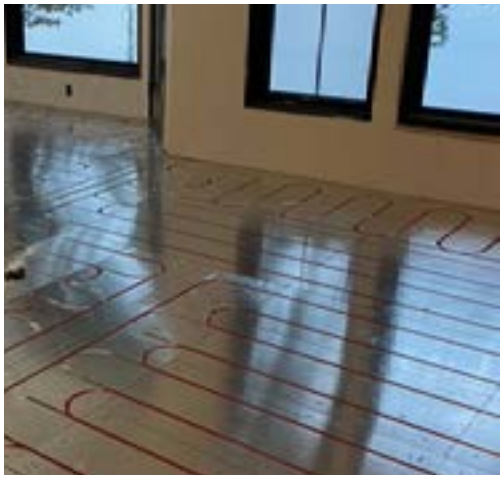
THERMALBOARD™

APPLICATION AND INSTALLATION MANUAL

Featuring the new 2-SKU Thermalboard Pro™



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DESIGN HELP
INSTALLATION TIPS
QUALITY PERFORMANCE

www.thermalboardradiantfloorheating.com

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NOTES:

THERMALBOARD™ APPLICATION AND INSTALLATION MANUAL
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INSTALLER CAUTION:

This manual is deemed to be current at the time of publication. It is the installer's responsibility to install according to the most current Application and Installation Manual. This guide does not purport to address all relevant issues; it assumes a knowledge of good practices in both hydronics and construction methods. Installers should always consult all relevant local, regional and national codes, and adhere to good construction practice. Thermalboard™ should only be installed by knowledgeable, qualified installers. Thermalboard™ installations frequently require the coordination of trades. These are, most typically, mechanical and flooring trades. Any issues regarding this coordination should be worked out in advance. Failure to follow the instructions of this guide, failure to adhere to relevant local, regional and national codes, failure to coordinate trades, and failure to follow good construction practice may cause an unsatisfactory result. See also "limitations of use" elsewhere in this publication. The limitations and instructions of use for PEX pipe and other hydronic components, as provided by their respective manufacturers, shall also be referenced and adhered to during installation; this manual does not address many aspects of a hydronic installation.

INTRO to THERMALBOARD™

The Thermalboard™ hydronic radiant heating system has been a customer favorite for decades, bringing our clients reliable comfort.

Today's Thermalboard™ is even more efficient, more responsive, easier to install and, as always, compatible with standard construction practices. Ideal for new construction and remodeling alike—low profile, light weight, and with rapid response—Thermalboard™ is a genuine advance in the finest heating system of our day. . . hydronic radiant heat.

Why it works so well

Non-structural Thermalboard™ is designed specifically for subfloor applications. It is constructed of a dense composite board covered with aluminum — a heat transfer layer that spreads heat quickly and evenly from hydronic tubing inserted into the boards' pre-cut grooves.

Thermalboard™ heats rapidly, and is easy to control with setback thermostats for maximum energy efficiency. It contains just enough thermal mass to be effective, but not so much that it is difficult to control. No other product offers the Thermalboard™ combination of performance, cost-effectiveness, and ease of installation.

TB ADVANTAGES

- ***Low profile and light weight for easy installation***
- ***Avoids the moisture, mess and weight of radiant in gypsum, cement or concrete***
- ***Scheduling radiant installations, big or small, is easier with no lost time waiting for concrete to cure***

Thermalboard™ is typically glued and screwed, or glued and stapled to a wood subfloor. Then PEX pipe, which will carry warm water, is snapped into the groove. Heat is transferred from the pipe to the aluminum and board, and to the floor.

Thermalboard™ is manufactured from MDF (Medium Density Fiber) board, a relatively conductive wood product weighing about 44-50 lbs. per cubic foot. The board is grooved with one of two patterns, then laminated with a top layer of highly conductive aluminum to efficiently disperse and transfer heat from warm water flowing through the inserted tubing — away from the groove to the entire surface area of the board, and then on to the floor above.

ACCELERATION: REACHING OPTIMUM TEMPERATURE

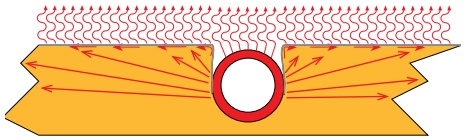


Illustration A-1

Acceleration is the measurement that tells us how fast a radiant heating system responds. Aluminum is approximately 1000 times more conductive than wood, so the Thermalboard™ aluminum layer, both on top of the board and pressed down into the grooves to contact the tubing, significantly enhances the board's transfer of heat and the evenness of its heat distribution. Illustration A-1 shows how heat transfers through Thermalboard™. Thermalboard's thin profile and relatively high density contributes to the superior acceleration and deceleration of Thermalboard™ heating.

ACCELERATION OF THERMALBOARD™ — RAPID RESPONSE

Traditional radiant heating systems in concrete work well, but the circulating warm water must first charge a large thermal mass before heat can begin to radiate from the panel. Thus, it accelerates and decelerates very slowly due to concrete's large thermal mass, and can be hard to control. Thermalboard™, being thin but relatively dense—and aided by its 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 setback thermostats.

HEAT TRANSFER LAYER

The Thermalboard™ aluminum top layer provides multiple benefits. It is both highly conductive and moisture resistant. Additional moisture protection is added when the edges and grooves of the Thermalboards™ are sealed with silicone caulking; this also provides a barrier to the transmission of any outgassing.

TB ADVANTAGES

- *Planet friendly*
- *Thermalboard™ employs fully recyclable wood and a recyclable aluminum alloy*
- *The board is made of recovered and recycled materials*

NO DETECTABLE OUTGASSING

Thermalboard™ is manufactured to meet the Federal Housing Authority (FHA) outgassing standard of less than 0.3 ppm of formaldehyde. Independent laboratory tests using 144F° water indicate that, due to its aluminum layer, ***Thermalboard™ has virtually no detectable levels of outgassing.***

THE THERMALBOARD™ ADVANTAGE

Hydronic radiant heating is the most comfortable and efficient way to heat your home or building, with many construction benefits and unsurpassed flexibility in zoning. For many years, typical installations of radiant systems involved embedding tubing in concrete slabs or pouring "lightweight concrete" over tubing stapled to subfloors. The lack of good alternatives to these systems permitted designers to overlook the limitations and disadvantages of concrete systems. **Thermalboard™ provides that alternative.** It is designed for the application of hydronic radiant tubing over a variety of construction types. Thermalboard™ may be used in new construction and is also advantageous in the growing retrofit market. While only adding 5/8" to the existing floor height, Thermalboard™ provides a superior performing radiant heating system. In addition, application of the system is easy because only two shapes of grooved board designs are required for installation.

✓ CONSTRUCTION FRIENDLY

Thermalboard™ avoids the joist upsizing, double plating, and hardwood nailing strips associated with gypsum-based concrete radiant heating systems. Thermalboard™ also eliminates the substantial drying time required by concrete and gypsum-based cement. Time is money. Thermalboard™ eliminates scheduling and curing delays.

✓ COST FRIENDLY

Thermalboard™ is installed using conventional construction practices and common tools. With a layout plan, the two Thermalboard™ panel patterns can be systematically arranged on the subfloor. Not only are the boards light weight—they're easy to handle, cut and attach.

✓ FLOORING FRIENDLY

Thermalboard™ gives you a quality flat surface for floor covering assemblies. Each flooring assembly is supported by detailed drawings and instructions on pgs. 24 - 36.

- ***Hardwood***
- ***Engineered Wood***
- ***Tile/Stone***
- ***Carpet***
- ***Vinyl/Resilient Flooring***
- ***Laminate***

✓ PLANET FRIENDLY / GREEN

Thermalboard™ is made with Medium Density Fiberboard (MDF) manufactured with recycled California rice straw, with no added formaldehyde (NAF). The glue for the aluminum is zero VOC when cured, and the aluminum layer may be recycled. Being NAF, the MDF used in Thermalboard™ has less than HUD minimum formaldehyde content, and the aluminum layer is a positive barrier to outgassing of any naturally occurring formaldehyde. A report by Environmental Analysis Incorporated has provided independent testing of MDF under real-life heating conditions. See our website for more on the environmental benefits of this planet-friendly product.

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

HEAT LOSS ANALYSIS and SYSTEM DESIGN

Systematic heat loss and design for the structure you want to heat should be done prior to any Thermalboard™ installation. As with all floor heating jobs, 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 Radiant Professionals Alliance Guidelines for standards on insulation and heat loss.

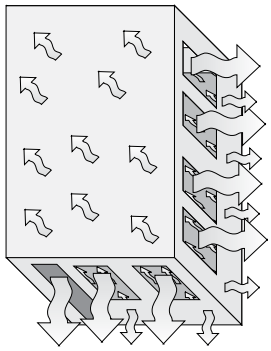


Illustration A-2: Account for all heat losses of the building

DESIGNER'S NOTE

Perform your heat loss analysis of the structure at the design stage. This way, floor covering selections can be made with the system requirements in mind. If the heat loss is too high, add insulation or auxiliary heat. In a very high heat loss room, Thermalboard™ can also 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 transfer, typically measured by their R-Value. As with all radiant systems, the higher the R-Value of the floor covering, the higher the average water temperature it will take to overcome this resistance and to generate the desired amount of heat. If the R-value of any covering on top of Thermalboard™ is excessive, as with any radiant heating system, performance will be compromised due to the lack of heat transfer, or would require exceeding the 150F° maximum supply water temperature. The maximum recommended supply water temperature for Thermalboard™ is 150°F.

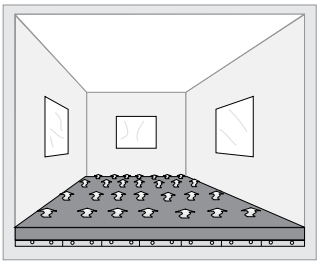


Illustration A-3:Always account for the resistance of floor coverings.

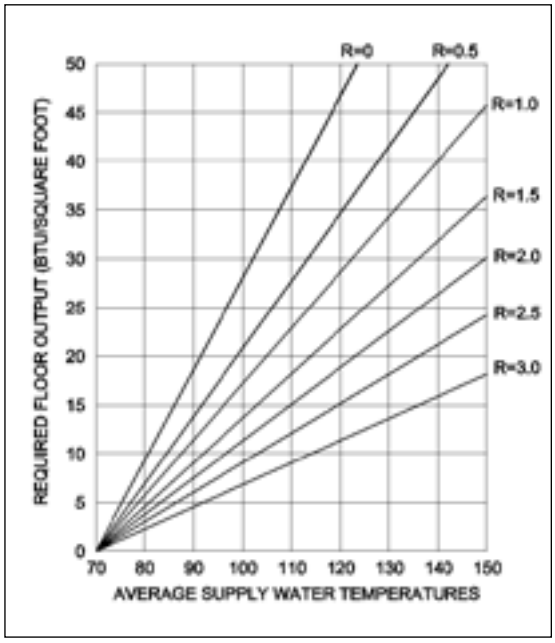
DESIGNER'S NOTE

Remember, average water temperature means the average of both 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.

SYSTEM OUTPUT

Chart C-1 can be used to estimate system output with different floor coverings. This chart shows the steady state performance of Thermalboard™. To the left are the BTU/Sq. Ft/Hour. The diagonal lines represent the resistance of the floor coverings on top of Thermalboard™. Along 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 you find the line indicating the correct R-Value of the floor assembly on top of Thermalboard™. At that point, drop down vertically to see average water temperature. See the previous page for a list of estimated floor covering R-Values.

CHART C-1



DESIGNER'S NOTE

Learn about the resistance of intended floor coverings at the design stage, and make sure they are within the requirements of the system. Realize also that your calculation should include the resistance of the whole flooring assembly above the Thermalboard™. If you are unfamiliar with hydronic design, good practice and the physics of hydronic heat transfer, you should not design a Thermalboard™ system. Consult your Thermalboard™ distributor for assistance and referral to third party design services.

CAD LAYOUT & DESIGN SERVICES

Our Thermalboard™ team or third party design services can provide you a complete recommended system design and CAD layouts for Thermalboard™ installation. Contact your Thermalboard™ distributor for details. See pgs 45- 48 for layout design considerations and samples.

