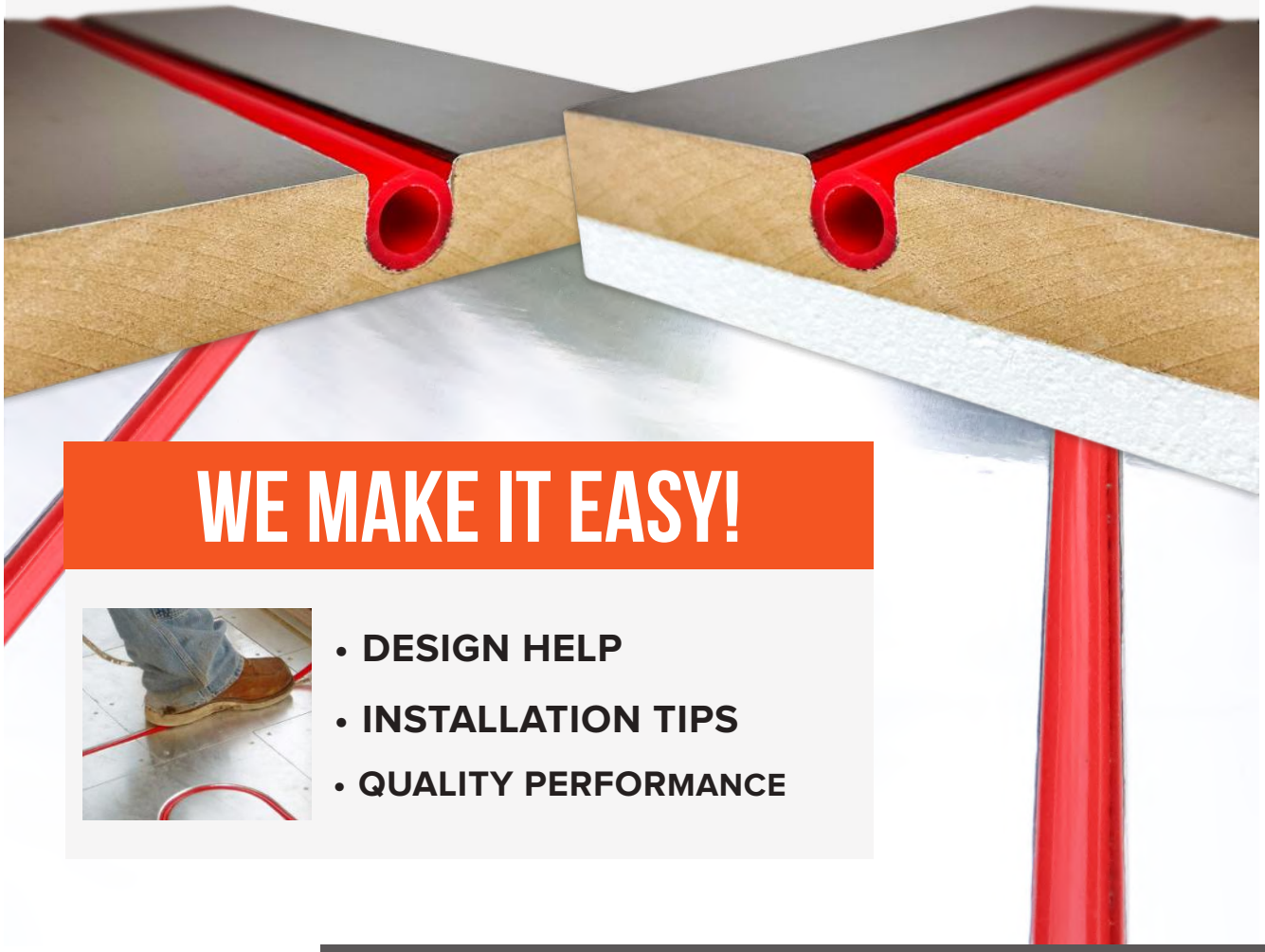
TB

A WBI PRODUCT

THERMALBOARD™

APPLICATION AND INSTALLATION MANUAL

FEATURING **NEW THERMALBOARD EPS™ PANEL**



WE MAKE IT EASY!

- **DESIGN HELP**
- **INSTALLATION TIPS**
- **QUALITY PERFORMANCE**

thermalboardradiantfloorheating.com

WBI
THE RADIANT PANEL COMPANY

2024 EDITION — VERSION 24.2

NOTES:

THERMALBOARD™ APPLICATION AND INSTALLATION MANUAL
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U.S. PATENT #6,533,185

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WARM BROTHERS INC.
P.O. Box 4680 • Rollingbay, WA 98061
866-414-7244

APPLICATION AND INSTALLATION MANUAL — TABLE OF CONTENTS

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, typically mechanical and flooring. 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.

WE NOW HAVE TWO THERMALBOARD™ PRODUCTS IN THIS MANUAL

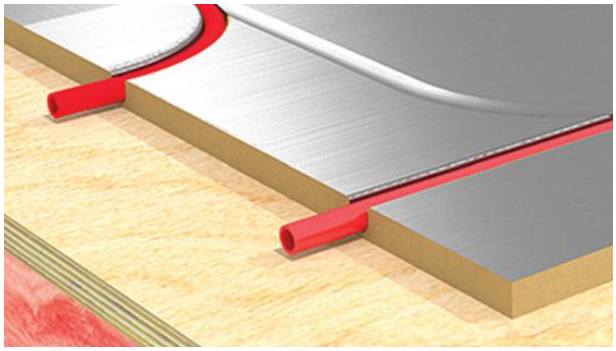
THERMALBOARD™ **THERMALBOARD™ EPS** PATENT PENDING

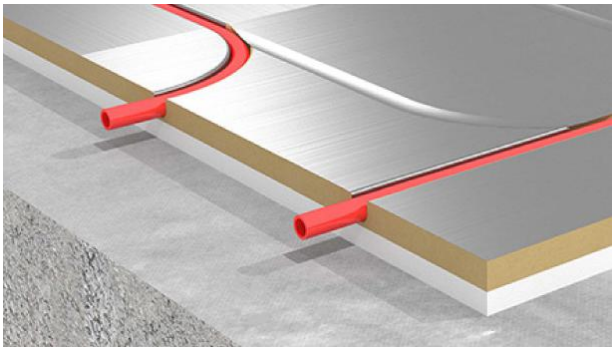
Thermalboard™ Sample

The Thermalboard™ panel is higher performing and more sustainable with no added formaldehyde, new moisture resistance levels, and high recycled content certifications. Panels are installed by gluing and screwing or cross stapling to a subfloor.

Thermalboard EPS™ Sample

Our new Thermalboard EPS™ panel is the same high quality board but available with many thicknesses of durable, high quality EPS foam. The panels are normally attached to subfloor with adhesive and in some cases additionally anchored to the concrete.





INTRO TO THERMALBOARD™

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

Now Thermalboard™ is even more efficient, more responsive, easier to install and compatible with standard construction practices. Ideal for new construction and remodeling alike—low profile, lightweight, 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 pre-cut grooves on the panel.

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 lightweight 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 carries 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 and laminated with a top layer of highly conductive aluminum. This disperses and transfers heat from warm water flowing through the PEX tubing — away from the groove to the entire surface area of the board and then on to the floor above.

ACCELERATION: REACHING OPTIMUM TEMPERATURE

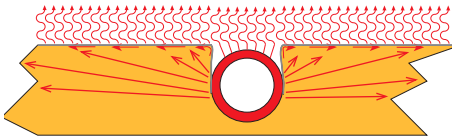


Illustration A-1

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™. The thin profile and relatively high density of the panel 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 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 out gassing.

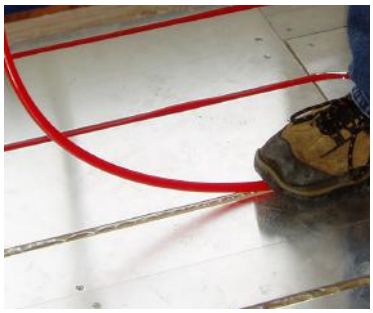
TB ADVANTAGES

- Planet friendly
- Sustainable wood MDF substrate and recycled aluminum alloy laminate
- No VOC's and no added formaldehyde.

NO DETECTABLE OUT GASSING

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

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 in the growing retrofit market. Thermalboard™ provides a superior performing radiant heating system while only adding 5/8" to the existing floor height. Application of the system is easy because only two shapes of grooved board designs are required for installation.

✓CONSTRUCTION FRIENDLY

Thermalboard™ avoids the joist up-sizing, 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. Thermalboard™ eliminates scheduling and curing delays. Time is money.

✓ 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 lightweight—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. 33-37.

HARDWOOD	ENGINEERED WOOD	TILE / STONE
CARPET	VINYL / RESILIENT FLOORING	LAMINATE

✓ PLANET FRIENDLY / GREEN

Thermalboard™ is made with Medium Density Fiberboard (MDF) manufactured with no added formaldehyde (NAF), high recycled content and new MR-30 moisture residtance certification. The glue for the aluminum is zero VOC when cured, and the aluminum layer contains recycled content. Being NAF, the MDF used in Thermalboard™ has less than HUD minimum formaldehyde content, and the aluminum layer is a positive barrier to out gassing 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.

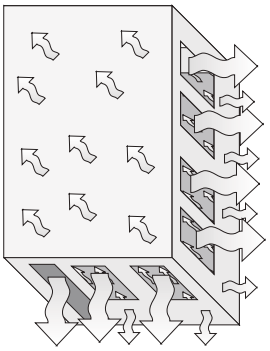


Illustration A-2 Account for all heat losses of the building

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. Add insulation or auxiliary heat if the heat loss is too high. In a very high heat loss room, Thermalboard™ can also be added to the walls or ceilings for extra radiant 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.

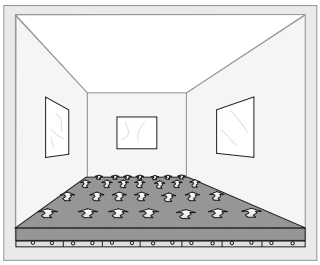


Illustration A-3 Always account for the resistance of floor coverings

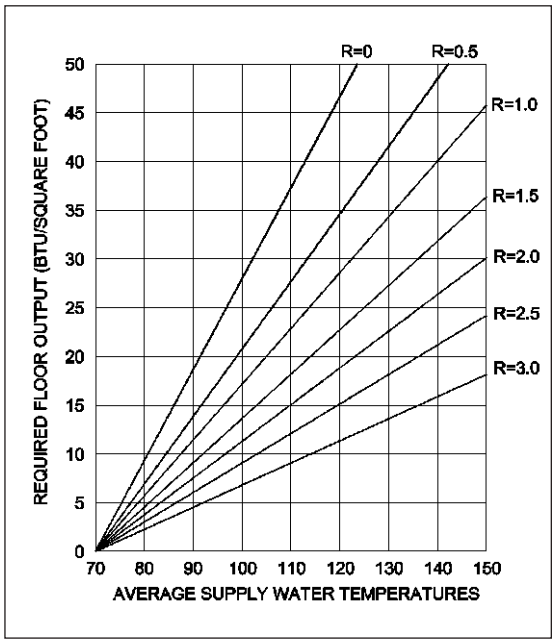
DESIGNER'S NOTE

Remember, average water temperature means the average of both the supply and return water temperatures flowing to and from the loop. 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. Your calculation should include the resistance of the whole flooring assembly above 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

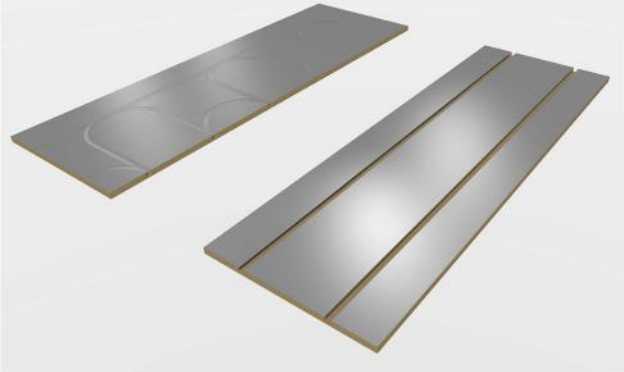
Our Thermalboard™ team or third party design services can provide you a complete recommended system design and CAD layouts for Thermalboard™ installation. Contact your Thermalboard™ distributor for details. See later pages for layout design considerations and samples.

ALL THERMALBOARD™ SYSTEMS SHOULD BE INSTALLED BY QUALIFIED INSTALLERS.

Above: CAD layouts are particularly useful for first time installers.

THERMALBOARD™

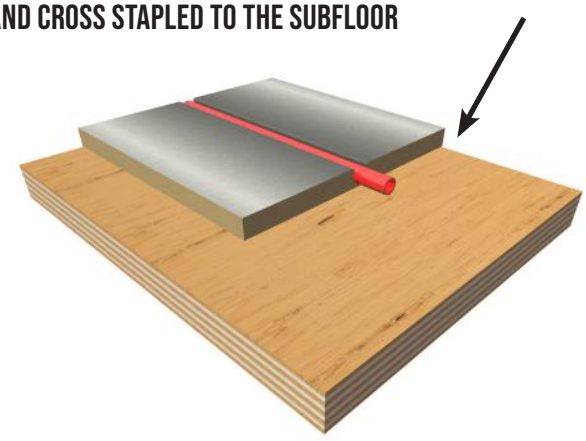
Thermalboard is higher performing and more sustainable than before with no added formaldehyde, new MR 30 moisture resistance and high recycled content certifications. It is normaly glued and screwed or cross stapled to a subfloor.



Thermalboard™ is a modular radiant panel system constructed from 92% pre-consumer recycled content. Meets LEED® v4 Criteria – with zero added formaldehyde and certified to MR30 moisture resistance. The panels are laminated with aluminum sheeting for maxiumum conductivity and efficiency.

