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WBI
THE RADIANT PANEL COMPANY

INSULHEAT™ UNDERSLAB
INSTALLATION MANUAL

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NOTICE TO CUSTOMERS AND INSTALLERS:

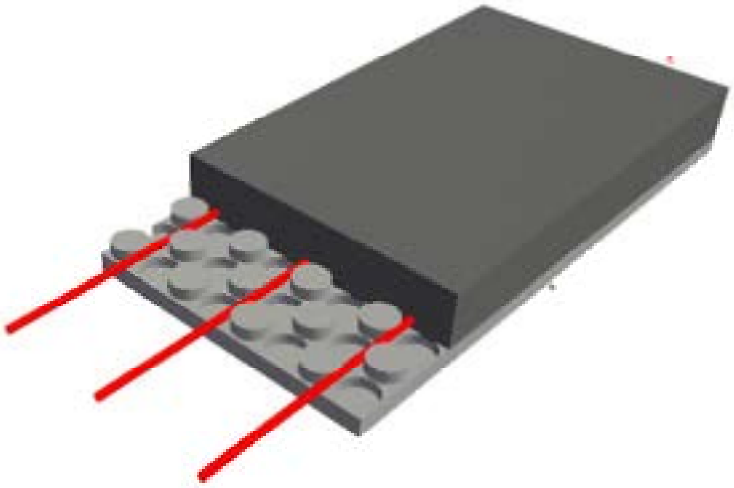
In supplying InsulHeat™ Underslab™, Warm Brothers Inc. is supplying the insulation for use under a hydronic radiant concrete slab heating system that will be installed by others and is the responsibility of others. It is the responsibility of the installer or installers to install the system and components correctly. The installation is beyond the control of Warm Brothers Inc. and issues of site preparation, tubing installation, slab reinforcement, pouring of cement, installation of floor coverings, compliance with local, regional and national codes are all the responsibility of the installer or installers. The purpose of this manual is to provide general useful information. It does not address every situation that may arise. Insulheat™ should be installed by knowledgeable contractors who are familiar with hydronic good practice.

InsulHeat™ Underslab™ Installation Manual V 25.1.2 © March 24 2025

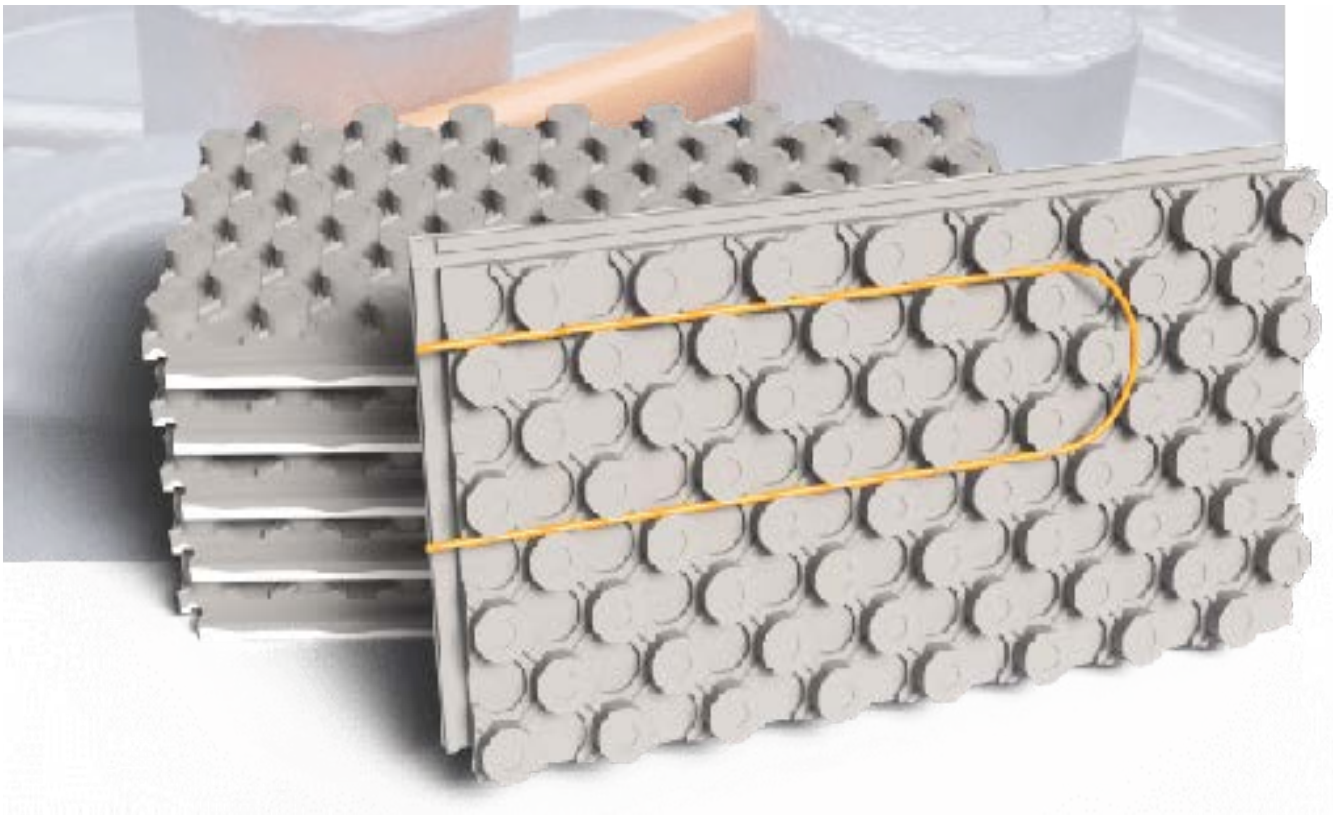
WHAT IS INSULHEAT™ UNDERSLAB

INSULHEAT UNDERSLAB

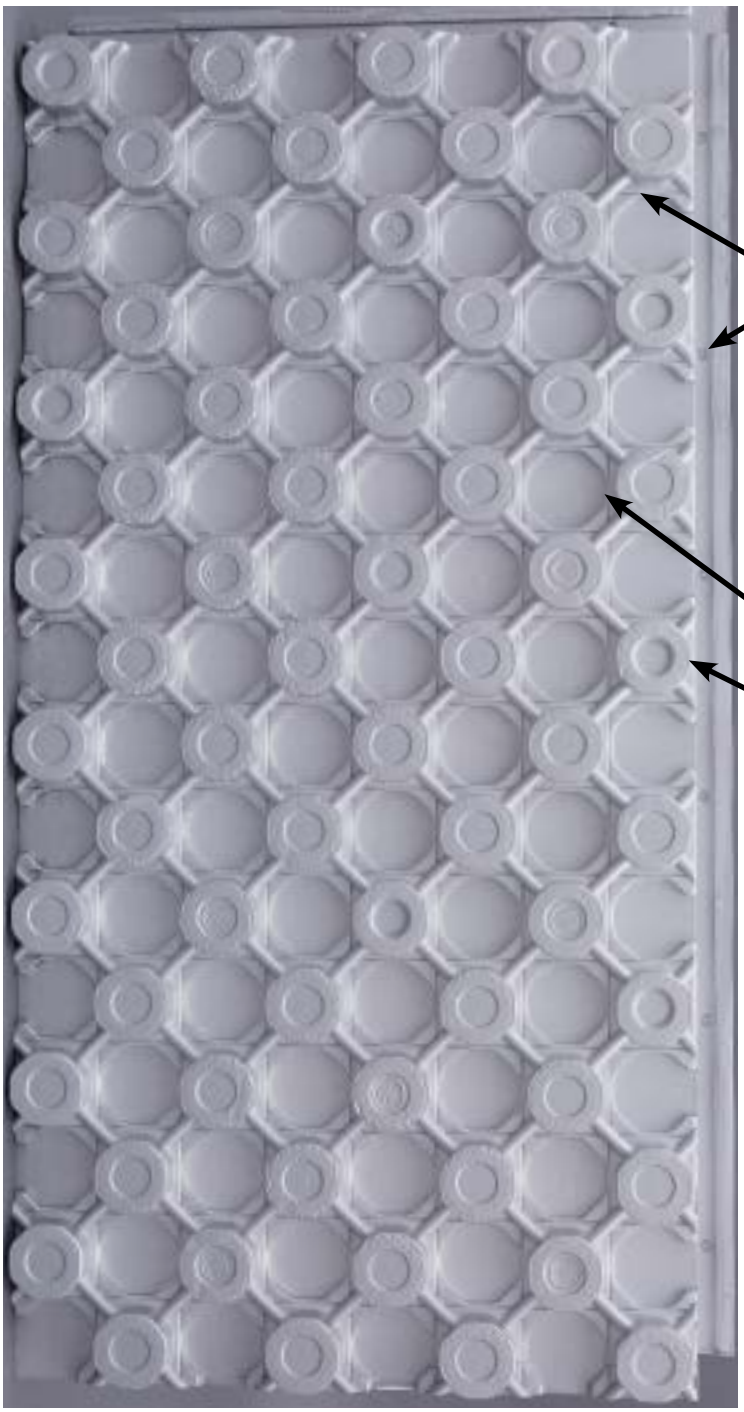
InsulHeat Underslab radiant floor heating panels combine rigid insulation, a vapor barrier, and a PEX tubing locking mechanism into a single solution that significantly reduces installation time. The patented “mushroom” shaped nubs lock PEX tubing in place without staples or zip ties.



- Bridge connectors ensure even heat distribution
- Mushroom nubs securely lock tubing
- No need for concrete dobies
- Lock PEX tubing without staples or zip ties
- Four-sided interlocking connectors
- Durable HIPS film acts as a vapor barrier
- Easier installation and higher compression than blue-board



INSULHEAT™ UNDERSLAB PANEL TOP VIEW



INTRO TO INSULHEAT

The InsulHeat™ Underslab panels are designed for use with hot water radiant hydronic tubing as a substrata under concrete, both indoors, interior, and exterior applications. The panels combine a layer of closed cell, molded expanded polystyrene (EPS) insulation with a high impact film layer of high impact polystyrene (HIPS). The combination makes for a strong panel.

The panel combines rigid insulation, a vapor barrier layer, and a locking profile that retains PEX tubing. The grid and slightly "mushroom" shaped nubs allow retention of PEX tubing accommodating 3/8", 1/2", 5/8", 3/4" and 1". Most residential systems use 1/2" PEX. InsulHeat™ Underslab saves significant labor and time over alternative installation methods of embedding PEX tubing in a slab due to the ease of walking tubing into the grid between the nubs.

The consistent 3" nub pattern allows for uniform or customized layouts. Due to the cavity shape and tubing supports, the PEX ends up well embedded in the concrete. The interlocking panels are light and easy to move and place.

The consistent nub height protrusions above the tubing make it safe for other trades to walk on the panels when required. The quick and easy "walk in" installation of tubing does not require bending over or the need for staples, zip ties, or other tubing retention methods.

When reinforcement is required, square mats of steel can be easily used, but are best pulled to the middle of the slab.

InsulHeat™ Underslab panels have a four-sided interlocking system and measure 24" x 48" when locked together and are 3.375" inches thick. Since the interlocking panels retain the contiguity of the vapor barrier layer, it eliminates the need for a dedicated vapor barrier unless required by building code or unusual situations.

STORAGE: Store panels in a dry location, protected from the elements. Panels should be stacked at least 4" (102mm) above the ground. Limit the use of open flame or ignition sources near product and avoid contact with hydrocarbons and petroleum based products.

WARRANTY: InsulHeat™ Underslab supports building owners, designers, and contractors by offering a 20-year limited thermal warranty on the panels. This warranty is available to the building owner at the time the building is completed and is transferable to any subsequent owner during the 20-year period.

APPLICATIONS

- Under concrete slab
- Basement slab
- Slab on grade
- Snow melt for driveways and walkways
- Garages, barns, workshops, and green house heating

STARTING INSTALLATION

BEFORE STARTING THE INSTALLATION

CALCULATE NUMBER OF PANELS: First calculate the usable area of InsulHeat™ UnderSlab™ remembering an InsulHeat™ panel is 24x48" and covers 8 square feet. Once the area is calculated from the drawings (in square feet), divide the total area by 8 to get the number of panels required. For example, to cover 1,000 square feet, divide by 8 to get the result that 125 panels would be required - provided there would be no waste. Adding a few panels for waste and errors is always a good idea: a prudent amount varies with the complexity of the job.

