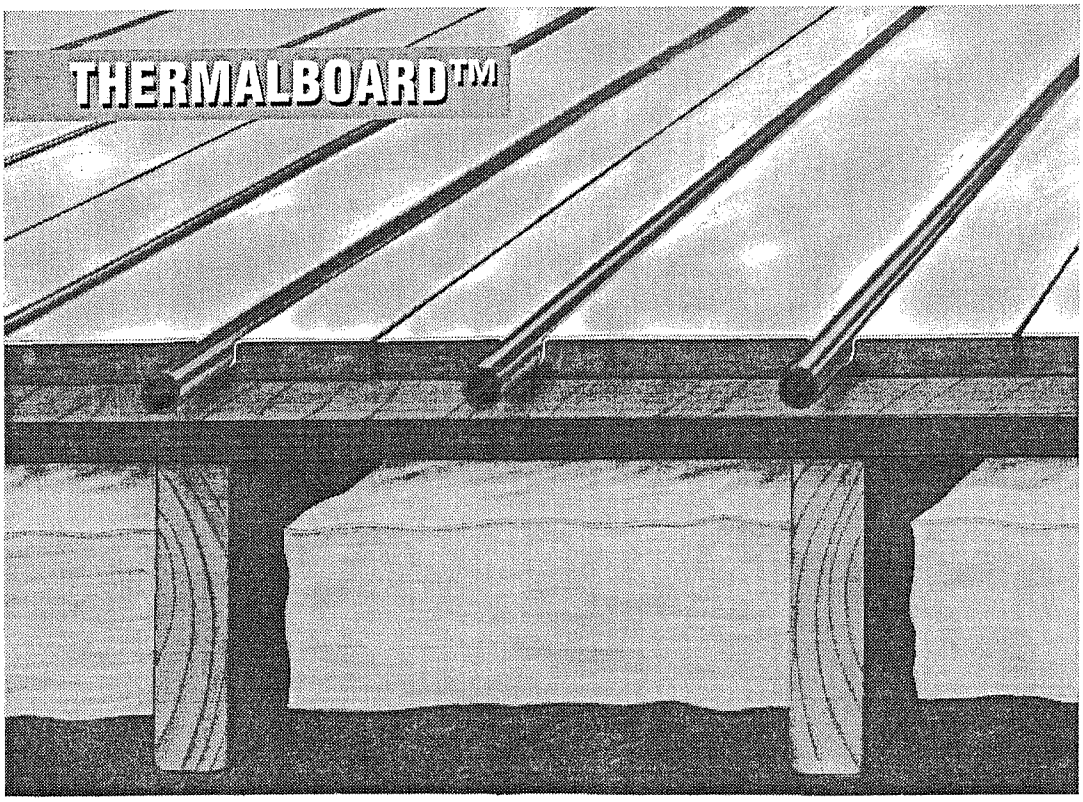
THERMALBOARD™

APPLICATION GUIDE



MODULAR RADIANT THERMAL MASS

APPLICATION GUIDE FOR THERMALBOARD™

PATENT PENDING

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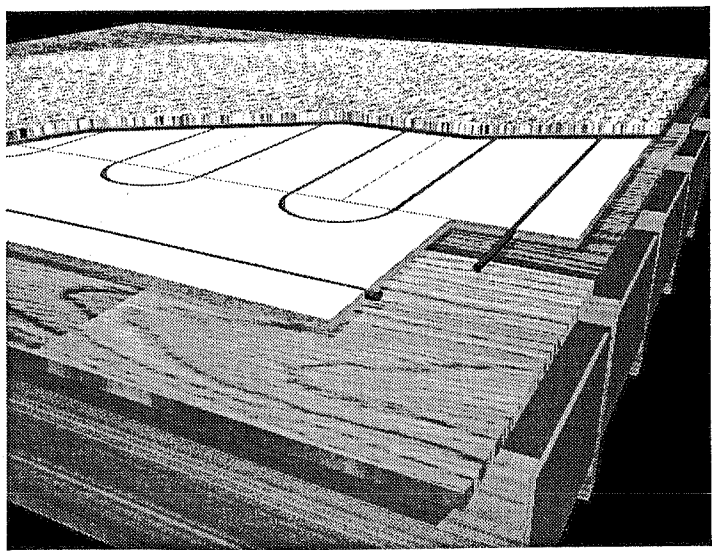


Contents

THERMALBOARD™, HOW IT WORKS:

Thermalboards are typically glued and screwed to a subfloor or glued to cement. Then PEX pipe carrying warmed water is snapped into the groove. Heat is transferred from the pipe to the aluminum and the board. Thermalboards are manufactured from MDF (medium density fiber board), a dense relatively conductive wood product weighing 44-50 lbs. per cubic foot. It is grooved and then laminated with a top layer of highly conductive aluminum to efficiently disperse and transfer heat away from the groove to the surface area of the whole board. Acceleration is a measure of how fast a radiant heating systems responds. Aluminum is approximately 1000 times as conductive as wood. The layer of aluminum on Thermalbord™ and in the groove, significantly en-

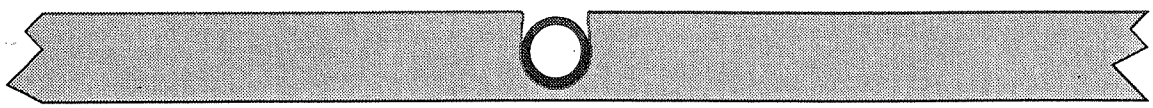


FIGURE A-1, a cross section, showing PEX pipe in groove and board with aluminum top layer

hances the transfer of heat and evenness of heat distribution of the board (See figure A-2) to see how the heat transfers through Thermalboard™. The thin profile and relatively high density contributes to the superior acceleration of Thermalboard™ and the relatively high density means that it is a good thermal mass.

Traditional radiant heating systems in concrete work well but they must first charge a large thermal mass before heat will begin coming out of the panel. They accelerate very slowly due to the large thermal mass and they can be hard to control. Thermalboard™, being thin but relatively dense and aided by it's conductive aluminum layer responds very rapidly. This results in greatly improved response time with almost no overheating since there is almost no "thermal lag" to overcome. Thermalboard can be controlled with standard set back thermostats.

THERMALBOARD™ WARMCOAT:

The Thermalboard™ Warmcoat aluminum top layer provides multiple benefits. It is conductive with benefits as described below. The Warmcoat aluminum layer is also moisture resistant. When the edges and grooves of the Thermalboards™ are sealed using the Thermalboard thermal sealant, it provides significant moisture protection for the board. And provides a barrier to the transmission of any outgassing from the board. Thermalboard™ is manufactured to meet the less than 0.3 ppm formaldehyde Federal Housing Authority (FHA) standards. Independent laboratory tests with 144F° water indicate, that due to the aluminum Warmcoat layer, Thermalboard™ has virtually non detectable levels of outgassing.

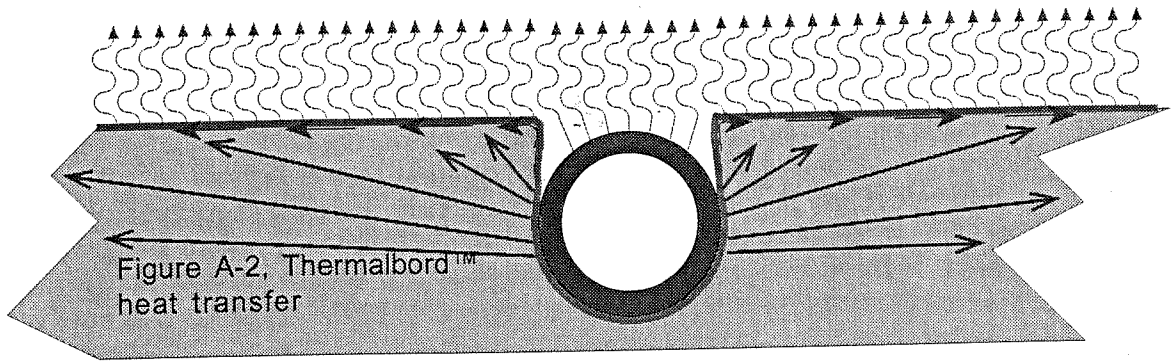


Figure A-2, Thermalbord™ heat transfer

Rapid acceleration from the aluminum layer and just enough thermal mass in a thin dense board to make the radiant heating system stable and easy to control.