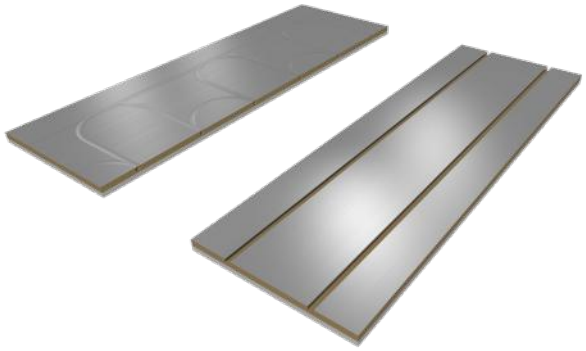
Thermalboard is designed for both new construction and remodeling over a sub-floor or cement. The system includes straight and end combo panels laid out and installed in a pattern. The pattern creates the pathway into which 3/8" PEX or PERT tubing is placed that meet standards specified in this manual.

MOST FREQUENTLY GLUED AND SCREWED, OR GLUED AND CROSS STAPLED TO THE SUBFLOOR



THERMALBOARD™ EPS PATENT PENDING

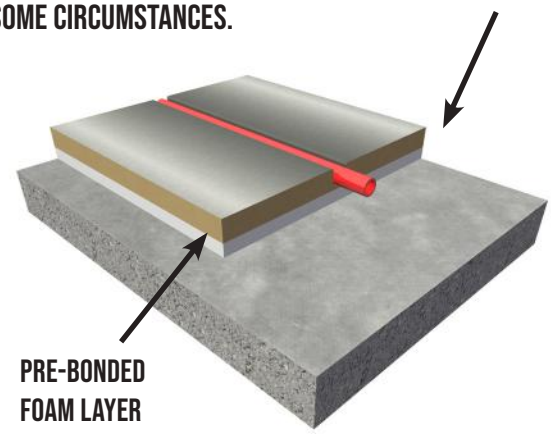
Thermalboard EPS is the same high quality board but with many available thicknesses of EPS foam pre-bonded to the bottom of the board. It is normaly adhered to a concrete subfloor and if necessary with additional anchors into the concrete.



Heat up, not down. Thermalboard EPS™ combines our traditional Thermalboard™ panels with an underlayment of EPS foam insulation. This unique combination directs heat where you want it most.

- Insulating and Sound Dampening.
- High Compression.
- High Impact Assembly.
- Flooring Goods Friendly.
- Water/ Mold Resistant EPS Foam.
- MR 30 Moisture Resistant
- Uses Same Tubing as Thermalboard™

MOST FREQUENTLY ATTACHED WITH ADHESIVE TO CONCRETE. EXTRA ANCHORS MAY BE REQUIRED IN SOME CIRCUMSTANCES.



THERMALBOARD PRODUCTS

THERMALBOARD™ RADIANT FLOOR HEATING SUSTAINABLE PANEL SYSTEM

Perfect for modern homes and specifiers who strive to include both efficiency and sustainability in their building heating solutions. Thermalboard is the superior selection over wood fiber or gypsum radiant panels. Use quality 3/8" PEX OR PERT pipe as specified in *Associated Products Appendix* of this manual. These pipes measure on the outer diameter .5" +/- .004" and must meet the standards specified.

Thermalboard™ Part Infomation

PART NUMBER	DESCRIPTION	DIMENSIONS	WEIGHT	PALLET	R-VALUE
TBPRO-S2	Thermalboard Straight	16"x48"x 5/8"	13.4	99	.5
TBPRO-C2	Thermalboard Combo	16"x48"x 5/8"	13.4	99	.5

THERMALBOARD™ EPS PATENT PENDING

Thermalboard™ EPS Part Infomation

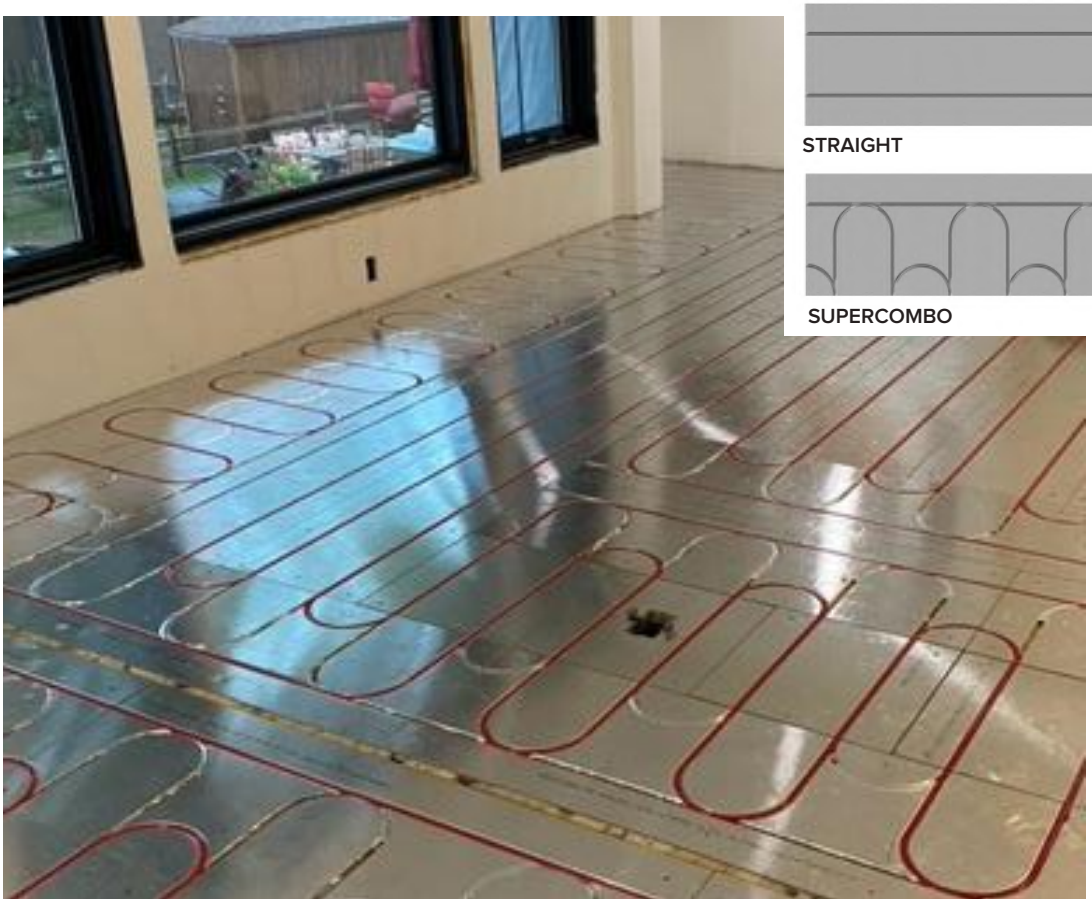
PART NUMBER	DESCRIPTION	DIMENSIONS	WEIGHT	PALLET	R-VALUE
TBEPS0375-S2	Thermalboard Straight EPS .375" Foam	16"x48"x1"	13.7	96	2.25
TBEPS05-S2	Thermalboard Straight EPS .05" Foam	16"x48"x1.125"	13.9	93	2.87
TBEPS075-S2	Thermalboard Straight EPS .75" Foam	16"x48"x1.375"	14.1	90	4.00
TBEPS10-S2	Thermalboard Straight EPS 1" Foam	16"x48"x1.625"	14.3	75	5.18
TBEPS20-S2	Thermalboard Straight EPS 2" Foam	16"x48"x2.625"	15.2	48	9.85
TBEPS035-C2	Thermalboard Combo EPS .375" Foam	16"x48"x1"	13.7	96	2.25
TBEPS05-C2	Thermalboard Combo EPS .05" Foam	16"x48"x1.125"	13.9	93	2.87
TBEPS075-C2	Thermalboard Combo EPS .75" Foam	16"x48"x1.375"	14.1	90	4.00
TBEPS10-C2	Thermalboard Combo EPS 1" Foam	16"x48"x1.625"	14.3	75	5.18
TBEPS20-C2	Thermalboard Combo EPS 2" Foam	16"x48"x2.625"	15.2	48	9.85

THERMALBOARD EPS™ RADIANT FLOOR PANEL HEATING SYSTEM

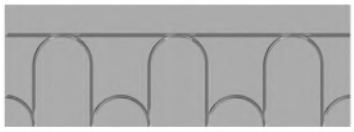
Perfect for modern homes and very suitable for retro-fitting old basements with uninsulated slabs. Can also be easily used on radiant walls and ceilings or to upgrade insulation over a crawl space. The 3/8" and 1" are standard foam thicknesses, however additional thicknesses of foam may be special ordered.

As opposed to the older method of putting the hydronic tubing in the slab, EPS panels deliver a faster response time and higher efficiency over concrete. Use quality 3/8" PEX OR PERT pipe as specified in "Associated Products" Appendix of this manual. These pipes measure on the outer diameter .5" +/- .004" and must meet the standards specified.

THERMALBOARD™ AND THERMALBOARD EPS™



STRAIGHT



SUPERCOMBO

ESTIMATING THE REQUIRED NUMBER OF BOARDS

The following applies to both Thermalboard™ and Thermalboard EPS™

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 us to get 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 factors: Straight—0.11 and 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 estimate to cover for waste and errors.

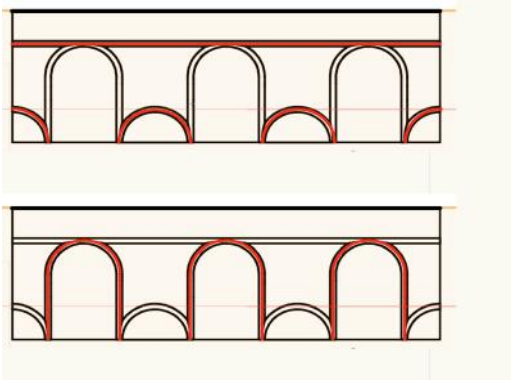
UNDERSTANDING DIFFERENCES BETWEEN COMBOS AND STRAIGHTS

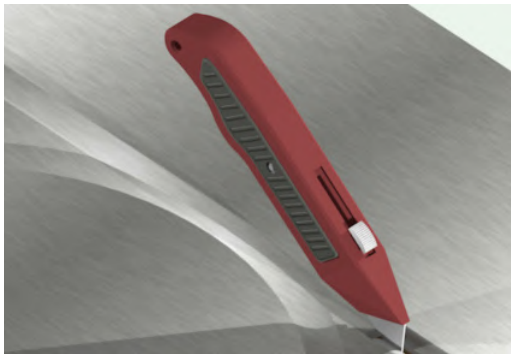
Thermalboard™ and Thermalboard EPS™ Combos and Straights are made differently for a reason. The higher density MDF substrata is by itself quite conductive, and is significantly enhanced by the conductive layer of alumminum laminated across the board.

THE STRAIGHTS: The conductive alumuminum layer is indented at the tubing grooves factory slit and pushed down along the side of the tube grooves for good contact with the tubing.

THE COMBOS: Laminated and indented at the numerous tubing channels. Only some of the choices of tubing channels are used on any Combo. Leaving the aluminum intact over the unused grooves maintains the continuity of lateral heat transfer. For the combo grooves use:

1. **Use a high quality utility knife.**
2. **Mark the channels you need to slit.**
3. **Slit the middle of the tubing channels you are going to use (shown red).**
4. **Walk the tubing into channels.**
5. **Use a flat piece of plywood and a rubber mallet to tap PEX tubing in place if neccessary.**



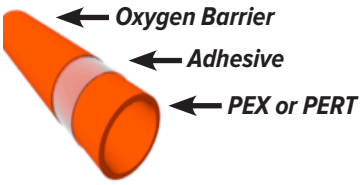


UNDERSTANDING PEX AND PERT HYDRONIC TUBING

Thermalboard™ and Thermalboard EPS™ may be used with PEX or PERT tubing made by quality manufacturers and manufactured to the appropriate standards. DO NOT USE PEX/AL/PEX (pex aluminum pex) since it ovals slightly going into our undercut groove and will not be retained well in the groove and protrude above the board due to its ovality.

USE OF OXYGEN BARRIER PEX AND PERT TUBING

Use of tubing with an oxygen barrier is highly advised to reduce likelyhood of corrosion of metal parts in the system. PEX pipe is avalable with an outer EVOH layer that is the oxygen barrier. PERT pipe is available with an outer oxygen barrier layer or in a version that sandwiches the oxygen barrier between two PERT layes. This has the advantage that the oxygen barrier is protected by being in the middle. PERT pipe is more flexible than PEX and may be an aid to faster installation. PERT is often also referred to as PE-RT.



PEX OR PERT WITH OUTER OXYGEN BARRIER LAYER

PERT WITH INNER OXYGEN BARRIER LAYER

Properly manufactured tubing is a lifetime investment. Buy a quality brand from a company with an established history and warranty in the United States and Canada. PEX Pipe should be certified to ASTM F876, ASTM F877 for Use in the USA, and/or CSA B137. 5. for use in Canada. PERT pipe should be certified to ASTM F2623 for Polyethylene of Raised Temperature PE-RT.

IMPORTANT: FOLLOW LOOP LENGTH RECOMMEDATIONS ON NEXT PAGE!

USE OF NON TOXIC ANTIFREEZE: In climates subject to freezing it is advisable to use non toxic antifreeze to protect pipes from freezing. The most common form of this is Propylene Glycol. Do not use Ethylene Glycol (automotive type antifreeze) since it is very toxic. Buy only premium brands from a knowledgeable supplier who can assist you, provide you test kits for maintenance, and give good advice about use of corrosion inhibitors if advisable for your system. Remeber to calculate the amount of fluid in your system. You need the total volume of fluid in your heat source, mechanical room piping, supply and return lines including your manifolds and the total amount of fluid in your radiant tubing.

TB LOOP LENGTHS

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

TUBING AND LOOP LENGTHS

Thermalboard™ and Thermalboard EPS™ are designed for use with 3/8" nominal ASTM F-876 or F-877 PEX (cross-linked polyethylene) or ASTM F2623 PERT (polyethylene of raised temperature) 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 (shaded area = over 25 BTU/s.f.). Friction losses in the chart are approximate; actual friction losses depend on fluid viscosity and temperature. Determine the square footage and multiply 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, you could use three 250' loops and one 150' loop, provided that the flow to the different loops is balanced by using and correctly adjusting balancing valves on each loop.

