order to perform properly. If the system was designed for bare wood flooring, adding area rugs may lead to a situation where heat output is diminished.

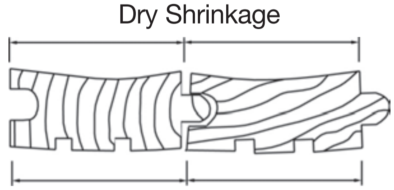
Moisture

Allow the radiant system to run for at least a week before installing the hardwood. This will ensure that the subfloor is dry. Wood flooring should be acclimated to the job site before installation. When checking the moisture content of the subfloor and wood flooring with a moisture meter, aim for a reading of 6% to 8%. Moisture will affect the hardwood floor with or without a radiant system.

- Moisture absorption causes wood to swell.
- Moisture loss causes wood to shrink.

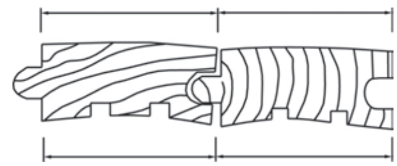
If the moisture content of the wood is relatively high near the bottom of the plank, cupping upward will occur exaggerating cracks.

Dry Shrinkage



If the moisture content is relatively high near the top surface of the plank, it will crown downward on the edges.

Wet Expansion



Sources from below:

- Inadequate moisture barrier
- Ground water wicking through the slab
- Unsealed subfloor

Sources from above:

- High relative humidity

Both solid plank flooring and engineered wood floors are acceptable choices over radiant heating.

Choosing narrower planks and harder woods minimizes dimensional change in the wood. Engineered wood flooring usually has less expansion and contraction and can be a good choice to minimize gaps between planks.

Note: Follow the flooring manufacturer's installation manual or NOFMA's (National Oak Flooring Manufacturers Association) manual.

4 INCH SLAB ON OR BELOW GRADE APPLICATION WITH 6" TUBING SPACING

Based on 68°F room temperature with 1/2" ViegaPex Barrier tubing with R5 insulation below the slab.

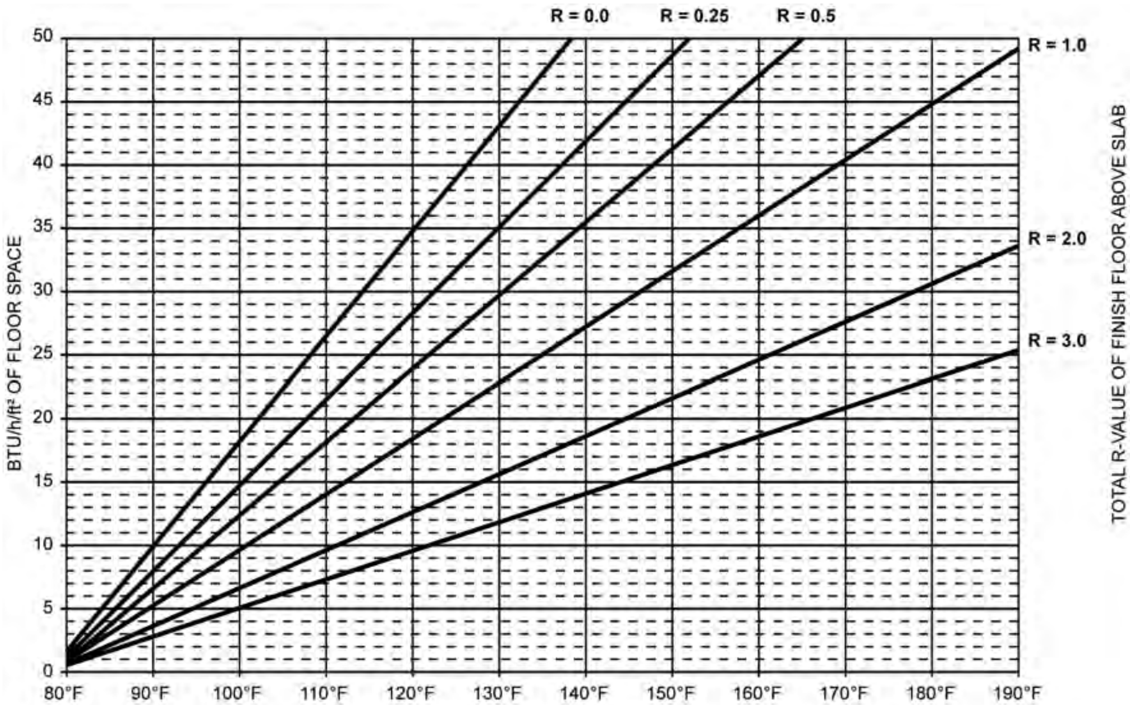


Figure Appendix A.a

4 INCH SLAB ON OR BELOW GRADE APPLICATION WITH 9" TUBING SPACING

Based on 68°F room temperature with 1/2" ViegaPex Barrier tubing with R5 insulation below the slab.