ESTIMATE THE TOTAL AMOUNT OF YARDS OF CONCRETE NEEDED FOR A GIVEN SLAB THICKNESS ABOVE THE TOP OF THE NUBS: Calculate using the following formula: (.02632 x # of panels)+(.0244 X slab thickness in inches x number of panels). For example, for 4" thick slab covering 1000 square feet using 125 panels, the calculation would be (.02632 x 125) +(.0244 x 4 x 125) or 3.639 yards plus 12.2 yards = 15.84 yards. Add extra for waste and errors. This calculator in a simple form may be accessed for use on our website at www.wbiwarm.com/insulheat/calculator.

TUBE SPACING: It is important that the hydronics designer/specialist is aware that InsulHeat™ Underslab™ panels are designed around 3" spacing. For most residential use, 1/2" PEX is the default tube size for our designs and works most easily on 9" centers. 1/2" tubing may be laid out on 6" and 12" centers, but the turns for these requires a slightly irregular offset which is illustrated under design service.

AGGREGATE BELOW INSULHEAT: When installing under a new slab, make sure there is 4–6" of well compacted and leveled gravel or pit run underneath where the InsulHeat™ Underslab™ will be installed. Insure that the InsulHeat™ will be at the correct elevation before proceeding with panel installation.

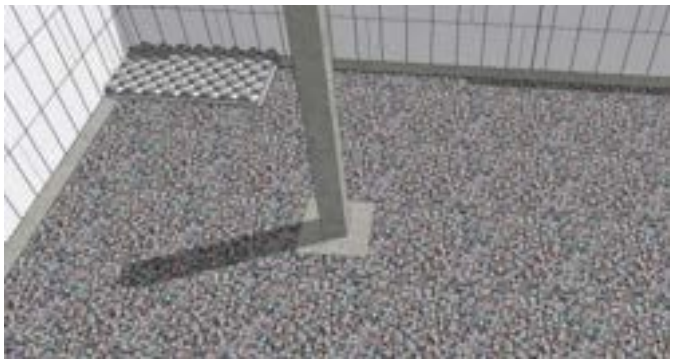
CHECK CODE FOR VAPOR BARRIER REQUIREMENTS: Check to see if the local building code requires a dedicated vapor barrier which will need to be installed prior to placing the panels.

GLUING PANELS: If it is necessary to glue some of the panels, use construction adhesive that is compatible with foam insulation and PEX pipe when present. Many foam glues damage PEX pipe so we recommend Bostik Green Force since it does not.

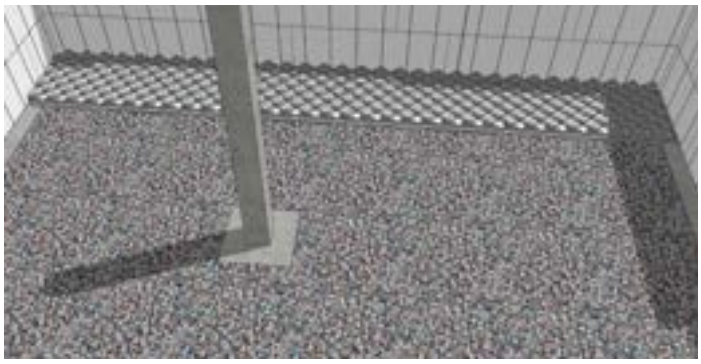
INSULHEAT™ PANELS MAY BE WALKED ON: Panels are designed to securely lock the tubing in place allowing other trades to continue walking on the panels without running the risk of damaging or dislocating the tubing.

INSTALLATION STEP-BY-STEP

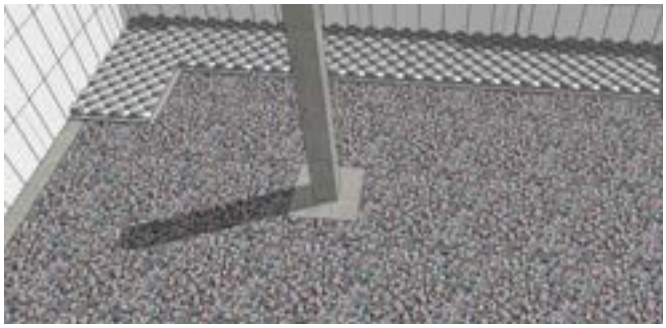
These general installation steps are applicable to InsulHeat™ Underslab™ panel installation for basements, slab- on-grade and exterior snow melt applications.



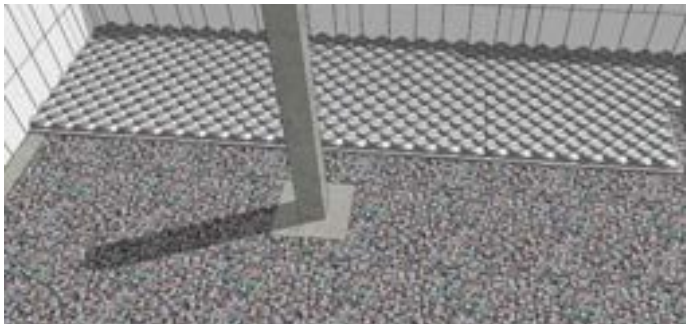
STEP 1: **Start at the far-left corner and work from left to right. Lay down the first panel so the exposed interlock is to the right side and forward. Panels can be placed down either along the length or width of the outer wall.**



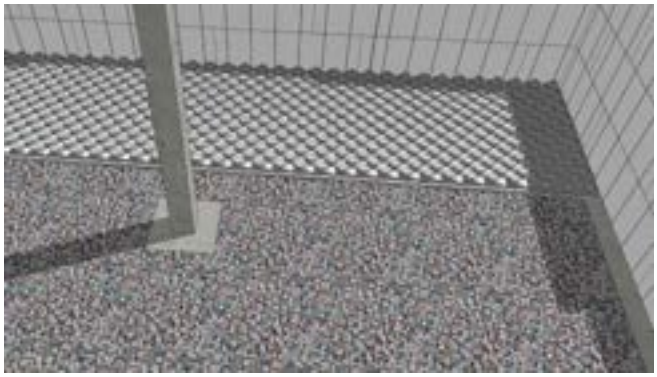
STEP 2: **Continue to lay the panels ensuring they are properly aligned, working from left to right across the floor along either the length or width of outer wall.**



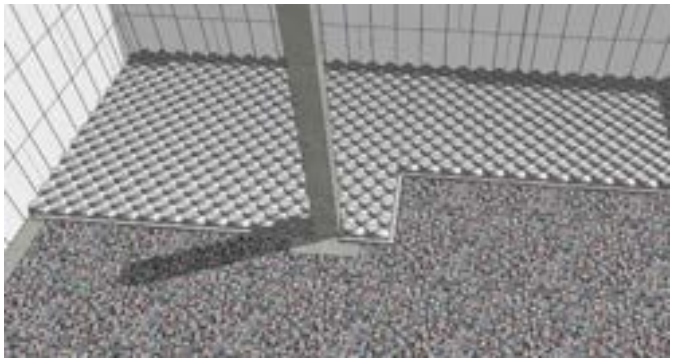
STEP 3: **Start the next row with half a panel. This will stagger the seams, creating a running bond and ensuring that panels are properly interlocked and aligned.**



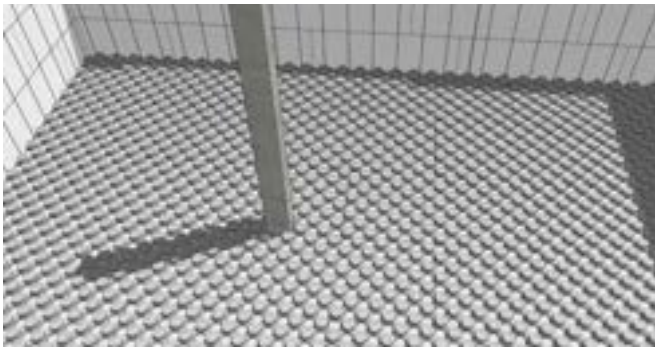
STEP 4: **Continue to lay the panels ensuring they are properly interlocked and aligned with a snug fit.**



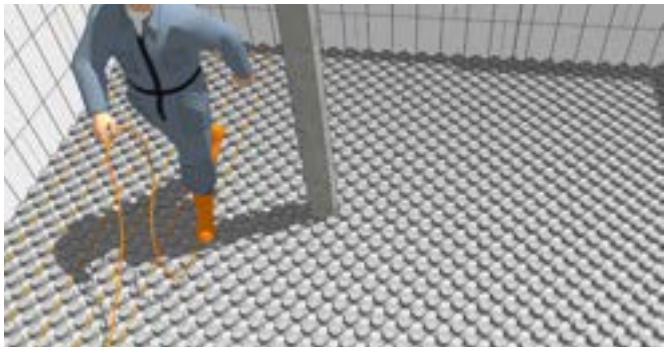
STEP 5: Use the second half of the cut panel to finish the row.



STEP 6: It may be necessary to cut the panels to work around columns or walls.



STEP 7 Continue to place rows of panels maintaining a staggered running bond layout.

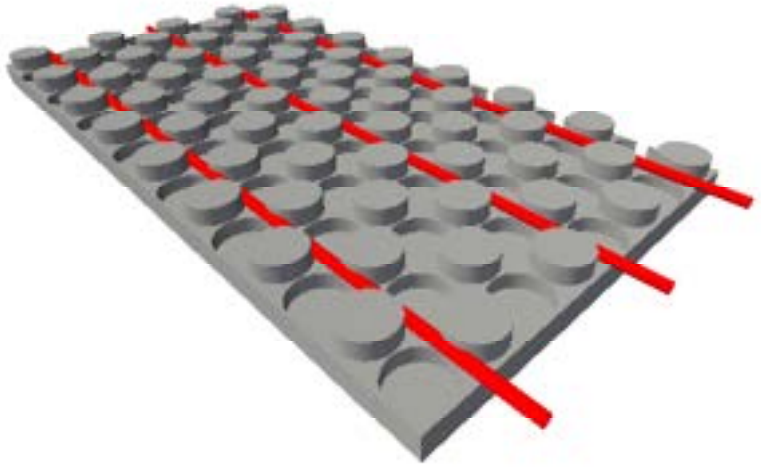


STEP 8 Install PEX tubing by walking it into the nubs of the panels according to the design layout.

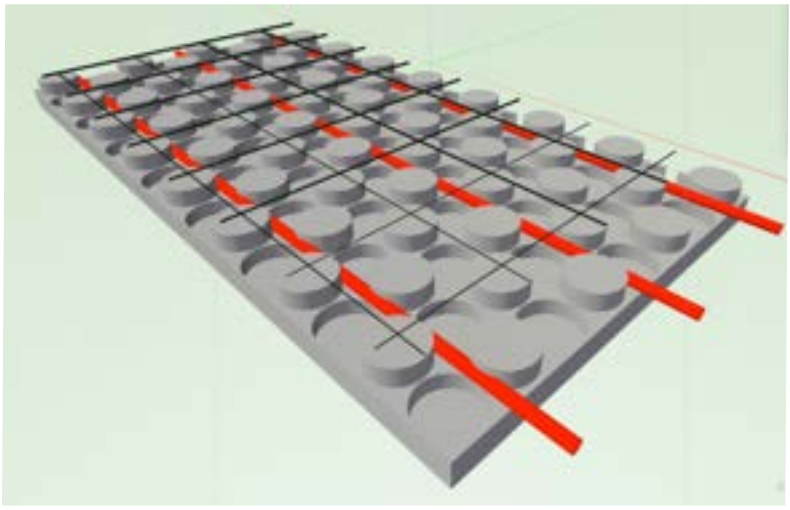
CEMENT COVERING: Use cement with fine enough aggregate that it flows around the pipe and fills all recesses in the InsulHeat™ Foam. A minimum 3 to 4 inches above the top of the nubs is recommended. For cases with an existing basement slab and limitations on thickness, a special order, lower-profile product may be used such as 1" thick Thermalboard EPS™.

HEAT LOSS REQUIREMENTS: When utilizing our design service please provide a heat loss. Typically your mechanical contractor can verify the actual R-Values of materials used on your project and provide a Manual J format Heat Loss. If not, a very inexpensive on-line program Coolcalc (www.coolcalc.com) can be used to provider a good room by room heat loss in Manual J Format. While InsulHeat™ Panels can normally heat almost every residential space, there are limitations to R-Values of floor coverings and water temperature that may be used. Great rooms with high ceilings and lots of glass in cold climates need to be carefully assessed. Our design services will send get a questionnaire about your floor coverings and zoning preferences. This information is very important for our designers. This manual contains basic general reference materials that may be of use regarding floor covering R-Values, tubing loop lengths, and performance of different tubing at different spacing. Most residential systems will be designed with 1/2" PEX.