THERMALBOARD™ 250' LOOPS 20°F TEMPERATURE DROP — CHART C-2

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

**Shaded areas have high head loss*

THERMALBOARD™ 200' LOOPS 20°F TEMPERATURE DROP

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

DESIGNER'S NOTE

Average water temperature means *the average of supply and return water temperatures flowing to and from the loop*. 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.

THERMALBOARD INSTALLATION

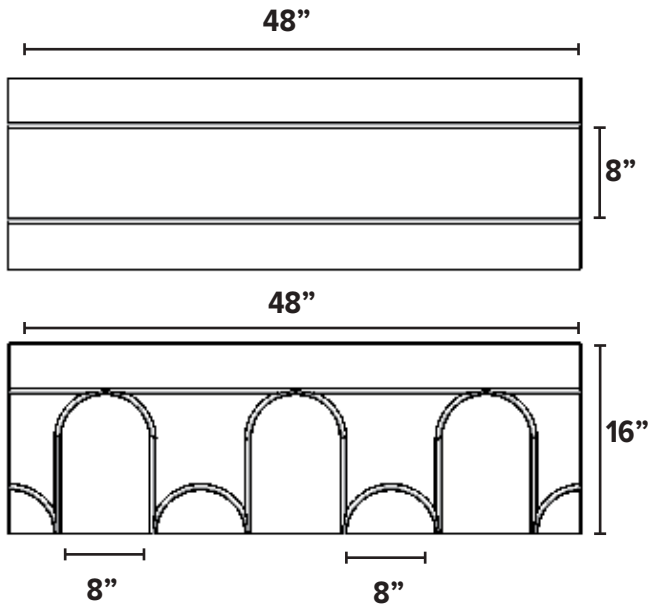
Thermalboard™ and Thermalboard EPS™ come in two different board configurations: Straight and Combo. The boards are arranged to create a continuous channel for each loop. Each board type measures 16” x 48”. The grooves are centered 8” apart. Thermalboard™ is easily cut with a circular, table or radial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

STRAIGHTS are normally used about 68% of the time and **SUPERCOMBOS** about 32% of the time. The panels are shipped to your job site palletized and shrink wrapped then field cut to the various sizes your plan requires. An experienced installer may 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

The length, width, and tubing channels of the two panel designs of Thermalboard™ and Thermalboard EPS™ are identical, but the thickness of the EPS boards are different.



Top: Straight Panel ***Bottom:*** Supercombo Panel

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

INSTALLATION ESSENTIALS

PROPER STORAGE AND MOISTURE CONTACT — GUIDELINES

Thermalboard™ and Thermalboard EPS™ should always be stored in a temperate, dry place (40F°— 90F°). Avoid prolonged exposure to sunlight. Do not store in a damp location. Follow all instructions in this manual to protect the boards from prolonged contact with moisture. If these instructions are not followed board expansion could create undesirable results.

THERMALBOARD EPS™ SHIPPING

Pallet weight varies with thickness. See product specs on page 13. Pallet Appearance: Shrink wrapped, Corners Protected. Recommended Product Mix: Straight 68%, Supercombo 32% (Allow 10% extra for waste)

TRADITIONAL 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 panels per row, 33 rows stacked per pallet]

Approximate Pallet Weight: 1386 lbs

Approx. Truckload Quantity: 16,357.77 square feet or 31 pallets / 42,966 lbs.

Pallet Appearance: Shrink wrapped. Corners protected.

Recommended Product Mix: Straight 68% Super-combo 32% (Allow 10% extra for waste)

SUBFLOOR REQUIREMENTS — FLAT, DRY, QUIET

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 with a leveling compound. Allow the leveling compound to dry thoroughly before beginning the installation. Check with the compound manufacturer to be sure it is compatible with the application. High areas can be grinded down or floated over with a self-leveling compound. Finally, 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 potential water problems.

High areas on the subfloor should be sanded or planed. Patch or fill low areas with an appropriate leveling compound or cover with a rigid underlayment. Follow the manufacturers recommendations when using a leveling compound and allow to dry before you begin installing the floor.

EQUIPMENT FOR INSTALLATION OVER WOOD SUBFLOORS

You'll need the following tools to install Thermalboard™ or Thermalboard EPS™:

- **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)
- **Screws** of sufficient length to penetrate subfloor min. 1/2" (if using screws)
- **Impact Drill** if installing ThermalboardEPS™
- Recommended **glue or adhesive**
- 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

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 between rooms (hallways can be particularly tricky), allow proper zoning, and ensure all loops arrive at the manifold(s) within the loop length guidelines. While the Thermalboard system helps simplify the design process, piecing together a system can be complex, especially if it's your first time. Your Thermalboard™ sales rep can help you arrange this design service.





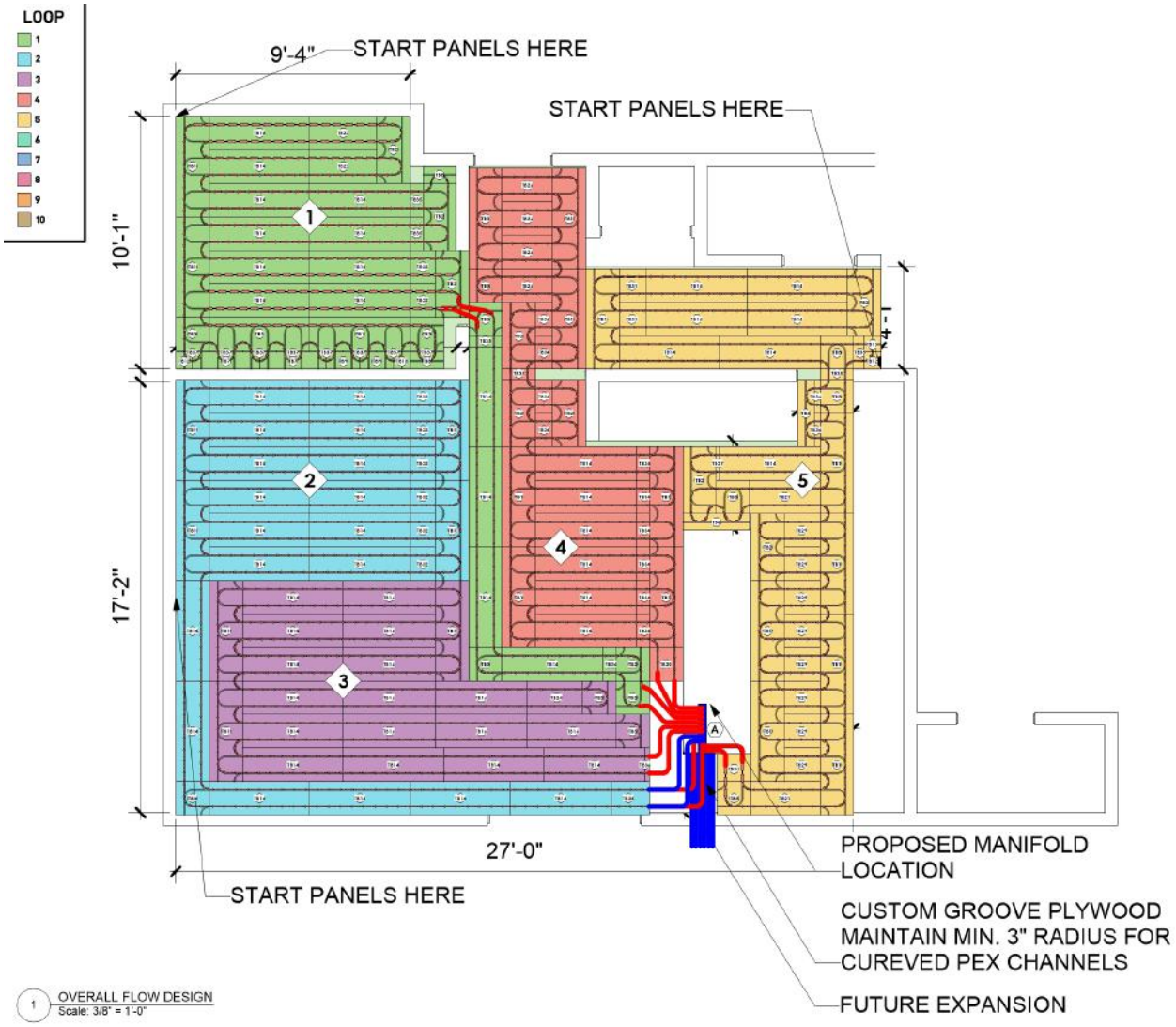
INSTALLATION STEP BY STEP

UNDERSTAND HOW TO SPACE THE BOARDS

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

When aligning Straight panels with the Supercombo ends by using a 6” piece of tubing, 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 panels, but most importantly, always make sure all grooves align.

SAMPLE CAD GENERATED BOARD LAYOUT



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 ends. Make sure to cut each board square and align them carefully as your arrange the panels on the subfloor, so that each subsequent piece will fit correctly. This is not difficult, but paying attention to squareness as you cut will prevent major problems as the job progresses.

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

HOW TO ALIGN THE TUBING GROOVES

The easiest way to ensure tubing grooves are correctly aligned between boards is to cut 6" pieces of 3/8" ASTM F-876 PEX or ASTM 2623 PERT to use as alignment tools. First place the boards close to the desired alignment, then press a piece of tubing into each groove. Overlap the tubing by roughly 3" into the groove of each panel. After the board is attached, these should be removed.

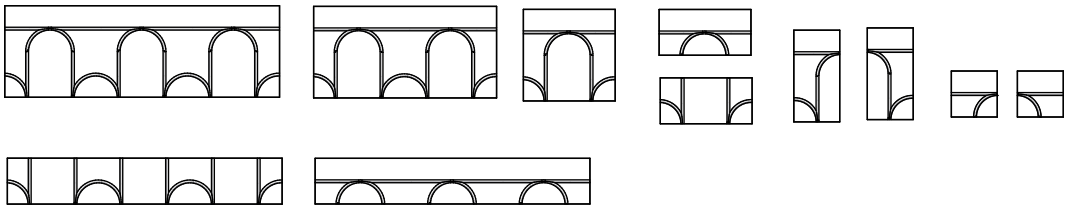
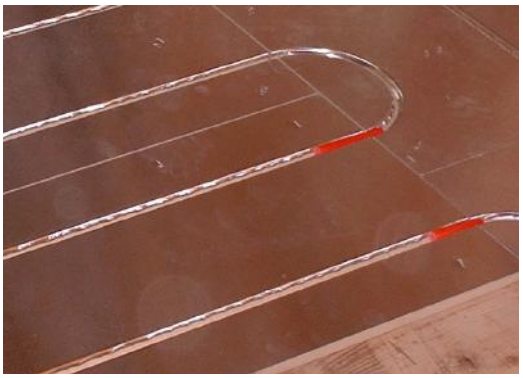


Illustration: Common panel configurations. Refer to the sample cuts.



Right: Use 6" sections of PEX tubing as alignment guides when laying out the panels. These should be removed when laying PEX.

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 including 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 ensures 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 top level of the panel 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 specifications on page 40
- **DO NOT USE PEX-AL-PEX!** It will not fit properly into a Thermalboard™ groove. See Specification page.

INSTALLER'S NOTE: THE THERMALBOARD™ GROOVES

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

CONNECTIONS AT THE MANIFOLD

Manifolds are usually located in a space with an access panel near the heating zone they serve—in places like 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:

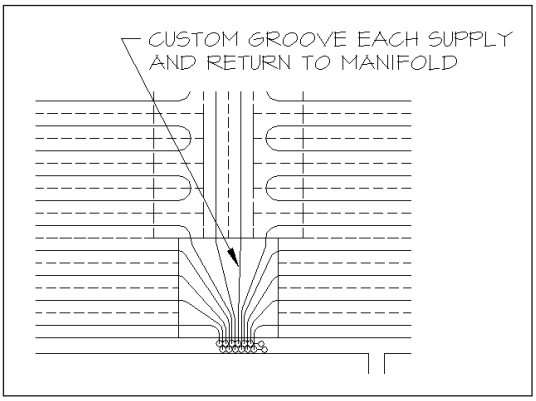
1. **Insert tubing directly into the Thermalboard™ grooves, which works when just a few loops end adjacent to the manifold location.**

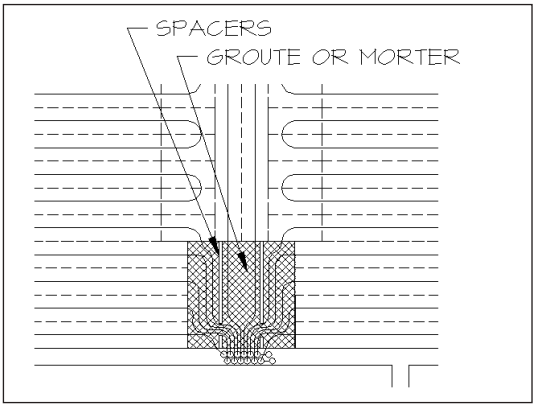
2. **If there is a level change required, drill a tapered slot through the subfloor, dive the tubing under the floor, and bring it up again to attach to the manifold.**

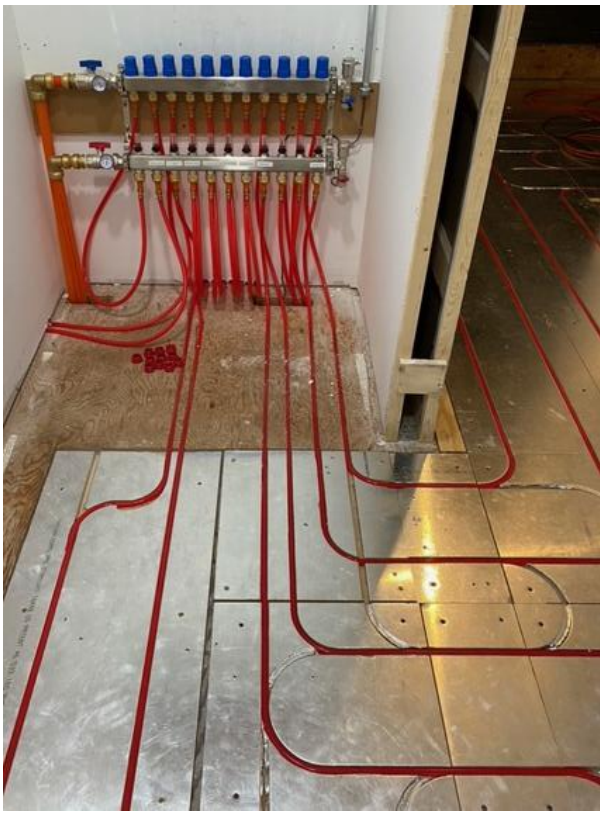
3. **Place a solid MDF sheet next to the manifold into which supply and return lines are custom routed to the grooves of the Thermalboard™.**

4. **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.