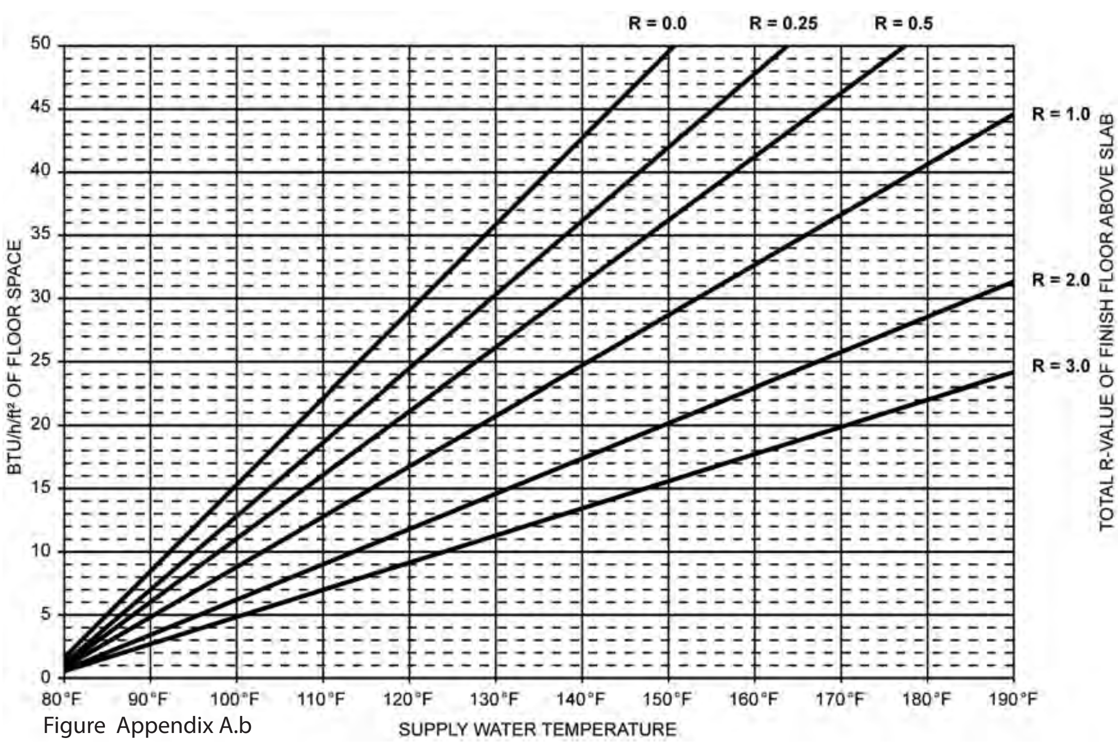


Figure Appendix A.b

4 INCH SLAB ON OR BELOW GRADE APPLICATION WITH 12" TUBING SPACING
Based on 68°F room temperature with 1/2" ViegaPex Barrier tubing with R5 insulation below the slab.

