REHAU®

RAUPEX® Radiant Floor Heating Systems Installation Guide

Contents

Introduction

As a REHAU Radiant Floor Heating (RFH) system installer, it is recommended that you follow these instructions when installing our products. Read this guide thoroughly, keep it with you during all installations and consult it as needed.

This guide assumes that design of the RFH system is complete before installation begins and that no design changes will be made unless the system designer is consulted.

Note: This guide contains instructions recommended and/or required by REHAU for proper system installation and product warranty coverage (see RAUPEX® Limited Warranty for details). Mandatory instructions incorporate the words: "must", "shall" or "required". Check local codes for conformity to these instructions. Local codes prevail where there is any variance.

If you have questions about an installation procedure, or if the procedure is not covered in this guide, please contact the designer or supplier of the system, or contact your REHAU regional sales office. Additional design and product information can be found in the *RAUPEX Radiant Floor Heating Systems Technical Manual*. Much of the information in this guide is also applicable to the installation of RAUPEX Snow & Ice Melting (SIM) systems.

Installation Documents

The radiant floor heating (RFH) system design should be complete before attempting installation. You should have all design details. This includes heat loss information, manifold size(s), pipe size, pipe circuit locations, pipe spacing and circuit lengths for each heated area. Typically, RFH WarmSource® software or a pipe layout drawing can provide these details.

RFH WarmSource

REHAU's design software is a radiant floor heating system design tool. When the design is complete, print the RAUPEX Schedule, which includes the RAUPEX Layout Summary. This report lists manifold size(s), pipe size, pipe circuit locations, pipe spacing and circuit lengths for each heated area. The RAUPEX Schedule also helps minimize material waste by suggesting coil lengths and cutting suggestions for pipe coils. RFH WarmSource also lists room dimensions, building panels, room-by-room heat loss, and flow and head loss requirements.

Pipe Layout Drawing

On some projects, the designer may provide a computer-aided design (CAD) pipe layout drawing. This drawing typically shows the location and length of each RFH circuit. In addition, CAD designs typically show installation details for construction joints, fastening of the pipe, manifold location(s) and pipe connections.

Preparing for Installation

Products

Several different products are required for any RFH installation. REHAU offers many product choices in the *RAUPEX Heating & Plumbing Systems Product Catalog* including pipe, manifolds, fasteners, fittings, controls and tools.

RAUPEX and RAUPEX O_2 Barrier Pipe

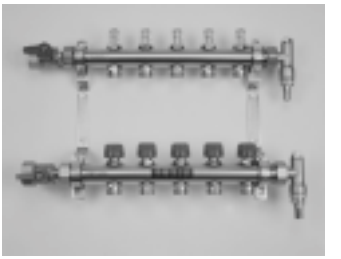
RAUPEX is REHAU's trade name for its specially formulated cross-linked polyethylene (PEXa) pipe manufactured using the highly controlled 'Engel' (high-pressure peroxide) method. RAUPEX is available in 3/8", 1/2", 3/4" and 1" pipe sizes (copper tube size OD, SDR9). RAUPEX is a natural white color.

To control the diffusion of oxygen through the pipe wall into heating system fluid, REHAU also offers RAUPEX O_2 Barrier pipe with a co-extruded EVAL barrier that limits oxygen diffusion into the pipe. RAUPEX O_2 Barrier exceeds the requirements of international standard DIN 4726. This red-colored barrier makes RAUPEX O_2 Barrier suitable for many types of hydronic heating systems with ferrous (iron or steel) components. RAUPEX O_2 Barrier is available in 3/8", 1/2", 5/8", 3/4" and 1" pipe sizes and has the same dimensions as RAUPEX pipe.

Both RAUPEX and RAUPEX O_2 Barrier have continuous-use pressure ratings up to 160 psi (1105 kPa) and temperature ratings up to 200°F (93.3°C).

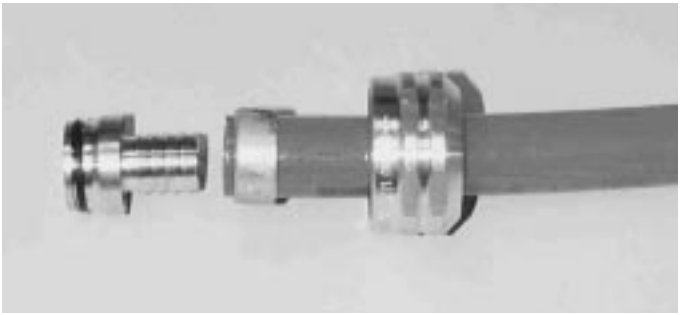
Note: All future references to "RAUPEX" also apply to RAUPEX O_2 Barrier, unless otherwise stated.

Manifolds



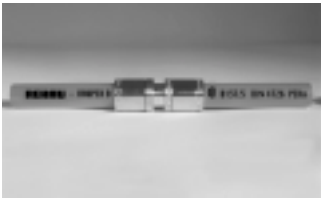
REHAU offers several distribution manifolds. The PRO-BALANCE® Manifold with Gauges is a pre-assembled brass manifold with integral balancing valves and flow gauges. This manifold allows the installer to visually set the flow of RFH circuits without the use of special balancing charts. We also offer the HKV Balancing Manifold (without gauges) and the HLV Non-Balancing Manifold. All brass manifolds come with 1" NPT supply and return isolation valves.

REHAU copper manifolds are available in four header sizes and three outlet sizes, for all flow requirements. Copper outlets are high-temperature brazed into the headers. Either REHAU valves or fittings can be soldered onto the outlets. When using copper manifolds, RAUPEX fittings and/or valves, brackets, end pieces, and isolation valves must be purchased separately.