All Thermalboard™ systems should be installed by qualified installers.

CAD layouts are particularly useful for first time installers.

THERMALBOARD™ PRO — JUST TWO SKUs

STRAIGHT

SUPERCOMBO

ESTIMATING THE REQUIRED NUMBER OF BOARDS

For simple and fast installation, it is highly recommended that you work from a full Thermalboard™ plan that illustrates the precise panel and tubing layout. This can be provided through our company. Contact Thermalboard™ about getting a layout and a design. A full plan is recommended for the first few jobs. The following calculations can be used to estimate the required number of boards. For experienced installers, calculate the net square footage of each room, then multiply by the following factors:
Straight—0.116 Supercombo—0.0713

EXAMPLE: For 1000 sq. ft. of heated area, multiplying 1000 by 0.116 will give you a suggested quantity of approximately 116 straight boards. Multiplying 1000 by 0.0713 suggests approximately 71 Supercombo boards. The length and width of rooms can alter this average mix, hence the need for a job-specific plan. We recommend adding an additional 10% to your board count estimtate to cover for waste and errors.

TB LOOP LENGTHS

- ***Notice that loop lengths should never be more than 250'. And for heat loss areas over 25 BTUs/s.f., loop lengths should not be over 200'***
- ***Since the tubing is installed 8" on center, a 250' loop will cover a maximum of 166 s.f. A 200' loop will cover a maximum of 133 s.f.***
- ***Remember to allow for the length required to attach your tubing to the manifolds***

TUBING AND LOOP LENGTHS

Thermalboard™ is designed for use with 3/8" nominal ASTM F-876 or F-877 PEX (cross-linked polyethylene) with an average outer diameter measuring .5 inch. Loops should not exceed 250 feet, including sufficient leaders to the manifolds. For areas with heat loss greater than 25 BTU/s.f., loops shall never be over 200 ft. This is due to high pressure drops and water velocity, as shown in Chart C-2* below (grayed area = over 25 BTU/s.f.). Friction losses in the chart are approximate; actual friction losses depend on fluid viscosity and temperature. Once you've determined a room's square footage, 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 thus require 4 loops at 225 ft. each. Alternatively, you could use three 250 foot loops and one 150 foot loop, provided that the flow to the different loops is balanced by using, and adjusting correctly, balancing valves on each loop.

CHART C-2

THERMALBOARD™ 250' LOOPS 20°F TEMP DROP

BTU/SQ/FT	10.00	15.00	20.00	25.00	30.00	35.00	40.00
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

THERMALBOARD™ 200' LOOPS 20°F TEMP DROP

BTU/SQ/FT	10.00	15.00	20.00	25.00	30.00	35.00	40.00
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

DESIGNER'S NOTE

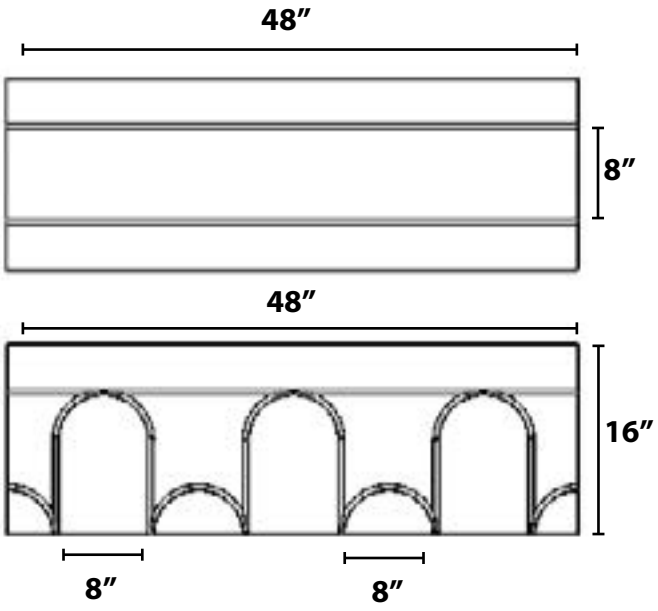
Remember, average water temperature means the average of supply and return water temperatures flowing to and from the loop. Most typically, Thermalboard™ is designed with a 20°F temperature drop. This means the supply water temperature would typically be 10F° higher than the average water temperature.

INSTALLATION – THE PRODUCT

1) THERMALBOARD™ BOARDS

Thermalboard™ Pro comes in two different board configurations: "Straight" and "Supercombo". The boards are arranged to create a continuous channel for each loop. Each board type measures 16" x 48". The grooves are centered 8" apart. Thermalboard™ is easily cut with a circular, table or radial arm saw. A high tooth count carbide tipped blade works best. Accurate cuts keep the boards aligned and fitting together well.

STRAIGHTS (top, below) are normally used about 68% of the time, and **SUPERCOMBOS** (bottom) about 32% of the time. The two SKUs of Thermalboard™ are shipped to your job site palletized and shink wrapped, then field cut to the various sizes your plan requires. An experienced installer may learn to install small spaces without a plan, but **it is advisable to have a project layout plan prior to every installation.**



TB ALWAYS PLAN

- *Carefully read and follow the installation instructions*
- *Before you start, familiarize yourself with the materials and installation methods*
- *Use and follow a CAD layout—particularly if you're a first time installer*

Note the creative tubing layout designed to route tubing from the room down this narrow hallway.

2) THERMALBOARD™ SHIPPING

Nominal dimensions: Each board is 16" x 48" x 5/8" thick, or 5.333 square feet

Weight: Approximately 2.5 lbs. per square foot, or 13.3 lbs. per board

Pallet Size: 4' x 4' x 24" tall (three Thermalboards to a row, 32 rows high)

Approximate Pallet Weight: 1280 lbs..

Approx. Truckload Quantity: 16,885.44 square feet, or 33 pallets / 42,214 lbs.

Pallet Appearance: Shrink wrapped, corners protected + color coded by part #

Recommended Product Mix: Straight 68%, Supercombo 32%
(Allow 10% extra for waste)

3) PROPER STORAGE AND MOISTURE CONTACT – GUIDELINES

Thermalboard™ should always be stored in a temperate, dry place (40F°— 90F°). Avoid prolonged exposure to sunlight. Do not store in a damp location. Be sure to follow all instructions elsewhere in this manual about protecting the board from any prolonged moisture contact. If these instructions are not followed, board expansion could create undesirable results.

INSTALLATION – THE ESSENTIALS

1) SUBFLOOR REQUIREMENTS – FLAT, DRY, QUIET

IN GENERAL:

The surface of the subfloor must be flat: This 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 a self-leveling compound. In addition to being flat, the surface of the floor must be clean and dry.

WOOD SUBFLOORS:

Wood subfloors must have a stable moisture content, between 6% and 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's within the 6 – 10% range. Always check the crawl space or basement for excessive moisture, and look for any other signs of a potential water problem.

High areas on the subfloor should be sanded or planed. Any low areas should be patched or filled with an appropriate leveling compound, or covered with a rigid underlayment. When using a leveling compound, follow the manufacturer's recommendations, and allow the compound to dry completely before you begin installing the floor.

2) EQUIPMENT FOR INSTALLATION OVER WOOD SUBFLOORS

You'll need the following to install Thermalboard™:

- **Table or circular saw.** A carbide blade with a high tooth count recommended.
- **Electric or cordless drill** with a No. 2 Phillips bit (if you are screwing down the boards) and a 5/8" drill bit for supply and return bury points.
- **Sheathing type pneumatic stapler** (if you are cross stapling boards)
- **Rubber or hard hide mallet**
- **Chalk line, marking pencils** and a **square**
- **Vacuum cleaner** to clean grooves prior to installation
- **6" lengths of 3/8" PEX** for properly aligning the grooves
- **Tubing uncoiler** is recommended for installing the tubing

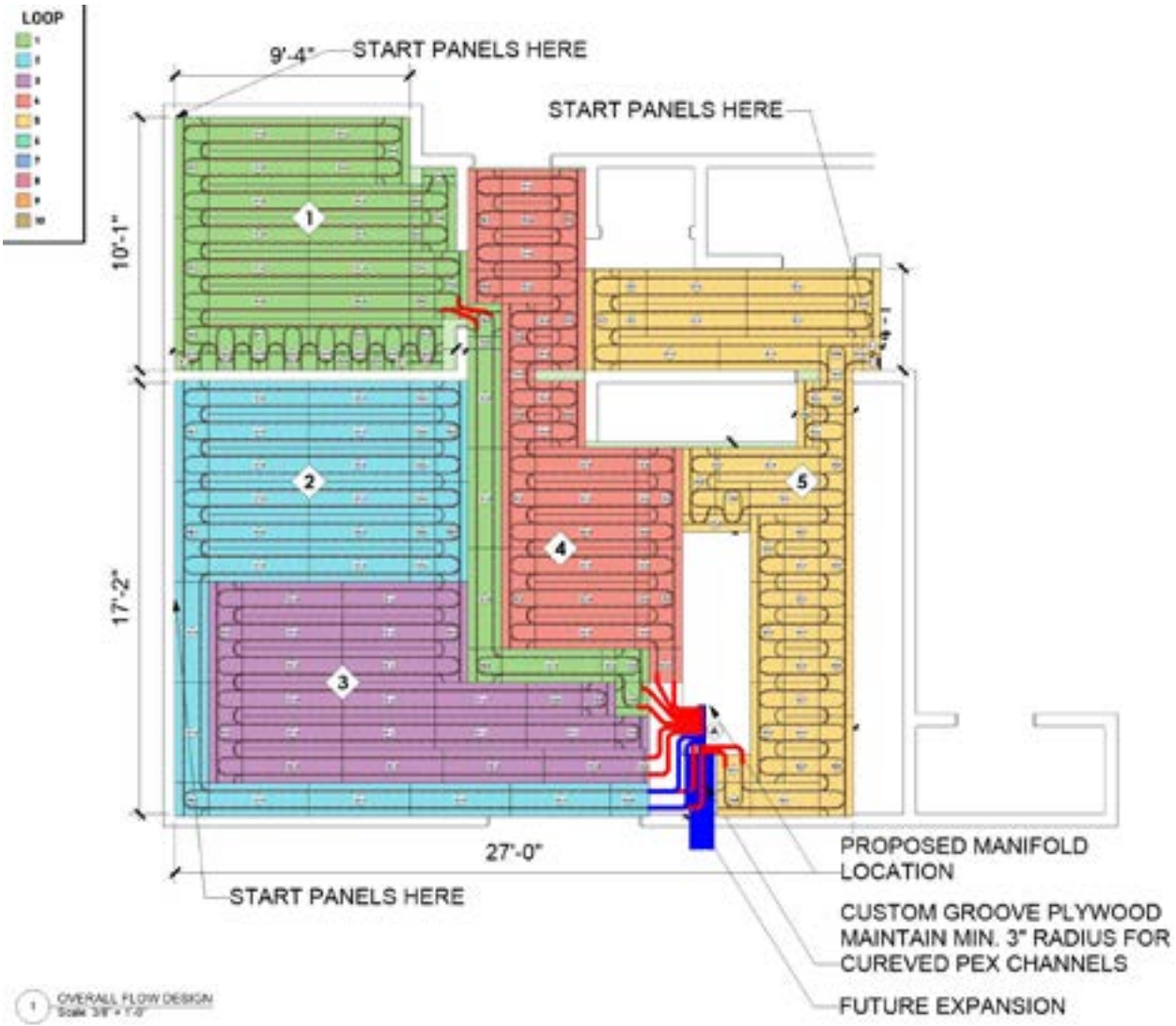




3) THE THERMALBOARD™ LAYOUT IS KEY

Work from a CAD plan specific to your project for Thermalboard™ installation to assure optimum performance**.** This will properly route heat around built-ins, assure flow from room to room (hallways can be particularly tricky), allow proper zoning, and assure all loops arrive at your manifold(s) within the loop length guidelines. While Thermalboard's two SKU system helps simplify the design process, piecing together a system can be complex, especially if it's your first. Your Thermalboard™ sales rep can help you arrange this design service.