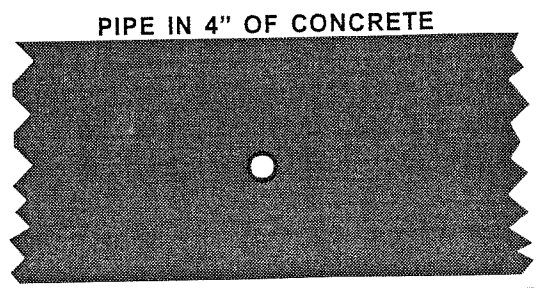
THE ADVANTAGES OF THERMALBOARD:

Hydronic radiant heating is the most comfortable and efficient way to heat your home or building with numerous construction benefits and unsurpassed flexibility in zoning. For many years typical applications for radiant systems involved embedding tubing in concrete slabs or pouring "lightweight concrete" over tubing stapled to sub-floors. Because of the lack of a good alternative to these types of systems, the limitations and disadvantages of concrete systems were overlooked. Thermalboard is designed for the application of hydronic radiant tubing over a variety of construction types. Thermal board may be used in new construction and is particularly advantageous in the growing retrofit market. While only adding 5/8" to the existing floor, Thermalboard provides a superior performing radiant heating system. Application of the system is made easy as only three types of pieces are required for installation. The utility piece may be cut to accommodate 90 degree bends. The Thermalboard™ radiant floor heating system provides an attractive alternative to concrete with numerous advantages:

- •Superior performaning, high density thermal mass
- •Excellent response time to heat up
- •Easy layout and installation
- •Lightweight – 5 times lighter than concrete
- •Even distribution of heat
- •Superb design and zoning flexibility
- •Excellent compatibility with floor coverings
- •Lightweight reduces need for structural upgrades

RESPONSE TIME: notice how in these to scale side by side drawings how much more mass pipe in 4 inches of cement must overcome before it begins giving off heat.

Figure A-3



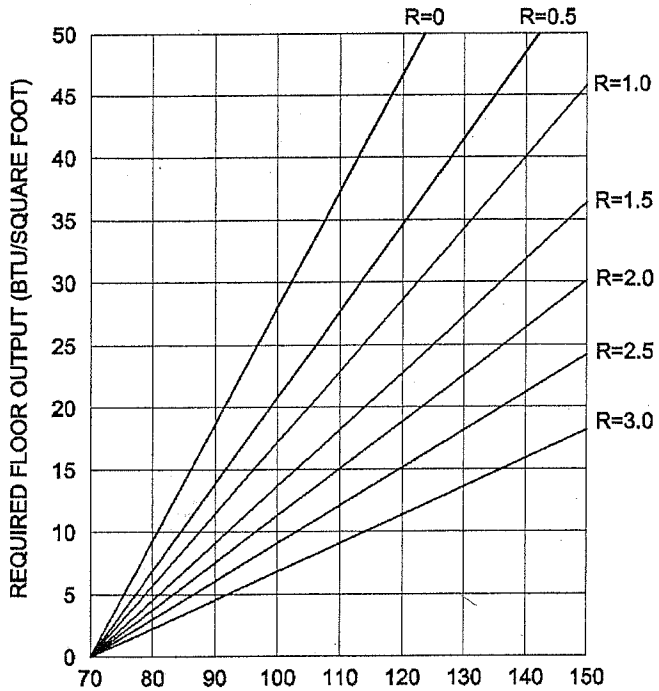


CHART C-1 THERMALBOARD™
AVERAGE WATER TEMPERATURES

STEADY STATE PERFORMANCE
CHART C-1 shows the steady state performance of Thermalboard™. To the left are the BTU/Sq.Ft/Hour, the lines represent the resistance of the floor coverings on top of Thermalboard™ and on the bottom is the average water temperature required to achieve the output. The chart is read by selecting the correct BTU requirement and then moving horizontally until the line indicating the correct R-Value of the floor assembly on top of Thermalboard is encountered, at that point drop down vertically to see average water temperature.

Installers Note: Remember average water temperature means the average of the supply and return water temperatures flowing to and from the loop. Most typically Thermalboard™ is designed with a 20F° temperature drop. This means the supply water temperature would typically be 10F° higher than the average water temperature.

HEAT LOSS:
As with all floor heating jobs a detailed and accurate heat loss must be calculated in order to determine proper design conditions. This may be provided by a design service (See Design Services) Refer to the 1999 Radiant Panel Association Guidelines For The Installation Of Radiant Panel Systems for standards on insulation and heat loss. The maximum recommended supply water temperature for thermalboard is 150F°.

Installers and designers note: Do the heat loss of the structure at the design stage. This way choices of floor coverings can be done with the requirements of the system in mind. If the heat loss is too high, add insulation or auxiliary heat. In a high heat loss room Thermalboard™ might be added to the walls or ceilings for extra heat.

R-VALUE OF FLOOR ASSEMBLIES
While Thermalboard™ will work with a wide variety of floor coverings over the top of the boards it is important to realize that all floor coverings offer a resistance to heat trans-

fer as measured typically by their R-Value. The higher the R-Value of the floor covering the higher the average water temperature it takes to overcome this resistance and to put out the desired amount of heat. If the R-value of any covering on top of Thermalboard becomes excessive, as in any radiant heating system performance will be compromised due to lack of heat transfer, or by exceeding the 150F° maximum supply water temperature. Chart C-1 can be used to estimate system output with different floor coverings

Installers and designers note: Learn about the resistance of the intended floor coverings at the design stage and make sure that they are within the requirements of the system.

COMPONENTS:

Thermalboard™ comes in 3 different board configurations. These are "straight", "utility" and "combo end piece". They are assembled to make a channel for the pipe. Thermalboards cut easily with a circular saw.