Fittings

Compression Nut Fitting: These removable threaded connections attach with a common pipe wrench or pliers and are designed to attach RAUPEX pipe to manifold outlets on brass manifolds (PRO-BALANCE, HKV or HLV). Compression nut fittings that will connect RAUPEX pipe to copper manifolds are also available.



EVERLOC®: The EVERLOC coupling can be used to join sections of RAUPEX pipe for the repair of damaged pipe or to complete a circuit. EVERLOC fittings can be buried within a thermal mass provided they are completely wrapped with PVC tape or sleeved in an approved heat shrink sleeve (such as REHAU's RAUCROSS™). Special EVERLOC fitting tools are required.

Tools

Cutters: Use a sharp pipe cutter designed for plastic pipe that makes clean, square cuts. Do not cut RAUPEX with a saw blade – this will interfere with fitting connections. REHAU offers several easy-to-use pipe cutters.

Fastening Tools: Different types of installations require different tools. For faster pipe installation, REHAU offers a Pneumatic Stapler, a Screw Clip Tool, the RAUTACKER Foam Staple Tool, the Staple Clip Gun, and more.

EVERLOC Tools: To assemble EVERLOC fittings, you will need the EVERLOC Expander Tool, an expander head of the correct size, and one of the EVERLOC compression tools.

RAUPEX Uncoiler: REHAU offers an uncoiling device to speed pipe installation. The REHAU Uncoiler has pneumatic tires for easy maneuvering and handling on the job site.

Other tools that may be required include:

- Phillips screwdriver to hang the manifold
- Adjustable wrench up to 1 1/4" (32 mm) for manifold connections
- Measuring tape for pipe spacing
- Chalk line
- Air compressor for pneumatic stapler and/or pressure test
- Various saws and drills for cutting wood as required.

Inspecting the Job Site

Before beginning the installation, you will have to perform a site inspection. If there are potential problems with the construction that could affect the quality of the RFH installation or the system performance, notify the appropriate contractor(s), the builder or owner immediately.

1. Familiarize yourself with the installation sequence and scheduling for the various building components. Make sure that any other work that is scheduled to follow the installation of the RFH system will not damage the system components in any way. This may require changes in the construction schedule to ensure the integrity of your installation.
2. Confirm that the job site - as built - matches your building plans or drawings. Check for anything that might interfere with pipe installation such as concrete walls or footings where they were not expected, changes to the wall or floor layout. Note any changes; a redesign of the pipe layout might be required.
3. Inspect the condition of the building site. The sub-grade should be level and drained; if required, a vapor barrier is installed; insulation is installed and is of correct type and thickness; wire mesh or rebar is installed correctly, and will not be moved after installation of pipe; the subfloor is properly installed. Correct any discrepancies before installing pipe.
4. Inspect the site for possible hazards that could damage RAUPEX pipe, such as nails, staples, materials or tools from other trades, or chemicals that could spill and damage the pipe (see REHAU's *RAUPEX Chemical Resistance Chart*). Eliminate or remove any items or potential hazards before installing pipe.
5. It is recommended that other construction (drywall, plumbing, etc.) that might interfere with the pipe installation is not scheduled during the installation.

Handling RAUPEX Pipe

Protection

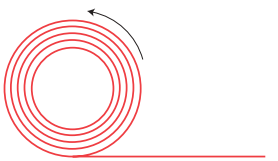
RAUPEX pipe is shipped in a cardboard box to protect it from sunlight, rain, dirt, and other hazards. Keep pipe in the box until it is required for installation, and return unused pipe to the box.

When handling RAUPEX, it is important to avoid:

- dragging it over rough objects such as gravel or concrete,
- contact with oil or oily products such as gasoline, paint thinner, etc.,
- soldering operations or any open flame,
- exposure to sunlight for more than 90 days.

Uncoiling

- First, carefully cut the outer binding strings. When working with 1,000 ft (305 m) coils, cut only the outer binding strings at first. This will release approximately half the pipe for uncoiling.



Uncoiling RAUPEX by hand

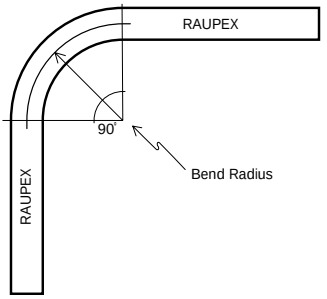
- RAUPEX cannot be pulled off of a coil that is sitting flat. It must be unwound from the coil, pulling from the top or the bottom of the coil. This will require one person to hold the pipe off the ground between their arms, or the use of an uncoiling device such as the RAUPEX Uncoiler.

- The RAUPEX Uncoiler can be used to facilitate installation. The uncoiler should be located in an area that will not interfere with the installation. Pipe should be loaded onto the uncoiler with the spool in the horizontal position. Pull the pipe through the dispensing guide, with the uncoiler spool in either a horizontal or vertical position (vertical is usually easiest). The spool is rotated by hand after removing the lock pin.

Twisting

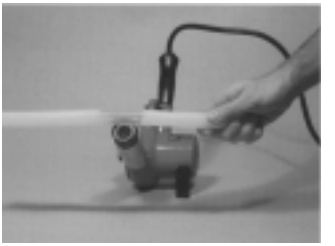
Occasional twisting in the pipe may occur during installation, particularly when installing without the benefit of the RAUPEX Uncoiler. This must be corrected before installing additional pipe. If the pipe becomes twisted when installing by hand, simply rotate the coil 90 degrees or more, in the direction of the twist, until the pipe lays flat. If the pipe becomes twisted when using the uncoiler, rotate the spool 90 degrees or more, in the direction of the twist, until the pipe lays flat.