SAMPLE CAD GENERATED BOARD LAYOUT:



INSTALLATION – STEP BY STEP SPECIFICS

1) UNDERSTAND HOW TO SPACE THE BOARDS

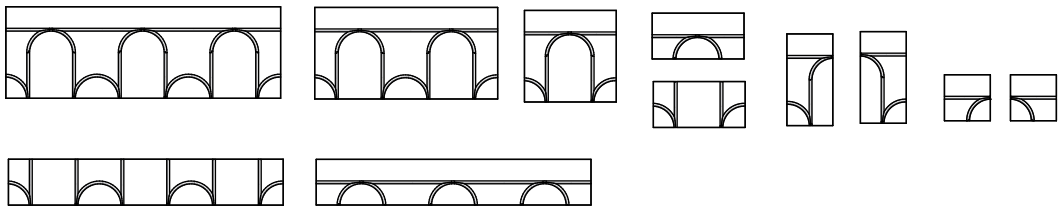
The actual width of each Thermalboard™ board is 15 7/8 inch, which allows you to install the boards with a slight gap in between: This allows for natural expansion at different temperatures, and for normal variances in humidity in a finished home.

When aligning straights with the supercombo ends by using a 6" piece of tubing, as shown below, a slight gap of approximately 1/16" will naturally occur between the straight boards and Supercombos. This is normal. Try to allow a similar 1/16" inch gap between the ends of all boards, but most importantly, always make sure all grooves align, as described in 3 below.

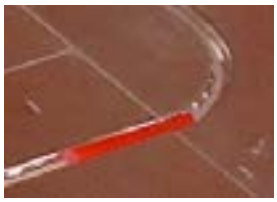
2) CUTTING THERMALBOARD™ RADIANT FLOORING BOARDS

Since Thermalboard™ is a modular system, the boards are manufactured to tight tolerances in both groove spacing and squareness at both the sides and the ends. When cutting Thermalboard™, make sure to cut each board squarely, and to align them carefully as your arrange them on the subfloor, so that each subsequent piece will fit correctly. This is not difficult, but paying attention to squareness as you cut each board will prevent major problems as the job progresses.

These cuts from a Thermalboard™ Supercombo board can help solve specific routing challenges. Straight boards can always be cut to shorter lengths.



3) HOW TO ALIGN THE TUBING GROOVES



The easiest way to assure tubing grooves are correctly aligned between boards is to cut 6" pieces of 3/8" ASTM F-876 PEX to use as alignment tools. First, place the boards close to the desired alignment, then press a piece of tubing in each groove, lapping 3" into the groove of each board, as shown below. After the board is attached, these should be removed.

CHECKLIST – INSTALLATION START TO FINISH

1. Do not install Thermalboard™ without an accurate room-by-room heat loss analysis of the structure to be heated and a design/layout for Thermalboard™ that takes into account the resistance and heat transfer of the actual floor coverings. If Thermalboard™ cannot provide all the necessary heat, make provisions for additional back up heat.
2. 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. See requirements for flatness and moisture. 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. 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 should be 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.
3. Chalk lines of a square reference point, as walls may out of square.
4. Lay out boards according to the plan.
5. Secure boards with construction adhesive to the wooden subfloor. Be sure to use adequate adhesive and follow the recommended pattern.
6. Start layout of all pieces by securing a corner to allow for proper alignment.
7. Use 6" lengths of tubing in the grooves, lapping 3" into each board to help align the grooves of the boards.
8. A 1/16" width space shall be used between boards.
9. After gluing boards in place, drill and screw or cross staple Thermalboard™ to subfloor, according to recommended pattern.
10. Once all boards are installed, clean out all grooves with a vacuum.
11. Snap tubing into groove and route to manifold per plan.
12. Follow specific extra recommendations for each floor covering, and refer to the complete installation manual for further instructions on the installation of the Thermalboard™ system.

4) ATTACHING THERMALBOARD™ TO A SUBFLOOR

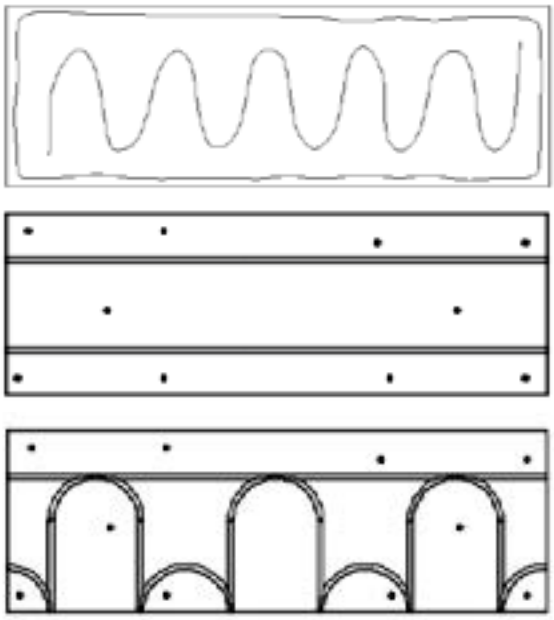
Thermalboard™ is **first glued, then screwed or cross-stapled** to the subfloor.

GLUING:

Each Thermalboard™ should be glued to a wooden subfloor using construction adhesive-type glue* at a minimum 1/8" bead in the gluing pattern below. Every board should be glued. **See Recommended Glues on pages 42-44.*

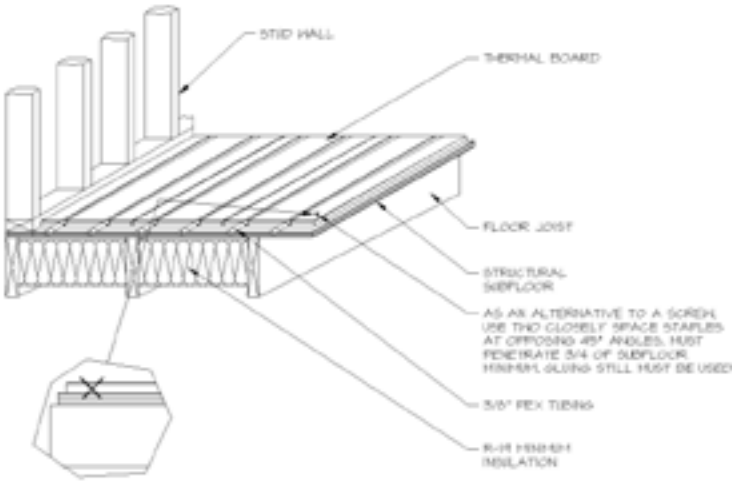
TB GLUING TIPS

- ***The glue may be applied either to the underside of a board or to the floor itself***
- ***Avoid getting glue in the groove or anywhere it may come in contact with the tubing***
- ***Many glues can damage PEX tubing***



SCREWING OR CROSS-STAPLING:

After you've glued the boards, screw them to the subfloor. On full size board pieces (16"x48"), use ten screws — 8 on the perimeter and 2 in the middle— as a general rule, 16" O.C. for the perimeter, 24" O.C. for the interior, as shown above. Thermalboard™ may also be glued and stapled. When this method is used, it is very important to use the same quantity of glue and staple points shown in the screwing pattern above. Cross-staple these boards for extra strength. Cross stapling means putting 2 staples closely together at opposing 45° angles, as shown in this illustration.



5) INSTALLING TUBING IN THE GROOVES

First, vacuum the grooves so there's nothing to damage tubing or prevent it from fitting fully into the groove. We recommend using a tubing uncoiler to minimize the chance tubing will kink or twist. Start at the intended manifold location and allow enough tubing to serve as a 'leader" to attach to the manifold. You may then begin! But make sure you understand the layout, and where and how you will return to the manifold.

There is, intentionally, a tight tolerance between the ASTM F-876 PEX tubing and the slightly undercut groove. This assures that the tubing will be retained in the grooves once it's pushed into place. Usually, this only requires "walking the tubing into the groove" as shown. Occasionally, tubing installation may require you to use a rubber or hide mallet, as shown on page 15, to force the tubing into place in the grooves.

After installing a loop of tubing, always walk the full loop and make sure the tubing is fully in the groove for the entire length of the loop. This is very important! The top of the tubing should be just below the level of the top of the Thermalboard™, and fully retained in the groove.

TB TUBING TIPS

- ***Use a tubing uncoiler to prevent kinks or twists***
- ***Pressure-test (air) the system before installing anything over tubing— see Specs, page 40***
- ***DO NOT USE PEXALPEX! It will not fit properly into a Thermalboard™ groove. See Specs.***

INSTALLER'S NOTE: THE THERMALBOARD™ GROOVES

The Thermalboard™ aluminum layer is slit along the path of the grooves. This allows the aluminum to be pushed down into the groove when tubing is added, pressing the heat-conductive aluminum against the tubing, which adds to Thermalboard's conductive warmth.

6) CONNECTIONS AT THE MANIFOLD

Manifolds are usually located in a space with an access panel near the heating zone they serve—in places like in the back of a closet. Depending on the scale and layout of your project, the tubing may be routed to the manifold in one of four ways:

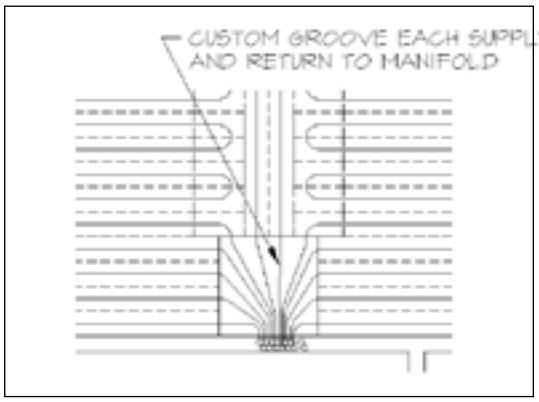
1. Insert tubing directly into the Thermalboard™ grooves, which works when just a few loops end adjacent to the manifold location.

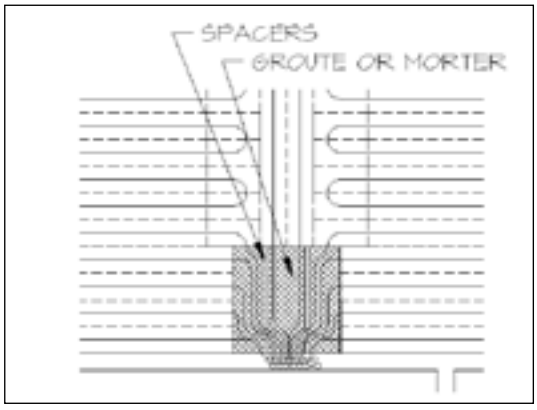
2. If there is a level change required, drill a tapered slot through the subfloor, dive the tubing under the floor, and bring it up again to attach to the manifold.

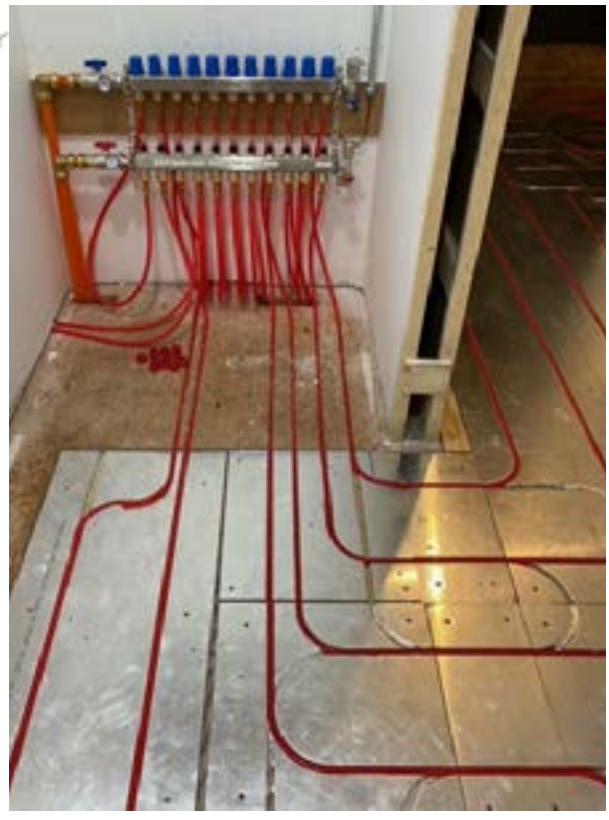
3. Place a solid MDF sheet next to the manifold into which supply and return lines are custom routed to the grooves of the Thermalboard™.