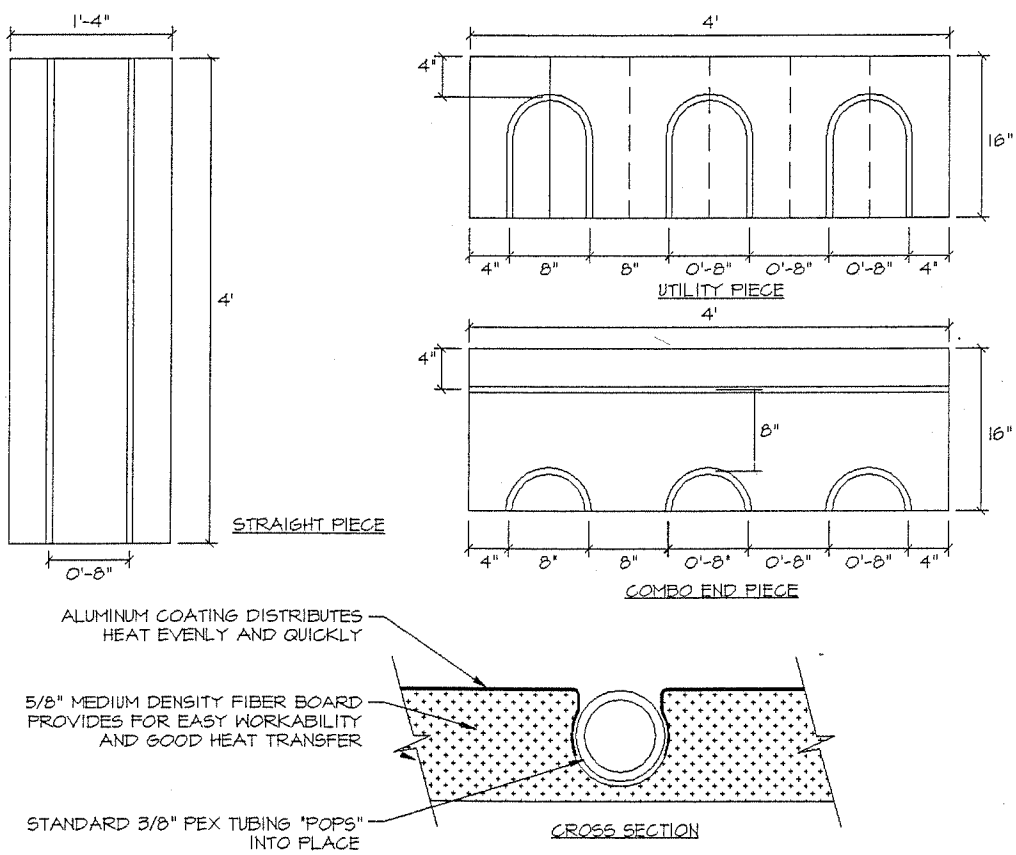
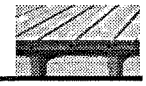


Illustration A-4, Thermalboard™ components



THERMAL BOARD PRODUCT HANDLING INFORMATION:

Dimensions: each board is 16" x 48" x 5/8" thick, or 5.333 square feet a board
Weight: approximately 2.5lbs per square foot, 13.3 lbs. per board
Pallet Size: 4' x 4' x 24" tall (3 Thermalboards to a row 35 rows high)
Approximate Pallet Weight: 1400 lbs.
Approximate Truckload Quantities: 16,790 square feet or 30 pallets 42,000 lbs.
Pallet Appearance: shrink wrapped corner protected color coded corners by part #
Recommended Product Mix: straight 70% combo end 15%, utility 15%, allow 10% extra for waste.

THERMALBOARD STORAGE:

Thermalboard should be stored in a temperate, dry place (40F°-90F°). Avoid prolonged exposure to sunlight. Do not store in a damp location.

ESTIMATING THE REQUIRED NUMBER OF THERMALBOARDS:

For simple and fast installation, it highly recommended that a full Thermalboard layout which indicates precise panel and tubing layout be used. This can be provide by the National Radiant Design Center (See Design services on page 13). A plan is necessary for the first few jobs.
For experienced installers, calculate the net square footage of each room and multiply by the following factors: Straight – 0.133 Utility – 0.028 Combo End – 0.028
Example: For a 600 sq. ft. room, multiplying 600 by 0.133 gives approximately 80 straight boards. Multiplying 600 by 0.028 gives 17 Utility pieces. Multiplying 600 by 0.028 gives 17 Combo end pieces. It is always recommended that a 10% material excess be added to the estimation.

TUBING:

Thermalboard is designed for use with 3/8" nominal ASTM F-876 PEX (cross linked Polyethylene) with an outer diameter measuring 0.5". **Loops shall never be over 250 feet including the leaders to manifolds.** For areas with heat loss greater than 25 BTU/Sq.Ft. loops shall never be over 200 ft. This is due to high pressure drops and water speeds as shown in the following chart C-2* (greyed area over 25 BTU/ Sq.Ft). Friction losses in chart are approximate, actual friction losses depend on fluid viscosity and temperature.

**Shaded area in 250' loop chart C-2 on the following page indicates high pressure drop. It is recommended to use the shorter 200' loop length in this case, as shown in the second chart.*

Once the room square footage is determined, multiply the total by 1.5.
Example: For a 600 sq. ft. room, multiplying 600 by 1.5 gives 900 lineal feet of 3/8" PEX tubing. This room would require 4 loops at 225 ft each. Alternatively three 250 foot loops and one 150 foot loop could be used, provided that means were provided to balance the flow to the different loops by balancing valves.

Thermalboard 250' loops 20°F Temp Drop*							
BTU/SQ/FT	10	15	20	25	30	35	40
Friction Loss (Ft.Head)	2.22	4.7	8.01	12.1	16.96	22.8	28.87
Water Speed Ft./Second	0.6	0.9	1.2	1.5	1.8	2.1	2.4
GPM Per Loop	0.18	0.27	0.36	0.45	0.54	0.63	0.72
*shaded area indicates high head loss							

Thermalboard 200' loops 20°F Temp 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

CHART C-2 3/8" PEX FLOW AND PRESSURE LOSS DATA

SPACING OF BOARDS:

Allow a credit card thickness space (1/64") between Thermalboards on the long side and a 2 credit card thickness (1/32") between boards on the short side. This will allow for expansion and contraction of the boards at different temperatures. The edges of the boards may be sealed with Thermalboard™ thermal sealant to provide additional moisture protection for the boards

Contractors Note: Be sure to follow all instructions elsewhere in this manual regarding protecting the board from prolonged moisture contact, if these instructions are not followed, expansion of greater magnitude could create undesirable effects. See illustration.

OVERVIEW OF FLOOR SURFACE REQUIREMENTS:

Note: See also the specific application drawings and notes for installing Thermalboard™ that follow in this manual.

SUBFLOOR REQUIREMENTS GENERAL:

The surface of the subfloor must be flat. The requirement for flatness is defined as the maximum difference between two adjacent high points and the intermediate low point. The maximum acceptable difference in level is 3/16 of an inch in a 10-ft. radius.

Fill excessive voids or low areas using a leveling compound. Allow the leveling compound to dry thoroughly before beginning the installation. Check with the leveling compound manufacturer to be sure it is appropriate for the application. High areas can be ground down or floated over with an approved self-leveling compound.

The surface of the floor must be clean and dry.

SUBFLOOR REQUIREMENTS, WOOD SUBFLOORS:
Wood subfloors must have a stable moisture content between 6 – 10%.

Creaking subfloors must be repaired before installation. If the subfloor sags, inspect the joists below for twists or weakness. If the subfloor is cupped or uneven at the joints, recheck the moisture content of the subfloor to be sure it is in the 6 – 10% range. Check for excessive moisture in the crawl space or basement and look for other signs of a potential water problem.

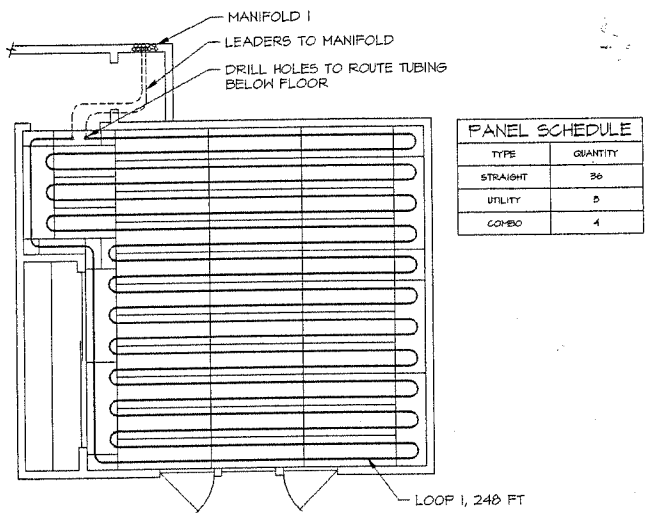
High areas are sanded or planed, low areas patched or filled with an appropriate leveling compound, or covered with a rigid underlayment. When using a leveling compound, be sure to follow the manufacturer's recommendations, and allow the compound to dry completely before starting to install the floor.