Bending



RAUPEX pipe is one of the most flexible RFH pipes available. The minimum bend radius of unheated pipes (at room temperature) is 5 times the actual outside diameter (OD). For example, 1/2" RAUPEX can be installed at 6 1/4" (16 cm) on-center. Heated bends allow a bend radius of 3 times the actual OD (1/2" RAUPEX can be installed at 3 3/4" [9.5 cm] on-center spacing). This allows REHAU designers to specify pipe spacing as low as 4" (10 cm) on-center. If tighter bends are required, consider using a smaller pipe diameter.

Often, it is recommended to bend the pipe at a greater radius to speed installation and prevent kinking.



Kinking

RAUPEX is flexible and will resist kinking even at temperatures well below freezing. However, if the pipe is kinked by excessive bending, flow may be obstructed or reduced. Kinked pipe must be repaired. Due to the thermal memory of RAUPEX (a thermo-set polymer), you can repair kinked pipe. To repair a kink, straighten the pipe and simply heat the area with a hot air gun until the kink disappears. Rotate the heat gun around the pipe to evenly heat the surface. When the kink is gone, turn off the heat gun and let the area cool.

When fully heated, white RAUPEX pipe will get soft and become clear (at approximately 275°F [135°C]), however, these conditions are not necessary to repair the kink. Do not overheat the pipe, as this will damage it. White RAUPEX pipe will turn back to white as it cools. Pipe that is overheated will turn brown. RAUPEX O_2 Barrier pipe will get soft in the area where it has been heated but it will not turn clear.

This type of heating will “anneal” or stiffen the pipe, making it stronger but also less flexible in the heated area. Therefore, do not try to bend the pipe in the same spot. This may require a slight adjustment of fasteners so that the previously kinked section of pipe is installed without being bent again.

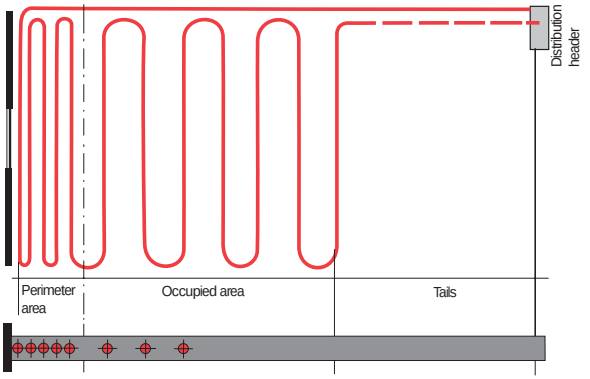
Always use caution when operating a heat gun and never use a torch or open flame to heat the pipe.

Cutting

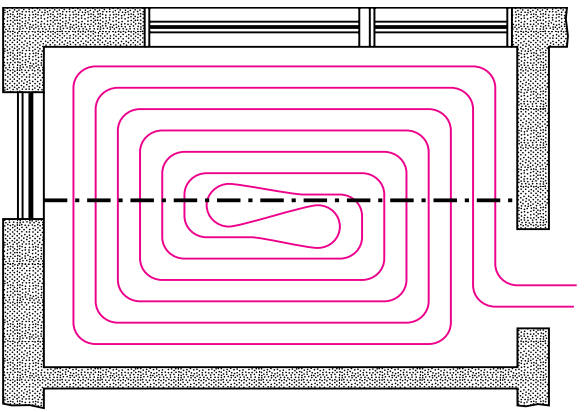
Use a pipe cutter designed for plastic pipe that is sharp and produces clean, square cuts. Do not cut RAUPEX with a saw blade, the rough edges will interfere with fitting connections. A clean, square cut is required.

Pipe Layout Patterns

To install pipe in occupied or perimeter areas, either a serpentine or counterflow spiral pattern may be used.

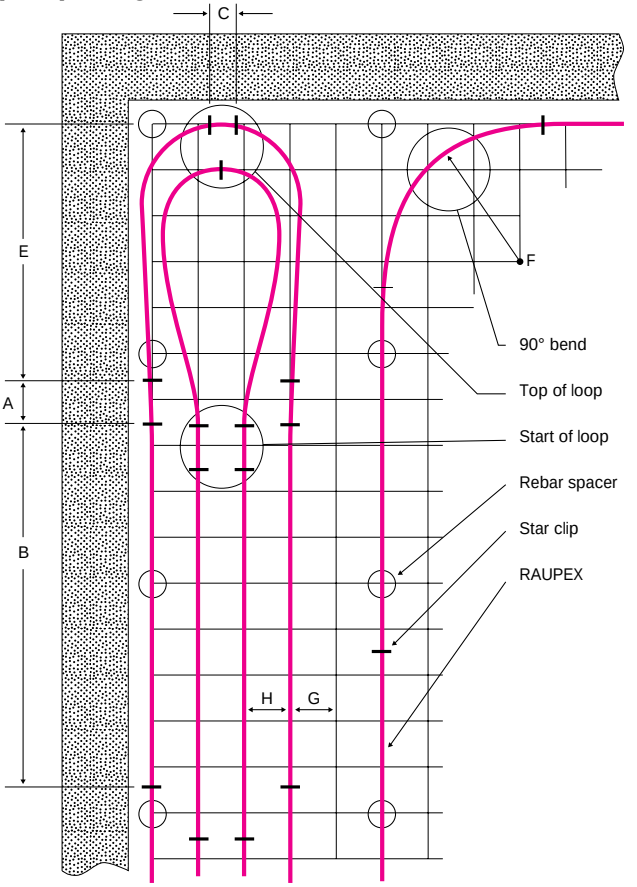


Serpentine pipe layout pattern showing perimeter and occupied areas.