4. Or, tubing may be run out of the Thermalboard™ at the end of your board layout, stapled to the subfloor, and routed directly to the manifold. You would then need to grout over the tubing to bring it level with the Thermalboard™. If needed, place sleepers between tubing to provide a nailing or screwing base for floor coverings. Use nailing plates as necessary to protect the tubing from damage.

Depending on how many circuits are on a given manifold, various sizes of sheets or grouting area are required to properly route the tubing.

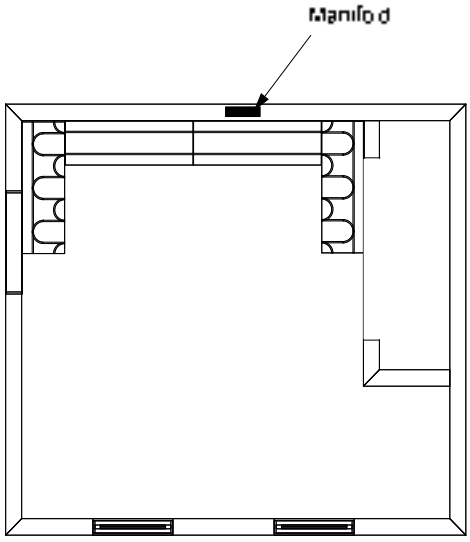


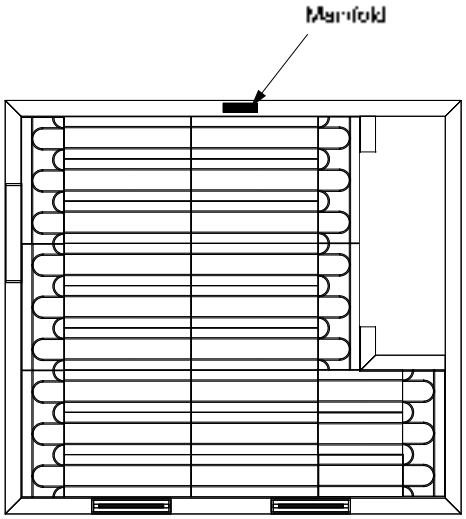




INSTALLATION STEP 1:

Using your plan layout, determine panels needed and tubing lengths required. Be sure to allow for sufficient tubing at the loop ends to serve as leaders to the manifolds. Your plan should indicate which type of manifold system will be used.



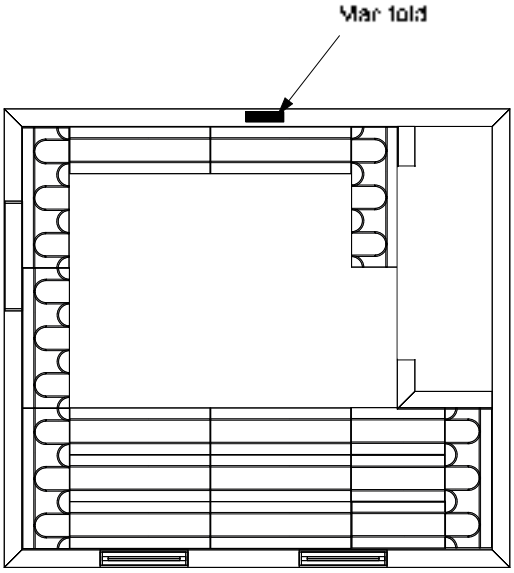


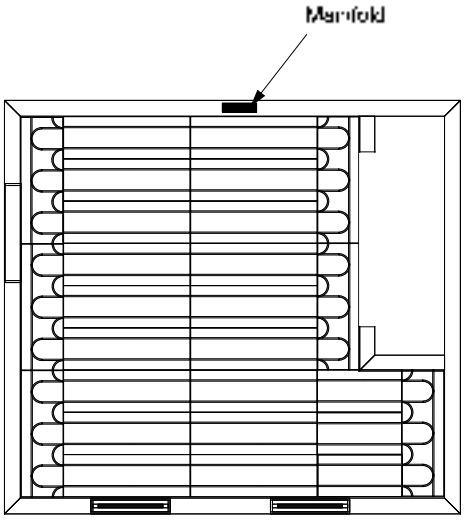
INSTALLATION STEP 2:

Begin your Thermalboard™ Pro board layout by starting at the beginning of the supply run into the space, then running boards along the perimeter of the heated space to the area of highest heat loss.

INSTALLATION STEP 3:

Add end pieces and straight pieces, working your way back away from the area of highest heat loss. Once all boards are in place, drill holes (into the subfloor if you're doing access application), or route the leader back to the manifold via custom grooves or grout (for slab or existing subfloor application) for your supply and return leaders to manifolds.





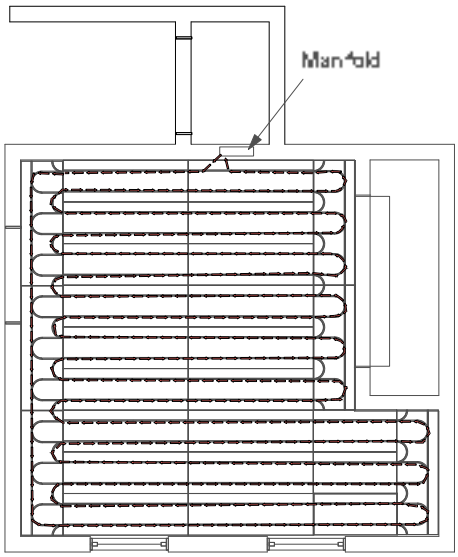
INSTALLATION STEP 4:

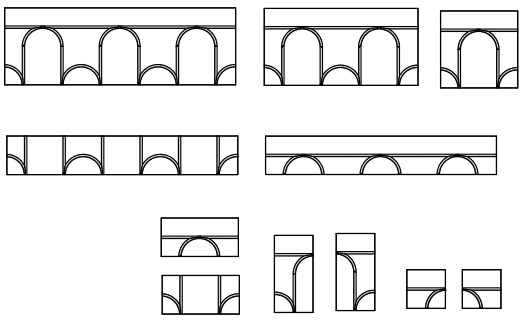
Feed enough supply tubing to route it to the manifold, as specified by your layout: Through a drilled supply hole below the floor, or, before the start of a groove, if the groove goes directly to the manifold. Once all the grooves have been thoroughly cleaned with a vacuum cleaner, the tubing may be popped in along the designed route. Once tubing has been routed back to the return location, cut enough length to route it to the return manifold.

INSTALLING TUBING ON THE ROUTE PLANNED

Note how tubing used a straight channel to go down the wall with no offsets, and wove back using the curved channels. If you need to create a custom channel to the manifold:

- **Use a 1/2" round nose routing bit in a router.**
- **Do not bend PEX pipe on less than a 3" radius.**





THERMALBOARD™ PRO CUTS

Thermalboard™ can be easily cut with a hand held circular saw, table saw, or radial arm saw. These Thermalboard™ shapes (left), cut from a Supercombo, are helpful in solving special problems.

Shorter lengths of straights may always be cut from the Straight boards.

THERMALBOARD™ radiant heating systems are effective under many popular, widely used floor coverings—*but not all.*

To assure optimum comfort and performance, this section explains the most effective methods for installing a variety of flooring goods over a Thermalboard™ radiant system.

IMPORTANT: Thermalboard™ AND FLOORING CHOICE

Before your customer falls in love with a particular floor covering, be sure to research its installation requirements and whether it is appropriate and/or warranted for use over radiant floor heating. We don't feature every possible floor covering here, but give a good sense of the relationship between flooring choice and quality warmth.

IMPORTANT: Thermalboard™ AND WOOD SUBFLOORS

Thermalboard™ was initially designed to be installed over a wooden subfloor. The proper prep of your subfloor will help your installation go well, and assure the best heat transfer. Please refer to "General Thermalboard™ Installation Requirements For All Flooring Over Wood Subfloors" elsewhere in this manual.

IMPORTANT: Thermalboard™ AND CONCRETE SUBFLOORS

Thermalboard™ was initially designed to be installed over a wooden subfloor.

Installation over concrete has been successfully done, but requires extra care and an assured dry slab. ***When installing Thermalboard™ over concrete, refer to the instructions, limitations and details on pages 33-35.***

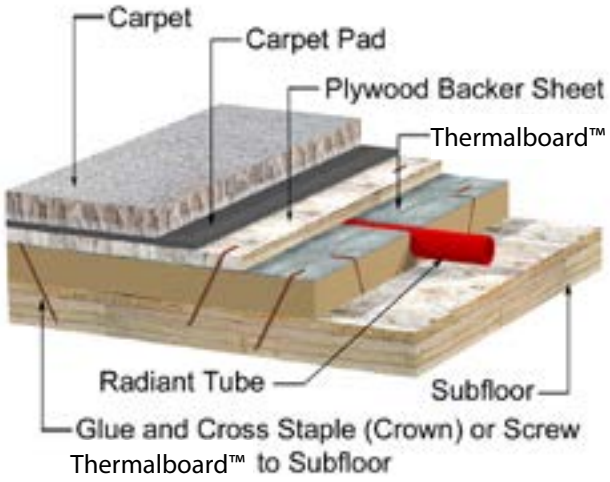
IMPORTANT: Thermalboard™ RECOMMENDED RELATED PRODUCTS

Optimum performance of Thermalboard™ installations depends on the use of our recommended associated products, found on pages 34 and 35 of this manual. As you consult the Thermalboard™ floor covering guidelines in the next section, please keep these product recommendations in mind.

CARPET OVER THERMALBOARD™

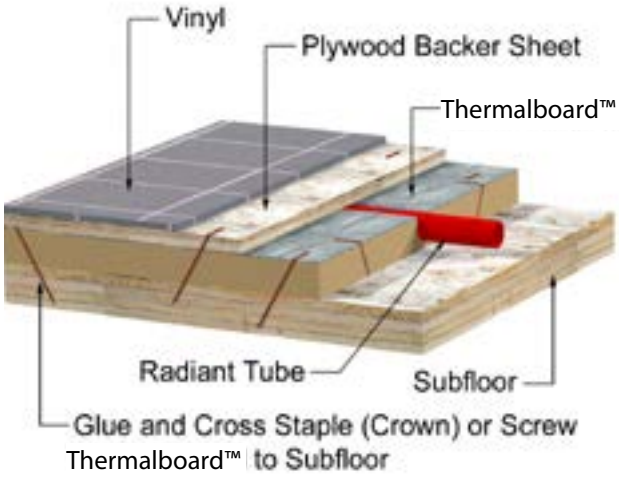
Thermalboard™ shall be installed over a wooden subfloor, in compliance with "General Thermalboard™ Installation Requirements For All Flooring Over Wood Subfloor."

In addition, the following specific cautions and instructions shall be followed: Carpet and pad may both be installed over Thermalboard™. When installing the pad, take care to avoid puncturing the tubing. We advise adding thin underlayment plywood over Thermalboard™ prior to carpet and pad installation to protect the tubing from point loads. As with all radiant heating installations, a thin slab foam rubber pad and short, high density carpet should be used. If the carpet pad is glued, a high temperature latex adhesive must be applied. **Glue to the underlayment plywood: do not glue to Thermalboard™ or to tubing!** Maintain 2" minimum tubing clearance from carpet tack strips.



VINYL OVER THERMALBOARD™

Install Thermalboard™ over a wood subfloor, per "General Thermalboard™ Installation Requirements For All Flooring Over Wood Subfloor". Also follow these specific cautions and instructions: When installing sheet vinyl flooring, first apply a thin layer of underlayment plywood over Thermalboard™. In wet locations, add a sealant layer. Underlayment plywood printed with a grid helps locate tubing runs and prevent puncturing the tubing when the plywood is being screwed to the Thermalboard™. In the case of vinyl, use those underlayment, filler and glues suggested by the manufacturer for use over radiant heat. Most vinyl flooring is manufactured to an ASTM standard with an upper floor temperature limit of of 85°F. This limit should be followed. If installing edge lock vinyl, use only Mineral Core. Ask for our information sheet on vinyl flooring products over Thermalboard™.