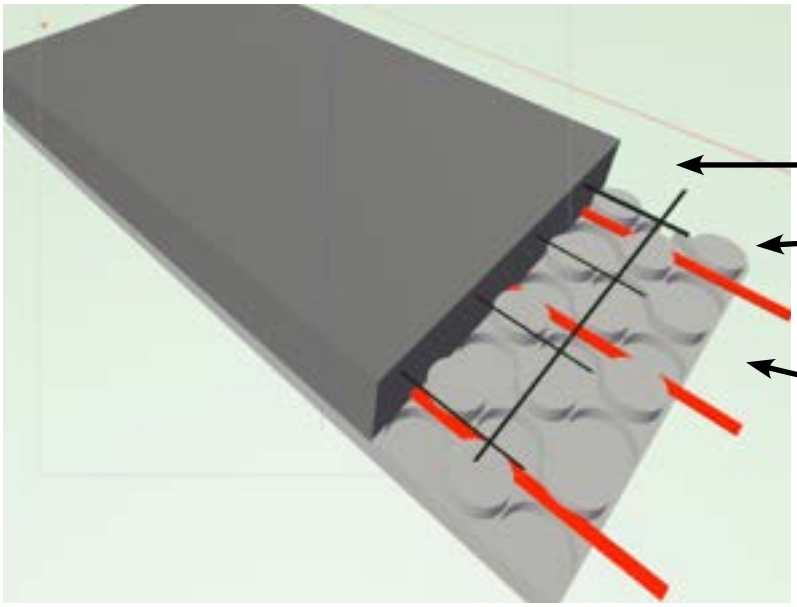
USE OF CONCRETE OR STEEL REINFORCEMENT



Tubing is easily walked into Insul-Heat™ with the PEX between the protruding "Nubs"



After tubing is installed mats of 6" x 6" steel wire may be supported on the nubs and cement poured. Since the deeper pockets are below the tubing and wire, it will be possible for the installers to reach down with their hards and pull the mesh up to the middle of the slab as shown below.



DRAWING SHOWING LAYERS

Cement

Wire Mesh

PEX Tubing

InsulHeat™

DESIGN SERVICE FLEXIBILITY AND INSTALLERS RESPONSIBILITIES

1) The Insulheat™ Underslab product is designed to allow for a great deal of flexibility for the installing contractor in exactly which pattern the tubing may be installed. This flexibility and freedom requires the self-designing installing contractor to be familiar with and use good hydronic practice with regards to code requirements, heat loss, flow rates, loop lengths, and heat transfer in relation to floor coverings. Experienced installers with the above mentioned knowledge can self design their installation of InsulHeat™ so long as they confirm the WBI "Self Design Form".

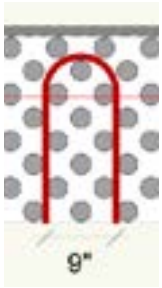
2) Experienced installers should find the layout flexibility, labor savings, and convenience of "walking" tubing into the grid instead of leaning over and attaching the tubing at many points a reason to use the product whenever they are installing radiant tubing in a slab.

3) All installers are advised to use PEX pipe from approved suppliers found elsewhere in this manual and to use pipe with foot markers so the limitations on length of loop lengths may be observed as installation is proceeding.

4) For customers who need a design, the WBI InsulHeat™ Design service will outline and illustrate the suggested spacing, number of loops, and amount of tubing expected to be used and in many cases illustrate how this is to be accomplished on the job-site.

5) Below are some examples of how end return curves may be accomplished using different tube spacing. 9" centers work best with the grid and should provide good performance, but other choices are possible–particularly in lower heat loss areas.

6) Due to the grid pattern of InsulHeat™, 9" O.C. spacing works most easily, with the understanding that 180° or 90° bends may need to be done slightly differently when utilizing 6" and 9" centers as shown below.

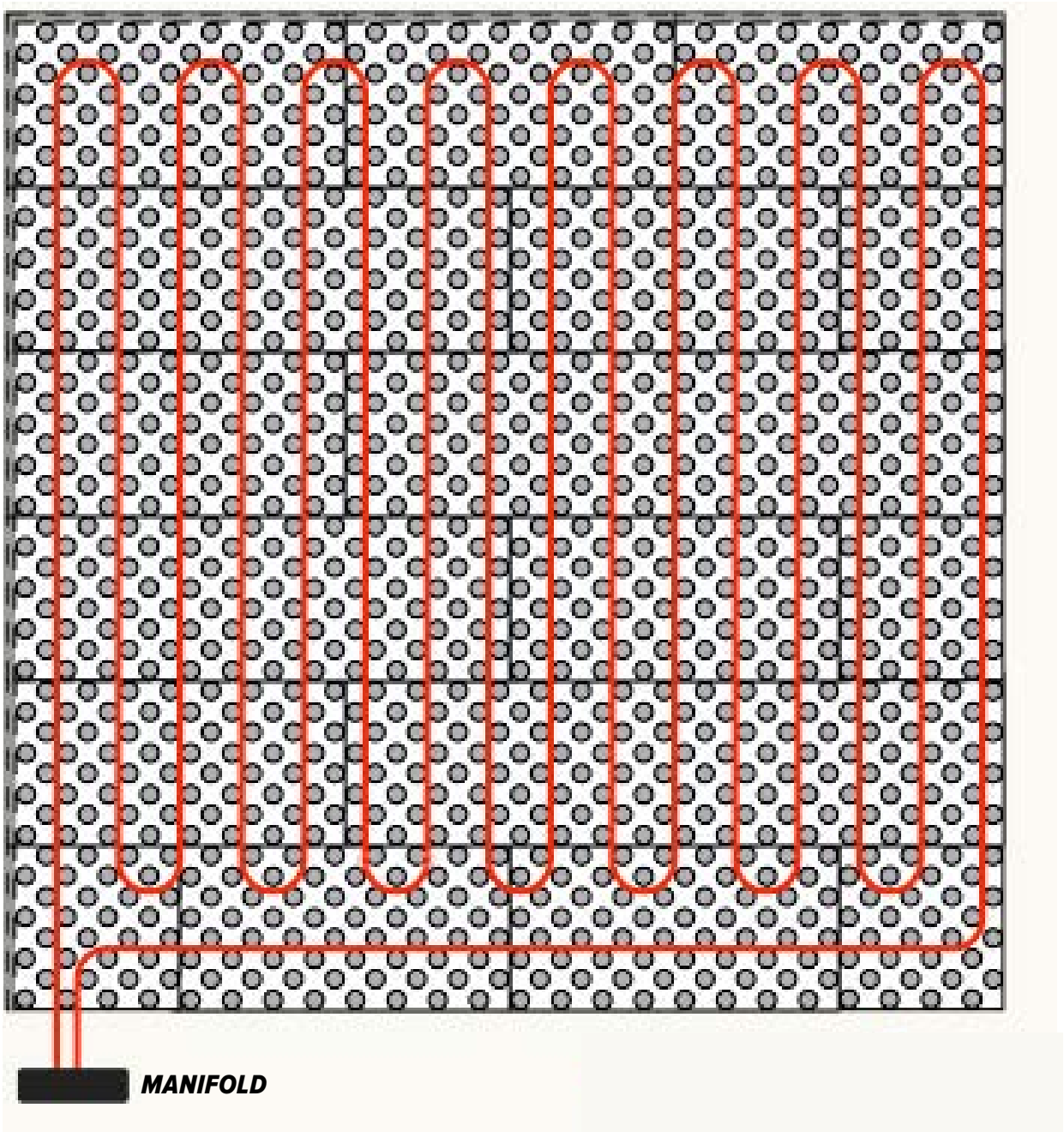


7) The shape of 6" OC, 9" OC, and 12" OC are illustrated above and other useful line profiles are shown to the right.

THE FOLLOWING PAGES WILL DEMONSTRATE COMMON LAYOUT PATTERNS USING THE INSULHEAT™ GRID.

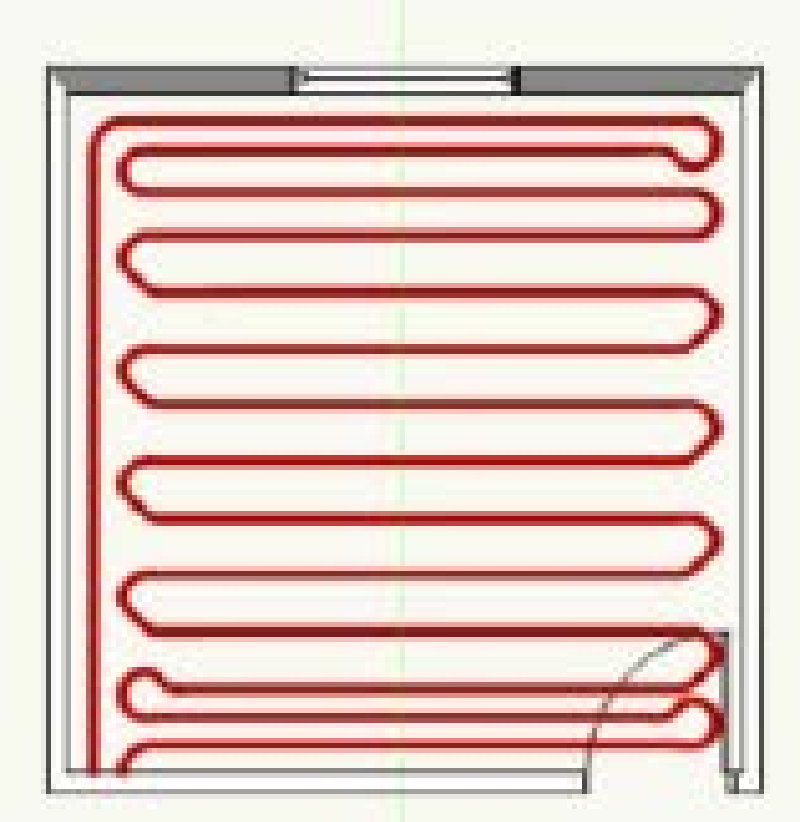
COMMON LAYOUTS

EXAMPLE 1: 12’ X 12’ ROOM 9” TUBE SPACING

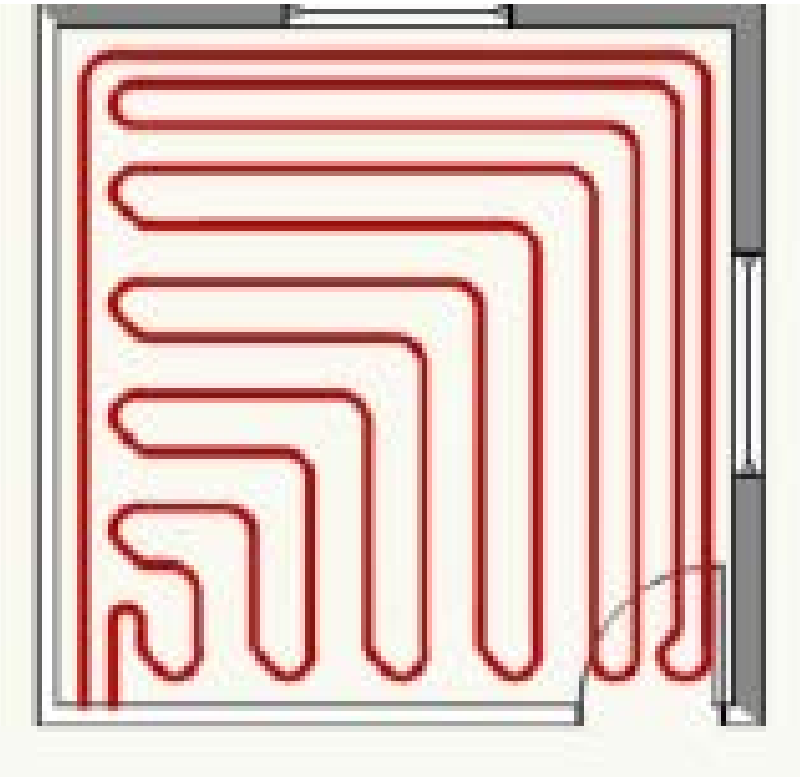


NOTE: See how 9” centers are easy to layout. The grid pattern allows tubing on the right side of the manifold to be easily moved 6” to the left, leaving 3” spacing between the loops which makes connecting to the manifold more convenient.