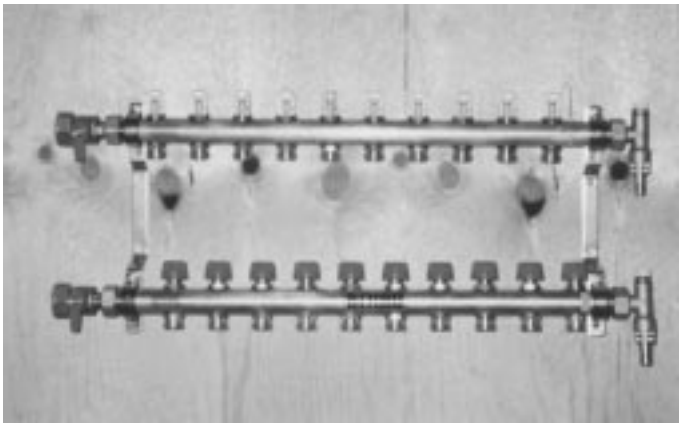
Counterflow spiral pipe layout pattern.

Pipe Spacing



A. Pipe attachment at start of loop (approx. 2 clips per mesh)
B. Pipe attachment on straights (approx. 3', 1 m)
C. Pipe attachment at the top of the loop (approx. 1 mesh)
D. Diameter of loop (> minimum bending radius)
E. Length of loop (> 20", 50.8 cm)
F. Bending radius (> 5", 12.7 cm)
G. Size of mesh
H. Distance between RAUPEX pipe

Step One: Manifold Installation



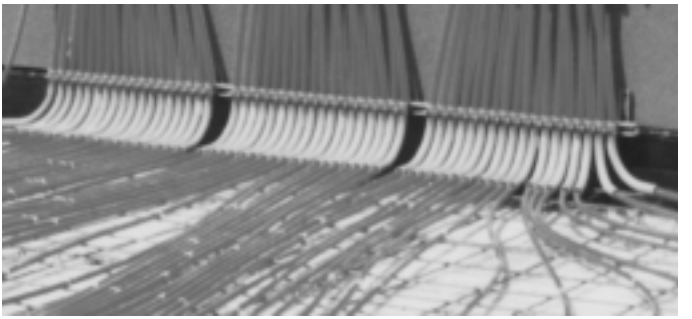
Install the manifold in the location indicated on the plans or pipe layout drawing. The location should be easily accessible to facilitate installation of the RAUPEX pipe, the feed pipes (supply and return) from the heat source, wiring from thermostats to connect to circuit actuators (if used), and for any future servicing requirements.

Manifolds can be mounted within a stud wall if desired. When choosing a manifold location, keep in mind that a manifold should be centrally located within the heated space for easier RFH pipe routing. Common locations include mechanical rooms, closets, cabinets, or crawl spaces. It is recommended that the manifold be located in a heated space, but not within an outside wall or building panel. REHAU offers steel manifold cabinets for use in commercial systems, or where required. These cabinets require a minimum insert depth of 4 1/2" (11.5 cm).

The manifold should be securely mounted, either horizontally or vertically, in its final position. If the permanent structure does not exist (common in slab-on-grade installations), you may have to build a temporary support for the manifold to place it in its permanent location. The temporary structure may be made from wood studs or rebar driven deep enough into the sub-grade to support the manifold.

- Position the manifold a minimum of 16" (40 cm) above finished floor level. A height of 36" (90 cm) to the top of the manifold will usually allow for most convenient pipe connections and future servicing. Make sure that the manifold is level.
- Protect the manifold from damage and vandalism during and after construction. An empty RAUPEX pipe box, placed over the installed manifold, provides some protection against weather and dirt.
- Performing water tests and/or filling the system with fluid and purging air can sometimes result in fluids being spilled in the area near the manifold. With this in mind, take care when choosing the location for the manifold.
- The manifold should remain accessible for service after completion of the job. This may require installation of an access panel.

Step Two: Installing Protective Bend Guides



REHAU requires the use of protection in areas where RAUPEX pipe passes through a thermal mass, such as at the base of a manifold. The recommended method for protecting RAUPEX in a thermal mass installation is the rigid PVC Bend Guide, which holds the pipe in a 90° bend, as well as protecting the pipe from abrasion at the thermal mass penetration, and damage by floor finishers.

To install PVC Bend Guides, simply insert RAUPEX pipe through the PVC Bend Guide to the appropriate length, usually 20-30" (50-75 cm) of pipe on the other side. The PVC Bend Guide should be positioned so that the pipe rises straight to the manifold and so that half the guide will be within the thermal mass.

Step Three: Connecting RAUPEX to the Manifold

After the manifold is securely mounted in its final position, you can begin connecting the RAUPEX pipe. For organizational purposes, it is best to connect each pipe to the manifold as it is being installed. Attach the pipe to the upper (supply) header first, passing it behind the lower (return) header.

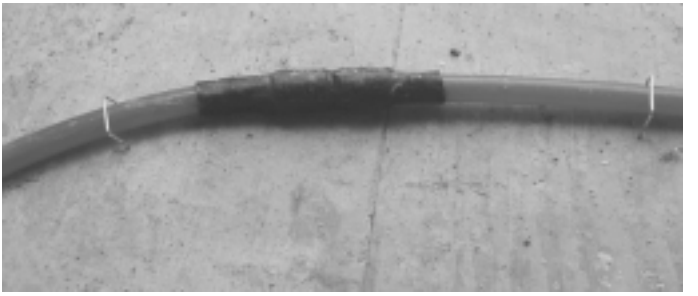
If you are installing brass manifolds, follow the instructions included in the manifold box.