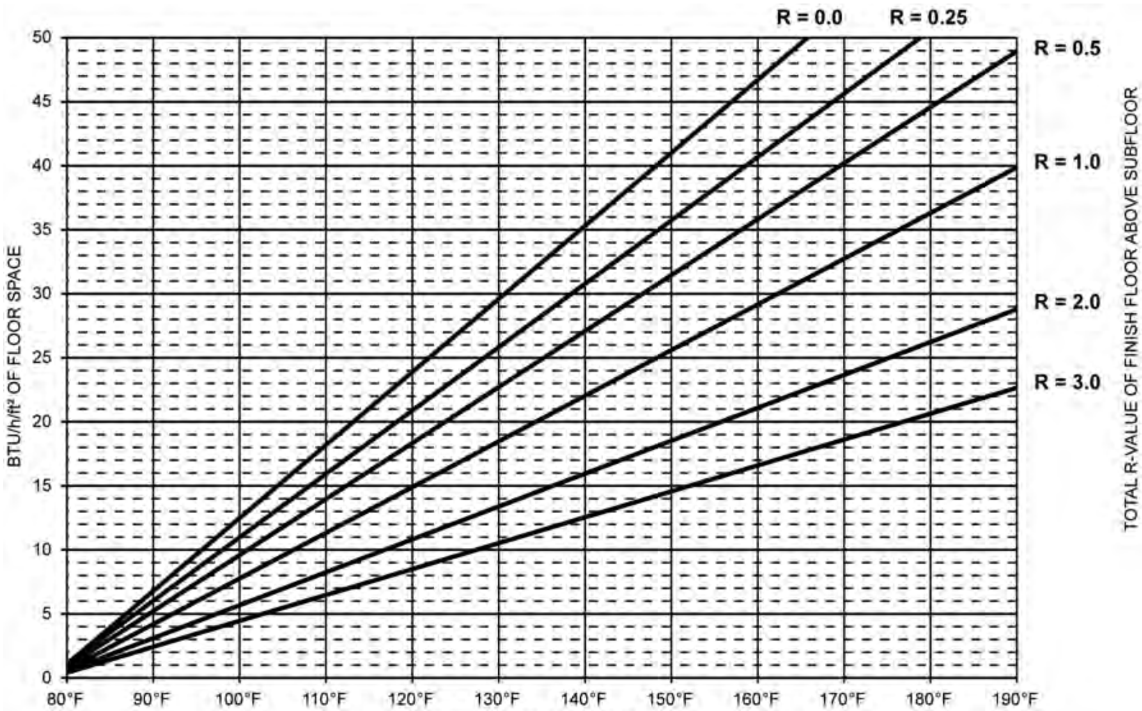


Figure Appendix A.c

1-1/2 INCH THIN-SLAB WITH 6" TUBING SPACING
Based on 68°F room temperature with 1/2" ViegaPex Barrier tubing with R19 insulation below the subfloor.

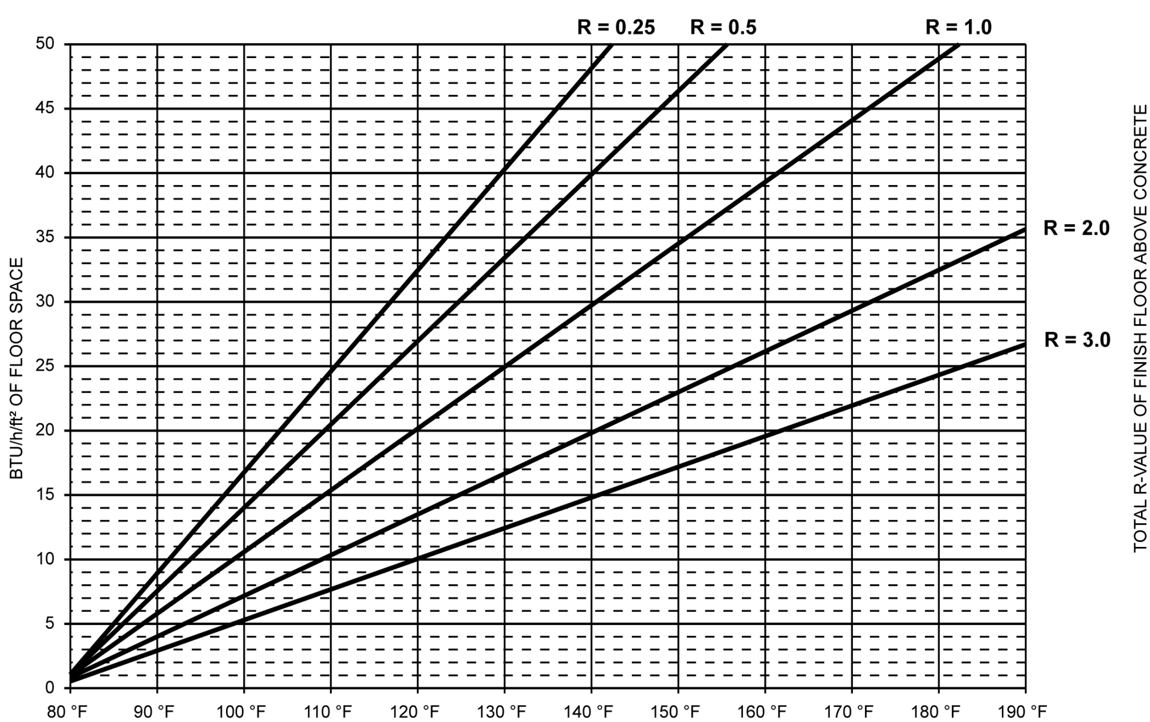


Figure Appendix A.d

1-1/2 INCH THIN-SLAB WITH 9" TUBING SPACING

BASED ON 68°F ROOM TEMPERATURE WITH 1/2" VIEGAPEX BARRIER TUBING WITH R19 INSULATION BELOW THE SUBFLOOR.