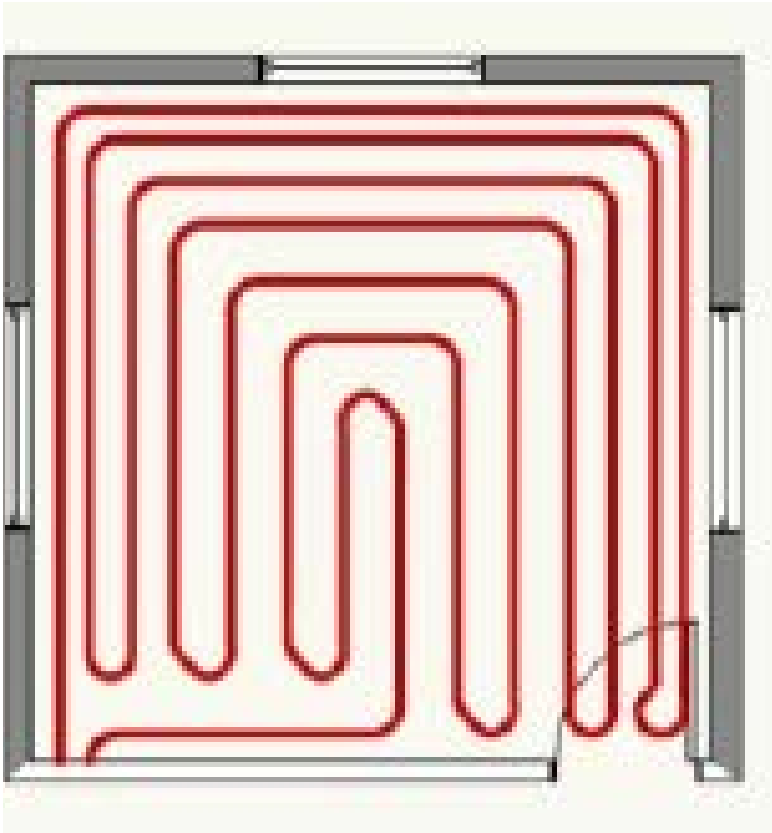
EXAMPLE 2: 12’ X 12’ ROOM 1 OUTSIDE WALL



EXAMPLE 3: 12’ X 12’ ROOM 2 OUTSIDE WALL



EXAMPLE 4: 12’ X 12’ 3 OUTSIDE WALLS



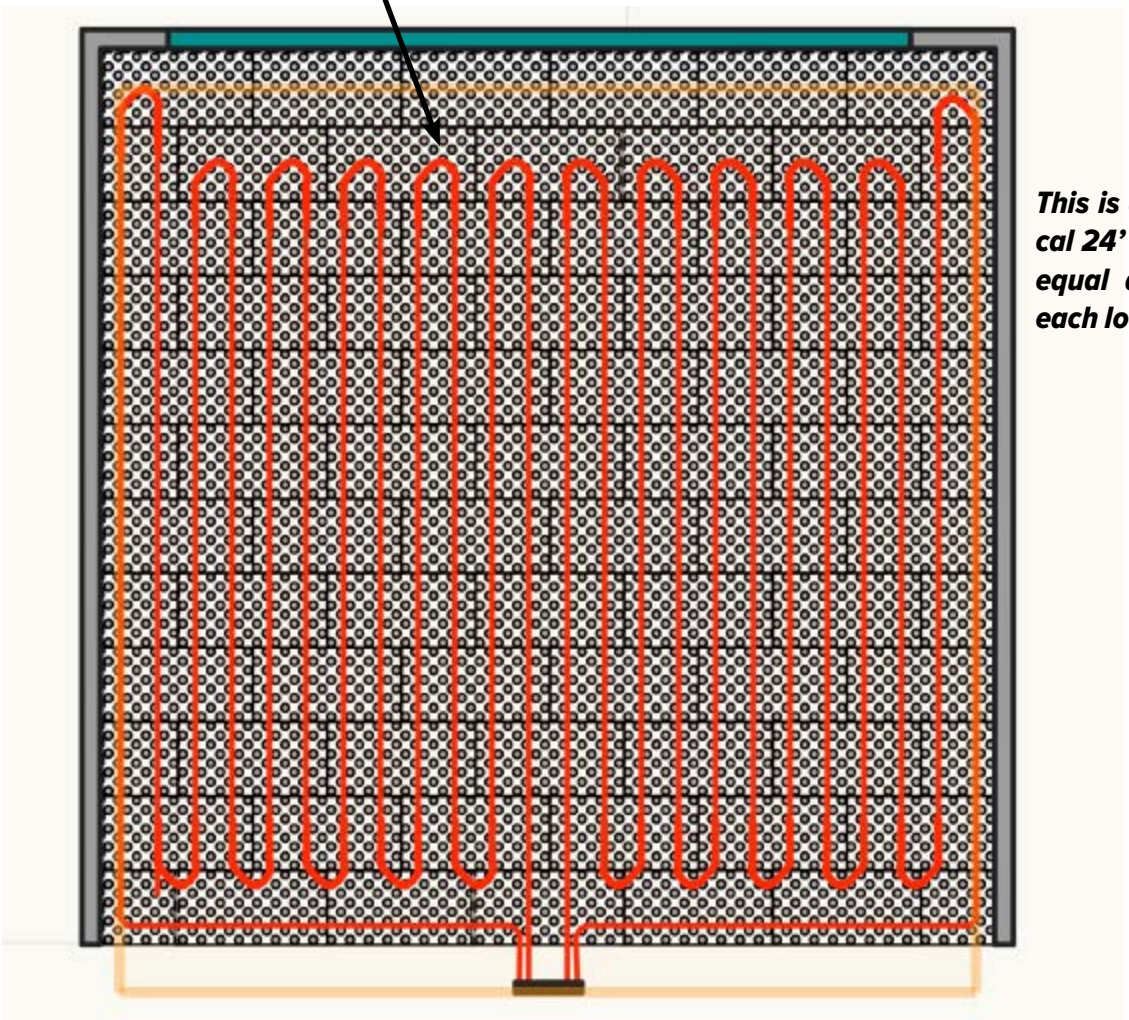
ADVICE FOR GARAGES, WORKSHOPS AND BARNS

If you are installing ***a hydronic radiant slab in a barn, garage, or workshop*** the concrete should be sealed in a way that prevents any spilled solvents or chemicals from absorbing into the cement and damaging PEX pipe. Many solvents and petroleum derivatives are problematic for PEX but easily prevented from absorbing into the concrete by sealants such as epoxy coatings.

If you are installing ***a radiant heated slab in a garage*** it is best to hold the tubing loops back from the door as shown below since it is difficult to put a thermal break in the concrete near the door. A thermal break of foam insulation may be adhered to a stem wall for the height of the slab to lessen outward heat loss in other areas.

If you are installing ***above an existing un-insulated garage slab***, you will have an elevation difference between an existing driveway and the new height of the garage floor. Pre-made ramp wedges are available to help with this problem.

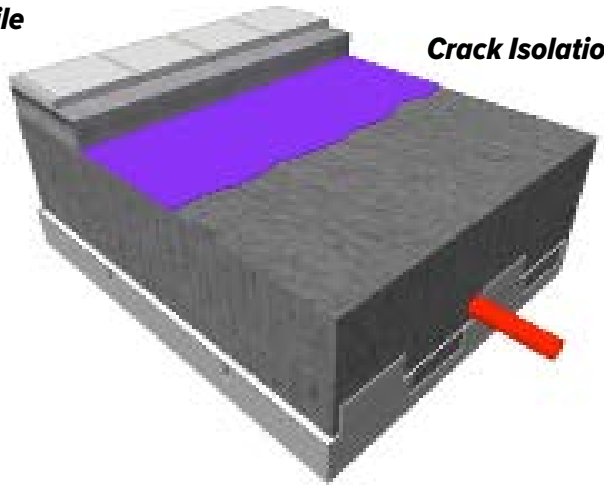
PEX tubing held back from garage door where there is no "thermal break"



This is a drawing of a typical 24' x 24' garage with 2 equal approximately 250' each loops of 1/2" PEX

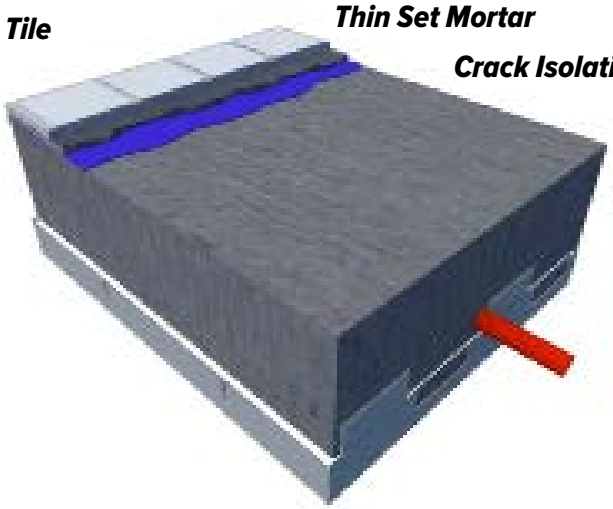
COMMON FLOOR COVERING CONCEPT DRAWINGS

TILE OVER CONCRETE WITH MORTAR BED



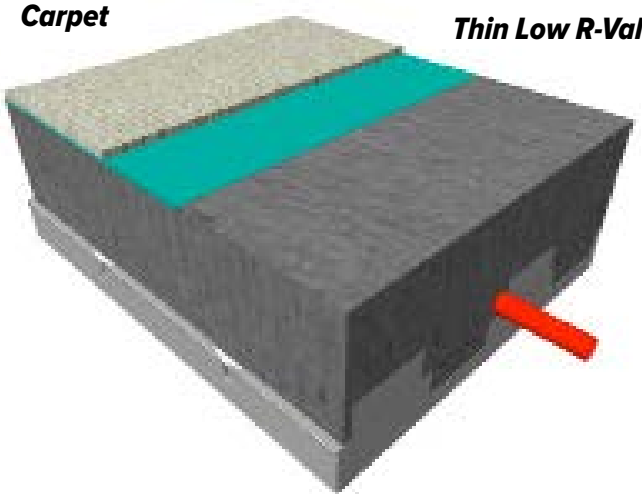
SEE NOTE #1

TILE OVER CONCRETE WITH THIN SET MORTAR



SEE NOTE #1

CARPET AND THIN PAD OVER CONCRETE

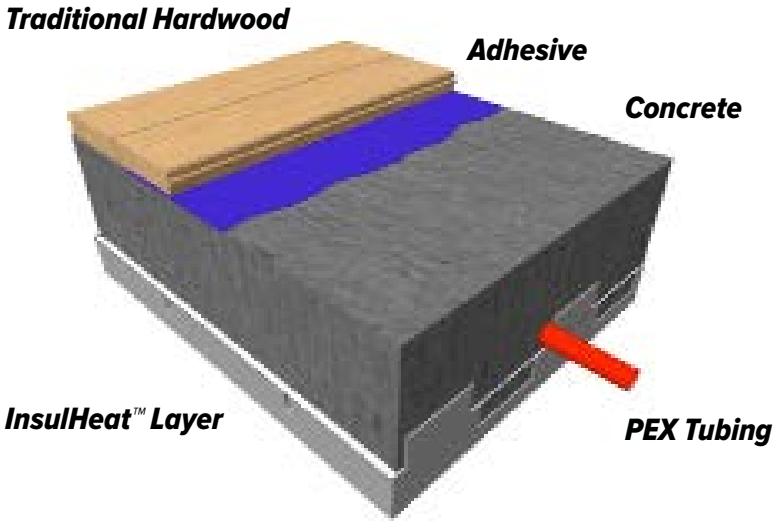


SEE NOTE #2

COMMON FLOOR COVERING CONCEPT DRAWINGS

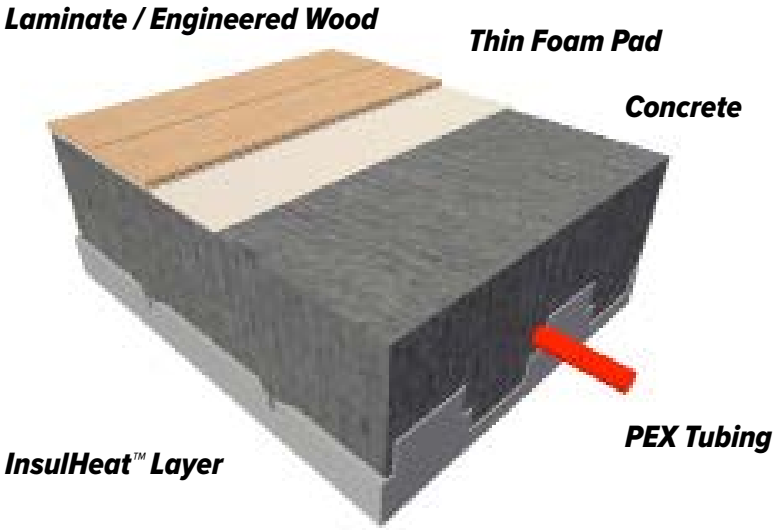
TRADITIONAL HARDWOOD GLUE DOWN

SEE NOTE #3



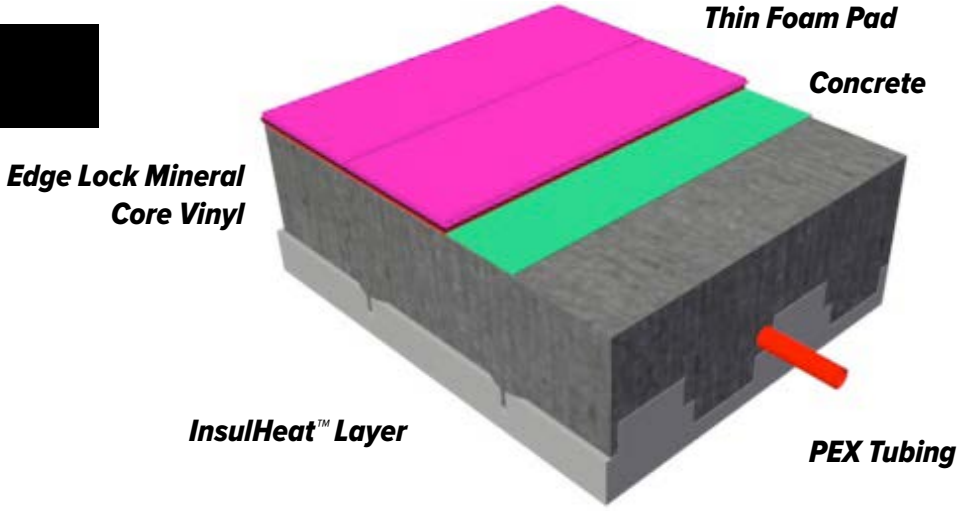
LAMINATE FLOORING & EDGE LOCK ENGINEERED WOOD