1. Cut the pipe to length so that there will be no stress on the manifold connection. Make sure that the pipe is cut squarely. Attach the manifold connector to the end of the RAUPEX pipe as shown. When using 3/4" RAUPEX manifold connectors, attach the manifold connector bushing to the manifold outlet, with the hex end of the bushing closest to the header. Thread sealant is not required.
2. Place the pipe end with attached connector up to the appropriate manifold outlet.
3. Hand-tighten the manifold connector nut. If the fitting is aligned properly, it will go on smoothly. Thread sealant is not required.
4. Once the connector nut is hand tight, use a 1 1/4" (32 mm) wrench on the connector nut and do not turn more than 1/2 turn (use a 1 1/2" [38 mm] wrench for 3/4" RAUPEX manifold connectors.) Do not overtighten, as this may destroy the integral O-ring. You may wish to tighten all fittings at the same time once all pipes are connected.
5. Connector nuts may need to be retightened after several hours of system operation. Be sure to check all nuts at a later time.

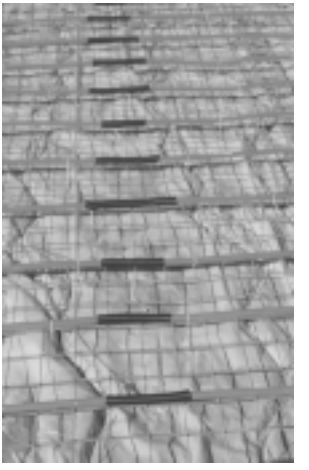
Step Four: Installing RAUPEX Pipe

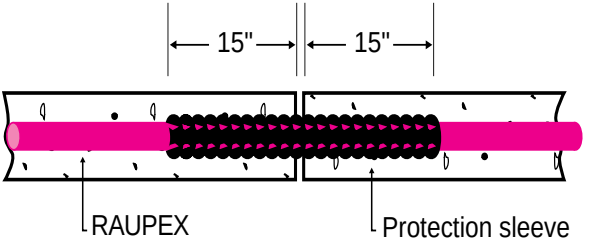
General Recommendations

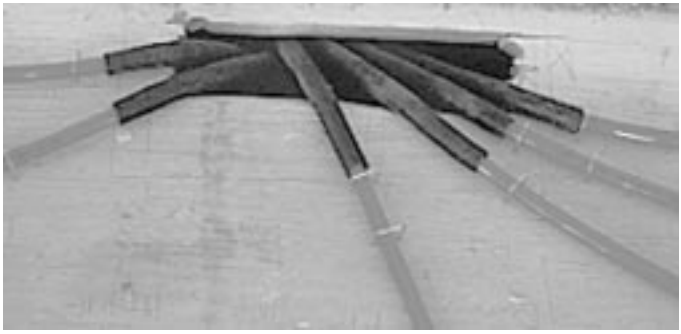
- If pipes are to pass into rooms through doorways and follow along walls that are not yet installed, it is recommended to use the building plans to measure and locate these walls and doorways, marking their planned locations with paint or wood studs. These “virtual” walls will act as a guide when installing pipe.
- Follow the pipe layout as closely as possible. If the layout cannot be followed due to changes in the structure, it is important to follow the pipe spacing as shown on the layout or RFH WarmSource design, and the designed circuit lengths (within 10%).
- Install the pipe along outside walls first so that the hottest (supply) water goes to the coldest areas.
- Keep pipe at least 6" (15 cm) from the edges of slabs, walls or other permanent objects such as bathtubs or cabinets. This will help to prevent damage to the pipe when these items or flooring materials are being installed.
- Keep pipe from 6" (15 cm) from wax seals on toilets.
- Pipe must not overlap when it will be encased in a thermal mass, as this will reduce the thickness of the thermal mass at that point, possibly leading to thermal mass damage and/or “hot spots”. Overlapping can be avoided by careful planning of the circuit paths, ensuring that pipes can connect to manifolds without crossing each other.
- Pipe should not be installed in areas under cabinets used for food storage or under appliances such as freezers. It is acceptable to install pipe under bathtubs and shower stalls to warm the bases. Pipe may be installed under cupboards on exterior walls and under stairs.
- If a pipe circuit is installed under floor coverings with different R-values such as carpet and tile, install pipe under the high R-value area first if possible, as this area will require a higher water temperature.
- Install nail guards where nailing is likely, such as doorways. REHAU can also provide caution labels as a warning to others during and after construction that pipes are located within the floor.



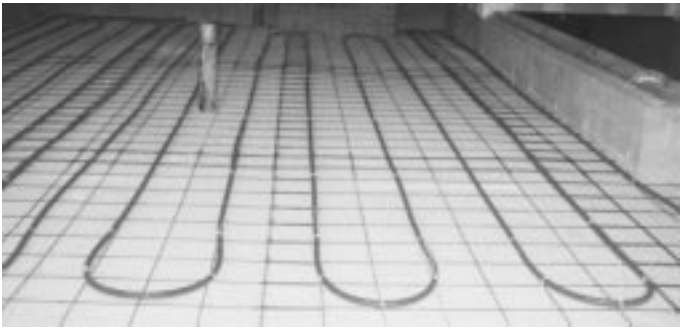
- If an EVERLOC coupling will be installed and encased in a thermal mass, it must be completely wrapped with PVC tape or sleeved in an approved heat shrink sleeve (such as REHAU's RAUCROSS). Two layers of PVC tape are required. EVERLOC fittings will not interfere with the flow through RAUPEX pipe, and REHAU recommends them to repair damaged pipe or to join shorter pipe sections together to complete a circuit (if local codes permit). Indicate locations of any couplings on "as-built" drawings.
- Pipe circuits must be planned and installed to minimize passes through expansion joints, saw cuts or other "movement" joints in the thermal mass. With proper planning, only the supply and return RFH pipes need pass through these areas. Any pipes that pass through such an area must be protected with REHAU PE protection sleeve for a minimum of 15" (38 cm) on both sides of the joint.