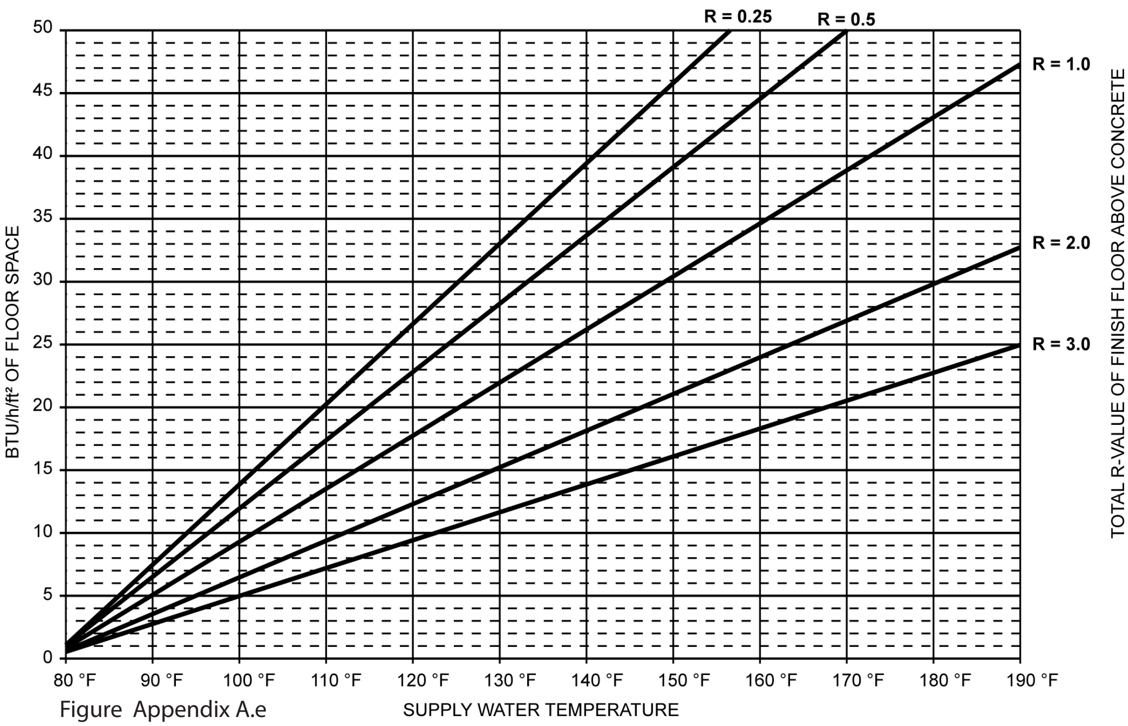


Figure Appendix A.e

1-1/2 INCH THIN-SLAB WITH 12" TUBING SPACING

BASED ON 68°F ROOM TEMPERATURE WITH 1/2" VIEGAPEX BARRIER TUBING WITH R19 INSULATION BELOW THE SUBFLOOR.