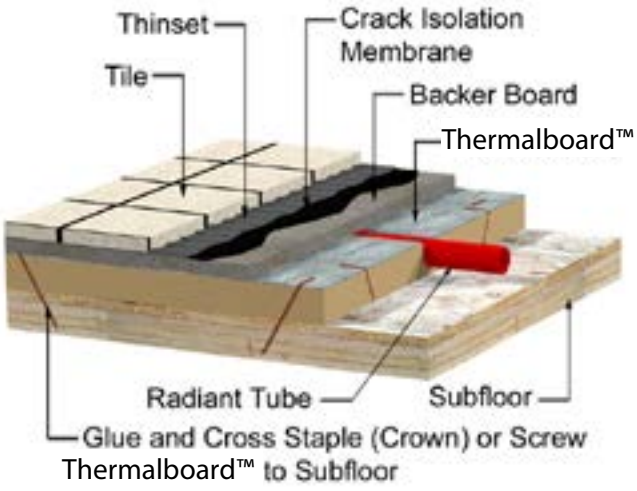


THINSET TILE OR STONE OVER THERMALBOARD™

Thermalboard™ shall be installed over a wooden subfloor, in compliance with "General Thermalboard™ Installation Requirements For All Flooring Over Wood Subfloor". Also, follow these specific cautions and instructions: When installing masonry, tile or stone, **use backer board over Thermalboard™. Thinset installation shall then be used.** In any kitchen, bath, laundry or any other area where water may be present, use a water sealant layer (i.e. Nobleseal or similar waterproof membrane). Where tile or stone is going to be thinset, an anti-fracture membrane (Nobleseal) or equivalent shall be installed over the backerboard. Maintain a 2" minimum tubing clearance when screwing backer board down. Refer to this complete installation manual for further instructions on the installation of the Thermalboard™ system.

INSTALLER'S CAUTIONS:

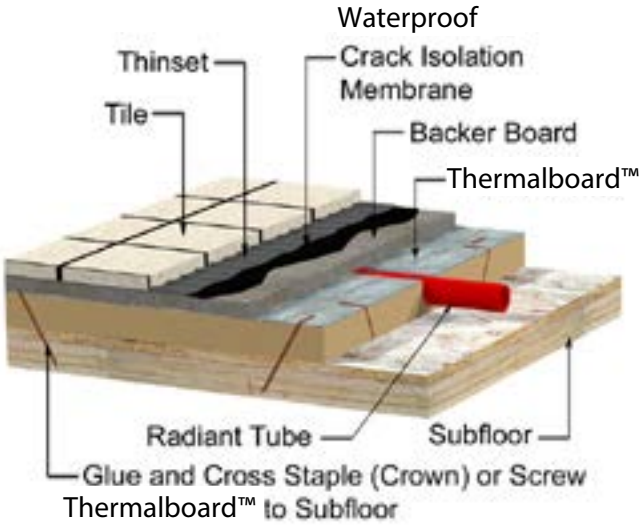
- *Do not omit the backerboard layer.*
- *Do not install crack isolation membranes directly to Thermalboard™—many of them use materials incompatible for contact with PEX*



THINSET TILE OR STONE FOR AREAS **UNLIKELY** TO BE SUBJECT TO MOISTURE

TB NOTES ON SEALING

- ***The aluminum layer on the top of each Thermalboard™ is highly water resistant. Thus, using silicon sealant as a caulk between the boards gives you a significant degree of moisture protection. Properly applied, this will profoundly reduce the likelihood of water transmission into the boards.***
- ***This is not a substitute for our recommended installation methods in wet areas.***

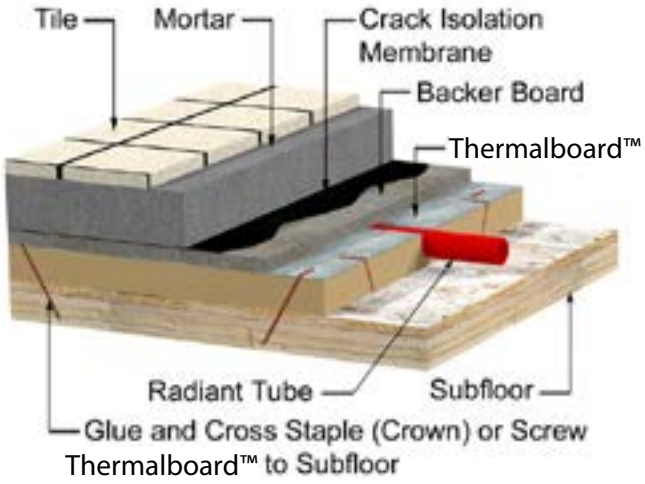


THINSET TILE OR STONE FOR AREAS **LIKELY** TO BE SUBJECT TO MOISTURE

MORTAR BED SETTING OF TILE OR STONE OVER THERMALBOARD™

Thermalboard™ shall be installed over a wooden subfloor, in compliance with "General Thermalboard™ Installation Requirements For All Flooring Over Wood Subfloor".

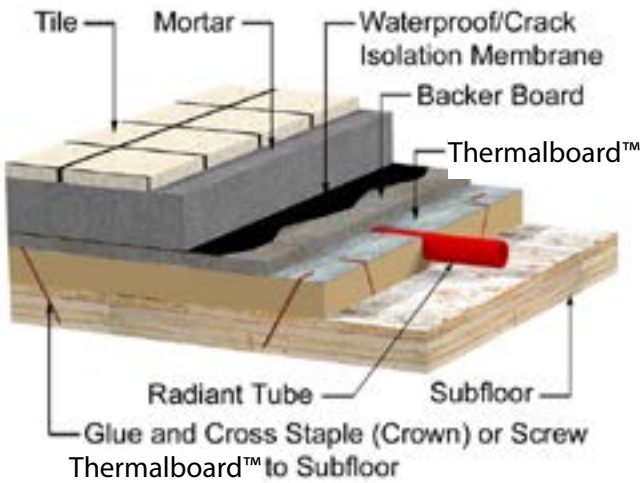
In addition, the following specific cautions and instructions shall be followed: When installing masonry, tile and stone, backer board shall be used over Thermalboard™. A conventional mortar bed shall then be used. In the kitchen, bath, laundry or any other area where water may be present, a water sealant (i.e. Nobleseal or an equivalent waterproof membrane) shall be used. 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.



MORTAR SET TILE OR STONE FOR AREAS **UNLIKELY** TO BE SUBJECT TO MOISTURE

INSTALLER'S CAUTIONS:

- *Do not omit the backerboard layer.*
- *Do not install crack isolation membranes directly to Thermalboard™—many of them use materials incompatible for contact with PEX.*



MORTAR SET TILE OR STONE FOR AREAS **LIKELY** TO BE SUBJECT TO MOISTURE

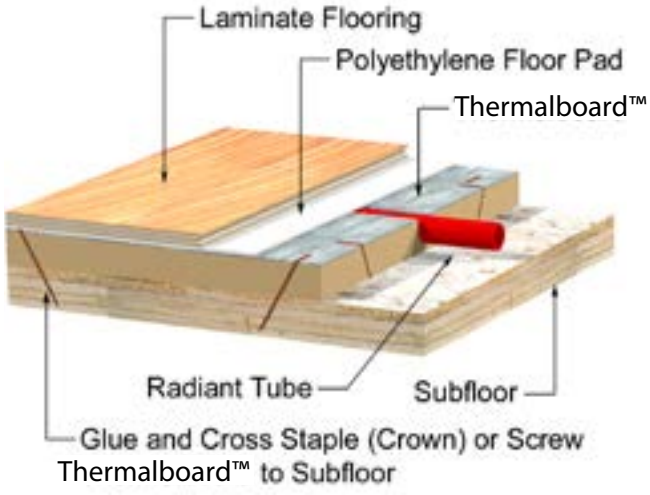
TB NOTES ON SEALING

- ***The aluminum layer on the top of each Thermalboard™ is highly water resistant. Thus, using silicon sealant as a caulk between the boards gives you a significant degree of moisture protection. Properly applied, this will profoundly reduce the likelihood of water transmission into the boards.***
- ***This is not a substitute for our recommended installation methods in wet areas.***

LAMINATE OVER THERMALBOARD™

Thermalboard™ shall be installed over a wooden subfloor, complying with "General Thermalboard™ Installation Requirements For All Flooring Over Wood Subfloor"

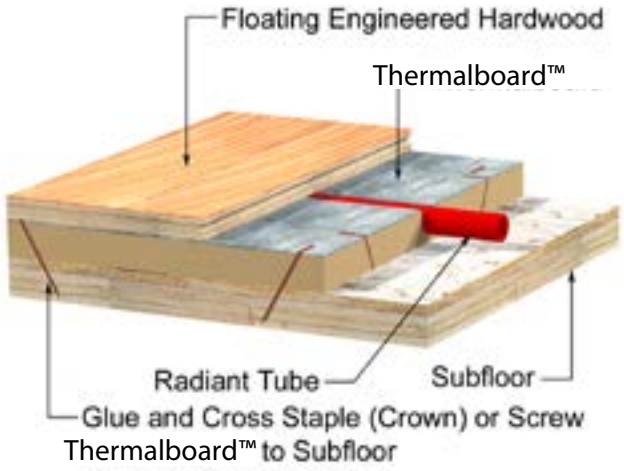
In addition, these specific cautions and instructions shall be followed: When installing laminate flooring, it is advised that in wet locations, a thin layer of underlayment plywood be applied over Thermalboard™. a sealant layer should be added over the underlayment layer of plywood. Many, but not all, laminate flooring products are suitable and recommended by the manufacturer for use with radiant floor heat. Check before installing. Many laminate flooring products have floor temperature limits that need to be observed as well. Install laminate flooring crosswise to Thermalboard™ whenever possible. It is recommended that laminate flooring installed over Thermalboard™ shall employ controls that gradually adjust water temperature going to the Thermalboard™ with a reset curve. A floor temperature limiting sensor can be used to comply with flooring manufacturer's flooring temperature specifications.



ENGINEERED WOOD OVER THERMALBOARD™

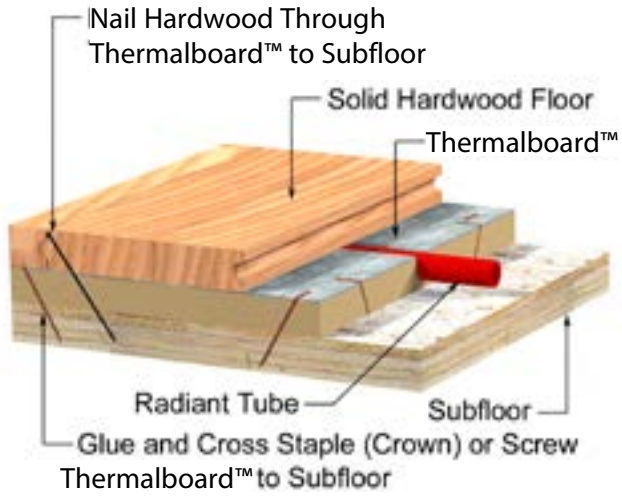
Thermalboard™ shall be installed over a wooden subfloor, complying with "General Thermalboard™ Installation Requirements For All Flooring Over Wood Subfloor".

In addition, the following specific cautions and instructions shall be followed:
Many, but not all, engineered wood flooring products are suitable and recommended by the manufacturer for use with radiant floor heat. Check before installing. Many engineered wood flooring products have floor temperature limits that need to be observed as well. Install engineered wood flooring crosswise to Thermalboard™ whenever possible. It is recommended that engineered wood flooring installed over Thermalboard™ shall employ controls that gradually adjust water temperature going to the Thermalboard™ with a reset curve. A floor temperature limiting sensor can be used to comply with flooring manufacturer's flooring temperature specifications.