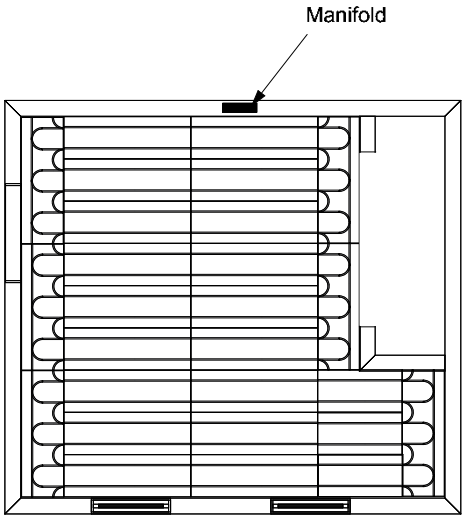


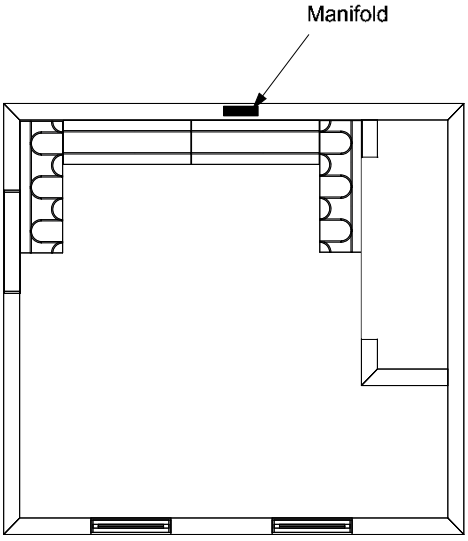


EXAMPLE LAYOUT AND INSTALLATION — THERMALBOARD™ PRODUCTS

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.



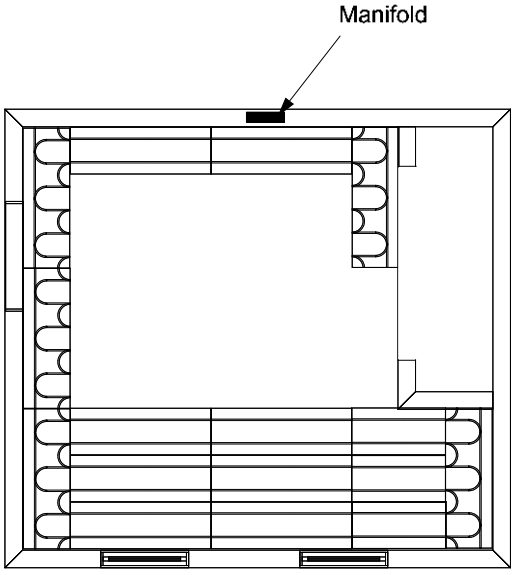


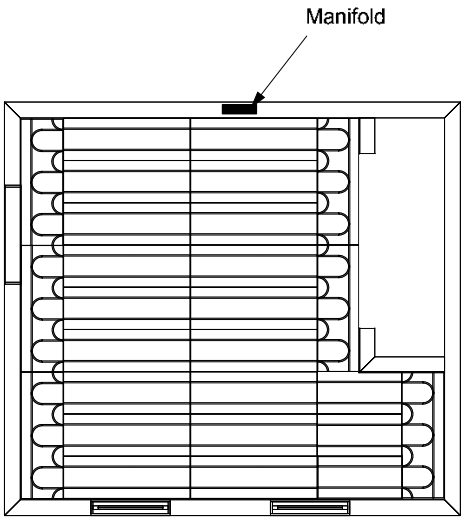
INSTALLATION STEP 2

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 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.





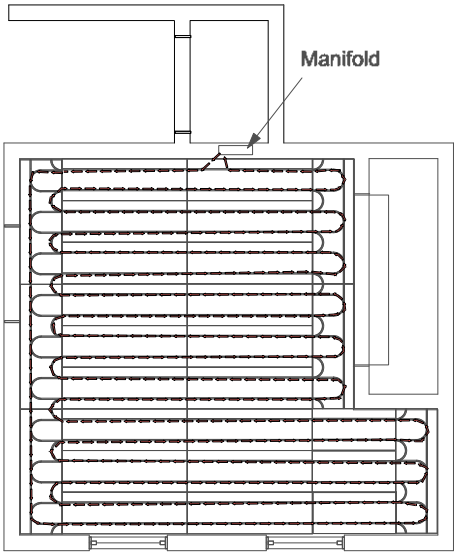
INSTALLATION STEP 4

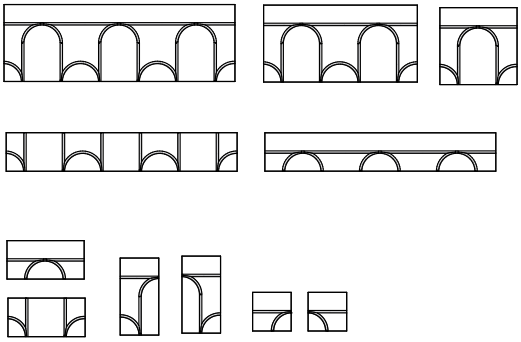
Feed enough supply tubing to route to the manifold as specified by your layout either through a drilled supply hole below the floor, or before the start of a groove - if the groove goes directly to the manifold. Once all the grooves have been thoroughly cleaned with a vacuum cleaner, the tubing may be 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 uses a straight channel to go down the wall with no offsets, and is woven back using the curved channels. If you need to create a custom channel to the manifold:

- Use a 1/2” round nose routing bit.
- Do not bend PEX 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.

INSTALLATION OVER WOOD SUBFLOOR

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. Patch or fill low areas with an appropriate leveling compound, or cover with a rigid underlayment. When using a leveling compound, be sure to follow the manufacturer 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 recommended adhesive to the wooden subfloor. Be sure to use adequate adhesive and follow the recommended amount.
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. Penetrate subfloor by minimum 1/2”.
10. Clean out all grooves with a vacuum once all boards are installed.
11. Snap tubing into the groove and route to manifold per plan.
12. Follow specific extra recommendations for each floor covering. Refer to the complete installation manual for further instructions on the installation of the Thermalboard™ system.

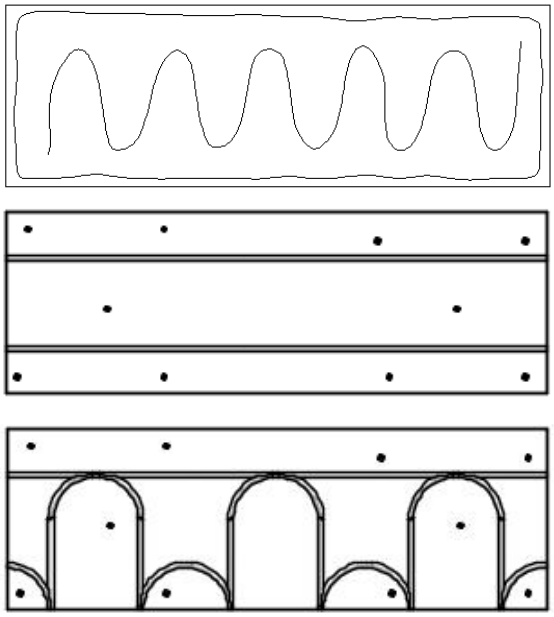
ATTACHING THERMALBOARD™ TO A WOOD SUBFLOOR

GLUING

Thermalboard™ is first glued then screwed or cross-stapled to the subfloor. Each panel 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 in back of manual.*

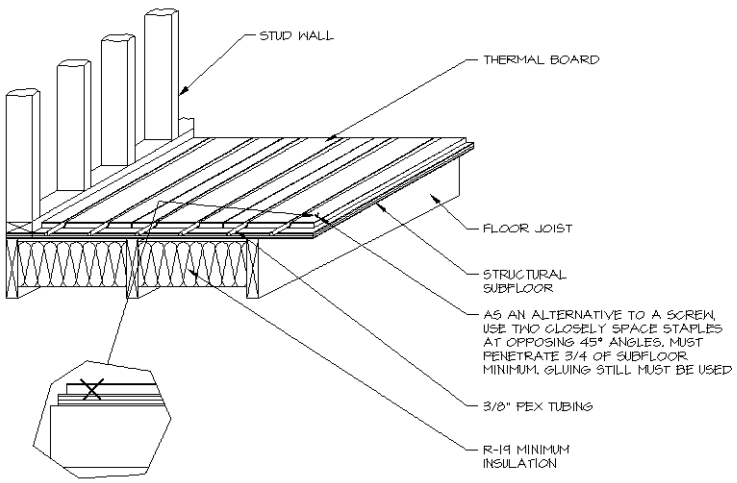
TB GLUING TIPS

- 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. When screwing Thermalboard EPS™ be sure to use long enough screws to penetrate subfloor a min 1/2".



INSTALLATION OVER WOOD SUBFLOOR ILLUSTRATIONS

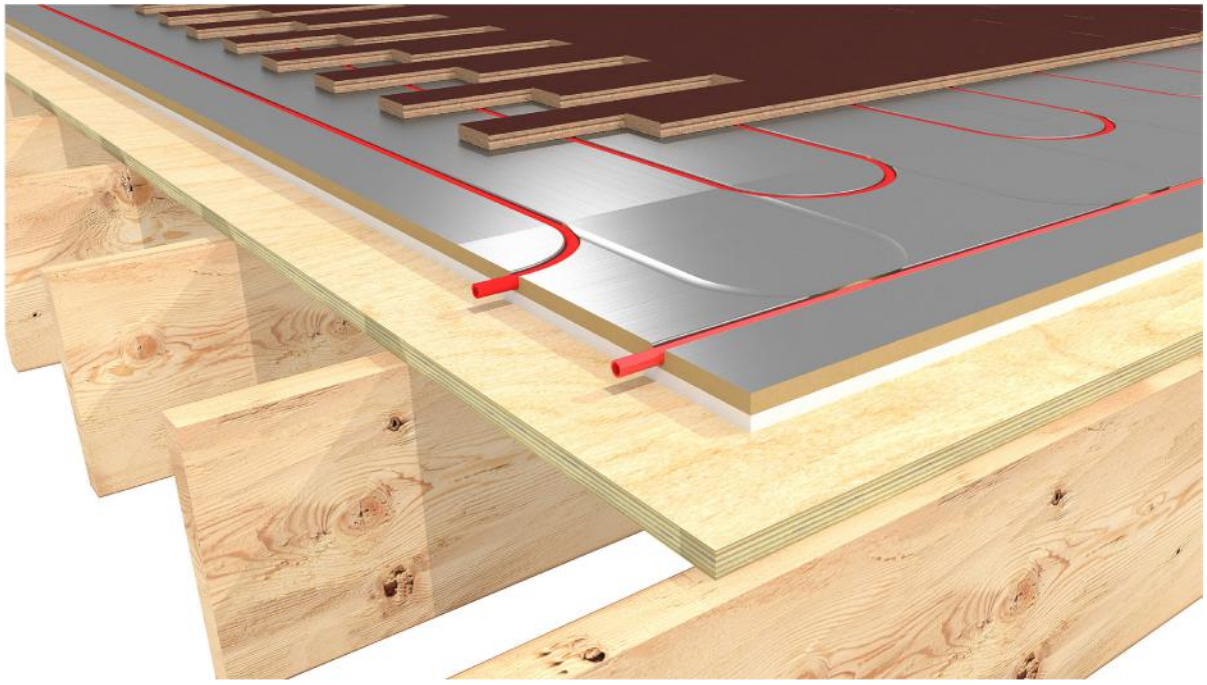


Illustration 1: Thermalboard EPS™ installed over **UNINSULATED** subfloor

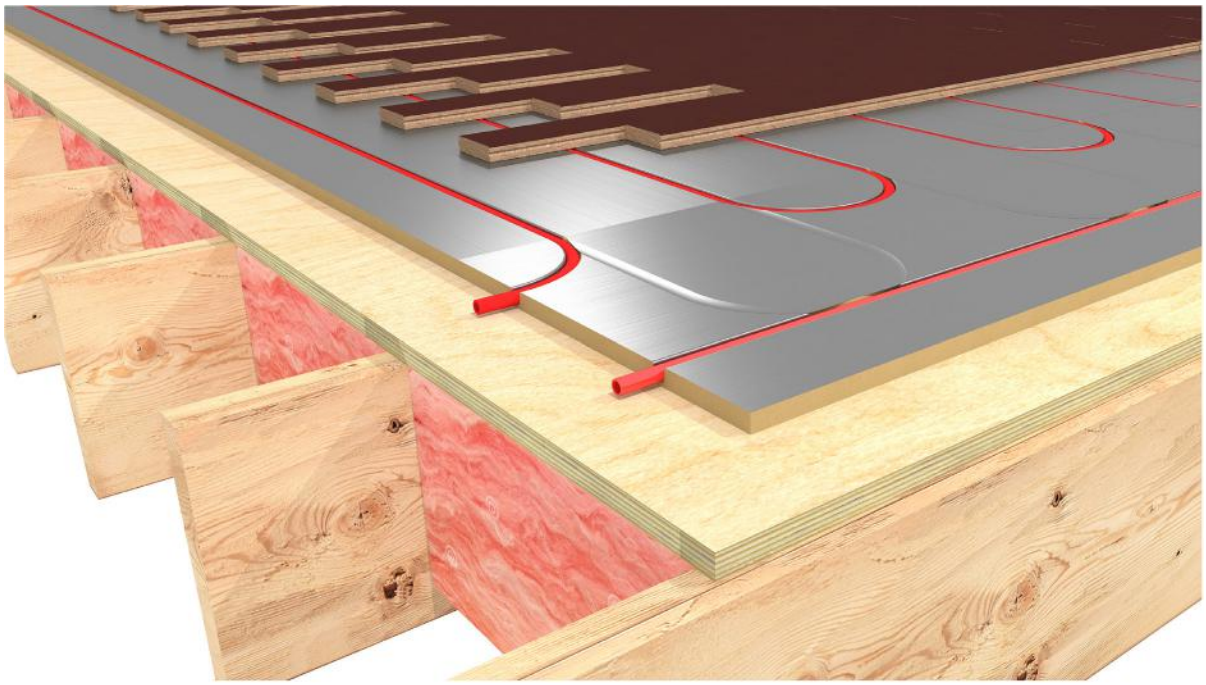
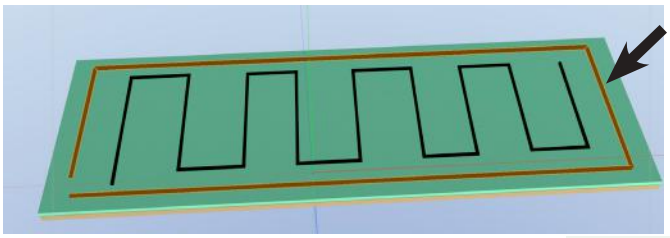