SUBFLOOR REQUIREMENTS, CONCRETE SUBFLOORS:
See specific details that follow in the application section of this manual.

EQUIPMENT REQUIRED FOR INSTALLATION:
The following is necessary for the installation of Thermalboard:
•Table or circular saw. A carbide blade is recommended.
•Electric or cordless drill gun with No. 2 Phillips bit and 5/8" drill bit for supply and return bury points.
•Caulk Gun
•Rubber or hard hide mallet
•Chalk line
•Square
Recommended optional items:
•Stand up drill
•Groove alignment tool
•If installing over concrete you will need roll down isolation and waterproofing sealant mebrane material as well as a compatible mastic for engineered wood products and appropriate rollers and trowels

Installers note: Thermalboard cuts easily with a quality circular saw blade. Pieces frequently must be cut to provide an accurate fit for each room. It is important that they be cut squarely to keep the alignment of grooves accurate in the installation. If you are installing large areas of Thermalboard™ you may wish to invest in a stand up drill so that you do not have to bend over to set every screw when glueing and screwing Thermalboard™ to a subfloor. In absence of a groove alignment tool, cut short (6") pieces of PEX pipe. These can be used to align the grooves of the boards during installation by snapping them into the grooves with 3" in the groove on each board. Once the board is secured they may be removed prior to the installation of the pipe

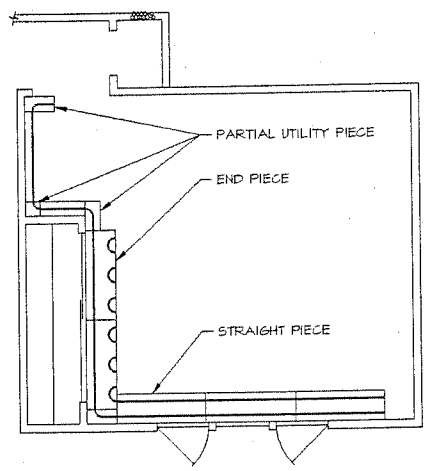
LAYOUT AND INSTALLATION:

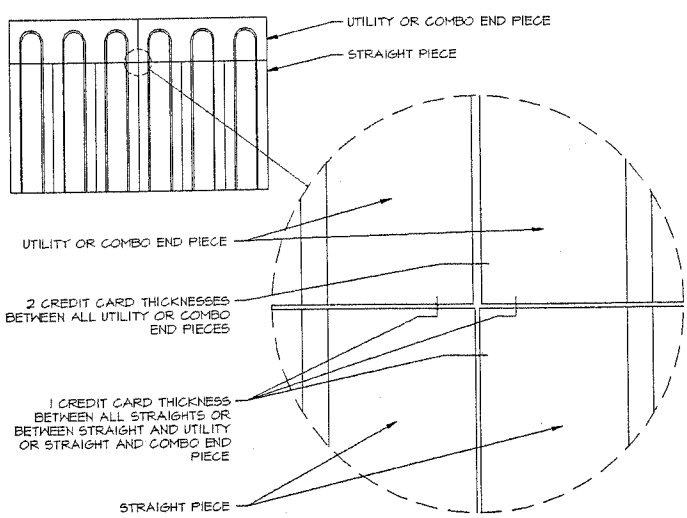


PANEL SCHEDULE	
TYPE	QUANTITY
STRAIGHT	36
UTILITY	5
COMBO	1

INSTALLATION STEP 1: Utilization a plan layout, determine panels needed (See material takeoff) and tubing lengths required. Be sure to always use good judgement in allowing enough tubing at ends for leaders up to manifolds. A plan should indicate which type of system will be implemented (See construction methods).

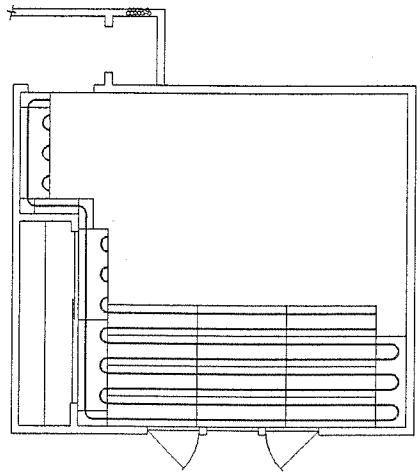
INSTALLATION STEP 2: Begin the Thermalboard layout by starting at the beginning of the supply run into the space and running board along the perimeter of the heated space to the area of highest heat loss.

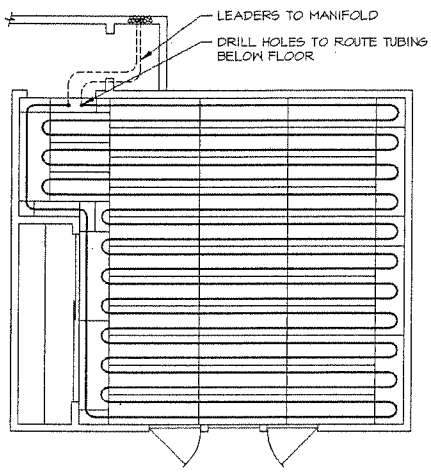




DETAIL SHOWING SPACING BETWEEN BOARDS:
Allow a credit card thickness space between boards on the side (1/64") and the thickness of two credit cards (1/32") on the ends.

INSTALLATION STEP 3: Add end pieces and straight pieces working your way back away from the area of heat loss. Once all boards are in place, drill holes (subfloor with access application) or route leader back to manifold via custom grooves or grout (slab or existing subfloor application) for supply and return leaders to manifolds.

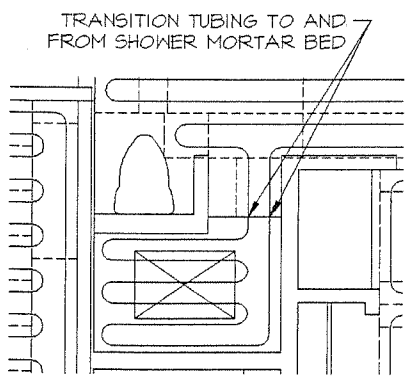




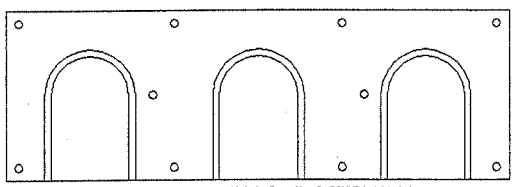
INSTALLATION STEP 4: Feed supply tubing (enough to route to manifold) through drilled supply hole below the floor. Tubing may then be "popped" into grooves. After all grooves have been thoroughly cleaned, apply conductive caulking to grooves (See applications section). Once tubing has been routed back to return hole, cut enough to route to return manifold.

ADDITIONAL APPLICATION GUIDELINES:

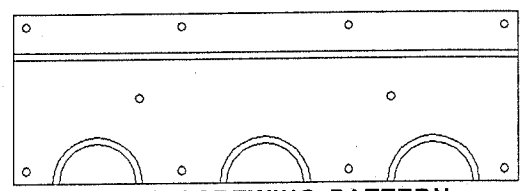
SPECIAL COVERAGE AREAS:
In areas of special coverage such as shower basins using tile grout as a base, tubing may be routed to and from Thermalboard in order to accommodate desired coverage.