TRADITIONAL HARDWOOD INSTALLED DIRECTLY OVER THERMALBOARD™

A conventional nailed and hardwood type system may be used directly over Thermalboard™ by using nails long enough to penetrate the subfloor, and by using recommended controls. *See also sections on general considerations with the use of traditional wood flooring, pgs. 30-31.* Thermalboard™ shall be installed over a wooden subfloor, complying with "General Thermalboard™ Installation Requirements For All Flooring Over Wood Subfloor". In addition, follow these cautions and instructions:



1. Care shall be taken to avoid nailing tubing.
2. Hardwood floor joints shall not be installed directly at the Thermalboard™ joint.
3. Hardwood floor nails shall be long enough to penetrate both hardwood and subfloor.
4. Hardwood floors installed directly over Thermalboard™ shall employ controls with a reset curve, that gradually adjust water temperature going to the Thermalboard™; the floor will expand and contract gradually with temperature changes. This will reduce the likelyhood of warpage, gapping or shrinkage problems. The use of a floor temperature limiting sensor is recommended.
5. 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 Thermalboard™ should run perpendicular to the direction of the strip flooring.
6. Install strip flooring with mallet driven nails that penetrate the Thermalboard™ 1/2" into the subfloor. Use 15 gauge nails (2.5" with 3/4" floors) to penetrate the subfloor. Use a nailer such as the Senco # SFM40, with a tongue and groove attachment such as # SFM40 TG.
7. Structure humidity shall be kept within the range specified by the flooring manufacturer.
8. The wood flooring shall be installed at the relative humidity recommended by the manufacturer for the climate involved.
9. Use narrower 2"-3 1/2" strips of wood flooring over radiant floors.
10. The lessons of local practice and climate shall be referenced
11. 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.
12. The flooring product shall be allowed to acclimatize before installation.
13. Use woods known to be dimensionally stable.

TRADITIONAL STRIP WOOD FLOORING OVER THERMALBOARD™

The key to installing wood floors over radiant heat is to give extra care to wood species, the wood's width and thickness, moisture levels, installation practices, your system's specific heat output requirements, and appropriate radiant heating controls.

BOARD WIDTH — 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, 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's significantly more dimensionally stable than wood that is plain sawn. Pick a wood that's known for its dimensional stability. 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 IN TROPICAL WOODS — If you're 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. 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, surprise stress-related problems are much less likely. Though it can be fun to be unique, avoid pioneering the use of a wood where there is little information on its dimensional stability.

MOISTURE — Wood naturally expands and contracts in response to changes in moisture. With this in mind, avoid installing wood flooring during stages such as sheet rocking or painting, when significant moisture may be introduced into a structure. 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 acclimatize to this humidity level by "sticking" (usually several weeks) before installation. 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 radiant at around 6 to 8 percent moisture content. This figure may change some 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 assures this will not be exceeded and brings the floors through temperature changes gradually.

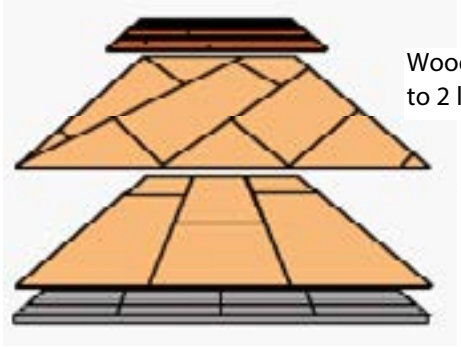
OTHER APPLICATION OPTIONS—WOOD FLOORS OVER THERMALBOARD™

Thermalboard™ may be used under traditional strip wood flooring in several ways:

A conventional nailed and hardwood type system may be used directly over Thermalboard™ using nails long enough to penetrate sub-floor, and with controls as described in the previous section. There are many advantages to this method; quick response, lower installation cost, higher heat output due to lower resistance of the flooring, and a quality control that brings the flooring through temperature changes gradually and accurately, which will also increase comfort.

Optional floating methods for use with traditional strip wood flooring**:** 2 layers of 1/2-inch plywood may be floated on top of the Thermalboard™ and strip flooring nailed to it, as shown below, in a method recommended by the National Wood Flooring Association. This method has the advantage that it allows the wood flooring system to float independently from the Thermalboard™; but has significant disadvantages in that the 1" extra thickness of wood limits the output of the system. For example, two layers of 1/2" plywood with 3/4" of strip oak flooring has an R-value of about R-2.3. This limits the output of the floor at 150° F water temperature to about 26 BTU/Square Foot. A careful heat loss analysis must be done to see if this method will produce enough heat. If not, another method should be chosen, or provisions made for backup heat. A hydronic control strategy that gradually adjusts water temperature going to the Thermalboard™ with a reset curve is recommended, but not required, with this method.

NWFA DOUBLE PLYWOOD FLOATING METHOD



Wood flooring nailed to 2 layers of plywood

Plywood laid diagonally to first layer attached with 7/8" screws on 6" grid pattern

First layer of plywood is "floated" on Thermalboard™

Finished flooring assembly of strip wood flooring, and plywood "floats" independently on top of Thermalboard™

Clip style floating strip flooring systems must be installed directly over Thermalboard™ such that clips will never come in contact with the tubing.

The use of a floating engineered wood is a preferred method. Your engineered wood flooring product should have a specific warranty for use over radiant floors. Many manufacturers of these products have such a warranty, and many have extensive experience both in Europe and North America with radiant heating applications. Edge glued floating engineered 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.

Glued down wood flooring systems are not recommended unless a layer of plywood is first screwed down to the Thermalboard™ and the wood is attached to the plywood according to the flooring manufacturer's recommendations for installation over radiant heat.

INSTALLING THERMALBOARD™ OVER CONCRETE

Successful installations of Thermalboard™ over concrete require special care due to the difficulties of sealing concrete, moisture issues, and attaching Thermalboard™ to concrete.

All concrete slabs give off supplementary moisture whether above, on, or below grade. This can cause problems for any board product installed over it, including Thermalboard™. Thermalboard™ may be installed over concrete using the following 3 methods only when the installing parties are willing to assume full responsibility for the installation issues regarding moisture and attachment of Thermalboard™ to concrete.

When installing Thermalboard™ over concrete, moisture considerations must be carefully addressed. Remember that while a slab may appear to be, or actually be, dry during one time of year, this may change as environmental conditions change. Follow this procedure for testing the moisture of slabs, including those between floors, as in commercial construction. It is the contractor's as well as the installer's responsibility to test all concrete substrates, both new and old, for moisture content to determine they are sufficiently dry to install Thermalboard™. Moisture in the concrete should be tested according to ASTM F 1869 (Calcium Chloride Moisture Test using the Quantitative Method). With a calcium chloride test, the maximum acceptable reading is 3 lbs./ 4 hours/ 1,000 Sq. ft. New concrete slabs and basements must be cured for a minimum of 60 days prior to installation. Determine that the existing or new slab is sufficiently dry, and do any sealing of the slab before you proceed with any Thermalboard™ installation.

It is strongly recommended that all slabs below grade and slabs on grade be sealed against moisture penetration before installing Thermalboard™ by means of vapor barriers or product such as Hydroment Ultraseal that is a sealant and an adhesive. It is also important that all installations of Thermalboard™ over concrete slabs below grade and slabs on grade be insulated against downward heat loss either as shown in the detail below or under the slab or downward at the perimeter according to the Radiant Panel Association recommendations.

The increasing use in seismic areas of engineered "Seismic Slabs" means that fewer radiant floor heating systems will be installed with tubing in the slab, and there will be more need for the 3 details on page 33.

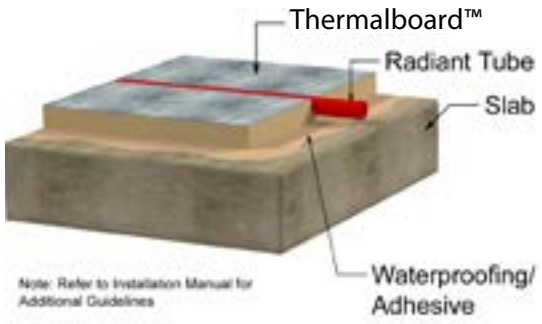
Recommendations for floor coverings installed over Thermalboard™ installed on concrete: For details on the installation of flooring materials above the Thermalboard™ layer, refer to details on the previous pages for additional information and requirements, but refer to the following page for details of how to install Thermalboard™ itself over concrete. For example, tile would be installed over Thermalboard™ with a backerboard layer, crack isolation membrane, mortar, etc. as shown on previous pages, but the Thermalboard™ itself should be installed as according to one of the 3 methods shown on the following page.

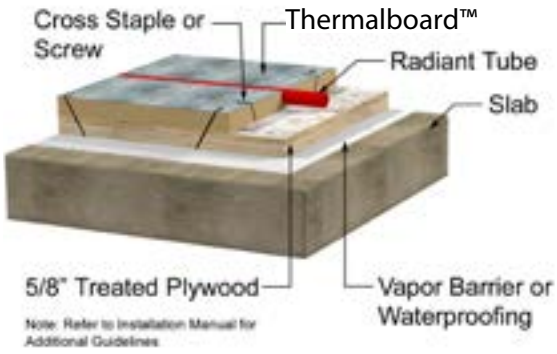
INSTALLER'S NOTE: ***When installing traditional strip wood flooring directly to Thermalboard™ installed over concrete, you must use one of the methods utilizing 5/8" treated T&G plywood under the Thermalboard™ to provide adequate nailing.***

THERMALBOARD™ OVER CONCRETE – APPLICATION DETAILS (3)

1) Thermalboard™ bonded to concrete using sealant and adhesive

Thermalboard™ may be installed directly over concrete slabs only when the contractor has verified that moisture conditions will be adequately controlled by the use of a sealant on the slab or a vapor barrier under the slab. When using a sealant and adhesive on top of the slab, the sealant may be a combination sealant/wood adhesive such as Hydroment Ultraseal or the sealant and adhesive may be two separate but compatible products.



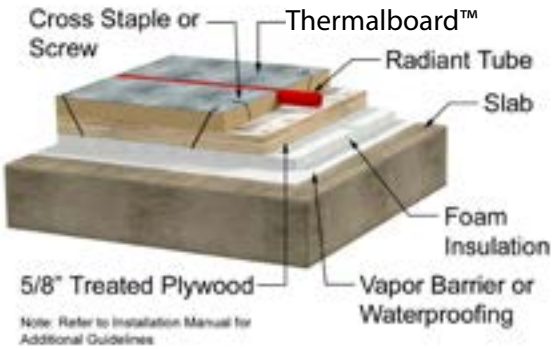


2) Thermalboard™ over plywood and vapor barrior or waterproofing

Thermalboard™ may be installed on 5/8" T&G treated plywood with a vapor barrier or waterproofing over concrete slabs only when the contractor has verified that moisture conditions will be adequately controlled by the use of a sealant on the slab or a vapor barrier over or under the slab.

3) Thermalboard™ over plywood, foam insulation and vapor barrier or waterproofing

Thermalboard™ may be installed on 5/8" T&G treated plywood, over foam and with a vapor barrier or waterproofing over concrete slabs only when the contractor has verified that moisture conditions will be adequately controlled by the use of a sealant on the slab or a vapor barrier over or under the slab.



CHECKLIST – INSTALLING THERMALBOARD™ OVER CONCRETE

for all regular flooring goods *EXCEPT* strip wood flooring

Installation shall comply with one of the 3 details on Page 33, and installing parties must accept responsibility for and understand all cautions on page 30 regarding moisture and attachment of Thermalboard™ to concrete and should refer to the complete installation manual for further instructions on the installation of the Thermalboard™ system. Do not install Thermalboard™ without an accurate room-by-room heat loss analysis for the structure to be heated as well as a design/layout for Thermalboard™ that takes into account the resistance and heat transfer of the actual floor coverings. If Thermalboard™ cannot provide all the necessary heat, make provisions for additional backup heat.