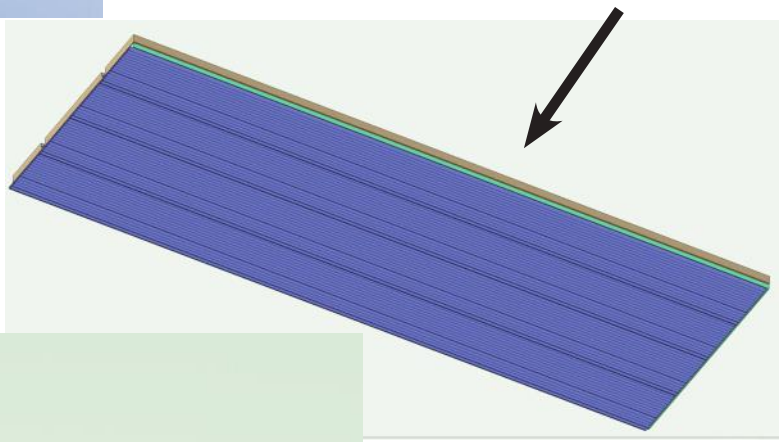
Illustration 2: Traditional Thermalboard™ installed over **INSULATED** subfloor

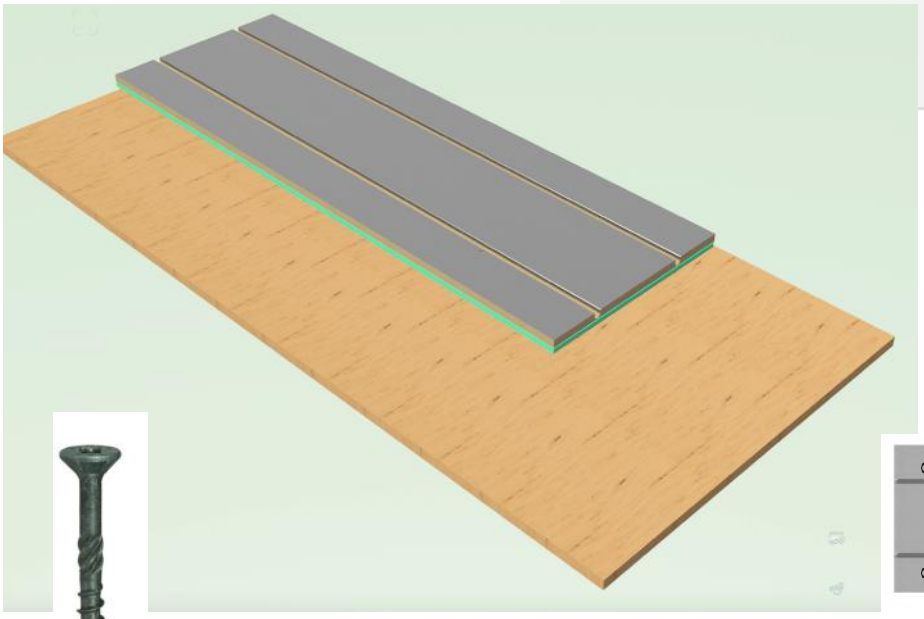
ATTACHING THERMALBOARD EPS™ TO A WOOD SUBFLOOR



To attach Thermalboard EPS™ to a wood subfloor use one of two methods. Either apply a thick 5/16" bead of approved adhesive to the foam side of the panel in the pattern to the left, **or** use a V notch 1/4" trowel as shown below to fully coat the back of each panel.

Firmly press the panels onto the subfloor and using the minimum length screws shown in the chart below screw down at the ten dotted locations shown on the boards. The screws should penetrate the subfloor a minimum of 1/2".

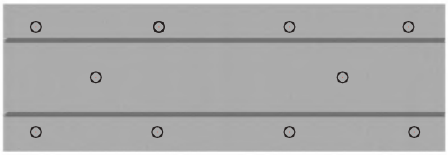




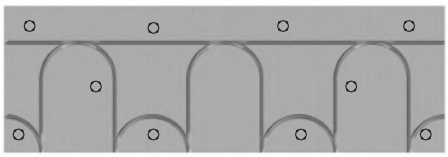
Use 10 quality screws of appropriate length in chart below to attach panels to subfloor. Make sure you penetrate subfloor a minimum of 1/2". Align panels as you go with short pieces of tubing.

CAUTIONS

Many adhesives that bond to foam can damage PEX tubing. Use recommended adhesives. Be aware of screw lengths if electrical or plumbing are directly underneath the subfloor.



Top: Straight panel screw location.
Below: Combo board screw pattern.



BOARD TYPE	DESCRIPTION	THICKNESS	MINIMUM SCREW LENGTH
TBEPS0375	Thermalboard EPS .375" Foam	1"	1.5"
TBEPS05-S2	Thermalboard EPS .05" Foam	1.125"	1.625"
TBEPS075-S2	Thermalboard EPS .75" Foam	1.375"	1.875"
TBEPS10-S2	Thermalboard EPS 1" Foam	1.625"	2.125"
TBEPS20-S2	Thermalboard EPS 2" Foam	2.625"	3.125"

ATTACHING PANELS TO A CONCRETE SUBFLOOR

Many older, unheated basements have concrete slabs with no insulation. Retrofitting with Thermalboard EPS™ offers an efficienct, low profile choice. The EPS panel includes pre-bonded foam which minimizes downward heat loss. You may still use traditional Thermalboard over un-insulated concrete however a higher downward heat loss may occur and installing over insulation requires extra work and layers.

MOISTURE ISSUES AND CONCRETE

It is important that a concrete slab be dry and stay dry year around. We recommend adhesives that also act as a moisture barrier, but they have a limit to how much vapor pressure they will withstand. 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 above concrete. Thermalboard™ may be installed over concrete only when the installing parties are willing to assume full responsibility for the installation issues regarding moisture and attachment of Thermalboard™ to concrete. It is the contractors and installers responsibility to test all concrete substrates, both new and old, for moisture content to determine if they are sufficiently dry.

Moisture conditions must be carefully addressed when installing Thermalboard over concrete. 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.

MOISTURE TESTING

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. Ensure the new or existing slab is sufficiently dry and finish sealing the slab before proceeding with the Thermalboard™ installation.

It is strongly recommended that all slabs *below grade* and slabs *on grade* are sealed against moisture penetration before installation of Thermalboard using vapor barriers or a sealant and adhesive product. It is also important to insulated against downward heat loss under the slab or downward

at the perimeter according to the Radiant Panel Association recommendations.

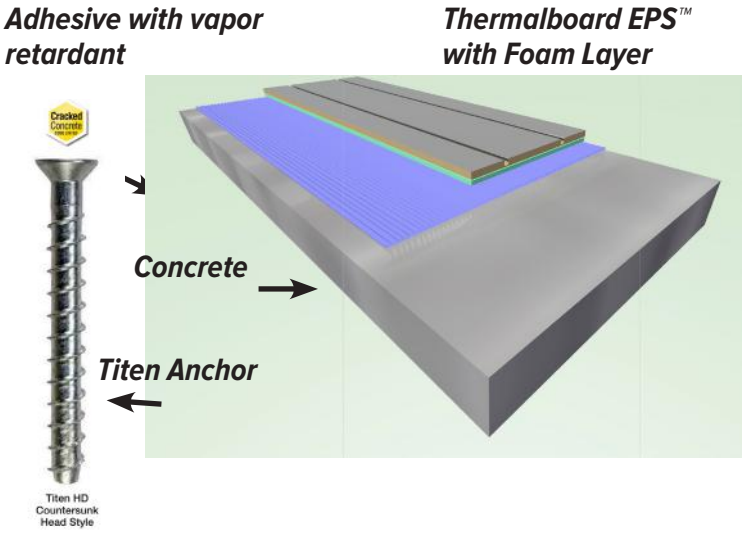
The increasing use in seismic areas of engineered "Seismic Slabs" means that fewer radiant floor heating systems will be installed with tubing in the slab. There will be more need for the Thermalboard EPS™ details and the *3 Ways to Install Traditional Thermalboard Over Concrete* details.

When installing traditional Thermalboard™ without the insulating EPS layer, refer to the details shown on pages 30 and 34. Refer to the Flooring Goods section for more details regarding individual floortypes such as tile or hardwood.

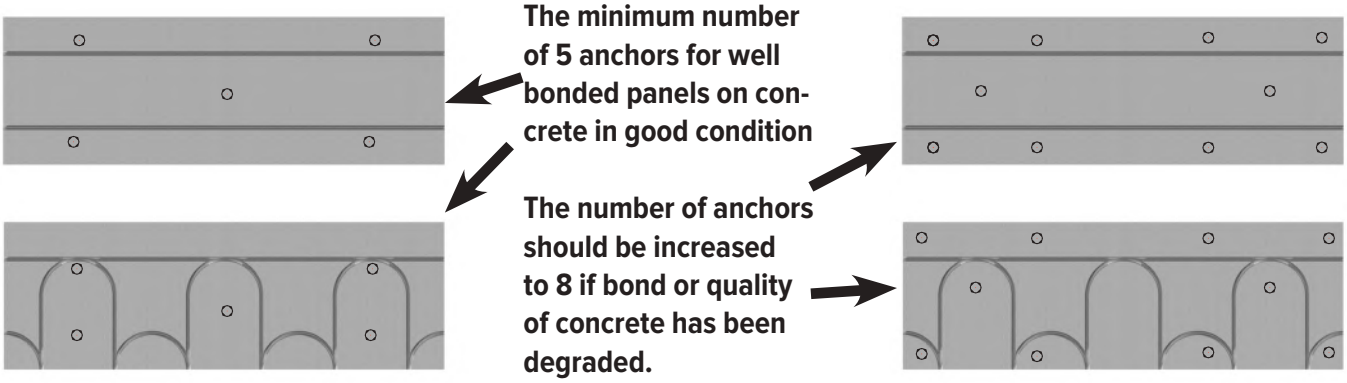
INSTALLING THERMALBOARD EPS™ OVER CONCRETE

Thermalboard EPS™ should be installed with an approved adhesive with a vapor retarding characteristic after being checked for flatness and tested for moisture content. The contractor shall make a test of the bond of the foam to concrete and let it cure to confirm there is a good bond to concrete. Extra security for the bond shall be provided by using a minimum of 4 anchors as shown below or 8 anchors per board in damaged or poorly bonded concrete in the pattern shown below. These anchors also assure that the panels stay in place while the adhesive dries. Cut nails, Tapcons, and Simpson Titan anchors of appropriate length may be used. Of these cut nails and Titen Anchors seem to be the fastest and preferred by contractors. Titen anchors have carbide infused threads and with the proper holes size and depth go in easily and have great holding power.

We recommend using Simpson Strong Tie Titen HD Counter Sink head screws because they have carbide treated threads with lower friction. Tapcons or cut nails of similar size may also be used. To use a Titen HD Anchor: Use a drill bit the same diameter as the nominal diameter of the anchor to be installed. Drill the hole to the specified embedment depth plus minimum hole depth over drill (see information below) to allow the thread tapping dust to settle, and blow it clean using compressed air. Alternatively, drill the hole deep enough to accommodate embedment depth and the dust from drilling and tapping. This is usually min 1/2" extra but you will have to test for right depth. Countersink the hole then insert the anchor through the panel and into the hole. Tighten the anchor into the concrete until the screw head is flush with the aluminum layer. Use the slowest setting on the impact drill for last portion of setting the anchor.



TB PART FAMILY	THICKNESS	SIMPSON LENGTH	SIMPSON PART	DRILL SIZE	BIT SIZE
TBEPS0375	1"	2–3/8"	THBDB25234CS	1/4"	T30
TBEPS05	1.125"	3–1/2"	THBDB25274CS	1/4"	T30
TBEPS075	1.375"	3–1/2"	THBDB25274CS	1/4"	T30
TBEPS10	1.625"	3–1/2"	THBDB25274CS	1/4"	T30
TBEPS20	2.625"	4"	THD37400CS	3/8"	T50



THERMALBOARD EPS OVER CONCRETE ILLUSTRATIONS

NOTE: Thermalboard EPS™ is the recommended product for installing radiant heat over un-insulated concrete. It streamlines the installation process over un-insulated concrete. Unless your existing slab is already insulated, we recommend Thermalboard EPS as the superior and preferable product to use over concrete.