- REHAU requires the use of PE protection sleeve in locations where RAUPEX pipe passes through a thermal mass, or in places where pipe may rub against an abrasive object. In all cases, cover the pipe on both sides of the joint or penetration, and secure the protective sleeve in place over the pipe.
- Label pipes as they are installed. You may want to record this information on the manifold, near the manifold, with tabs on the pipe, or on the plans (example: Circuit A-1, first circuit on Manifold A). Record actual circuit lengths along with circuit numbers. There are footage markings every three feet on RAUPEX pipe.
- When installing pipe in a confined area that does permit the suggested pipe spacing, it is recommended to use tighter spacing and more pipe rather than wider spacing and less pipe. This helps to avoid “cold spots”.
- In areas with high pipe concentrations (closer than 4" [10 cm]) such as near manifolds, if the thickness of the thermal mass permits, insulate the pipes to prevent “hot spots”. Careful planning of pipe locations will usually prevent this.



Pipe & Fasteners

RAUPEX pipe must be fastened at least every 36" (90 cm) when installed on wire mesh, insulation, or a wood subfloor. Pipe must be fastened at the beginning, midpoint and end of each 180° bend. Fasteners are designed to safely hold the pipe in place during and after construction. If pipe is not fastened correctly or enough, it can cause the pipe to “float” (pipe too close to the surface) during installation of the thermal mass. REHAU offers several excellent fastener choices to use during installation. The following guidelines can assist in estimating fastener quantities:

- To estimate the total number of ties, clips or staples that will be required in a residential application (many bends):
  One fastener for every 2 feet (60 cm) of pipe–feet of pipe ÷ 2
- To estimate the total number of ties, clips or staples that will be required in a commercial/industrial application (fewer bends):
  One fastener for every 2 1/2 feet (75 cm) of pipe –
  Feet of pipe ÷ 2.5
- To estimate the total number of heat transfer plates (plates are 24" [60 cm] long) for joist space installations:
  Feet of pipe X 0.6.
- To estimate the total number of pieces of RAILFIX (RAILFIX is 6 1/2 feet [2 m] long):
  The square footage for RFH pipes ÷ 20
- To estimate the total number of PVC Bend Guides: Use two for each circuit

Don’t forget to include PE protection sleeve for your installation. The amount required depends on previously mentioned factors.

Suspended Wood Floor Application (Poured System)

General Recommendations

It is common to install RAUPEX above a suspended wood floor, encasing pipe in a thermal mass overpour. There must be at least 3/4" (19 mm) of thermal mass above the pipe.

- When installing 1/2" RAUPEX (with an OD of 5/8" [16 mm]), an overpour thickness of 1 1/2" (38 mm) is required.
- When installing 3/8" RAUPEX (with an OD of 1/2" [13 mm]), an overpour thickness of 1 1/4" (32 mm) is required.

A useful guide for gauging the height of the thermal mass is to install 2" (nominal) lumber around the edges of all rooms (see final point below). An overpour 1 1/2" thick of common thermal mass materials will add 13-17 lb/ft^2 (63.5-83.2 kg/m^2) “dead load” to the floor structure. Confirm that the floor structure has been designed with this in mind, or that the structure has been approved by an architect or engineer to carry this weight.

Preparation

- Subfloor must be structurally sound, clean and free from all construction debris that could potentially damage the pipe. Replace any areas that appear weak. This is also applicable when working with an overpour above a pre-cast concrete subfloor.
- Seal all cracks on the wood floor with a liquid sealer or PE vapor barrier. When using concrete, a PE vapor barrier should cover the entire subfloor as well as the edges of base plates. This prevents the thermal mass from flowing through cracks and damaging the floor below. It also prevents bonding of the concrete to the subfloor and base plate edges. Inform the installer pouring the thermal mass of the purpose of the vapor barrier.
- When using gypsum cement thermal mass, a liquid sealant should be applied. Consult the gypsum product manufacturer for a detailed list of recommended procedures.
- Remove all unnecessary base plates from doorways and other areas.

Insulation

In an RFH system that is installed above a heated space, it is recommended to insulate the joist cavity below. This prevents unwanted heat transfer to the room below, and decreases the response time (time to change the temperature) of the heated space above. It is required to insulate the joist cavity below an overpour RFH system that is installed above an unheated space.

- The insulation should be installed 1-2" (25-50 mm) below the bottom of the subfloor.
- Ideally, a reflective surface of foil should be installed on the top of the insulation layer to reflect radiant heat to the bottom of the subfloor.
- In joist space installations over a heated space, the R-value of insulation below the subfloor should be 4-5 times greater than the total R-value of the floor structure and coverings above. Recommended minimum R-value over a heated space is R-11.
- In joist space installations over an unheated space, use insulation with a minimum of R-30 below this air gap.
- Insulation in the joist cavity may be a combination of a reflective “bubble foil” insulation closest to the pipe, with fiberglass or PS (polystyrene) board insulation below to achieve the required R-value.
- Be sure to insulate all ends of joist cavities or other places where heat could escape the joist cavity.