1. Thoroughly clean and level all surfaces where Thermalboard™ will be applied.
2. Prevent moisture penetration through slab either by sealing concrete with a vapor membrane such as Hydroment Ultraseal per manufacturer's guidelines. A continuous unperforated under slab vapor barrier or above slab vapor barrier as shown on page 31 are also acceptable.
3. Follow one of the details on page 3, chalking lines on floor as reference points and lay out boards according to plan.
4. If glueing Thermalboard™ to concrete sealed with a membrane, be sure to use adequate adhesive compatible with vapor membrane to glue down the Thermalboard™ to the membrane.
5. When attaching Thermalboard™ to plywood, lay out boards according to plan and glue and screw or glue and cross staple Thermalboard™ to plywood. Be sure to use adequate adhesive.
6. Start layout of all pieces by securing a corner, to allow for proper alignment.
7. Use 6" lengths of tubing in the grooves lapping 3" into each board to help align the grooves of the boards.
8. Once all boards are installed, clean out all grooves with a vacuum prior to tubing installation.
9. Snap tubing into groove and route to manifold per plan.
10. Install backerboard when applying tile or vinyl floor goods.
11. Maintain 2" minimum tubing clearance from carpet tack strips or other nailing.
12. Refer to previous drawings for additional details and requirement of flooring goods installed over Thermalboard™.

CHECKLIST – INSTALLING THERMALBOARD™ OVER CONCRETE

for strip wood flooring

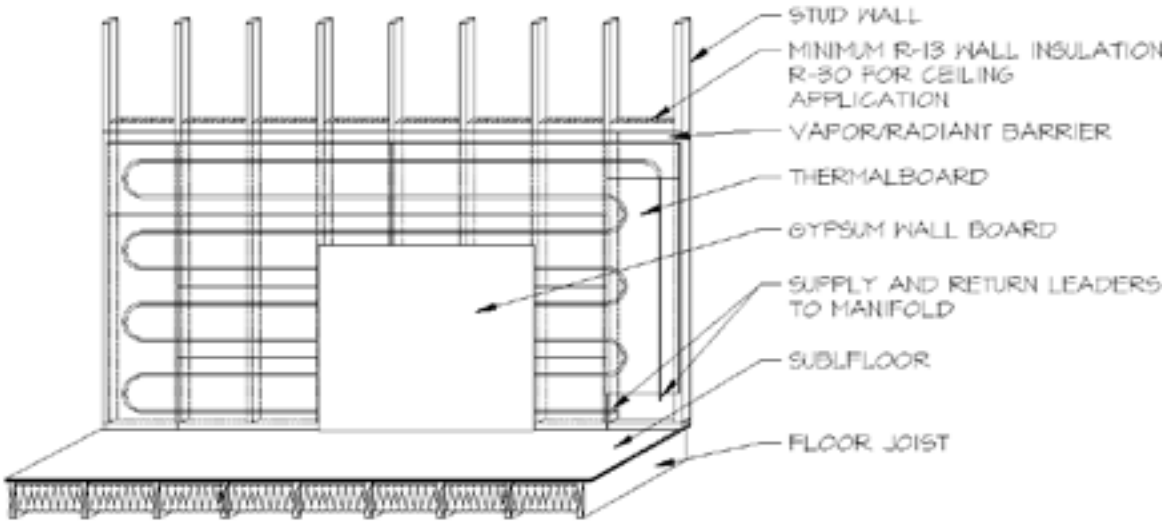
Installation shall comply with one of the two bottom details on page 33 utilizing 5/8" treated T&G plywood. Installing parties must accept responsibility for, and understand all cautions on page 30 regarding moisture and the attachment of Thermalboard™ to concrete, and should refer to this complete installation manual for further instructions on the installation of the Thermalboard™ system. Do not install Thermalboard™ without an accurate room-by-room heat loss analysis for the structure to be heated, along with a design/layout for Thermalboard™ that takes into account the resistance and heat transfer of the actual floor coverings. If Thermalboard™ cannot provide all the necessary heat, make provisions for additional backup heat.

1. Thoroughly clean and level all surfaces where Thermalboard™ will be applied.
2. Prevent moisture penetration through the slab either by sealing concrete with a vapor membrane such as Hydroment Ultraseal, per manufacturer's guidelines. A continuous unperforated under slab vapor barrier or above slab vapor barrier as shown on page 33 are also acceptable.
3. Follow one of the 2 details on page 30 that use 5/8" T&G treated plywood under the Thermalboard™, and lay out your boards according to plan
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 or staple Thermalboard™ 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 6" lengths of tubing in the grooves, lapping 3" into each board to align the grooves .
9. Once all boards are installed, vacuum all grooves just prior to tubing installation.
10. Snap tubing into the groove and route to the manifold per plan.
11. Install strip flooring with mallet driven nails, with nails penetrating Thermalboard™ 1/2" into the plywood. Use 15 gauge nails (2.5" with 3/4" floors) to penetrate into plywood. Use a nailer such as the Senco # SFM40 with a T&G attachment (i.e. # SFM40 TG).
12. Insulfoam under plywood may be used instead of plywood alone, as shown on page 33.
13. Hardwood floors installed directly over Thermalboard™ shall employ controls with a reset curve that will gradually adjust water temperature going to the Thermalboard™. Keep the structure humidity within the range specified by the flooring manufacturer.
14. Wood flooring shall be installed at the relative humidity recommended by the manufacturer for the climate involved.
15. Use narrower 2"-3 1/2" strips over radiant floors.
16. Always reference the lessons of local practice and local climate.
17. Before installation, run the heating system and maintain the space at at least 65F° long enough that temperature and humidity have stabilized to predicted future levels.
18. The flooring product shall be allowed to acclimatize before installation.

APPLICATION OF THERMALBOARD™ TO WALLS OR CEILINGS

Thermalboard™ may be installed on walls or ceilings as extra heat output areas when the floors cannot provide all the necessary heat. Radiant walls and ceilings may also be used to provide all the heat of a room in certain circumstances when properly designed. The heat output of radiant walls and ceilings is different from floors, due to differences in the strength of the convective component of the heat, which is stronger in radiant floor heating than in walls or ceilings. However, since walls and ceilings are typically covered only with the relatively low r-value of 1/2" of sheet rock, and acceptable surface temperatures are higher, the heat output of these systems can be quite substantial. It is very important not to overheat sheetrock, or discoloration or damage may occur. For design purposes, use chart C-1 on page 10, but correct the output in BTU's downward 5% for walls and 10% for ceilings. This is because the convective component of the heat output is lower in wall and ceiling radiant heating systems.

Thermalboard™ wall and ceiling systems shall be installed as follows: Thermalboard™ shall be installed square to framing, screwed to studs, rafters and/or blocking with as many joints as possible screwed securely to the framing. Thermalboard™ shall be secured to framing on both sides of the grooves on every board. Layout of all pieces shall be started by securing a corner to allow for proper alignment. 6" lengths of tubing shall be temporarily placed in the grooves lapping 3" into each board to help align the grooves of the boards during installation. Once all boards are installed, all grooves shall be cleaned out with a vacuum just prior to tubing installation. Tubing shall be snapped into the groove and routed to manifold per the plan. A 1" minimum tubing clearance from tubing shall be maintained for all nailing. Add steel plate protectors over tubing where tubing crosses studs. Water temperatures shall not exceed 120F° supply water temperatures when Thermalboard™ is installed under plaster or sheetrock.



SPECIFICATIONS

THERMALBOARD™ RADIANT BOARD
A modular non-structural radiant board system

PART 1 — GENERAL

1.01 General

A. Provide all labor, materials, transportation, equipment and services to install a Thermalboard™ radiant board non-structural modular board system, as indicated by the contract documents and these specifications.

B. Examine all contract documents for instructions, terms and conditions related to the installation of the Thermalboard™ non-structural system. Provide all work as described and required herein, and follow the specific installationa and application requirements of all related work.

1.02 References

A. *Radiant Professionals Alliance Guidelines for the Design and Installation of Radiant Heating Systems*

B. *Composite Panel Association's EcoCertified Composite Sustainability Standard (ECC)*

C. *ANSI (American National Standards Institute) standards for MDF*

D. *SCS Global Recycled Content Certification and Environmentally Preferred Product Certification*

E. *American Society for Testing Materials — Standard Specification for Cross Linked Polyethylene (PEX) Tubing*

F. *International Building Code (IBC)*

G. *Uniform Building Code (UBC)*

H. *Uniform Mechanical Code (UMC)*

I. *All applicable local modifications and codes in a project's jurisdiction.*

1.03 Submittals

A. Verification of SFI (Sustainable Forestry Initiative) certification of the board used in the manufacture of Thermalboard™ radiant board.

B. Verification of compliance with *RPA* Standard Guidelines* or local code requirements for heating system design sufficient to supply the heating needs of the structure in the environment in which it will be built.

** Radiant Professionals Alliance*

1.04 Delivery, Storage, Handling and Quality Control

A. The General Contractor and, if different, the receiving subcontractor, shall ensure that the Thermalboard™ modular boards are received in good condition and installed without damage and in accordance with construction documents, the current Thermalboard™ Installation Manual at the time of delivery, and applicable local code.

B. Upon delivery, the Thermalboard™ board shall be stored indoors in a temperate (40°F – 90°F), dry location. Avoid prolonged exposure to sunlight. Do not store in a damp location. Be sure to follow all instructions in the Thermalboard™ Installation Manual on protecting the board material from prolonged moisture contact.

C. PEX tubing, before and after installation, shall be protected from prolonged exposure to UV light, according to the tubing manufacturer's requirements.

1.05 Site Conditions Required for Installation of Thermalboard™ Radiant Board

A. Thermalboard™ shall only be installed on a subfloor, indoors, in enclosed, dry structures.

B. The surface of the subfloor must be flat: the requirement for flatness is defiined as the maximum difference between two adjacent high points and the intermediate low point. The maximum acceptable difference in level is 3/16" in a 10-foot radius.

C. Wood subfloors must have a stable moisture content, between 6 –10%. Creaking subfloors must be repaired before Thermalboard™ installation.

D. When installing Thermalboard™ radiant board over concrete, it is the contractor's—as well as the installer's—responsibility to test all concrete substrates, both new and old, for moisture content to determine whether they are sufficiently dry to install Thermalboard™ radiant board. Moisture in concrete should be tested according to ASTM F 1869 (Calcium Chloride Monitoring Test using the Quantitative Method). With a calcium chloride test, the maximum acceptable reading is 3 lbs. / 4 hrs / 1000 sq.ft. New concrete slabs and basements must be cured for a minimum of 60 days prior to installation.

1.06 Limited Warranty

Thermalboard™ warrants that its non-structural modular board products are free from defects in material workmanship in the manufacturing process when shipped from the factory. For the life of the original subfloor, any boards 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 much be inspected upon receipt by the customer for defects, stored and installed according to the most current Thermalboard™ Installation Guide (Manual) at the time, and used in conformity with the written specifications in the Manual. Assertions of defect must be presented to Thermalboard™ in the form of Return of Goods or other documentation acceptable to Thermalboard™. If Thermalboard™ agreeds that the defect is covered by its warranty, then Thermalboard™ shall, at its expense, ship replacement boards as the sole remedy. Thermalboard™ specifically disclaims any incidental, consequential or other claims of damage beyond the replacement of defective product. In no event shall damages exceed the cost of good provided. Thermalboard™ is a construction board product, and many aspects of its storage, transport and installation are beyond the control of Thermalboard™. Damage from the following are specifically excluded from warranty coverage: improper storage, improper installation, moisture intrusion, improper environmental and system control, abuse, damage from pests or fire, damage from the removal of floor products, and/or reinstallation, or from acts of God such as earthquakes and floods

PART 2 — ORIGINATING MANUFACTURER AND RELATED PRODUCTS

2.01 Approved Board Manufacturer

A. Thermalboard™ radiant board shall be manufactured solely by Thermalboard™ or by Thermalboard's approved manufacturer. No other modular radiant boards may be substituted.

2.02 Tubing

A. Tubing installed in Thermalboard™ radiant board non-structural modular boards shall be third-party certified to, and manufactured to, ASTM F-876 and ASTM F-877.

B. The PEX tubing shall have PPI (Plastics Pipe Institute) issued design and pressure ratings of 200°F @ 80 PSI, 180°F @ 100 PSI, and 73.4°F @ 160 PSI.