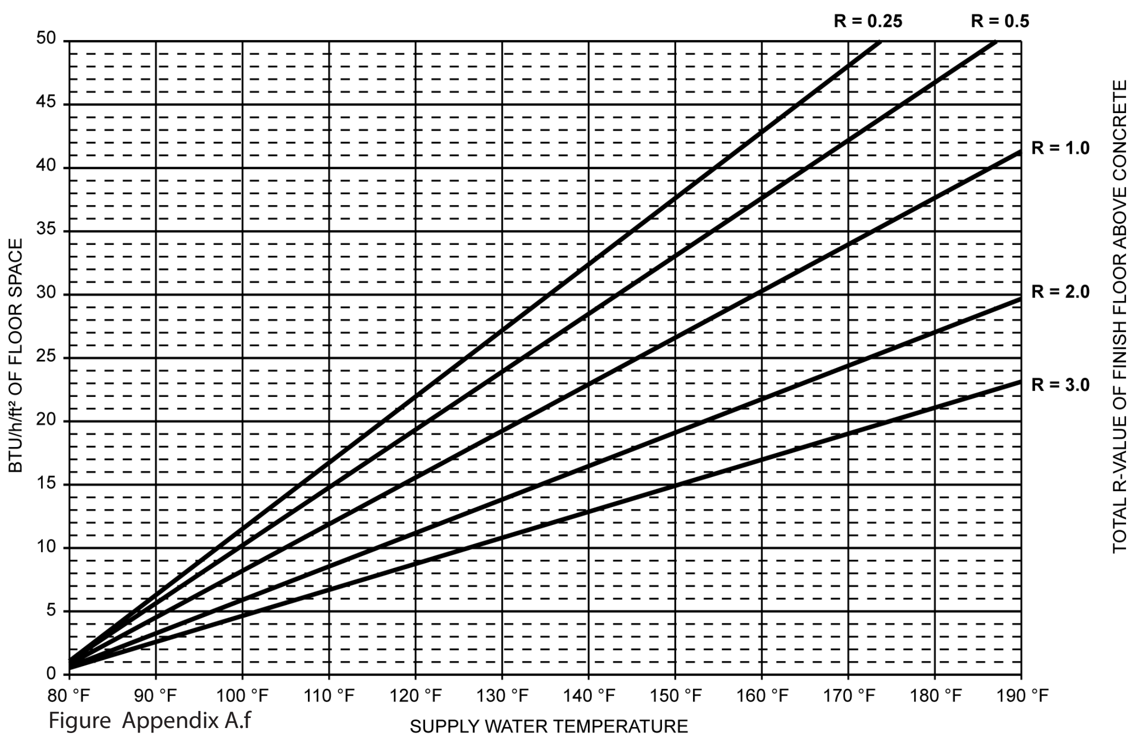


Figure Appendix A.f

SECTION THRU FIBROUS EXPANSION JOINT (TYPICAL)

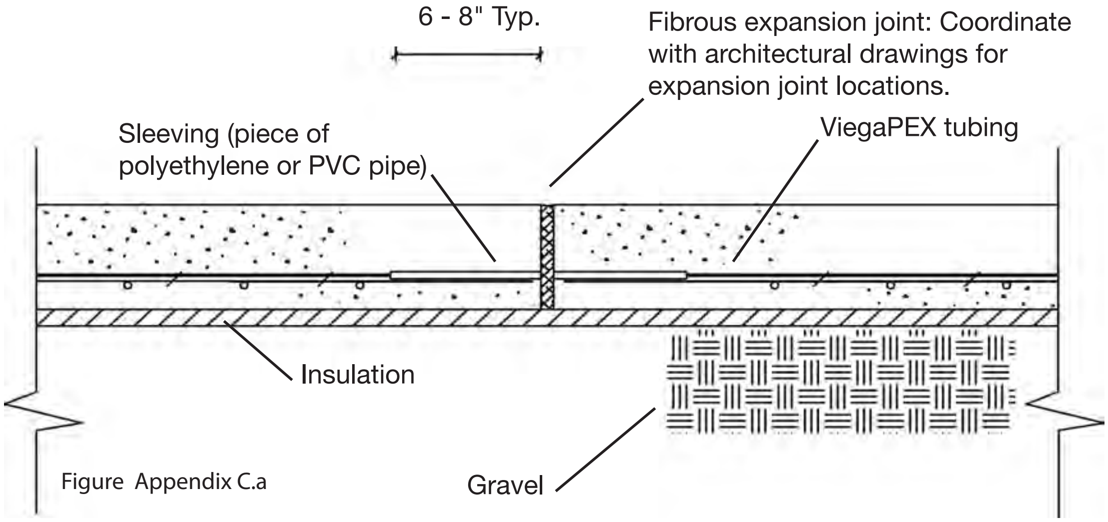


Figure Appendix C.a

SECTION THRU METAL EXPANSION JOINT (TYPICAL)