When installing traditional nail down wood flooring to Thermalboard EPS™ the nails should penetrate into the EPS but should not hit concrete. Traditional Thermalboard™ methods 2 and 3 on next page have better nail holding due to nails penetrating plywood.

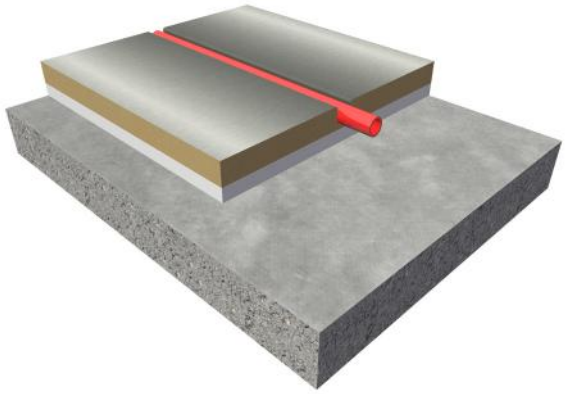


Illustration 1: Thermalboard EPS™ installed over **concrete** subfloor

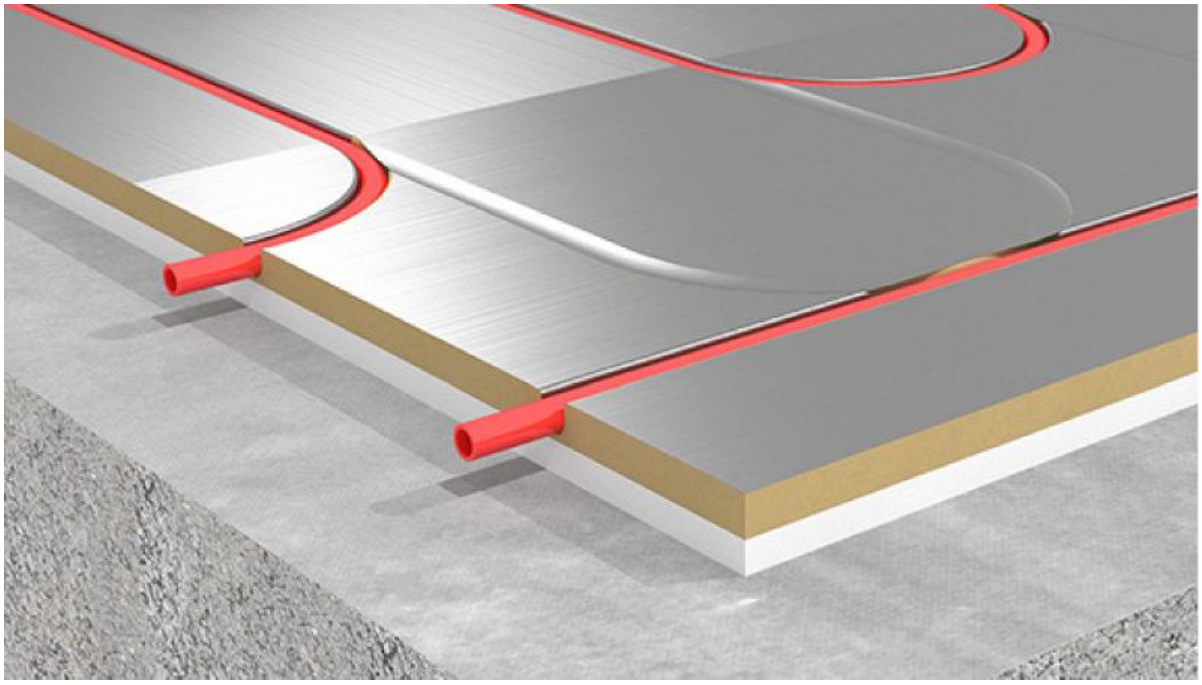


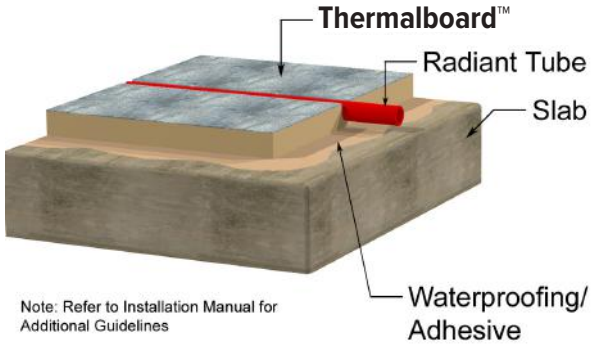
Illustration 2: Thermalboard EPS™ installed over **concrete** subfloor

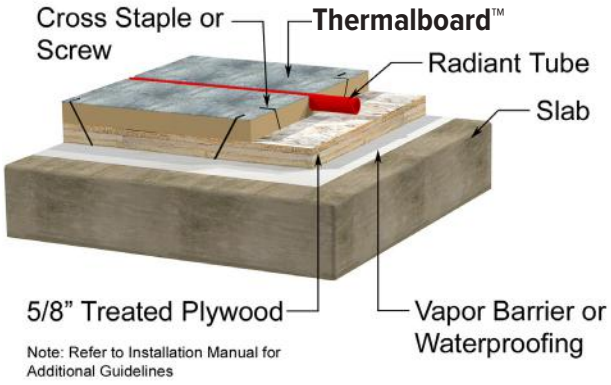
3 WAYS TO ATTACH OR FLOAT TRADITIONAL THERMALBOARD™ OVER CONCRETE

NOTE: Thermalboard EPS, as noted on previous page, is often the best choice over un-insulated concrete, not methods shown below. Method 1 below is a good choice over insulated concrete. It's use over un-insulated has the advantage of thinness but will result in significantly higher downward heatloss. Methods 2 and 3 allow traditional hardwood flooring nails to penetrate through the MDF into plywood which is preferred by many flooring installers and manufacturers.

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.



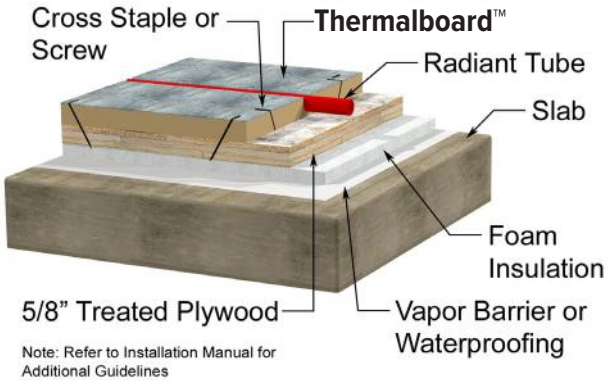


2) THERMALBOARD™ OVER PLYWOOD AND VAPOR BARRIER OR WATERPROOFING

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. The contractor should verify that moisture conditions are adequately controlled by the use of a sealant on the slab or a vapor barrier over or under the slab. As another option consider using Thermalboard EPS. This product has EPS foam preattached to the bottom of the panel allowing you to skip the foam insulation layer.



THERMALBOARD FLOOR COVERINGS

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.

USE THE SAME ASSEMBLIES FOR THERMALBOARD EPS™

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 provide a general overview 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 ensure 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™ can be installed over a wooden subfloor or concrete. Installation over concrete requires extra care and an assured dry slab. When installing Thermalboard™ over concrete refer to the instructions, limitations, and details on other pages.

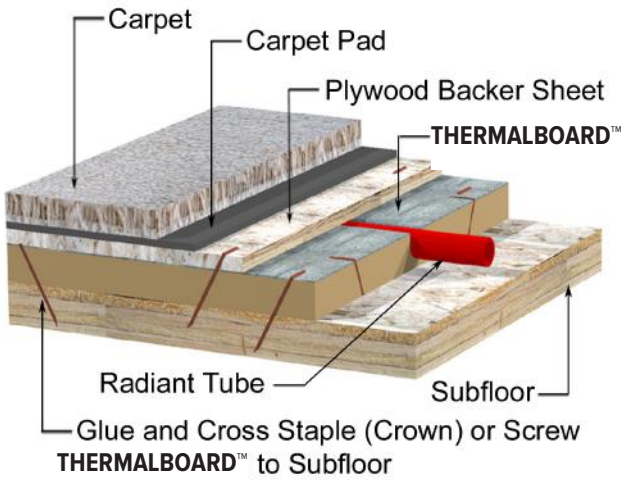
IMPORTANT: THERMALBOARD™ RECOMMENDED RELATED PRODUCTS

Optimum performance of Thermalboard™ installation depends on the use of our recommended associated products. As you consult the Thermalboard™ floor covering guidelines please keep these product recommendations in mind.

CARPET OVER THERMALBOARD™

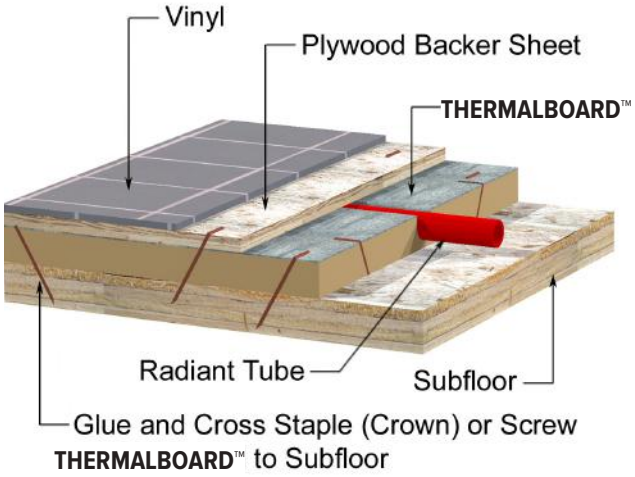
Thermalboard™ shall be installed over a wooden subfloor in compliance with *General Thermalboard™ Installation Requirements For All Flooring Over Wood Subfloor*.

Carpet and pad may be installed over Thermalboard™. Take care to avoid puncturing the tubing when installing the pad. 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. Ensure glue is applied to the underlayment plywood - do not glue to Thermalboard™ or the tubing! Maintain 2" minimum tubing clearance from carpet tack strips.



VINYL OVER THERMALBOARD™

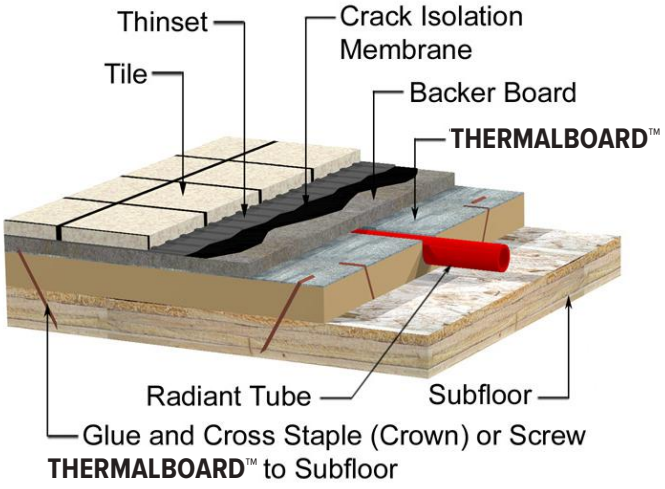
Install Thermalboard™ over a wood subfloor per *General Thermalboard™ Installation Requirements For All Flooring Over Wood Subfloor*. Also follow these specific cautions and instructions: When installing sheet vinyl flooring, first apply a thin layer of underlayment plywood over Thermalboard™. Add a sealant layer in wet locations. 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 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*. Follow these specific cautions and instructions. Use backer board over Thermalboard™ when installing over masonry, tile, or stone; then apply thinset mortar. Use a water sealant layer (i.e. Nobleseal or similar waterproof membrane) in any kitchen, bath, laundry room, or any other area where water may be present.

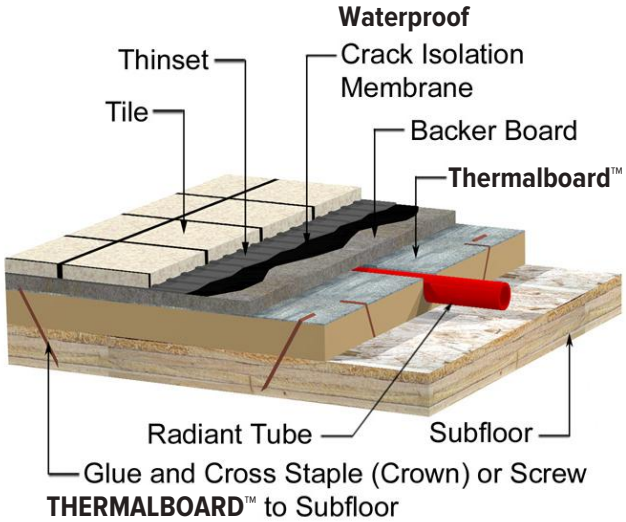
Do not install crack isolation membranes directly to Thermalboard™—many of them use materials incompatible for contact with PEX. Maintain a 2" minimum tubing clearance when screwing down backer board. Refer to this complete installation manual for further instructions on the installation of the Thermalboard™ system.