C. The PEX tubing shall be nominal 1/2" ID in accordance with ASTM F-876 and ASTM F-877; shall never have loops longer than 250 feet; and shorter loops shall be used in certain circumstances, as recommended in this Manual.

D. **DO NOT use PEXALPEX (Pex Aluminum Pex).** Thermalboard™ radiant board has a slightly undercut groove. Regular PEX will oval then rebound into the undercut, and be retained. PEXALPEX will oval but not expand into the slight undercut, may not be retained in the goove, and likely stand tall of the board.

2.03 Glues

See RECOMMENDED ASSOCIATE PRODUCTS, pgs. 42-44, for current recommended glues for use with Thermalboard™, or visit **thermalboardradiantfloorheating.com**

PART 3 — JOB EXECUTION AND SEQUENCING

3.01 Preparation

A. Thermalboard™ non-structural modular board shall be installed according to the contract documents and to the current Thermalboard™ Installation Manual.

3.02 Modular Board Installation

A. Using a layout plan for your specific job, install the Thermalboard™ boards to the subfloor as required by the contract documents and the current Thermalboard™ Installation Manual. Follow the recommended floor assemblies, gluing, and attachment patterns contained in the Manual.

B. Reference the planned direction of any wood flooring before installation, and align the Straight Thermalboard™ boards at 90° to the direction of the wood flooring. If this is a change from the submitted and approved layout plan, the plan should be re-done.

C. Perform any custom routing and drilling before installation of the tubing.

3.03 Tubing Installation

A. Channels shall be dry, clean and free of any debris before tubing is installed.

B. Tubing shall be pressed into the channels until it is flush with the top of the board.

C. Installation of tubing shall follow construction documents and an approved plan for tubing layouts, manifolds, controls and mechanical room.

D. After the tubing is installed, the system must be pressure tested with air (80 psi minimum) using a visible gauge, and this pressure maintained for a minimum of 24 hours, or until completing all stages of construction that may damage tubing.

E. No flooring goods may be installed over Thermalboard™ and the tubing prior to the system pressure testing described in 3.03 D.

F. Contractor must follow all manufacturer requirements for the care and handling of the tubing.

3.04 Subsequent to Tubing Installation

A. Care shall be taken to protect tubing from damage, debris, and prolonged exposure to UV light until covered by flooring goods. Tubing shall be vacuumed before covered.

B. Flooring goods shall be installed with care to avoid damaging tubing. Particular care must be taken where tubing goes under sills, door jams, or at any radius into walls for manifolds. Inform the other trades of the location of tubing and, if necessary, protect tubing from damage, with metal plates.

C. Continue to frequently check tubing pressure (3.03 D), and keep it under test during stages of installationg and construction that might damage the tubing.

D. Finish tubing installation and connect any and all loops to mechanical components as required by construction documents, all codes, and good practices.

3.05 Avoid Tubing when Screwing Backboard or Underlayment Plywood to Thermalboard™

In order to protect tubing from damage during installation, take a photograph as a reference, snap chalklines where the tubing runs are, and avoid screwing those areas. Remember, tubing runs are 8" apart. As an alternative, take a thick, clear sheet of plastic, cut it to size, and lay it out over the Thermalboard™ once tubing has been installed, then mark with a permanent marking pen the location of the tubing. This plastic sheet may be rolled up and later unrolled and used as a reference to avoid tubing when screwing other products to Thermalboard™.

RECOMMENDED ASSOCIATED PRODUCTS

REGULARLY UPDATED - Check website for most current recommendations

RECOMMENDED ADHESIVES / GLUES FOR THERMALBOARD™

Thermalboard™ has made a major effort to create a green product, so we recommend using green, low-VOC adhesives for gluing Thermalboard™ to a wood subfloor. Unfortunately, manufacturers use many different methods for stating the amount of VOCs in glue, so it is hard to compare brands. There are two related reasons for using low-VOC adhesives: indoor air quality and the contribution of VOCs to damaging our climate.

There are three (3) major categories of glue for use with Thermalboard™ depending on the adhesive's intended purpose, per type of installation. Before you begin your Thermalboard™ installation, be sure to reference the instructions of both the glue manufacturer and any products being adhered. In addition to gluing Thermalboard™ to the sub-floor, be sure to also screw or cross-staple the boards, as shown on page 19.

1) **Glues for adhering wood flooring, backer board, or underlayment wood material onto Thermalboard™.**

Sikabond T-35
Product data sheet link
https://usa.sika.com/content/dam/dms/us01/s/SikaBond-T35-PDS.pdf

Sikabond T-55
Product data sheet link
https://usa.sika.com/content/dam/dms/us01/0/sikabond_-t55.pdf

Mapei Ultrabond Eco-980
Brochure
https://cdnmedia.mapei.com/docs/librariesprovider10/products-documents/3000286-ultrabond-eco980-en_467140da4d0c4d8bb81b3.70

Bostick Greenforce
Product data sheet link
https://www.bostik.com/files/live/sites/shared_bostik/files/import-united-states/globalassets/tdsdocuments/greenforce_united_states_en2/technical-data-sheet/t4105greenforce_tds_061819.pdf

Bostik Best
Product data sheet link
https://www.bostik.com/files/live/sites/shared_bostik/files/import-united-states/globalassets/tdsdocuments/bostiks-best_united_states_en/technical-data-sheet/t2070_bostiks-best-tds_lowres_081718.pdf

Bostik BST
Product data sheet link
https://www.bostik.com/files/live/sites/shared_bostik/files/import-united-states/globalassets/tdsdocuments/bst_united_states_en/technical-data-sheet/bostik-bst_tds_t1948_011020.pdf

Bostik EFA
Product data sheet link
https://www.bostik.com/files/live/sites/shared_bostik/files/import-united-states/globalassets/tdsdocuments/efa_united_states_en/technical-data-sheet/bostik-efa-tds_t1506_082119.pdf

AVAILABLE AT LOWES:

Bostik Green Grip
Product data sheet link
https://www.bostik.com/files/live/sites/shared_bostik/files/import-united-states/globalassets/tdsdocuments/greengrip_united_states_en/technical-data-sheet/t4142_greengrip-tds_051719.pdf

Bostik Wood Grip Plus
Product data sheet link
https://www.bostik.com/files/live/sites/shared_bostik/files/import-united-states/globalassets/tdsdocuments/wood-grip-plus_united_states_en/technical-data-sheet/bostik-wood-grip-plus-tds

AVAILABLE AT LUMBER LIQUIDATORS:

Bostik Best

Mapei Eco 980

2) Glues for adhering Thermalboard™ onto a Wood Sub-floor:

Construction adhesive products marketed as low VOC / their effective temperatures:

OSI SF450 Heavy Duty Construction Adhesive	0°F to 140°F
Bostik Heavy Duty Construction Adhesive	40°F to 100°F
Bostik 975 Construction Adhesive	40°F to 100°F
SikaBond Pro Select Construction Adhesive	40°F to 100°F
Titebond Greenchoice Construction Adhesive	20°F to 120°F
Titebond Provantage Construction Adhesive	0°F to 120°F
Locktite PL 375 Heavy Duty Construction Adhesive	40°F to 100°F

Coverage Math:

Use approximately 25 lineal feet of glue per board
Use a minimum 1/8" bead on a very smooth floor, and more on an uneven floor.
A 28 fluid oz. tube with a 1/8" bead will extrude approx. 340 ft.
A 28 fluid oz. tube with a 1/4" bead will extrude approx. 86 ft.

Other Glues for Adhering Thermalboard™ to a Wood Sub-Floor:

There are many other construction adhesives that will work for bonding Thermalboard™ to a wood sub-floor, and since the boards should also be screwed or cross-stapled, as described in this Manual, the glues help bond the board and prevent squeaking. There is no uniformity in the adhesives industry regarding which method and units are used to describe VOC content, so it becomes difficult to evaluate. In general, the lower the VOC content, the better.

3) Glues for adhering Thermalboard™ to Concrete:

Before gluing Thermalboard™ boards to a slab, read and follow the glue manufacturer's installation instructions, as well as their limitations on the moisture content and moisture testing of the slab. Do not install on a slab that has a seasonal history of being wet or one that exceeds the recommended moisture content when testing.

The following glues function as both a vapor retarder and adhesive:

Sikabond T-35
Mapei Ultrabond Eco-980
Bostik Greenforce

INSTALLER'S NOTES

Use a notched trowel to apply the glue, with full coverage of the concrete, and 100% transfer to the back of each Thermalboard™ board. Any board that isn't flat—weigh it down until it is flat and the glue has fully dried.

THE BENEFITS OF SYSTEM DESIGN

Benefits to the Owner

A professionally designed radiant heating system can save any project money, time and headaches. Thermalboard™ system designs ensure the optional function of a new or retrofit installation, bringing the most comfortable heating system for your budget. Properly designed and installed, radiant heating systems add value to a home or building, and plans provide a permanent record of your system if resell or renovate.

Benefits to the Architect or Designer

The ability to offer a "complete heating system design" can be attractive to a client. A professional plan designer can offer expert advice on integrating mechanical systems into the design, suggest which type of system best suits a specific construction type, explore integrating the system with building controls, and, if applicable, can discuss system performance per various climates, floor coverings, ceiling heights, window configurations, even in multilevel, multi-zoned homes and buildings.

Benefits to the Installer

With a professionally designed plan, installation contractors can quickly get material takeoffs for bids. We pre-size all components, including 1/2" PEX distribution tubing and exact circuit lengths. Our plans offer balancing data for all circuits in a clear, concise table. Spend less time on design— focus on Thermalboard™ system installation. A plan designed to ensure proper operation is a good selling feature to prospective clients: an exact design prior to work, and a clear, permanent record of the system.

A standard layout design may include:

- A full size system plan: board and tubing layout, and manifold location(s)
- Separate tubing loop layout, including the lengths of each loop
- Board count of required Thermalboard™ Straights and Supercombos

A complete mechanical design can include :

1. System balancing data—a computer simulation report that summarizes zones, flows, water temperatures, and tube lengths. This allows the installer to properly bid, install and balance the system for optimal performance.
2. Complete component schematic, including specs on heat sources, pumps, valves, manifolds, expansion tank, etc., as well as sizing (length) the distribution tubing.
3. Installation notes and details.
4. A system controls page with controls schemes.

CAUTIONS AND LIMITATIONS OF USE

General Caution:

As with any radiant heating system, do not install Thermalboard™ without an accurate room-by-room heat loss analysis for the structure to be heated, as well as a design/layout for Thermalboard™ that takes into account the resistance and heat transfer of the actual floor coverings. If Thermalboard™ cannot provide all the necessary heat, make provisions for additional backup heat.

Installer Caution:

This manual is deemed to be current at the time of publication. It is the installer's responsibility to install according to the most current Application Guide. This guide does not purport to address all relevant issues; it assumes a knowledge of good practice in both hydronics and construction methods. Installers should always consult all relevant local, regional and national codes, and adhere to good construction practice. Thermalboard™ should only be installed by knowledgeable, qualified installers. Thermalboard™ installations frequently require the coordination of trades. These are, most typically, mechanical and flooring trades. Any issues regarding this coordination should be worked out in advance. Failure to follow the instructions of this guide, failure to adhere to relevant local, regional and national codes, failure to coordinate trades, and failure to follow good construction practice may cause an unsatisfactory result. See also "limitations of use" elsewhere in this publication. The limitations and instructions of use for PEX pipe and all other hydronic components provided by the manufacturers must also be referenced and followed during installation; this manual does not address many aspects of a hydronic installation.

Limitations of use:

Thermalboard™ is designed for interior use only, and is to be installed only on dry substrata once a structure is closed in, protected from the environment, and will remain dry. Thermalboard™ is not intended as, or rated as, a replacement or substitution for a structural sub-floor. The BTU output of Thermalboard™ is limited by the R-values of the flooring goods applied over it, and by the recommended and available water temperatures. Thermalboard™ is not intended for use with finish goods incompatible with the temperatures and conditions present in a radiant heating system. Thermalboard™ is not intended as a finish floor, and should be left uncovered and unprotected only during installation.

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