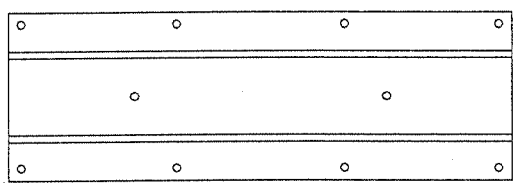
GLUING, NAILING AND SCREWING PATTERNS:
For full size pieces (16"x48") ten screws should be used, 8 on the perimeter as shown and 2 in the middle or general 16" O.C. for the perimeter and 24" O.C. for the interior. Use Construction adhesive type glue at minimum 1/8" bead in the gluing pattern shown on the bottom of all boards



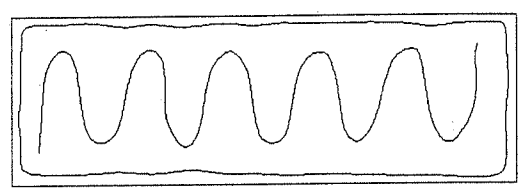
UTILITY SCREWING PATTERN



COMBO SCREWING PATTERN



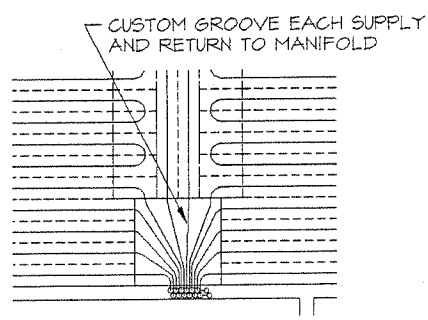
STRAIGHT SCREWING PATTERN

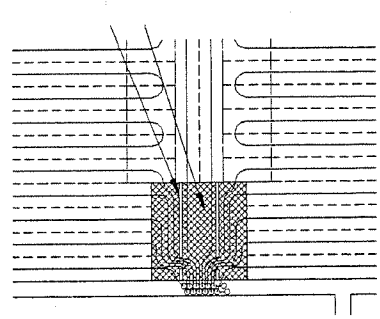


GLUEING PATTERN

CONNECTIONS AT MANIFOLD:

In situations where there are several loops from a single area running into one manifold and it is not possible to route tubing below subfloor two methods may be used to run tubing to the manifold:
1)A solid MDF sheet may be placed next to the manifold in which supply and return lines are custom routed to the wall at the manifold.
2)Tubing may be run out of the Thermal board, stapled to the subfloor and routed directly to the manifold. A grout may then be used to cover the tubing and leveled to the Thermalboard. If needed sleepers are placed in between tubing to provide a nailing or screwing base for floor coverings. Use nailing plates as necessary to protect tubing from damage. Depending on how many circuits are on a given manifold varying sizes of sheets or grouting area are required.





# Circuits	Area or Sheet Required
1-3	16"x16"
4-6	32"x32"
7-9	48"x48"

APPLICATION – CARPET OVER SUBFLOOR

Carpet and pad may be installed as normal over Thermalboard. When installing pad, care should be taken avoid puncturing tubing. In cases where extreme point loads are anticipated, it is advised that a thin layer of plywood be applied over Thermalboard prior to carpet and pad installation. As with all radiant heating installations, a thin slab foam rubber pad and short, high density carpet should be used. If carpet pad is glued, a high temperature latex adhesive must be applied, glue to backerboard do not glue tubing!

Installation:

1) Thoroughly clean all surfaces that Thermalboard will be applied to. The surface to which Thermalboard will be attached must be flat and dry prior to installation.
2) Chalk lines of a square reference point, as construction of walls may out of square
3) Lay out boards according to plan.
4) Be sure to use adequate adhesive.
5) Start layout of all pieces by securing a corner to allow for proper alignment.
6) Use groove alignment tool to ensure proper alignment of boards.
7) A credit card width space shall be used between boards.
8) Once all boards are installed clean out all grooves with a vacuum.
9) Apply a 1/16th inch bead of thermal caulking in all grooves.
10) Snap tubing into groove and route to manifold per plan.
11) Maintain 2" minimum tubing clearance from carpet tack strips.

Refer to the complete installation manual for further instructions on the installation of the Thermalboard system.

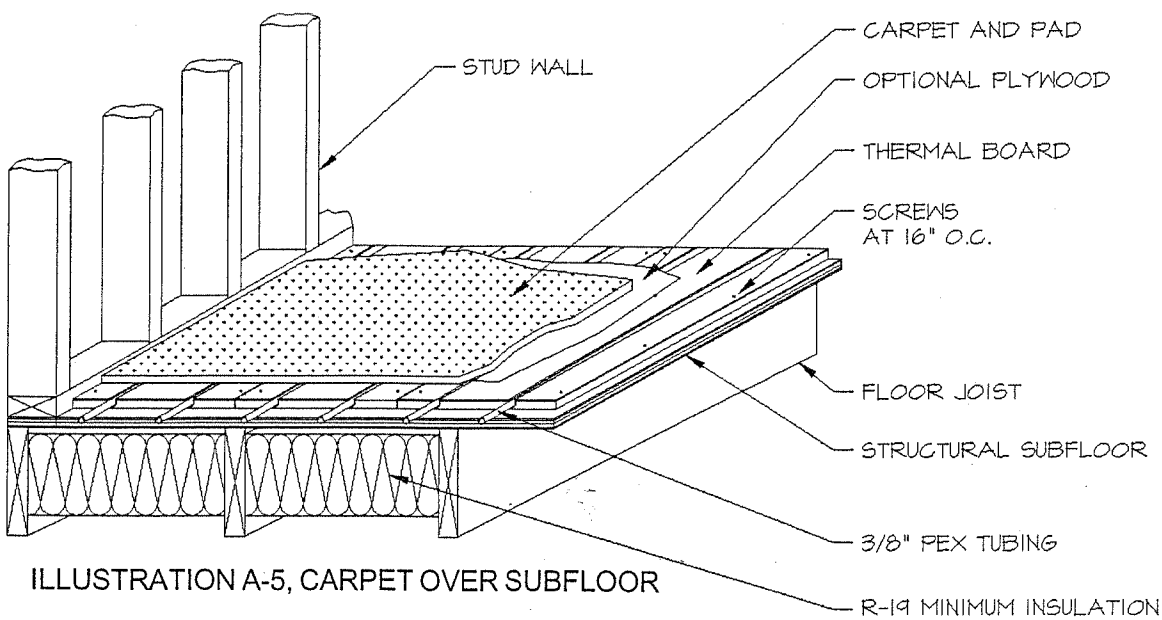


ILLUSTRATION A-5, CARPET OVER SUBFLOOR

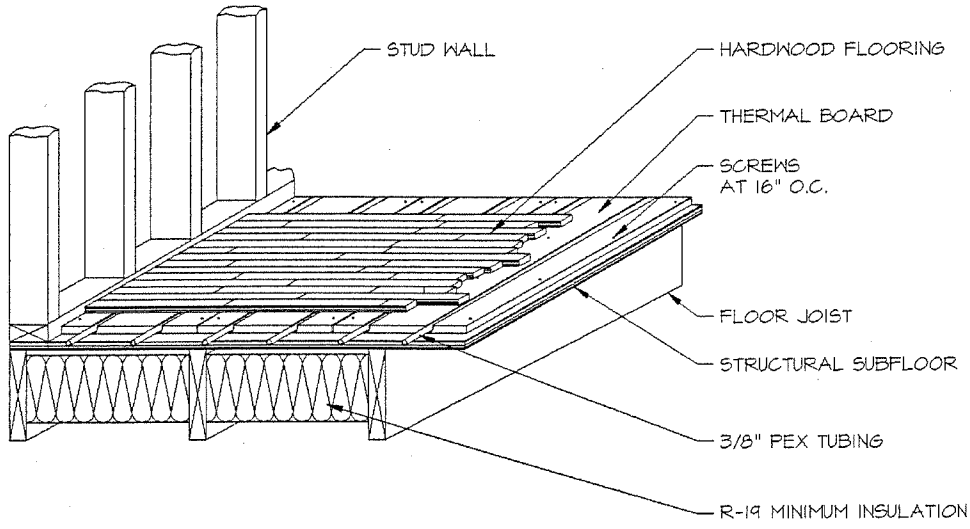
APPLICATION – HARDWOODS OVER SUBFLOOR:

Conventional nailed and hardwood type system may be used directly over Thermalboard™ with nailing long enough to penetrate subfloor. Glued down hardwood systems must employ latex high temperature adhesives only. Clip style floating systems must be installed such that clips will never come in contact with tubing. As with all radiant floor heating systems edge glued floating wood flooring systems are preferred since they are dimensionally stable, and expand independently from any thermal mass. Thermalboard should be installed such that the hardwood runs perpendicular to the majority of the tubing runs.