SEE NOTE #4



MINERAL CORE VINYL

SEE NOTE #5



GENERAL NOTES & ADVICE ABOUT FLOOR COVERINGS ON CONCRETE

While this manual provides some information and advice about floor covering over the cement that is typically poured over concrete by others, your flooring installer shall be your responsible party for any floor coverings installed over concrete poured on InsulHeat™. Make sure they warranty the work over radiant floor heating.

NOTE #1

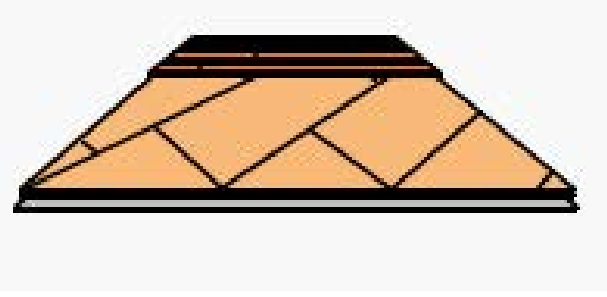
When installing Tile and Stone with a traditional Mortar Bed or Tile with Thin Set Mortar, it is always advisable to include a crack isolation membrane in the assembly to reduce the risk of cracking the tile or stone. There are many types of products that can work for this including roll down membranes and adhered crack isolation membranes.

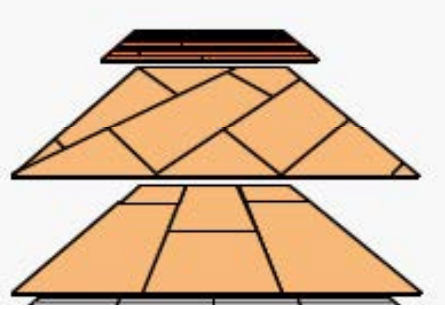
NOTE #2

When installing Carpet and Pad over concrete, it is best to use low pile carpet such as Berber or thin commercial carpet which have a low R-Value and a thin Low R-Value Pad. A very thin rubber pad such as provided by Sponge Cushion and others work well. Keep combined R-Value of carpet and pad under R-2 if possible for good heat transfer. Remember our associations with thick carpet relate to cold floors, but radiant warmth rising through thinner radiant heated carpet will feel more comfortable.

NOTE #3

When installing traditional hardwood flooring on concrete, it may be glued down with adhesive designed to bond wood to concrete. Do not use wide boards and use 3" quarter sawn wood from stable varieties that has been acclimatize to your job. Avoid softwoods and exotic wood varieties, or consider floating a layer of 3/4" T&G plywood in the pattern shown below and nailing the product down. Make sure it is something your flooring contractor will warrant. Also consider using engineered wood shown in Note 4 as it's more stable than milled hardwood. Avoid softwoods. There are several methods recommended by hardwood associations that add significant R-Value to an assembly. One is to float a layer of 3/4" edge glued T&G Plywood and nail the hardwood (or glue and nail). A layer of 3/4" plywood plus 3/4" hardwood has an R-vale of about 1.5. The other method has a higher R-Value of likely R-2.3 which is to screw down 2 layers of 1/2" plywood as shown. In each case there should be a vapor barrier.





NOTE #4

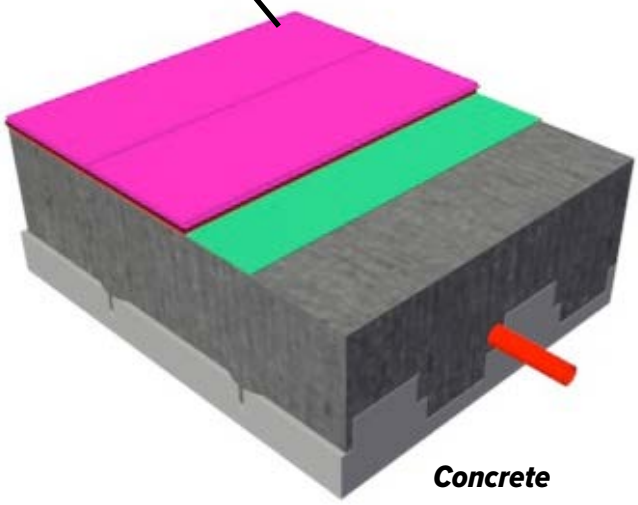
When installing laminate and engineered wood flooring over concrete, use a very thin foam pad often marketed as *Laminate Flooring Pad*. This will keep the floor quieter and increase comfort. Using flooring that is "Edge Lock" or glued together. Engineered wood can be floated, allowing the floor to expand and contract separately from the radiant thermal mass. The use of thicker molding to allow room for the floor to expand is advised. Check to make sure any brand of vinyl flooring is warranted for use over radiant heat and requirements for such a warranty.

NOTE #5

When installing vinyl flooring, there are several things to bear in mind. Vinyl expands a lot with changes in temperature and humidity. Therefore *mineral core edge lock vinyl flooring* is the most recommended since the non-vinyl mineral core reduces its expansion and contraction. Marmoleum and sheet vinyl should only be used in small spaces and modest heat loss spaces using modest floor temperatures. Mineral Core Luxury Vinyl plank has the lowest movement from temperature change and should be used. Check to make sure any brand of vinyl flooring is warranted for use over radiant heat and what the requirement for such a warranty.

Vinyl Plank Flooring

The best solution to the problems of the significant expansion of vinyl in temperature and humidity changes has been to add a bonded middle layer. *Mineral Core* is one such product that accomplishes this in some brands of Luxury Vinyl Planks. Due to the expansion and contraction, it is best to use an edge lock product over a very thin foam slip pad and use slightly thicker molding that will allow for expansion and contraction of the floating floor under the molding.



Concrete

Concept Drawing Only

ADDITIONAL CONSIDERATIONS FOR STRIP WOOD FLOORING OVER INSULHEAT

The key to installing wood floors over radiant heat is to give extra care to the species of wood you choose, wood strip width and thickness, ambient moisture levels, installation practices, the heat output requirements of your system, and radiant heating controls.

BOARD WIDTH / DEPTH: Install narrow board widths, preferably 3 inches or less. Avoid boards wider than 4 inches. Narrow boards provide more gaps for expansion and contraction across a floor; therefore, any gaps resulting from natural movement are much less noticeable. The maximum recommended board depth is 3/4 inch. Thicker boards add too much resistance to heat transfer.

DIMENSIONAL STABILITY: Use quarter sawn wood. It is significantly more dimensionally stable than wood that is plain sawn. Pick a wood known to be dimensionally stable. American cherry, ash, most softwoods and teak fill this bill, and oak is reasonably stable. By contrast, hickory, maple, madronne and American beech are known to be less stable.

AGE & DRYING OF TROPICAL WOODS: If you are importing tropical or exotic woods, pay close attention to the source, age and how the wood has been dried. Tropical wood needs to dry slowly to maintain its integrity upon installation. Quick drying creates stresses that can affect the wood later as it expands and contracts. If your supplier has stored the wood in your region with no problems for one to two years, the wood is much less likely to present surprise stress-related problems. Though it can be fun to be unique, please avoid pioneering the use of a wood for which little is known about its dimensional stability.

MOISTURE: Wood naturally expands and contracts in response to changes in moisture. With this in mind, avoid installing wood flooring during such stages of construction as sheet rocking or painting, when significant moisture may be introduced into a structure. Before installation, operate the heating system until the humidity in the structure stabilizes to the average level expected for the area in which the wood floor will be installed. Then, allow the wood to acclimate to this humidity level by "sticking" (usually several weeks) before installation. Sticking is an old term for stacking wood on slats so it can breathe at each layer. This will minimize dimensional changes due to moisture. Make sure the wood is dry, since radiant heat itself can be drying, experienced flooring installers recommend buying wood for flooring over radiant at around 6 to 8 percent moisture content. This figure may change somewhat regionally. Use a moisture meter during the construction process, and then use the average of many readings. Remember, the average expected humidity level of a structure is an average of seasonal conditions. So if the structure is expected to average 30 percent humidity in the winter and 50 percent in the summer, the average would be 40 percent. This equates to about a 7.5 percent moisture content in the wood. Most installers consider this average the ideal moisture level at which to install wood flooring. These numbers can vary significantly by region.

SURFACE TEMPERATURE: The maximum surface temperature of a wood floor should be limited to 85°F. Use a control strategy that ensures this will not be exceeded. Use an indoor or outdoor reset control that gradually brings the floors to temperature.

TYPICAL R-VALUES OF FLOORING GOODS AND MATERIALS

Material	Typical R-Value	R-Value Per Inch	Typical Thickness
Plywood	0.825	1.10	0.750
Plywood Underlayment (1/4)	0.275	1.10	0.250
Softwood	0.825	1.10	0.750
Sheet Vinyl	0.200	1.60	0.125
Vinyl Composition Tile (VCT)	0.200	1.60	0.125
Linoleum	0.400	1.60	0.250
Linoleum	0.200	1.60	0.125
Dense Rubber Flooring	0.250	1.30	0.325
Recycled Rubber Flooring	1.100	2.20	0.500
Cork	1.125	3.00	0.375
Cork/MDF/Laminate	1.175	2.35	0.500
Brick	3.375	2.25	1.500
Marble	0.400	0.80	0.500
Ceramic Tile	0.250	1.00	0.250
Thinset Mortar	0.050	0.40	0.125
MDF/Plastc Laminate	0.500	1.00	0.500
Laminate Floor Pad	0.300	1.92	0.160
Engineered Wood	0.250	1.00	0.250
Engineered Wood	0.375	1.00	0.375
Engineered Wood	0.625	1.00	0.625
Engineered Wood	0.750	1.00	0.750
Engineered Wood Flooring Pad	0.200	1.60	0.125
Engineered Bamboo	0.720	0.96	0.750
Oak	0.638	0.85	0.750
Ash	0.750	1.00	0.750
Maple	0.750	1.00	0.750
Pine	0.975	1.30	0.750
Fir	0.900	1.20	0.750
Carpet Pad/Slab Rubber 33lb	0.320	1.28	0.250
Carpet Pad/Slab Rubber 33lb	0.480	1.28	0.375
Carpet Pad/Slab Rubber 33lb	0.640	1.28	0.500
Carpet Pad/ Waffle Rubber 25 lb	0.620	2.48	0.250
Carpet Pad/Waffle Rubber 25 lb	1.240	2.48	0.500
Hair Jute	1.940	3.88	0.500
Hair Jute	1.250	3.88	0.325
Prime Urethane	1.400	4.30	0.325
Prime Urethane	2.150	4.30	0.500
Bonded Urethane	1.350	4.20	0.325
Bonded Urethane	2.100	4.20	0.500
Carpet	0.700	2.80	0.250
Carpet	1.050	2.80	0.375
Carpet	1.400	2.80	0.500
Carpet	1.750	2.80	0.625
Carpet	2.100	2.80	0.750
Wool Carpet	1.575	4.20	0.375
Wool Carpet	2.100	4.20	0.500