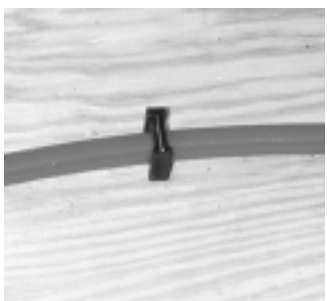
Stapled Method

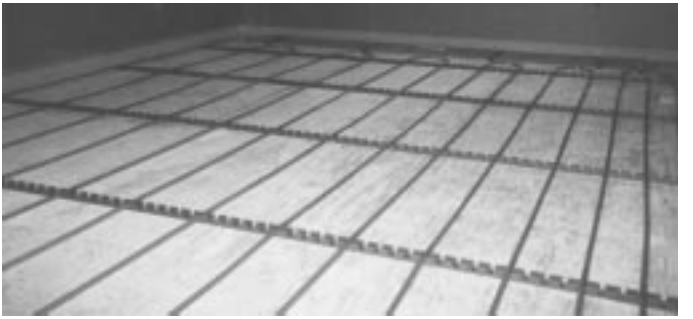
The REHAU Pneumatic Stapler is specially designed for use with RAUPEX pipe. It has a guide plate that aligns the staple correctly with 1/2" or 3/8" RAUPEX pipe to prevent punctures. Used in conjunction with REHAU staples, it provides a fast and secure method of fastening pipe to a wood floor.

With air pressure set at 90-100 psi (620-690 kPa), the staple should have a clearance of 1/16" (1.6 mm) around the pipe. If the staple actually touches the pipe, reduce air pressure, or check to ensure the correct staples are used (1" crown, 1 1/4" leg, Senco Model P15BAB). Different subfloor materials may require different air pressures. Test first on a short piece of pipe. Install staples at least every 2-3 feet (60-90 cm) on straight runs of pipe. If the pipe does not lay flat after installation, install extra staples to keep it close to the subfloor. This is necessary to prevent “hot spots”. Pipe must be fastened at the beginning, midpoint and end of each 180° bend.

Staples can be removed with pliers. Do not pull on the pipe to pull out staples.

As an alternative to the Pneumatic Staple gun with steel staples, REHAU also offers the Hand Powered (HP) Stapler that drives special plastic/steel staples into a subfloor from a standing position (see above), as well as the Staple Clip Gun that shoots plastic/steel staples from a hand-held gun.





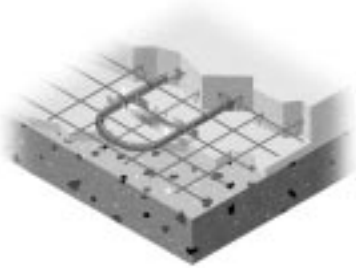
RAILFIX Method

RAILFIX pipe installation track comes in 6 1/2 foot (2 m) sections with slots every 2" (50 mm) for holding RAUPEX pipe. This product speeds installation by reducing the need to measure pipe spacing, and because pipe can simply be snapped into RAILFIX by foot.

RAILFIX must first be installed in a pattern that will suit the planned pipe layout. Space RAILFIX every 2-3 feet (60-90 cm). Pipe must also be fastened at the beginning, midpoint and end of each 180° bend. RAILFIX can be fastened to the subfloor with screws or nails, using pre-drilled holes in the bottom of the track. At bends and hard-to-reach areas, you may need to use pipe talons (nailed in with a hammer) or plastic staple clips to hold the pipe.

RAILFIX can be broken easily by hand into shorter pieces at pre-drilled slots. RAILFIX can also be installed above rigid board insulation. RAILFIX is fastened to the insulation (at least 1 1/2" [38 mm] thick) using REHAU Plastic Holding Pins.

There must be at least 3/4" (19 mm) of thermal mass above the top of the RAILFIX to prevent thermal mass damage. Since RAILFIX is 1" (25 mm) in height, this means that the minimum thickness of the thermal mass overpour is 1 3/4" (45 mm) when using this method.



Slab-On-Grade Application (Poured System)

General Recommendations

It is common to encase RAUPEX pipe within a poured slab, most commonly a slab-on-grade pour or a suspended structural slab.

In either case, the presence of the pipe usually does not require re-engineering of the slab, but a structural engineer or architect must verify this.

There must be at least 3/4" (19 mm) of thermal mass above the pipe. Usually, RAUPEX pipe is located at the mid-point of the slab, or closer to the bottom, depending on the fastener and slab reinforcement used.

Subgrade should be compacted, flat and smooth to prevent damage to pipe or insulation. Approved vapor barrier material should be installed. Reinforcing wire mesh, if required by structural design, must be flat and level, with all sharp ends pointing down to prevent touching the pipe.

There are several effects to consider when deciding where to locate the pipe within the slab:

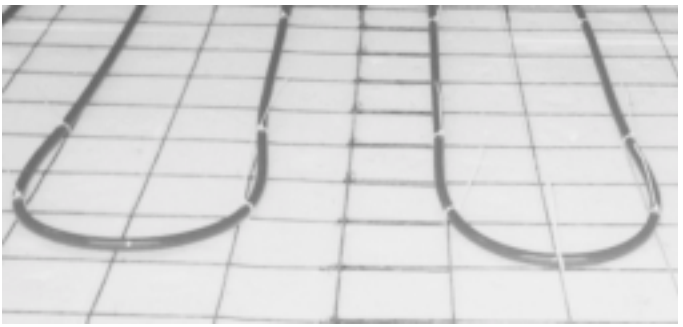
- Will wire mesh or reinforcing bar (rebar) be present? If not, consider using RAILFIX to hold pipe at the bottom of the slab.
- Pipe located closer to the bottom of the slab will result in a more even surface temperature.
- Pipe located closer to the top of the slab may result in “hot spots” or “striping”.
- Pipe located near the top of the slab will give the RFH system a faster response time to change temperature of the heated space.
- Pipe located closer to the bottom of the slab will be better protected from operations that may require drilling into the slab to mount machinery, or from saw cuts for expansion. (Saw cuts usually penetrate 1/4-1/3 of the slab thickness.)

Insulation

It is recommended to install minimum 1" (25 mm) thick edge insulation vertically along all exterior slab edges, including where the slab will touch footings or walls. Check with local code requirements. This will reduce heat loss to exterior walls, in addition to allowing the thermal mass to expand when heated. If the RFH system was designed assuming that this insulation would be installed, then it must be installed, or the RFH system design must be re-calculated.