INSTALLER CAUTIONS:

- **Do not omit the backer board 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



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

TB NOTES ON SEALING

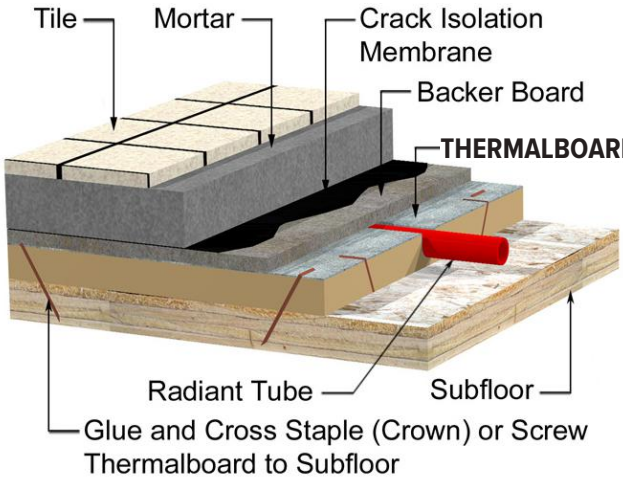
- The aluminum layer on the top of each panel is highly water resistant. Thus, using silicon sealant as a caulk between the boards gives you a significant degree of moisture protection. Properly applied, this will profoundly reduce the likelihood of water transmission into the boards.
- This is not a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

USE THE SAME ASSEMBLIES FOR THERMALBOARD EPS™

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.*

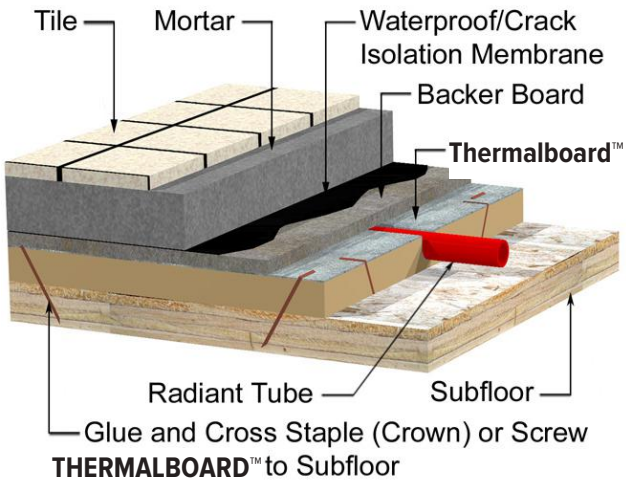
Follow these specific cautions and instructions. When installing masonry, tile, and stone, use backer board over Thermalboard™ then a conventional mortar bed. In the kitchen, bath, laundry or any other area where water may be present, a water sealant (i.e. Nobleseal or an equivalent waterproof membrane)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

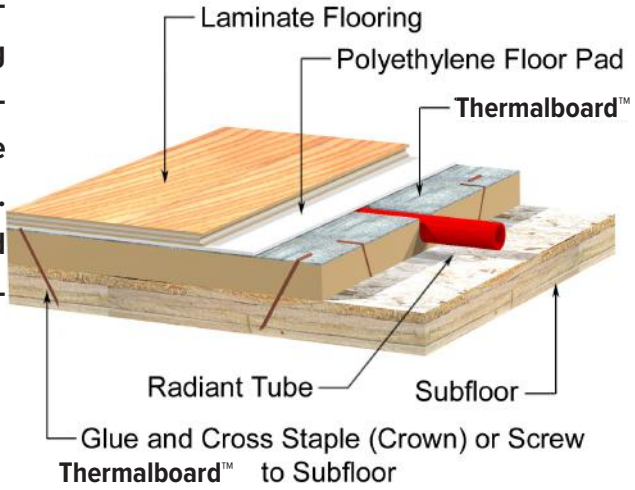
TB NOTES ON SEALING

- The aluminum layer on the top of each panel 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.

USE THE SAME ASSEMBLIES FOR THERMALBOARD EPS™

LAMINATE OVER THERMALBOARD™

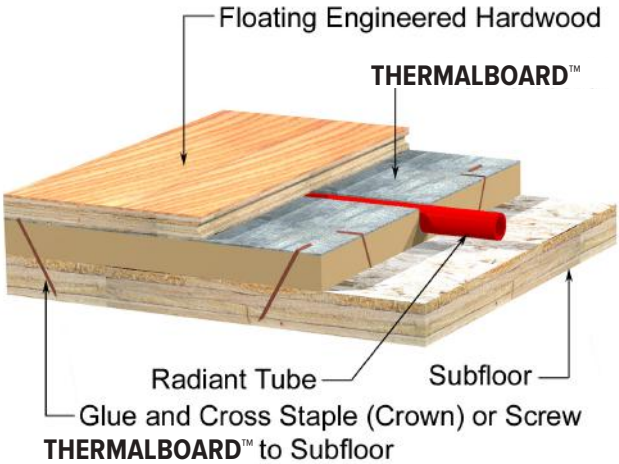
Thermalboard™ shall be installed over a wooden subfloor in compliance with *General Thermalboard™ Installation Requirements For All Flooring Over Wood Subfloor*. In addition, these specific cautions and instructions shall be followed. When installing laminate flooring in wet locations, apply a thin layer of plywood underlayment over Thermalboard™. A sealant layer should be added over the underlayment layer of plywood. Some laminate flooring products are 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. 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 temperature specifications.



ENGINEERED WOOD OVER THERMALBOARD™

Thermalboard™ shall be installed over a wooden subfloor in compliance with *General Thermalboard™ Installation Requirements For All Flooring Over Wood Subfloor*. Follow these specific cautions and instructions. Some engineered wood flooring products are 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. Install engineered wood flooring crosswise to Thermalboard™ whenever possible.

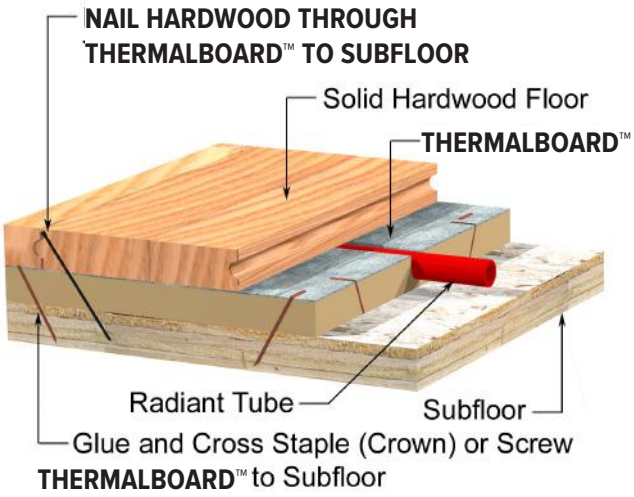
Engineered wood flooring installed over Thermalboard™ should employ controls that gradually adjust water temperature going to the panels with a reset curve. A floor temperature limiting sensor can be used to comply with flooring manufacturer temperature specifications.



USE THE SAME ASSEMBLIES FOR THERMALBOARD EPS™

TRADITIONAL HARDWOOD INSTALLED DIRECTLY OVER THERMALBOARD™

A conventional nailed and hardwood system may be used directly over Thermalboard™ by using nails long enough to penetrate the subfloor and recommended controls. Thermalboard™ shall be installed over a wooden subfloor in compliance with *General Thermalboard™ Installation Requirements For All Flooring Over Wood Subfloor*. In addition, follow these cautions and instructions:



1. Hardwood floor nails shall be long enough to penetrate both hardwood and subfloor.
2. 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.
3. 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.
4. 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.
5. Structure humidity shall be kept within the range specified by the manufacturer.
6. The wood flooring shall be installed at the relative humidity recommended by the manufacturer for the climate involved.
7. Use narrower 2"–3 1/2" strips of wood flooring over radiant floors.
8. The lessons of local practice and climate shall be referenced.
9. 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.
10. The flooring product shall be allowed to acclimatize before installation.
11. Use woods known to be dimensionally stable.
12. Take care to avoid nailing the tubing.
13. Hardwood floor joints shall not be installed directly at the Thermalboard™ joint.

USE THE SAME ASSEMBLIES FOR THERMALBOARD EPS™ but use foam rather than plywood under the board. It is also recommended to use glue.

CONSIDERATIONS: WOOD FLOORS AND THERMALBOARD™

TRADITIONAL STRIP WOOD FLOORING OVER THERMALBOARD™ AND THERMALBOARDEPS™

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.

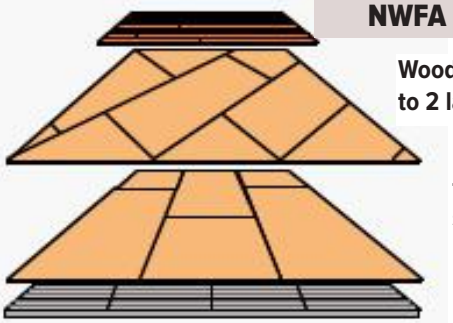
SURFACE TEMPERATURE — The maximum surface temperature of a wood floor should be limited to 85°F. Use a control strategy that assures this will not be exceeded and brings the floors through temperature changes gradually.

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.

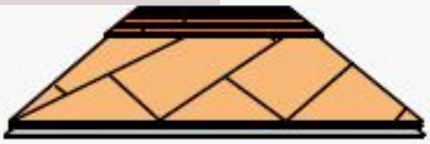
NWFA DOUBLE PLYWOOD FLOATING METHOD



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 into contact with the PEX 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 have extensive experience 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 so 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 recommendations for installation over radiant heat.

CHECKLIST — INSTALLING THERMALBOARD™ OVER CONCRETE

FOR ALL REGULAR FLOORING GOODS EXCEPT STRIP WOOD FLOORING

NOTE: Thermalboard EPS™ is the recommended product for installing radiant heat over un-insulated concrete. It streamlines the installation process over un-insulated concrete. Unless your existing slab is already insulated, we recommend Thermalboard EPS is the superior and preferable product to use over concrete.

Installation shall comply with one of the installation methods on Page 33 or 34 and installing parties must accept responsibility for and understand all cautions 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™ or ThermalboardEPS™ 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™ productwill be applied.
2. Prevent moisture penetration through slab either by sealing concrete with a vapor sealant or adhesive with integral moisture retardant such as Bostik Green Force per manufacturer's guidelines. A continuous unperforated under slab vapor barrier or above slab vapor barrier as shown on page 35 are also acceptable.
3. Follow one of the details in this manaual, chalking lines on floor as reference points and lay out boards according to plan.
4. If glueing Thermalboard™ to concrete sealed with a sealnt, be sure to use adequate adhesive compatible with vapor sealant to glue down the Thermalboard™ to the membrane. See preferences for using Thermalboard EPS™ on page 34.
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. Clean out all grooves with a vacuum prior to tubing installation.
9. Snap tubing into groove and route to manifold per plan.
10. Install backer board 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 WITH TRADITIONAL THERMALBOARD

NOTE: Thermalboard EPS™ may be used for nail down or glue down wood flooring, but nail down will have reduced holding power from penetrating through the Thermalboard™ into foam instead of the T&G plywood. Plywood or OSB are preferred by many installers for nail down wood floors.

Installation of traditional Thermalboard™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 31 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 sealant or adhesive with an integral vapor retardant such as Bostik Green Force, per manufacturer's guidelines. A continuous unperforated under slab vapor barrier or above slab vapor barrier as shown on page 34 are also acceptable.**
3. **Follow one of the 2 details on page 34 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 or if with EPS into foam. 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). See note at top of page regarding nail down holding power**
12. **Foam under plywood may be used instead of plywood alone, as shown on page 34.**
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 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.**

THERMALBOARD™ OR THERMALBOARD EPS™ APPLIED TO WALLS OR CEILINGS

Thermalboard™ and Thermalboard EPS™ 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, 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.

NEW: When installing on walls and ceilings sheath the area with 1/2" plywood backing and attach the panels by screwing to the plwood. This will avoid ever breaking Themalboard™ at the grooves when installing tubing and avoids locating framing. PERT tubing is more flexible and easier to install. It is less work to install the plywood rather than blocking behind the tubing grooves.

Wall and ceiling systems shall be installed as follows: The Panels shall be installed square to framing, screwed to studs, rafters, plwood backing and/or blocking with as many joints as possible screwed securely to the framing if not using plywood backing. Thermalboard™ shall be secured to framing on both sides of the grooves on every board. Thermalboard EPS™ shall be similarly attached. 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. 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.

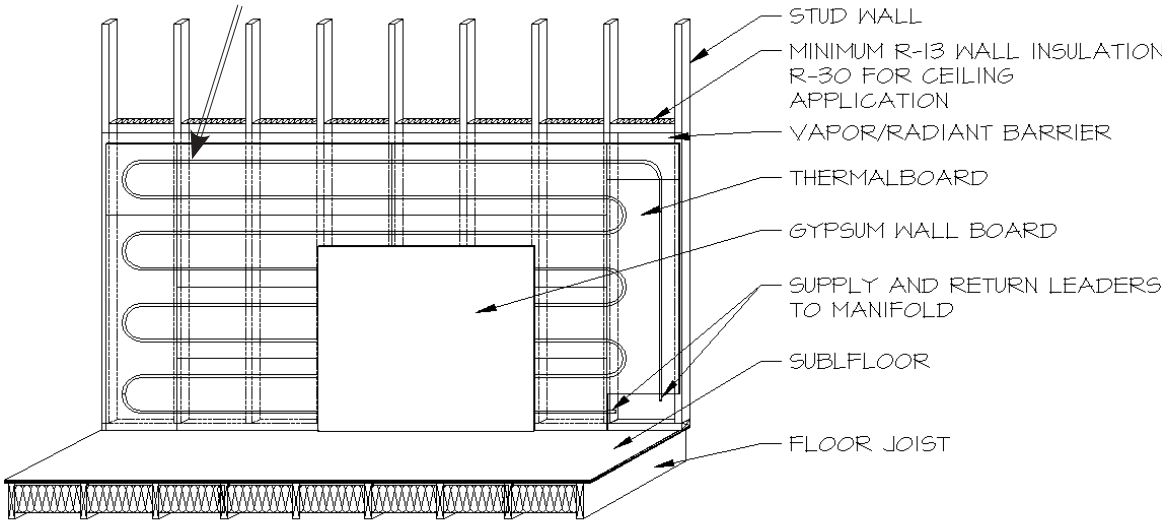


Illustration: NEW - 1/2" plywood now recommended attached to framing

THERMALBOARD DESIGN BENEFITS

BENEFITS TO THE OWNER

A professionally designed radiant heating system can save any project money, time and headaches. A system design ensures the optimal function of a new or retrofit installation, providing the most comfortable radiant heating system for your budget. Properly designed and installed, radiant heating systems add value to homes or buildings, while layout 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. They can also suggest which type of system best suits a specific construction type, explore system integration with building controls, and discuss system performance per various climates, floor coverings, ceiling heights, window configurations – even in multi-level, multi-zoned homes and buildings.