CALCULATING R-VALUE

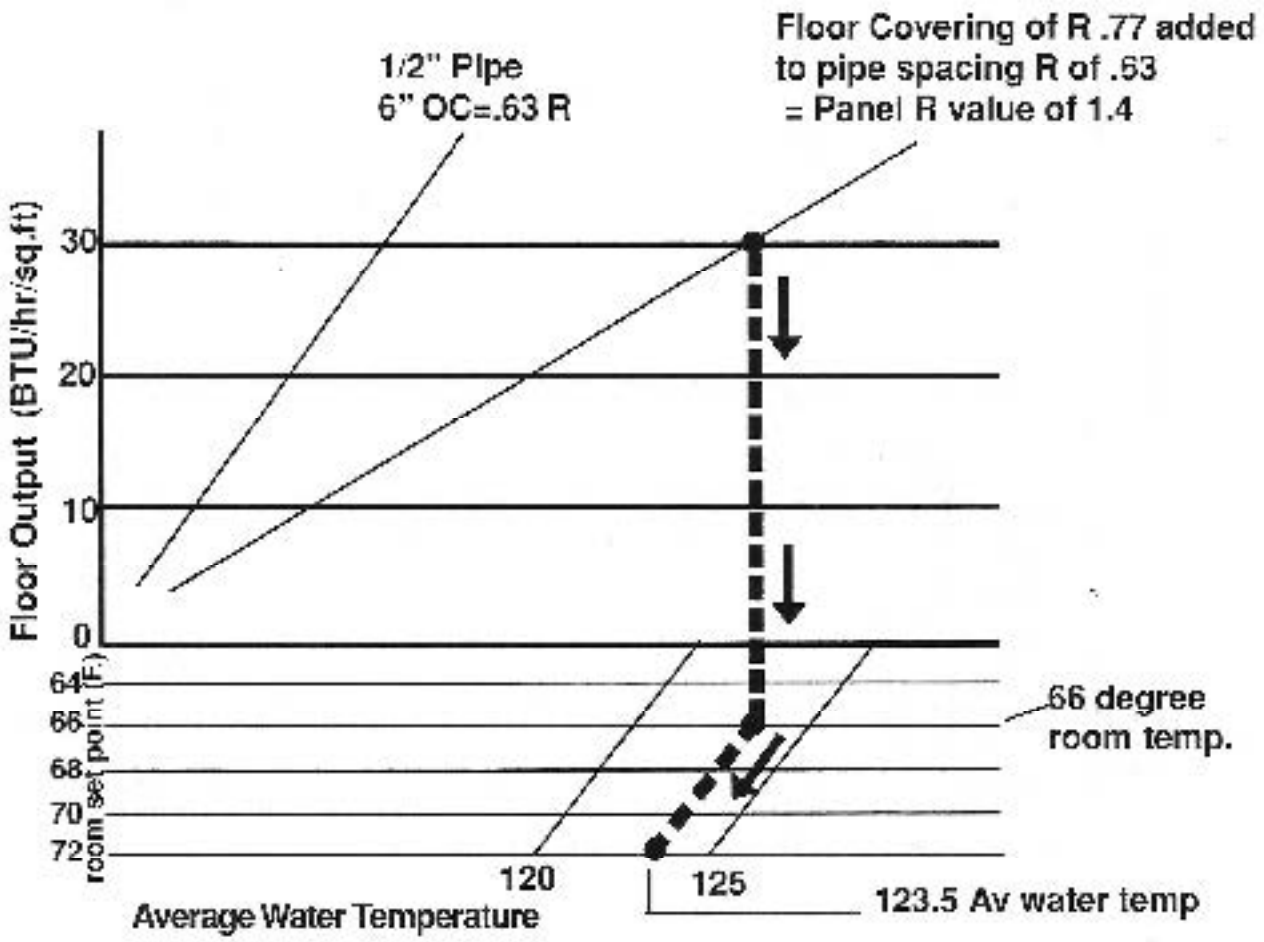
HOW TO CALCULATE R VALUE

These charts provide an R-Value for different spacing of each dimension of tubing. To use the chart you must first find the Panel R-value for the tube spacing you are using. You need to combine the tube spacing R-Value and the floor covering R-Value

1. Add the R-Value of the flooring being used to the tube spacing R-Value to come up with the total assembly R-Value.

2. Take the BTU requirements per square foot per hour of the space being heated and run across horizontally to the right until you intercept the angled line for your combined floor covering and panel R-value.

3. Drop down vertically to the desired room, temperature line and the angle forward to the left until you intercept the Average Water Temperature Line.



*These charts are for general reference in normal residential heating and do not reflect effects of high concentrations of propylene Glycol as anti freeze in very cold climates. Consult with anti freeze manufacturer for expected reductions in heat transfer for different concentrations.

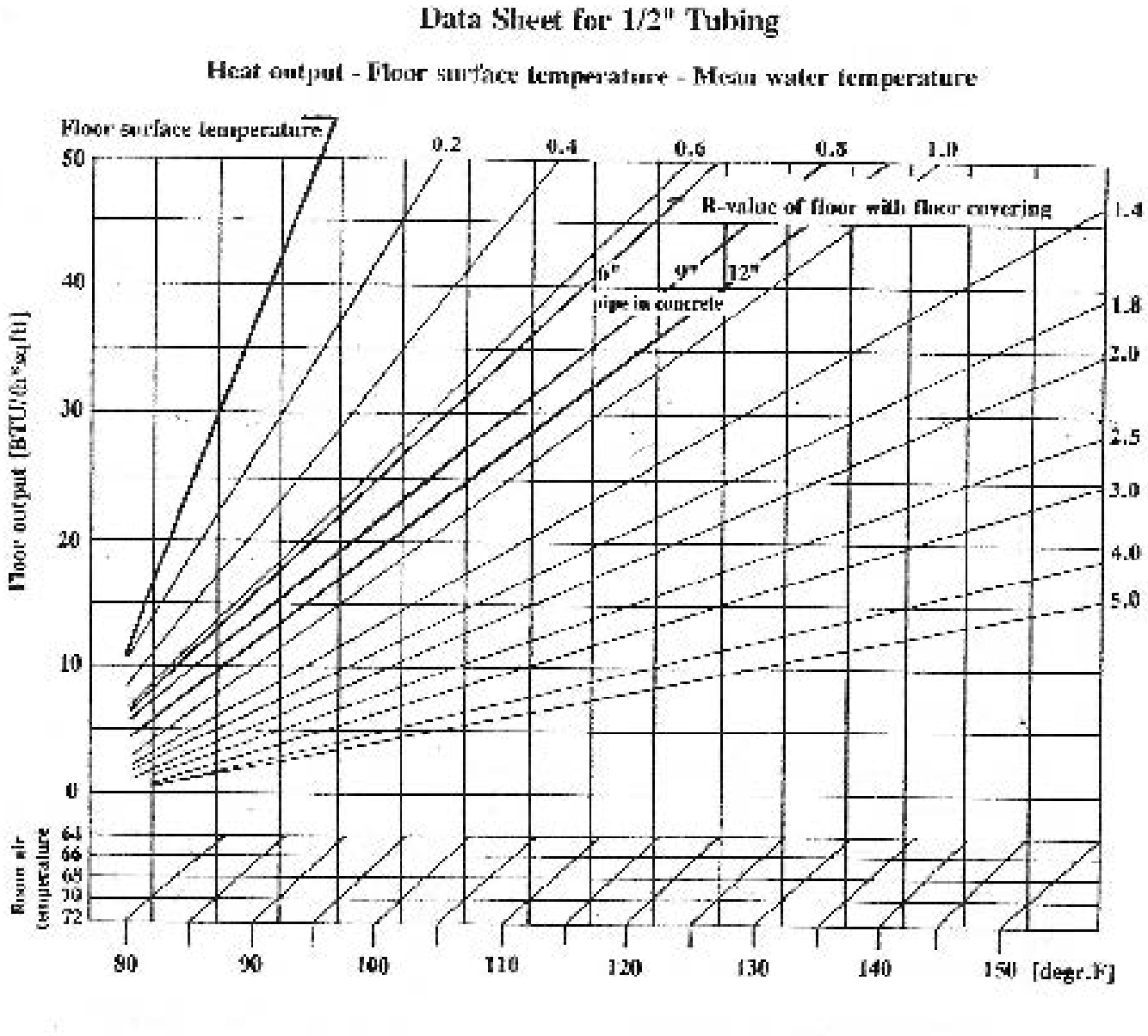
CALCULATING R VALUE FOR 1/2” TUBING

These charts provide an R-Value for different spacing of each dimension of tubing. To use the chart you must first find the Panel R-value for the tube spacing you are using. You need to combine the tube spacing R-Value and the floor covering R-Value

1. Add the R-Value of the flooring being used to the tube spacing R-Value to come up with the total assembly R-Value.

2. Take the BTU requirements per square foot per hour of the space being heated and run across horizontally to the right until you intercept the angled line for your combined floor covering and panel R-value.

3. Drop down vertically to the desired room, temperature line and the angle forward to the left until you intercept the Average Water Temperature Line.



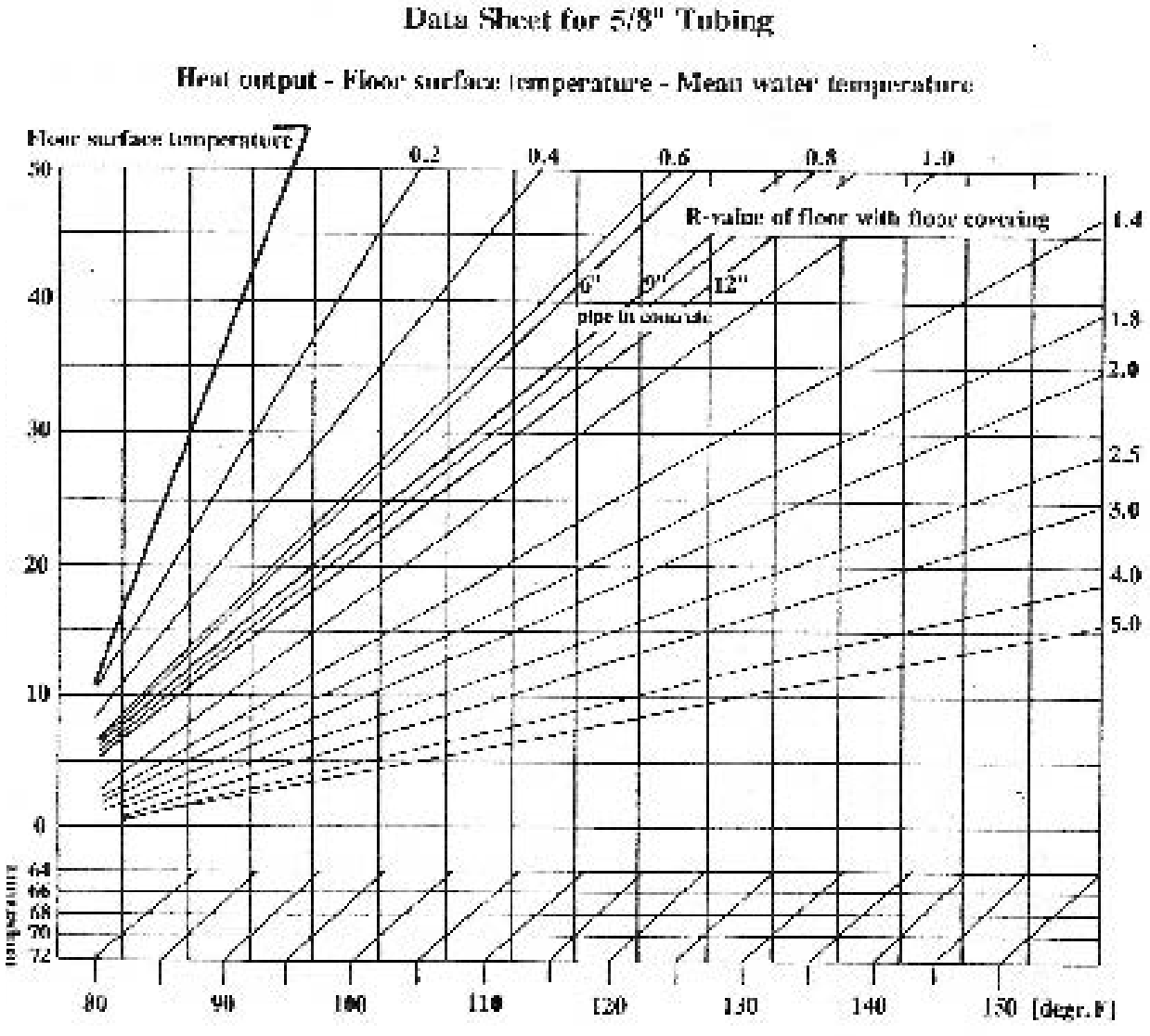
CALCULATING R VALUE FOR 5/8" TUBING

These charts provide an R-Value for different spacing of each dimension of tubing. To use the chart you must first find the Panel R-value for the tube spacing you are using. You need to combine the tube spacing R-Value and the floor covering R-Value

1. Add the R-Value of the flooring being used to the tube spacing R-Value to come up with the total assembly R-Value.

2. Take the BTU requirements per square foot per hour of the space being heated and run across horizontally to the right until you intercept the angled line for your combined floor covering and panel R-value.