Installation:

1) Thoroughly clean all surfaces that Thermalboard™ will be applied to.
2) Chalk lines of a square reference point as construction of walls may be inconsistent
3) Lay out boards according to plan.
4) Be sure to use adequate adhesive.
5) Start layout of all pieces by securing a corner to allow for proper alignment.
6) Use groove alignment tool to ensure proper alignment of boards.
7) A credit card width space shall be used between boards.
8) Once all boards are installed clean out all grooves with a vacuum.
9) Apply a 1/16th inch bead of thermal caulking in all grooves.
10) Snap tubing into groove and route to manifold per plan.
11) Care should be taken to avoid nailing tubing.
12) Do not end hardwood floor joint at Thermalboard joint.
13) Hardwood floor nails should be long enough to penetrate both hardwood and subfloor.

Refer to the following more detailed notes on wood flooring and Thermalboard™ as well as the complete installation manual for further instructions on the installation of the Thermalboard™ system.



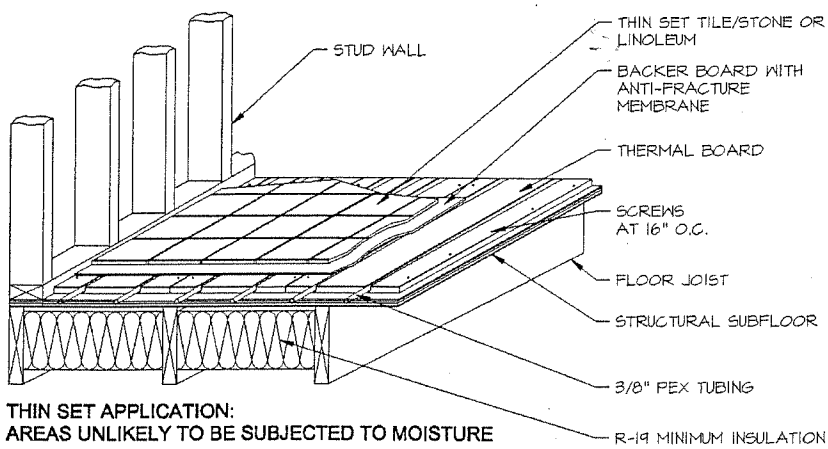
The preferred wood flooring over anyradiant heating system is to use a floating wood floor with a specific warranty for use over radiant floors. Many manufacturers of these products have such a warranty as well as having extensive experience both in Europe and North America with radiant heating applications. Most laminate wood floors are thinner than traditional strip wood floors, having a thinner floor improves the heat transfer and output of a radiant heating system. Additionally most laminated wood floors are biaxially oriented like plywood which gives great dimensional stability, and resistance to cupping, shrinkage and crowning. The top layer of most laminated wood flooring systems is almost as thick as the area above the nails of a strip wood flooring system, allowing almost as much refinishing. Another type of laminate flooring has emerged in the last few years. These are thinner and made of quite different materials. Typically the bottom layer is of MDF with plastic top layers, frequently made to look like wood, laminated to the board. These vary widely in quality. Most of these products are suitable for use with radiant heat, some are not. Check with the manufacturer before installing.

Traditional strip floors can be successfully installed over Thermalboard™, but there are important factors for the designer and installer to consider. It is extremely important that the designer know which way it is desired that the strip flooring be aligned prior to the design of the Thermalboard™ system since the direction of the Thermalboards should run perpendicular to the direction of the strip flooring. Most of these precautions are important for the installation of any solid wood strip flooring, regardless of the heating system. Wood is hydroscopic (it absorbs and releases moisture easily when the humidity changes). Such changes might be ascribed to the radiant heating system when in fact they are environmentally induced.

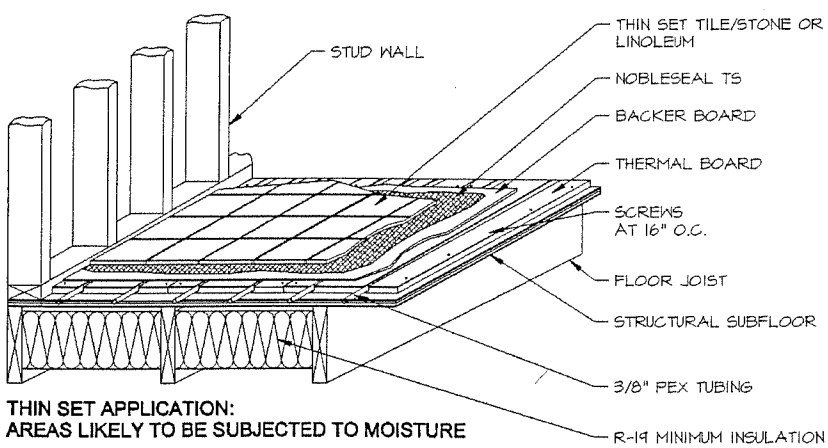
The following considerations should assist in a successful installation.

1) Install strip flooring with nails penetrating the Thermalboard 1/2" into the subfloor
2) Use 15 gauge nails (2.5" with 3/4" floors)
3) A nailer such as the Senco # SFM40 with a tongue and groove attachment # SFM40 TG should be used
4) Maintain structure humidity within the range specified by the manufacturer.
5) Install the wood at the relative humidity recommended by the manufacturer for the climate involved.
6) Use narrower 2"-3 1/2" strips over radiant floors.
7) The lessons of local practice and climate should be referenced
8) Make sure the heating system has been running and the space has been maintained at least 65F° long enough that temperature and humidity have stabilized to predicted future levels.
9) Let the product acclimatize before installation.

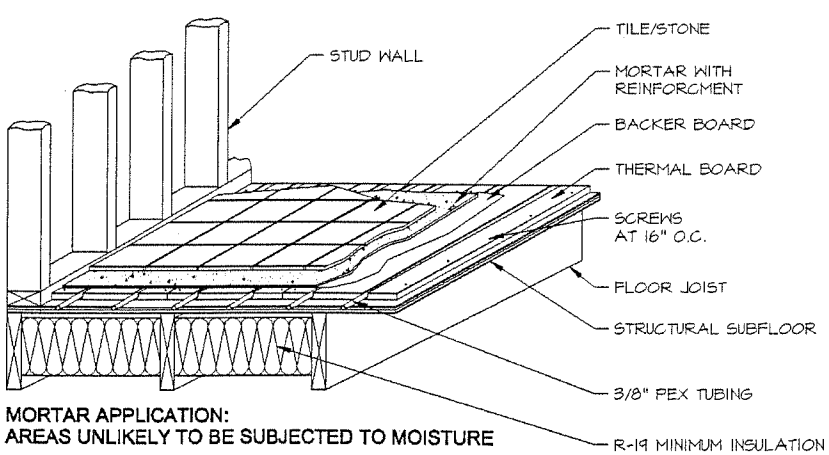
APPLICATION – TILE/STONE/LINOLEUM OVER SUBFLOOR:



THIN SET APPLICATION:
AREAS UNLIKELY TO BE SUBJECTED TO MOISTURE



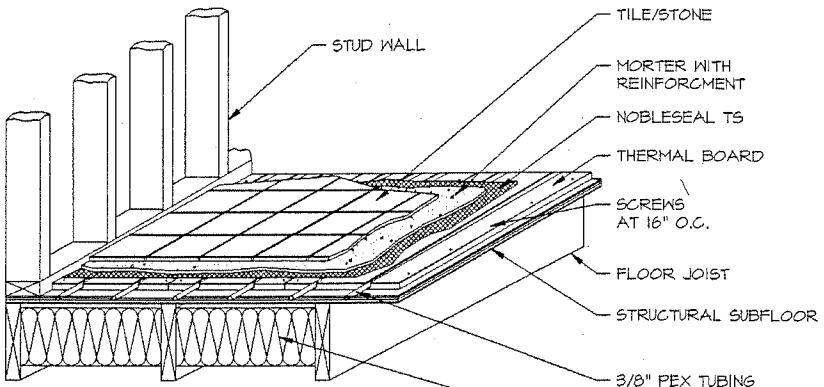
THIN SET APPLICATION:
AREAS LIKELY TO BE SUBJECTED TO MOISTURE



MORTAR APPLICATION:
AREAS UNLIKELY TO BE SUBJECTED TO MOISTURE

NOTE ON SEALING THERMALBOARDS:

The aluminum layer on the top of each Thermalboard™ is highly water resistant, this means that a significant degree of moisture protection can be given to the board simply by using the Thermalboard™ thermal sealant as a caulk between the boards. This will reduce the likelyhood of water transmission into the boards. This is not intended as a substitute for the membrane systems shown, but as a simple level of protection for any installation.



MORTAR APPLICATION:
AREAS LIKELY TO BE SUBJECTED TO MOISTURE

For masonry Tile, Stone and Vinyl flooring it is recommended that backer board be used over Thermalboard. Conventional mortar bed or thin set installation may then be used. Use of vinyl floors and associated adhesives and materials should be checked for temperature limitations. In Kitchen, Baths, Laundry or any other area where water may be present, water sealant (Nobleseal) shall be used. Where tile is going to be thin-set, anti-fracture membrane (Nobleseal) shall be used.

Installation:

1) Thoroughly clean and level all surfaces that Thermalboard will be applied to.
2) Chalk lines of a square reference point as construction of walls may be inconsistent
3) Lay out boards according to plan.
4) Be sure to use adequate adhesive.
5) Start layout of all pieces by securing a corner to allow for proper alignment.
6) Use groove alignment tool to ensure proper alignment of boards.
7) A credit card width space shall be used between boards.
8) Once all boards are installed clean out all grooves with a vacuum.
9) Apply a 1/16th inch bead of thermal caulking in all grooves.
10) Snap tubing into groove and route to manifold per plan.
11) Maintain 2" minimum tubing clearance when screwing backer board down.

Refer to the complete installation manual for further instructions on the installation of the Thermalboard system.

APPLICATION – OVER SLAB:

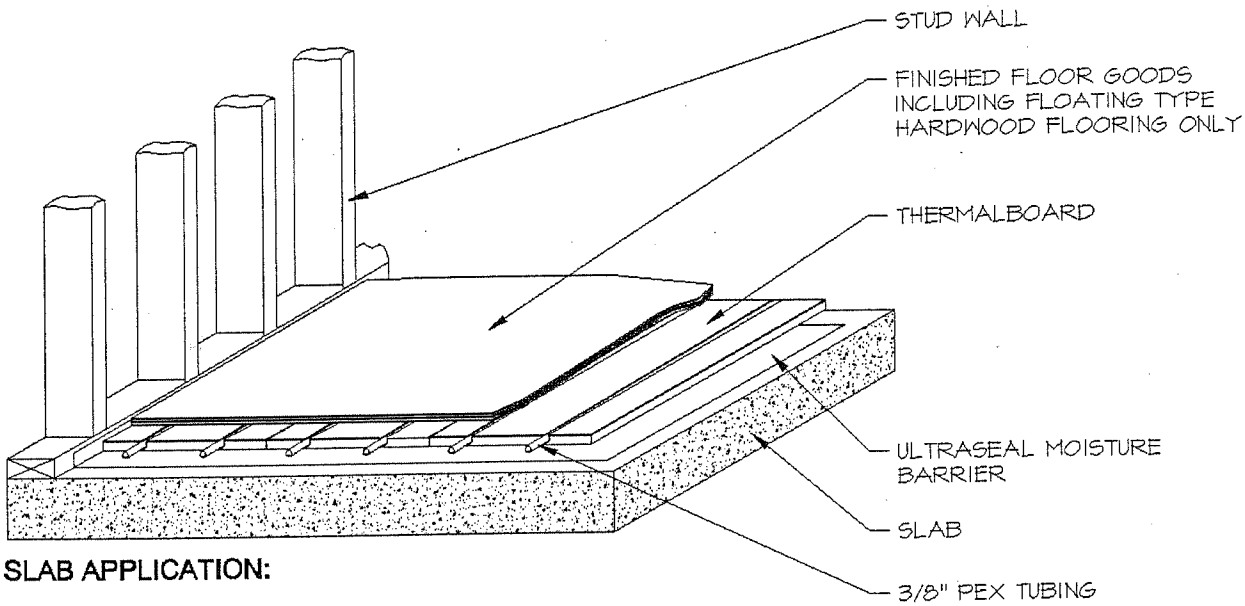
CONCRETE REQUIREMENTS:
Since all concrete slabs give off supplementary moisture whether above, on, or below grade, **it is strongly recommended that all slabs below grade and slabs on grade be sealed against moisture penetration before installing Thermalboard™.** A product such as Hydroment Ultraseal may be used. Thermalboard™ is then glued down using wood flooring adhesive rated for use with radiant floor temperatures. An alternate method using Homosote is also shown. This has the benefit of adding some insulation between the slab and the Thermalboard™. Remember that while a slab may appear to be or be dry during one time of year, this may change as environmental conditions change. Below is a procedure for testing moisture of above grade slabs such as between floors in commercial construction. When in doubt seal the slab before proceeding with the installation.

Initially, check the moisture by taping a 2 ft. x 2-ft. piece of polyethylene film in at least 2 or 3 locations (more in large areas). A rubber-backed mat can be used instead of the polyethylene film. Indications of a high moisture content include darker or discolored concrete, cloudy polyethylene film or condensation on the underside of the film. A moisture meter may be used, but it can only be used as an indicator because different additives in concrete can cause misleading results, If there are any indications of a high moisture content, use a test method that will determine the exact moisture content of the slab based on its dry weight, or use a calcium chloride test. When using the 6 mil polyethylene vapor barrier, the moisture content must not exceed 2.5% on a dry weight basis. With a calcium chloride test, the maximum acceptable reading is 5 lbs./ 4 hours/ 1,000 sq. ft. New concrete slabs and basements must be cured for a minimum of 60 days prior to installation. Remember, it is recommended that all slabs be sealed against moisture penetration before installing Thermalboard™.

After determining that the new existing or new slab is sufficiently dry, and sealing the slab you may proceed with the Thermalboard™ installation.

For masonry Tile, Stone and Vinyl flooring it is recommended that backer board be used over Thermalboard. Conventional mortar bed or thin set installation may then be used. Use of vinyl floors and associated adhesives and materials should be checked for temperature limitations. Conventional and floating type wood floor systems may be use directly over Thermalboard . Floating laminated wood floors are preferred. Traditional strip wood floors require that 3/4" T&G plywood is first glued to the slab Tubing is visible so hardwood may be directly nailed to Thermalboard. See additional notes on installing wood floors elsewhere in this manual. Thermalboard should be installed such that the hardwood runs perpendicular to the majority of the tubing runs. Carpet and pad may be installed as normal over Thermalboard. Carpet pad should avoid being stapled due to tubing being obscured. In cases where extreme weight loads are anticipated, it is advised that backerboard be applied over Thermalboard prior to carpet and pad installation. As with all radiant heating installations, a thin conductive foam rubber pad and short, high density carpet should be used.