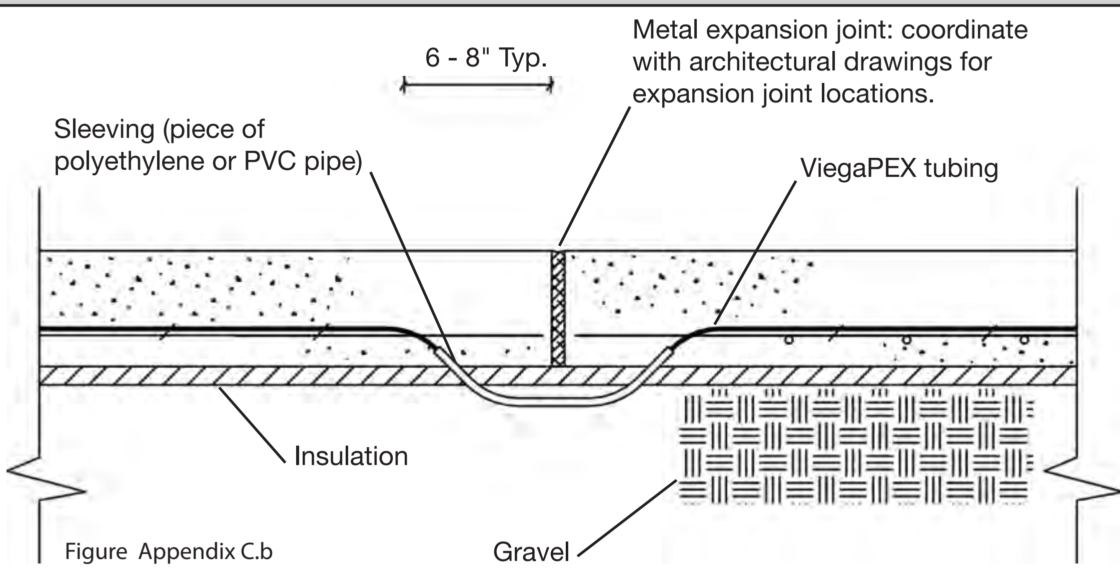


Figure Appendix C.b

SECTION THRU CONTROL JOINT (TYPICAL)

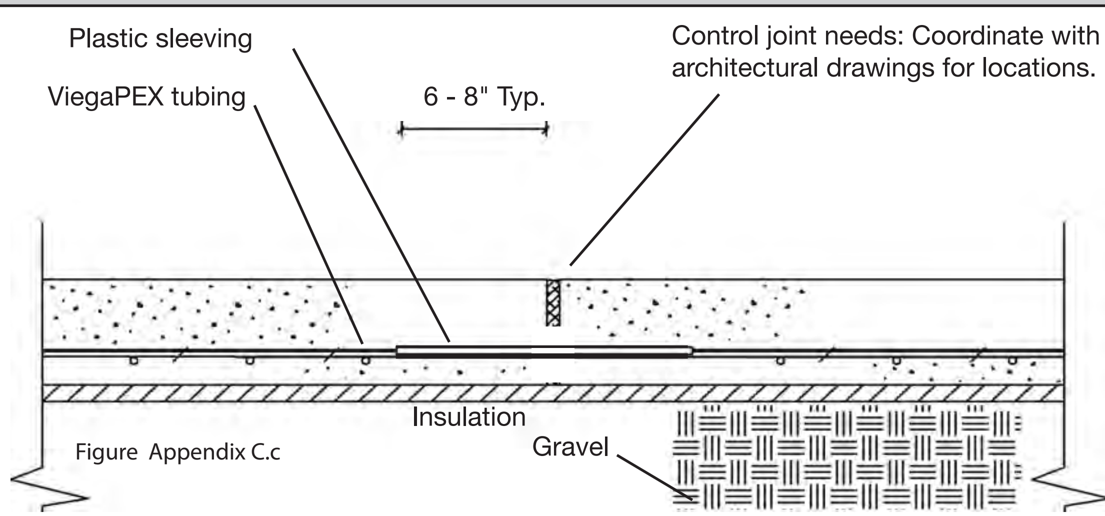


Figure Appendix C.c

NOTES

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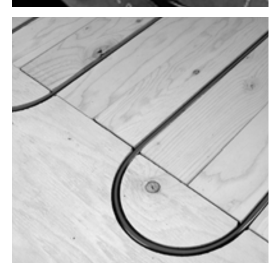

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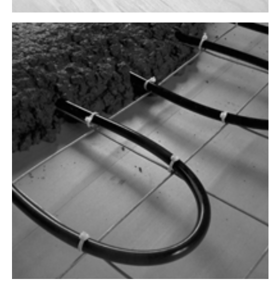

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