3. Drop down vertically to the desired room, temperature line and the angle forward to the left until you intercept the Average Water Temperature Line.



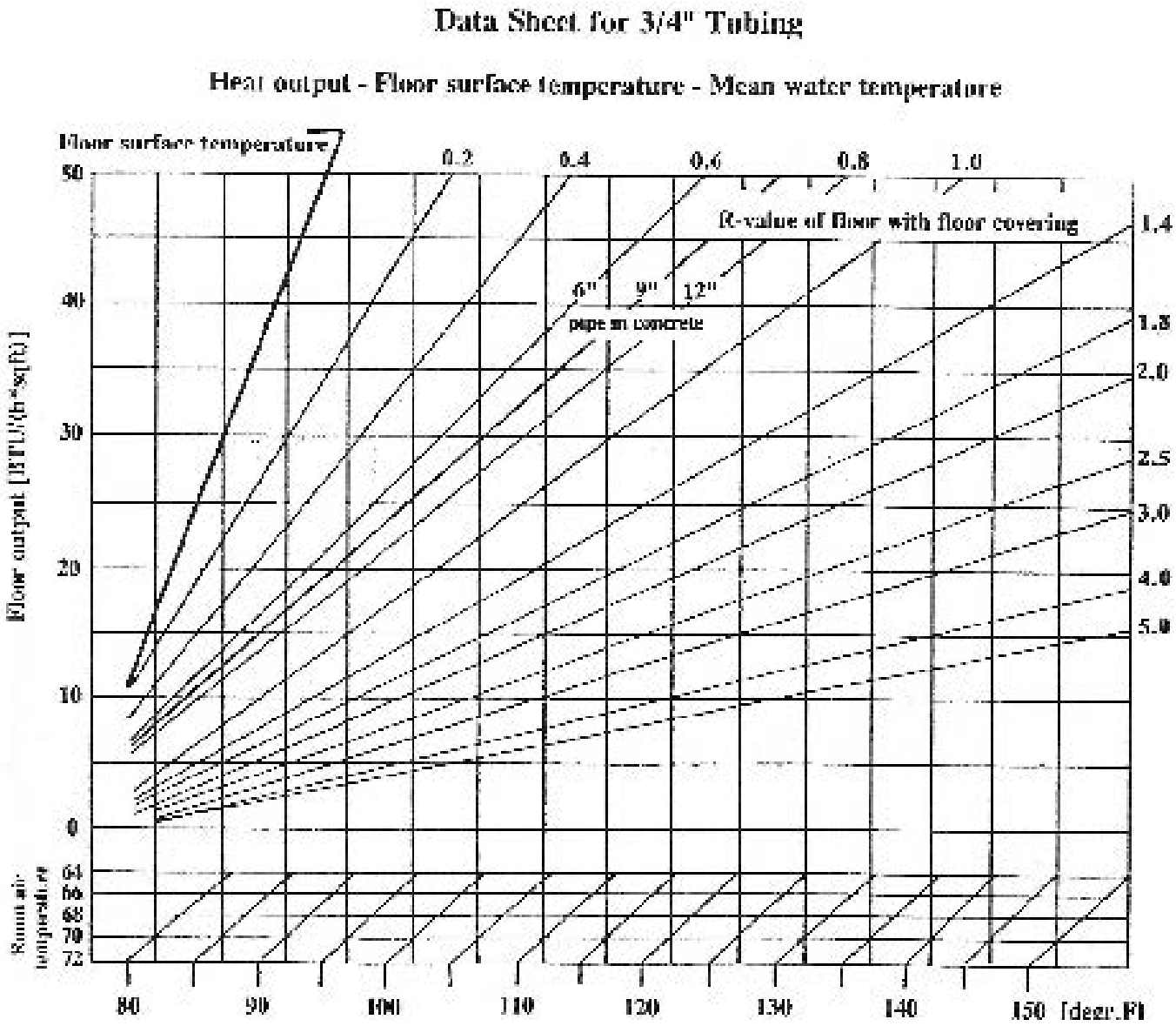
CALCULATING R VALUE FOR 3/4” TUBING

These charts provide an R-Value for different spacing of each dimension of tubing. To use the chart you must first find the Panel R-value for the tube spacing you are using. You need to combine the tube spacing R-Value and the floor covering R-Value

1. Add the R-Value of the flooring being used to the tube spacing R-Value to come up with the total assembly R-Value.

2. Take the BTU requirements per square foot per hour of the space being heated and run across horizontally to the right until you intercept the angled line for your combined floor covering and panel R-value.

3. Drop down vertically to the desired room, temperature line and the angle forward to the left until you intercept the Average Water Temperature Line.



TUBE SIZE AND LOOP LENGTHS

For general residential use 3/8" PEX and 1/2" PEX are the commonly used dimensions, but most contractors choose 1/2" due to longer loop lengths and fewer fittings. Both may be used with InsulHeat™ Underslab™. Max recommended loop lengths are designed to keep flow rates slow enough to not erode tubing and to minimize pump energy utilization. For general residential use stay away from the blue areas.* These charts do not take into account the effects of high levels of Propylene Glycol Anti Freeze on viscosity and heat transfer. Consult the manufacturer for more details.

3/8" PEX 250' LOOPS 20°F TEMPERATURE DROP

BTU/SQ/FT	10	15	20	25	30	35	40
FRICTION LOSS (FT. HEAD)	2.22	4.70	8.01	12.10	16.96	22.80	28.87
WATER SPEED (FT/SECOND)	0.60	0.90	1.20	1.50	1.80	2.10	2.40
GPM PER LOOP	0.18	0.27	0.36	0.45	0.54	0.63	0.72

**Shaded areas have high head loss*

3/8" PEX 200' LOOPS 20°F TEMPERATURE DROP

BTU/SQ/FT	10	15	20	25	30	35	40
FRICTION LOSS (FT. HEAD)	0.98	2.07	3.53	5.33	7.47	9.93	12.72
WATER SPEED (FT/SECOND)	0.45	0.68	0.90	1.13	1.35	1.58	1.80
GPM PER LOOP	0.14	0.20	0.27	0.34	0.41	0.47	0.54

1/2" PEX 350' LOOPS 20°F TEMPERATURE DROP

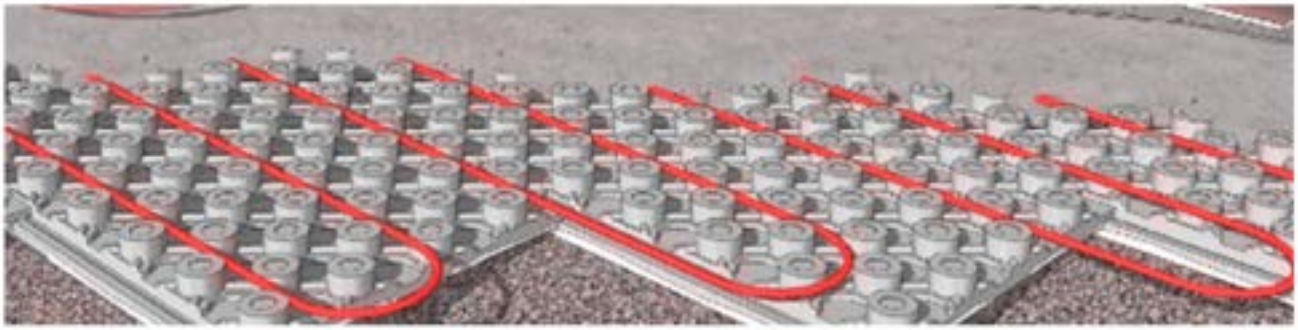
BTU/SQ/FT	2.86	7.14	14.29	21.43	28.57	35.71	42.00
FRICTION LOSS (FT. HEAD)	0.24	1.29	4.66	9.86	16.79	25.37	34.24
WATER SPEED (FT/SECOND)	0.18	0.45	0.91	1.36	1.81	2.26	2.66
GPM PER LOOP	0.1	0.25	0.5	0.75	1.00	1.25	1.47

1/2" PEX 250' LOOPS 20°F TEMPERATURE DROP

BTU/SQ/FT	4.00	10.00	20.00	30.00	40.00	42.00
FRICTION LOSS (FT. HEAD)	0.17	0.92	3.33	7.04	11.99	13.12
WATER SPEED (FT/SECOND)	0.18	0.45	0.91	1.36	1.81	1.90
GPM PER LOOP	0.1	0.25	0.5	0.75	1.00	1.05

5/8" PEX Loop Length range is 325' to 500' depending on flow rate and head loss. 3/4" PEX Loop Length range is 500' to 600' depending on flow rate and head loss. 1" PEX Loop Lengths range from 600' to 750'. *Note 3/4" and 1" are difficult to bend and rarely used in residential radiant floor heating.

INSULHEAT DATA SHEET



UNDERSLAB RADIANT INSULATION PANEL

Data Sheet

InsulHeat is an insulated panel used for hydronic radiant floor (under concrete slab) systems both for interior and exterior applications. The combination of closed cell, molded Expanded Polystyrene (EPS) insulation with High Impact Polystyrene (HIPS) film, makes for a strong and resilient panel.

The panel combines high density rigid insulation, a vapor barrier and PEX piping locking mechanism into a single solution that significantly reduces installation time. Ideal for installation in basements, driveways, garages, workshops and barns.

Features

- Consistent 3" (76mm) grid pattern of the panel allows for uniform pipe layout.
- Accommodates ¾", ½", ¾", and 1" nominal Pex tubing.
- Light and manageable 24" x 48" x 3 ⅜" panel size reduces waste due to damage on site.
- The nub height and film accommodates multiple tube sizes and protects the tubing from damage and dislocation when the panel is walked upon by other trades.
- Quick and easy walk-in installation of PEX piping without the need for staples and zip ties greatly reducing strain on the body.
- The large, four-sided interlocking shiplap connector system makes for a quick, easy and secure installation while maintaining the continuity of the vapor barrier and eliminating the need for a dedicated vapor barrier (unless specifically required by local building code).

PRODUCT DATA SHEET

Applications

- Under concrete slab
- Basement slab
- Slab on grade
- Garage and workshops

Storage

Store panels in a dry location, protected from the elements. Panels should be stacked at least 4" (102mm) above the ground. Limit the use of open flame or ignition sources near product. Avoid contact with hydrocarbons and petroleum based products.

Warranty

Insulheat supports building owners, designers and contractors by offering a 20-year, limited thermal warranty on Ampex product line. This warranty is available to the building owner at the time the building is completed and is transferable to any subsequent owner during the 20-year period.

Physical Properties Table

Compressive Strength	Thermal Resistance	Water Vapor Permeance	Flexural Strength	Panel Density	Panel Size[1] W*L	Panel Thickness	Supported PEX Pipe Sizes
ASTM D1621	ASTM C518	ASTM E96	ASTM C203	ASTM D1622	-	-	-
psi (kPa	F-ft²-hr/Btu (m²K/W)	US perms (ng/Pa·s·m²)	psi (kPa)	lb/ft³ (kg/m³)	inches (mm)	inches (mm)	inches (mm)
30	10	0.42	52	1.5	24×48	3-½"	⅝, ½, ¾, 1

RECOMMENDED TUBING FOR USE WITH INSULHEAT™

PEX tubing installed in InsulHeat shall be third party certified and manufactured to ASTM F-876 and F-877.

The PEX tubing should have PPI issued design and pressure ratings of 200°F @ 80 PSI, 180°F @100 PSI and 73.4°F at 160 PSI.

The PEX tubing shall be nominal 3/8", 1/2" 5/8", 3/4" or 1" ID in accordance with ASTM F-876 and F-877.

DO NOT use PEX-AL-PEX (Pex Aluminum Pex),since when ovalled this pipe may not be as well retained in the nubs

Use well established reputable brands of PEX such as : Uponor, Zurn, Watts, Mr. PEX, Rehau.

Use of Barrier Pex is recommended in most systems to reduce any potential corrosion of metallic components.

Recommended Glue for Insulheat™

If InsulHeat™ panels need to be glued we recommend Bostik Greenforce which will not harm pex pipe. Note some foam adhesives can damage PEX pipe.

WARM BROTHERS INC. – GENERAL TERMS AND CONDITIONS OF SALES AND DELIVERIES

August 8, 2024 Page 1

GENERAL

In these terms and conditions ("Conditions"), "Buyer" means the entity purchasing products, materials, works or services ("Goods") from Warm Brothers Inc. ("Supplier"), or whose order for such Goods is accepted by the Supplier.