APPLICATION OVER SLAB, REGULAR FLOOR GOODS EXCEPT STRIP WOOD FLOORING:



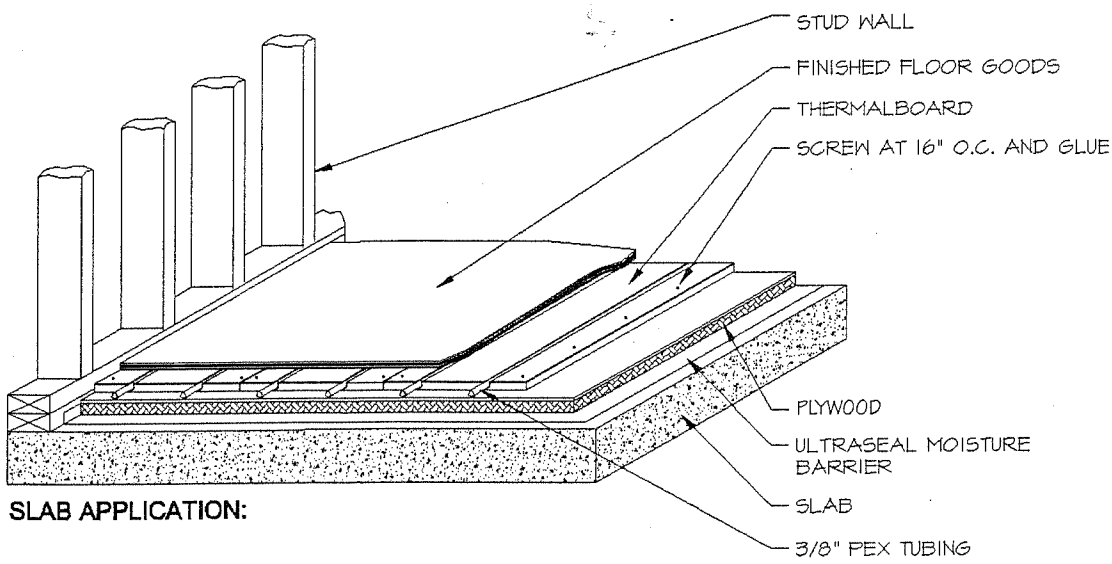
SLAB APPLICATION:

INSTALLATION OVER CONCRETE:

1) Thoroughly clean and level all surfaces that Thermalboard will be applied to.
2) Seal concrete with vapor membrane such as Hydroment Ultraseal per manufacturers guidelines.
3) Chalk lines of a square reference point as construction of walls may be inconsistent
4) Lay out boards according to plan.
5) Be sure to use adequate adhesive compatible with vapor membrane to glue down the Thermalboard™ to the membrane.
6) Start layout of all pieces by securing a corner to allow for proper alignment.
7) Use groove alignment tool to ensure proper alignment of boards.
8) A credit card width space shall be used between boards.
9) Once all boards are installed clean out all grooves with a vacuum.
10) Apply a 1/16th inch bead of thermal caulking in all grooves.
11) Snap tubing into groove and route to manifold per plan.
12) Install backerboard when applying tile or vinyl floor goods
13) Maintain 2" minimum tubing clearance from carpet tack strips or other nailing.

Refer to the complete installation manual for further instructions on the installation of the Thermalboard system.

APPLICATION OVER SLAB, STRIP WOOD FLOORING



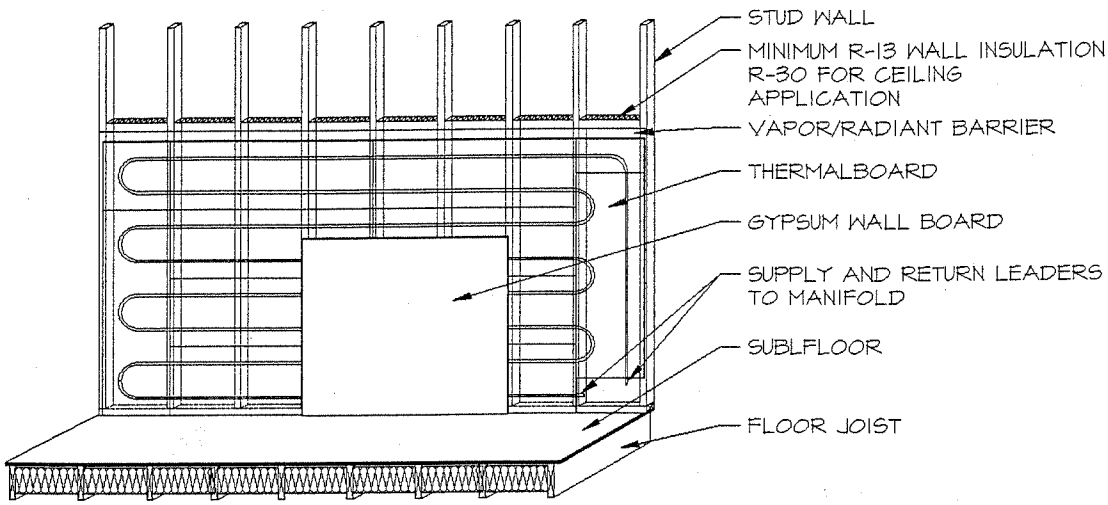
SLAB APPLICATION:

INSTALLATION OVER CONCRETE:

1) Thoroughly clean and level all surfaces that Thermalboard will be applied to.
2) Seal concrete with vapor membrane such as Hydroment Ultraseal per manufacturers guidelines.
3)Glue T&G 3/4" plywood down to vapor membrane. Be sure to use adequate adhesive compatible with vapor membrane to glue down the plywood to the membrane. Weight the plywood if neccessary to make it lie flat
4) Chalk lines of a square reference point as construction of walls may be inconsistent
5) Lay out boards according to plan.
6) Glue and screw Thermal board to plywood. Be sure to use adequate adhesive.
7) Start layout of all pieces by securing a corner to allow for proper alignment.
8) Use groove alignment tool to ensure proper alignment of boards.
9) A credit card width space shall be used between boards.
10) Once all boards are installed clean out all grooves with a vacuum.
11) Apply a 1/16th inch bead of thermal caulking in all grooves.
12) Snap tubing into groove and route to manifold per plan.
13) Install strip flooring with 15 guage nails of sufficient length to give 1/2" penetration into plywood.
14) Insulfoam/plywood combination may be used instead of plywood alone in strip flooring provided the plywood layer is at least 5/8" thick, (3/4" preferred) and the foam can be bonded with a compatible adhesive to the vapor membrane.

Refer to the complete installation manual for further instructions on the installation of the Thermalboard system.

APPLICATION – WALL



Installation:

1) Install Thermalboard level to the floor.
2) Screw Thermalboard to studs on both sides of groove.
3) Start layout of all pieces by securing a corner to allow for proper alignment.
4) Maintain credit card thickness spacing between boards
5) Use groove alignment tool to ensure proper alignment of boards.
6) After boards are installed add 5/8" thick furring strips to studs to provide even base for sheetrock.
7) Once all boards are installed clean out all grooves with a vacuum.
8) Apply a 1/16th inch bead of thermal caulking in all grooves.
10) Snap tubing into groove and route to manifold per plan.
11) Maintain 2" minimum tubing clearance from all nailing. Add steel plate protectors where tubing crosses studs.
12) Do not exceed 120F° supply water temperatures.
13) Ceiling detail similar but to follow in future manuals

Refer to the complete installation manual for further instructions on the installation of the Thermalboard system.