BENEFITS TO THE INSTALLER

With a professionally designed layout 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.

LAYOUT DESIGN

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

MECHANICAL DESIGN

A complete mechanical design can include:

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

Radiant floor heating — *everyone loves the quiet comfort and even warmth.*

THERMALBOARD SPECIFICATIONS

THERMALBOARD™ RADIANT FLOOR HEATING
A modular non-structural radiant board system

PART 1 — GENERAL

1.01 GENERAL

1. 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.

2. 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 installation and application requirements of all related work.

1.02 REFERENCES

1. Radiant Professionals Alliance Guidelines for the Design and Installation of Radiant Heating Systems
2. Composite Panel Association's EcoCertified Composite Sustainability Standard (ECC)
3. ANSI (American National Standards Institute) standards for MDF
4. SCS Global Recycled Content Certification and Environmentally Preferred Product Certification
5. American Society for Testing Materials — Standard Specification for Cross Linked Polyethylene (PEX) Tubing And PERT Tubing
6. International Building Code (IBC)
7. Uniform Building Code (UBC)
8. Uniform Mechanical Code (UMC)
9. Applicable CSA Standard in Canada
10. All applicable local modifications and codes in a project's jurisdiction.

1.03 SUBMITTALS

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

2. 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 is RPA.

1.04 DELIVERY, STORAGE, HANDLING AND QUALITY CONTROL

1. 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.

2. 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.

3. PEX and PERT 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™

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

2. 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" in a 10-foot radius.

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

4. 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™.

5. 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.

PART 2 — ORIGINATING MANUFACTURER AND RELATED PRODUCTS

2.01 APPROVED BOARD MANUFACTURER

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

1. Tubing installed in Thermalboard™ radiant board non-structural modular boards shall be third-party certified to, and manufactured to, ASTM F876, ASTM F877 for Use in the USA, and/or CSA B137. 5. for use in Canada. PERT pipe should be certified to ASTM F2623 for Polyethylene of Raised Temperature PE-RT.

2. 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.

3. The 3/8' PEX or PERT tubing shall be nominal 1/2" OD (.50" +/- .004") in accordance with ASTM F-876 and shall be used in certain circumstances, as recommended in this Manual.

4. Fittings used with Pex or PERT Tubing shall be certified for use with the tubing to an ASTM or CSA Standard.

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

2.03 GLUES

See RECOMMENDED ASSOCIATE PRODUCTS elsewhere in this manual for current recommended glues for use with Thermalboard™ or visit thermalboardradiantfloorheating.com.

PART 3 — JOB EXECUTION AND SEQUENCING

3.01 PREPARATION

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 Thermalboard™ 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 installation 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 reference, snap chalk lines 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. 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™.

3.06 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™ agrees 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 re-installation, or from acts of God such as earthquakes and floods.

RECOMMENDED ASSOCIATED PRODUCTS

4.0 RECOMMENDED ADHESIVES / GLUES FOR THERMALBOARD™

Thermalboard™ has made a major effort to create a green product. 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 five major categories of glue compatible with Thermalboard™ and Thermalboard EPS™ depending on the adhesives intended type of installation. Before you begin your Thermalboard™ installation be sure to reference the instructions of both the glue manufacturer and any installation drawings elswhere in this manual.

4.01) Glues for adhering wood flooring, backer board, or underlayment wood material on top of Thermalboard™ and Thermalboard EPS™.

RECOMMENDED ADHESIVES & GLUES FOR THERMALBOARD

SIKABOND T-35

SIKABOND T-55

MAPEI ULTRABOND

BOSTIK GREENFORCE

BOSTIK GREENGRIP

BOSTIK BEST

BOSTIK BST

BOSTIK EFA+

REGULARLY UPDATED - Check website for most current recommendations. Note: Bostik Green Grip and Bostik WoodGrip Plus are available at Lowes. Bostik Best, Bostik Green Force, and Mapei Eco 980 are available at most lumber liquidators.

RECOMMENDED ASSOCIATED PRODUCTS

4.02) GLUES FOR ADHERING THERMALBOARD™ ONTO A WOOD SUBFLOOR

Most normal construction adhesives will bond Thermalboard to a wood subfloor but low VOC glues contribute less volatile emissions and make for a healthier home. The list below also gives the temperature range at which it may be appied. Coverage Math: Use approximately 25 linear 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.

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

4.03) GLUES FOR ADHERING THERMALBOARD™ TO A CONCRETE SUBFLOOR & ADHERING MATERIAL ON TOP OF THERMALBOARD™ AND THERMALBOARD EPS™

SIKABOND T-35

SIKABOND T-55

MAPEI ULTRABOND

BOSTIK GREENFORCE

BOSTIK BEST

BOSTIK BST

4.04) GLUES FOR ADHERING THERMALBOARD EPS TO CONCRETE SUBFLOOR

Locktite PL300 Foam Adhesive is a latex water-based adhesive formulation for bonding most foam insulation panels to a variety of porous construction materials incluing but not limited to wood, gypsum board and concrete. It is compatible with all "unfaced" foamboard insulation products and won't burn through foam if used as directed. Low VOC formulation meets stringent State and Federal VOC Regulations. **NOTE: Locktite IS NOT COMPATABLE WITH PEX OR PERT PIPE.**

Bostik Greenforce is available through Lowes as Green Grip.
NOTE: Bostil Greenforce and Green Grip ARE COMPATIBLE WITH PEX AND PERT PIPE

BOSTIK GREENFORCE*

LOCKTITE PL300

4.05) ROLL ON LIQUID CRACK ISOLATION MEMBRANES FOR USE OVER BACKER BOARD

- **USG Durock Liquid Crack Isolation Membrane**
- **Mapei Mapelastic CI Crack Isolation Membrane**
- **Redgard from Quikcrete**
- **AquaBlue by Nobel Company**
- **AquaSeal™ from Nobel Company Water proof crack isolation membrane**
- **SikaTile-200 Fracture Guard Rapid**
- **Hydroban XP from Laticrete**

4.06) SHEET CRACK ISOLATION MEMBRANES FORUSE OVER BACKER BOARD

- **SikaTile®-225 Fracture Guard PNS also some sound deadening upt 3/8”**
- **NobelSeal TS**
- **Hydroban from Laticrete Moisture and crack isolation**
- **Durock Tile Membrane**

4.07) PRECAUTIONS TO AVOID PUNCTURING TUBING WHEN INSTALLING BACKER BOARD

- Take a photograph of the Thermalboard™ or Thermalboard EPS™ and tubing before attaching backer board with screws.
- Take a thick piece of clear plastic and make a see-through template of where the tube runs are with a permanent magic marker.
- Use the template to snap chalk lines on the backer board of where to avoid tubing runs when screwing down the backer board.

4.08 ADHERING BACKER BOARD TO THERMALBOARD™ AND THERMALBOARD EPS™

- Make sure any adhesive you use is compatible with and will not degrade tubing,
- Most modified Thinsets are compatible with PEX and PERT pipe but call your brand of tubings tech support and get it confirmed. Do this for any adhesive not listed here.
- The following may be used to bond backerboard Thermalboard™ or Thermalboard EPS:

  Bostik Green Force
  Bostik Green Grip (Lowes brand of Green Force)
  Bostik Best
  Mapei Eco 980
  Sika T-35
- Also screw the backer board down with screws into the panel every 8” on the edges and every six inches in the field where possible. Make a template of the floor to show where the tubing runs are by using a thick clear plastic and using a marking pen to draw where the tube runs are. Use it to put chalk lines on backer board to avoid screwing into tubing.

4.09 THICKNESS OF BACKER BOARD AND CUTTING BACKER BOARD

- Use a thin dense cementitious backer board such as Hardy 1/4” backer board when possible, because of the low R-value and good heat transfer.
- Wear eye and breathing protection from cement dust when cutting backer board
- Use a product like a Snapper to cut backer board to greatly reduce cement dust. This product may be purchased through home depot and is called a Metal Snapper Shear 6.5 Amp Corded Fiber Cement Backer Board Siding Shear.

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.

Thermalboard™ IS A PATENTED PRODUCT FROM WARM BROTHERS INC.

WARM BROTHERS INC. – GENERAL TERMS AND CONDITIONS OF SALES AND DELIVERIES 7/1/2024

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

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

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

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

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

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

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

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

Delivery options that may affect shipping and freight cost:

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

INSPECTION OF GOODS UPON DELIVERY
The Buyer shall inspect the Goods upon delivery. Heavily damaged shipments should be rejected at the time of delivery. Any claim for any defect in the quality or condition of the Goods shall be presented in writing to the Supplier

within five (5) working days of delivery or, where the defect was not immediately apparent, within five (5) working days of discovery.

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

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

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

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

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

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

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

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

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

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

INTELLECTUAL PROPERTY

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

EFFECT OF WAIVER

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

FORCE MAJEURE

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

WARRANTY

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

LIMITATIONS TO LIABILITY

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

EXCLUSIONS TO WARRANTY

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

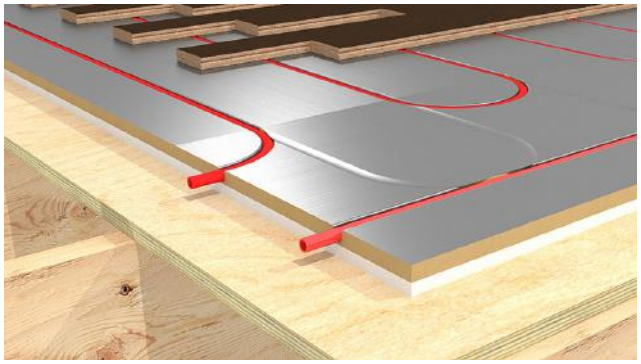
- **Improper storage**
- **Jobsite damage caused by others**
- **Installation for any use other than the Goods' intended use**
- **Installation in violation of guidelines in the Installation Manual**

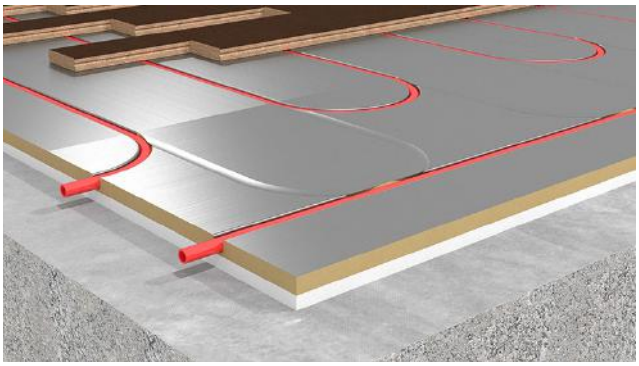
JURISDICTION, FORUM AND DISPUTES

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

COMPLETE AGREEMENT

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

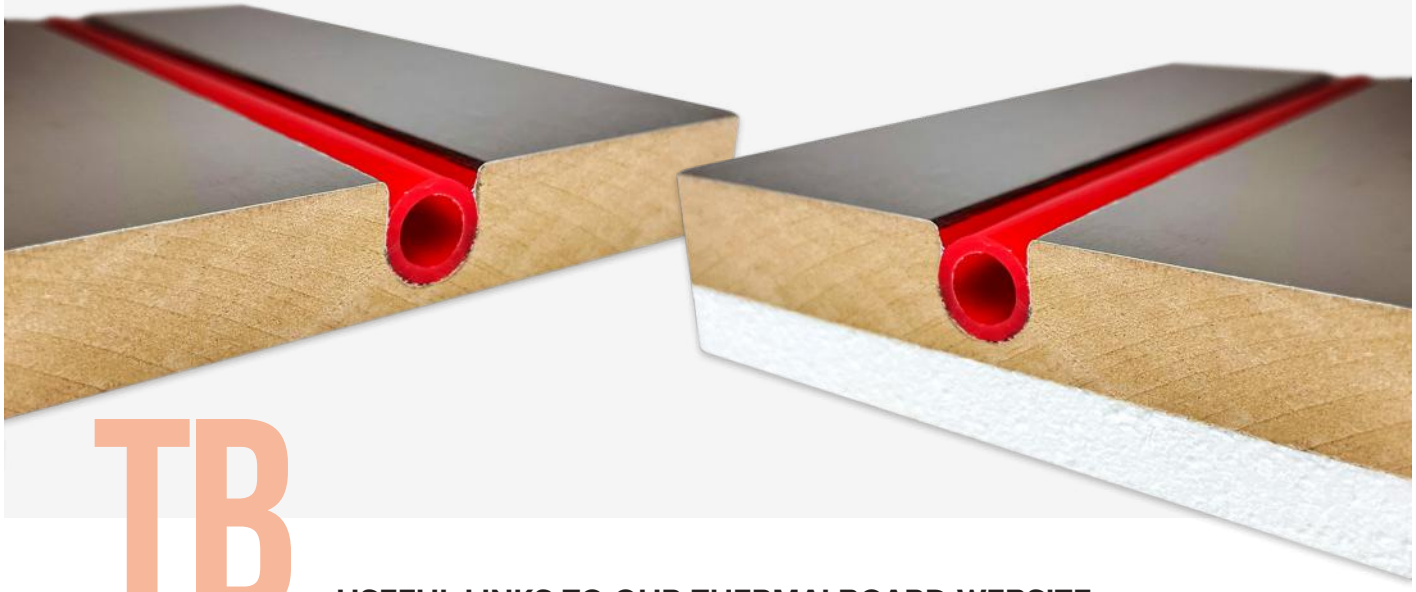




Above: Top view of Thermalboard panel. **Bottom Left:** Thermalboard EPS panel over subfloor. **Bottom Right:** Thermalboard EPS panel over concrete.

A WBI PRODUCT

THERMALBOARD™



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USEFUL LINKS TO OUR THERMALBOARD WEBSITE

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