SALES

The Supplier shall sell and supply the Goods to the Buyer subject to these Conditions, which shall exclusively govern the contract ("Contract") for the sale of the Goods provided by the Supplier hereunder, to the exclusion of any other terms and conditions of the Buyer.

ORDERS AND SPECIFICATIONS

No order submitted by the Buyer is accepted by the Supplier unless confirmed in writing by the Supplier, or upon delivery of the Goods by the Supplier. Supplier shall be entitled to accept or reject orders and customers at its sole discretion.

PANEL LAYOUT

Buyer acknowledges that Supplier recommends using Supplier's panel layout service which provides a detailed layout of the radiant panel shapes, loop lengths, zoning and manifold locations specific to the Buyer's project needs. With a panel layout plan, due diligence, and adherence to the Supplier's current Installation Manual for the product, many individuals and contractors may successfully install the radiant panels. However, the integration of overall heating requirements, design, and components of a hydronic radiant heating system requires specialized knowledge. Therefore, as a condition of sale, the Buyer acknowledges being either a knowledgeable, qualified installer trained in the installation, codes, permitting, safety, heat transfer, piping and other relevant issues relating to installing hydronic systems, or, if not, Buyer will use a qualified installer for integrating, testing and starting up the system. The Buyer further acknowledges that if they want to buy Warm Brothers Inc.'s radiant panel products without a layout design, they must sign a form saying they have read the Installation Manual and are qualified to install the goods purchased from the Supplier. At a higher cost, Buyers of Warm Brothers Inc. Radiant Panel products can, in some regions, be provided a full mechanical design.

PAYMENT TERMS FOR INVOICES

The Buyer shall pay the invoice (in full without any offset, deduction or counterclaim) in U.S. Dollars, unless the Supplier specifies otherwise. Due to the volatility of freight and material prices, the validity of estimates and invoices will be for the time limit stated on the invoice or estimate. After the expiration of any estimate or invoice, at Supplier's sole discretion, the estimate or invoice will either be extended, or redone at the then prevailing price of freight and goods. Invoices will contain a link to pay electronically. Supplier accepts Visa, Mastercard, Discover, American Express, and eCheck (electronic check) transfers. Supplier requires prepayment before shipment of our radiant panel products.

ESTIMATE PROCESS, INVOICES AND PAYMENT

Budgetary estimates are provided by Supplier to Buyer free of cost. Supplier invoices Buyer a cost for layout design services, as agreed in advance by the Buyer. A portion of this design fee may be credited back to the Buyer when the radiant panel product is purchased. Once a Buyer has accepted the final design, Supplier will send Buyer an Invoice for Goods based on the layout design, which normally requires prepayment prior to Supplier shipping product.

SHIPPING AND FREIGHT

Supplier's quotation or estimate to Buyer includes a freight quote that can be affected by issues such as those enumerated below. A Buyer's shipping requirements may change, as well as the freight estimate, prior to delivery. Since freight costs vary with each order, Supplier generates and includes a custom freight quote for each Buyer.

Supplier's board shipments are usually sent out by an LTL trucking company. The least expensive way to ship these boards is to ship to a commercial location that operates during regular business hours, has a forklift, and has personnel available to unload the boards. If this option is not available, the freight company will charge extra delivery fees. Below is a list of special services that affect freight charges. These delivery conditions should be discussed by Supplier and Buyer prior to purchase. If delivery conditions change, Buyer should notify Supplier of such changes prior to delivery; this may result in additional cost.

Delivery options that may affect shipping and freight cost:

- **Inside property drop-off (long driveways, specific drop spot)**
- **Liftgate drop-off (if Buyer or site does not have a forklift to unload boards from the truck)**
- **Limited Access Delivery (i.e. construction sites, utilities, churches, schools, etc.; a steep long driveway; no turn around space; gated community)**
- **Phone notification required prior to delivery**
- **Appointment delivery (within a set time window); redelivery if Buyer misses appointment**
- **Residential Delivery**
- **Redelivery (second attempt if no one was at original delivery)**

INSPECTION OF GOODS UPON DELIVERY

The Buyer shall inspect the Goods upon delivery. Heavily damaged shipments should be rejected at the time of delivery. Any claim for any defect in the quality or condition of the Goods shall be presented in writing to the Supplier within five (5) working days of delivery or, where the defect was not immediately apparent, within five (5) working days of discovery.

DELIVERY AND PERFORMANCE
Terms of delivery shall be by freight prepaid by the Buyer, unless otherwise agreed. Any dates quoted for delivery of Goods are estimates only, and the Supplier shall not be liable for any transit delay in the delivery of Goods. If Supplier cannot ship purchased Goods within three weeks of a pre-agreed date with the Buyer, then the Buyer may cancel the order for Goods not yet shipped, including freight, and will receive a full refund, with the exception that design layout costs are not refundable.

DEFECTIVE GOODS
In case of defective Goods, the Supplier may, at its sole option, replace or repair the Goods free of charge, or refund the price of the Goods. The foregoing shall be the Buyer's only and exclusive remedy. Under no circumstances shall the Supplier be liable to the Buyer for loss of contracts, profits, revenue, business, goodwill or other indirect or consequential loss, regardless of the ground of the claim. Notwithstanding anything to the contrary in the Contract or these Conditions, the Supplier's entire liability shall never exceed the price of the Goods provided.

TRANSFER OF OWNERSHIP
Risk of Loss transfers to the Buyer upon delivery. Transfer of Ownership normally transfers to the Buyer at time of delivery, provided Supplier has received clearance of all funds due for Goods being supplied.

TAX
Supplier's Goods are sold electronically on the internet, and under some conditions no tax is charged. However, ongoing U.S. Supreme Court decisions on internet taxation, as well as evolving state-by-state internet sales tax requirements, means that all U.S. suppliers are presented with a complex and fluctuating array of laws regarding internet sales and use taxes. We comply with these as we become aware of the specific tax obligation in any state. Therefore, we reserve the right to charge tax at the time of sale. You, the Buyer, acknowledge that you are responsible for paying any sales tax, use tax or fees that may be due in your locality, state or other legal jurisdiction. If a Buyer has a valid resale certificate in a state where we are charging tax, the Buyer may provide Supplier a valid copy of this resale certificate and the Supplier will not charge the tax.

RETURNS AND CANCELLATIONS
Supplier's products are assembled and packaged for each Buyer's order, with the component configuration of the Buyer's requested order and Supplier's Invoice. Payment in full is required prior to preparing an order. A Buyer's order may be cancelled with a 95% refund if the cancellation is requested before our factory has begun assembling the order. If a Buyer's order is cancelled after packaging has started, but prior to shipment, the order may be cancelled subject to a 35% cancellation fee.

Any Buyer's order that is to be returned to the factory requires factory approval and an RGA, (Return Goods Authorization), and must be returned within 10 working days of receipt of Goods by the Buyer, provided that it: 1) has not been installed, 2) is in original condition, and 3) is returned in the original packaging. An RGA# (Return Goods Authorization) from Supplier is required for any such return.

Return instructions will specify where and how to ship the product, and the RGA# and documentation must accompany each box or pallet of any such shipment. Buyer is required to pay shipping/freight charges on all returned Goods. Returned Goods are subject to Supplier's 35% restocking fee.

The balance of Buyer's purchase price, less any additional shipping charges or restocking fee, will be refunded within 10 working days of the factory receiving the Goods, if the Goods are in resalable condition, meaning they have not been installed, abused, altered or damaged. If the factory rejects the returned Goods for the above reasons, no refund to the Buyer will be issued. Warranty returns must also be agreed to in advance by the factory, and must have an RGA#.

BUYER INTENDED USE
Buyer acknowledges that the Supplier's radiant panel products are intended for indoor use as a non-structural modular radiant panel system, are intended to be stored, installed and used according to the most current Warm Brothers Inc. radiant panel Installation Manual for the product, and have been integrated into the Buyer's overall mechanical system by qualified installers familiar with hydronic good practices, and installed in compliance with all relevant codes.

PRIVACY AND SECURITY
Warm Brothers Inc. values your privacy. We do not share a Buyer's confidential information with anyone other than as required by credit processors to complete a transaction, or if compelled by law. We do, however, provide our factory with each Buyer's name, company, address, phone, fax and e-mail for shipping purposes. We keep information regarding transactions as long as required by law.

INTELLECTUAL PROPERTY
Supplier retains all right, title and interest in and to all intellectual property rights ("IPR") regarding the Goods, and to all confidential information (including, but not limited to, drawings, designs, specifications), as well as the results of any joint development, and any IPR of whatever nature contained therein. The Buyer shall not receive any right to Supplier's IPR or confidential information.

EFFECT OF WAIVER
No waiver by the Supplier of any breach of the Contract by the Buyer shall be considered a waiver of any subsequent breach of the same or any other provision. If any provision of the Contract is held to be invalid or unenforceable, the validity of the other provisions of the Contract shall not be affected. Buyer shall not assign or transfer this contract without prior written consent of Supplier.

FORCE MAJEURE
Supplier's performance shall be excused, and Supplier shall not be liable or responsible to Buyer, nor be deemed to have breached any obligation to Buyer, in the event of any acts of God; flood, fire, earthquake, or other natural disaster; disease; explosion, war, invasion, hostilities, terrorism, riot, or other civil unrest; government action, order or law, embargoes, or blockades; national or regional emergency; strikes, labor stoppages or slowdowns, or other industrial disturbances; shortage of adequate power or transportation facilities; or other events beyond the control of Supplier.

WARRANTY
Warm Brothers Inc. warrants that its non-structural modular board products are free from defects in material and workmanship in the manufacturing process when shipped from the factory. For a period of one (1) year after shipment from the factory, any boards that are determined to have been defective when they left the factory will be replaced by a like number of boards as the exclusive remedy. To qualify for warranty, Goods must be inspected upon receipt by Buyer for defects, stored and installed according to the most current Warm Brothers Inc. Installation Manual for the product involved, and used in conformity with the written specifications in the manual. Assertions of defect must be presented by Buyer to Warm Brothers Inc. in the form of a request for return of goods within 7 days of receipt, or by other documentation acceptable to Warm Brothers Inc. If Warm Brothers Inc. agrees that the defect is covered by the Warm Brothers Inc. warranty, then Warm Brothers Inc. shall, at its expense, ship the Buyer replacement boards as the sole remedy. Warm Brothers Inc. specifically disclaims any incidental, consequential, or other claims of damage beyond the replacement of defective Goods. In no event shall damages exceed the cost of the goods provided.

LIMITATIONS TO LIABILITY
Supplier specifically disclaims any liability for property or personal injury damages, special or punitive damages, consequential, incidental, or contingent damage for lost profits, revenues, down time, shutdown or slowdown costs, or for any other types of economic loss; or for claims of Buyer's customers or any third party for any such damages. Warm Brothers Inc.'s total liability arising in connection with the Goods shall be limited to the value of the product provided to the Buyer.

EXCLUSIONS TO WARRANTY
Any product that has been removed and reinstalled is excluded from warranty coverage. Radiant Panels provided by Warm Brothers Inc. are construction board products, and many aspects of their storage, transport and installation are beyond the control of Warm Brothers Inc. Lack of Buyer's inspection of product at time of delivery, or lack of notification within 7 days to Warm Brothers Inc. of any defect or damage, excludes Goods from warranty coverage.

- **Improper storage**
- **Job-site damage caused by others**
- **Installation for any use other than the Goods' intended use**
- **Installation in violation of guidelines in the Installation Manual**

JURISDICTION, FORUM AND DISPUTES
Buyer acknowledges that any claims brought against Supplier for breach of warranty, or for any other reason, shall be governed and construed by the laws of the State of Washington without resort to any conflict of laws principles. For any disputes arising from Warm Brothers Inc.'s Limited Warranty, or any other dispute, the parties agree to the exclusive jurisdiction of federal and state courts located in King County, Washington. Each party hereby waives any right it might otherwise have, but for this provision, to file a motion to dismiss or transfer jurisdiction from such courts based on lack of personal convenience or forum non conveniens. Any dispute, controversy, or validity thereof, shall be finally settled by arbitration in accordance with the Arbitration Rules of the American Arbitration Association. The number of arbitrators shall be one (1). The seat of arbitration shall be Seattle, Washington, USA. The language of the arbitration shall be English. Without prejudice to the clause above, the Supplier, at its sole discretion, reserves the right to sue the Buyer at the general place of jurisdiction for the Buyer.

COMPLETE AGREEMENT
All of the above policies and practices are specifically incorporated as conditions of sale from Supplier to Buyer. By purchasing on this website, the Buyer specifically acknowledges and accepts these conditions of sale.