Insulation under the slab is also recommended, both to prevent heat loss to the earth below, and to decrease the response time of the heated slab. Insulation at the perimeters of the slab is the most important. If the RFH system was designed assuming that this insulation would be installed, then it must be installed.

EPS (extruded polystyrene) and PUR (polyurethane) insulation is recommended, as long as the product meets loading requirements.



Nylon Pipe Ties/Star Mesh Clips

Use nylon pipe ties to fasten RAUPEX pipe to wire mesh or rebar in the pattern indicated by the design. When using nylon pipe ties, pull them snug, but not too tight. Also, make sure that the ends of the ties are pointed down towards the bottom of the slab so they will not be exposed after the slab is poured. If ties are not pointed down, you will have to cut them later before pouring the slab.

Mesh star clips are designed for use on 3 mm wire mesh to hold pipe in either of two orientations - running parallel to the wire or perpendicular to the wire. Mesh star clips should be installed before laying RAUPEX pipe. Pipe can then be snapped into the clips by foot. Mesh star clips can be installed by hand or with the Rigid Star Clip Tool.

Space ties and clips every 2-3 feet (60-90 cm). Pipe must be fastened at the beginning, midpoint and end of each bend.

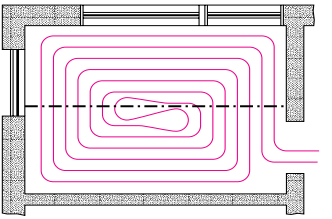
Note: Do not use wire ties without plastic coating or other metal fasteners on RAUPEX pipe. Use only plastic fasteners when tying pipe to wire mesh or rebar.

RAILFIX/RAUFIX Method
RAILFIX pipe installation track comes in 6 1/2 foot (2 m) sections with slots every 2" (50 mm) for holding RAUPEX pipe. RAILFIX speeds installation by reducing the need to measure pipe spacing. The pipe can easily be snapped into RAILFIX by foot.

RAILFIX can be installed directly above rigid board insulation. RAILFIX is fastened to insulation that is at least 1 1/2" (38 mm) thick using REHAU Plastic Holding Pins. RAILFIX must first be installed in a pattern that will suit the planned pipe layout. Space RAILFIX every 2-3 feet (60-90 cm). Pipe must also be fastened at the beginning, midpoint and end of each 180° bend. RAILFIX can be fastened to the subfloor with screws or nails, using pre-drilled holes in the bottom of the track. At bends and hard-to-reach areas, you may need to use Screw Clips or RAUTACKER Foam Staples to hold the pipe.

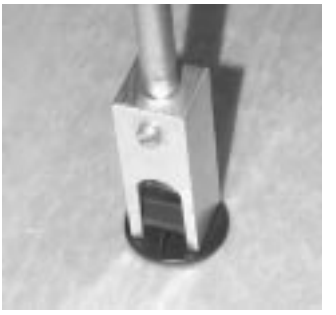
RAILFIX can be broken easily by hand into shorter pieces at pre-drilled slots.

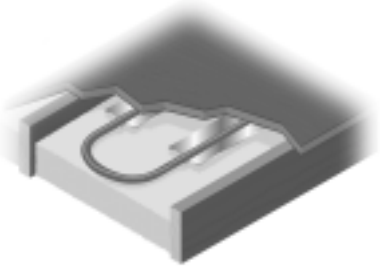
REHAU also offers RAUFIX in 3 1/4 foot (1 m) sections that have built-in holding pins on the bottom surface. RAUFIX also has slots every 2" (50 mm) for holding the pipe.



Screw Clip Method

Plastic screw clips are designed to be installed in EPS rigid board insulation that is at least 1" (25 mm) thick. If the RFH installation uses this type of insulation above the subfloor (such as over unheated spaces), or over a sub-grade base, screw clips work well.





Joist Space Application (Subfloor System)

General Recommendations

Installing RAUPEX pipe in the joist space, or subfloor, can be an effective alternative to overpour installations. RAUPEX pipe works well in these installations.

RAUPEX pipe may be installed in a joist space using either plastic pipe talons or aluminum heat transfer plates, or a combination of both. REHAU's Locking Clips (CLIC® brand) may also be used.

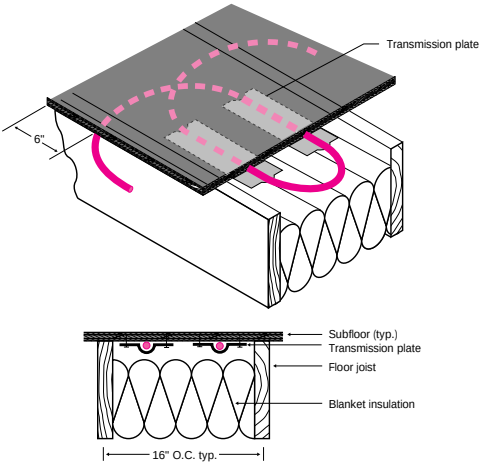
Other fasteners, such as steel staples or other metal supports should not be used for this type of installation. This is based on concerns about abrasion of the pipe wall due to expansion/contraction cycles, as well as durability of the fasteners themselves.

Installation into a joist space will require additional planning.

- Before drilling holes in a joist, check with the builder and local code to be sure that holes are acceptable. Normally, drilling in the center 1/3 of the joist is the best place for holes, as this is the least stressed part of the joist.
- Drill holes large enough for pipe to pass through freely as joist installations require considerable pulling of pipe through these holes. Larger holes help to reduce friction and the pulling force. Ensure that the hole is at least 1/4" (6 mm) larger than the outside diameter (OD) of the pipe (3/4" [19 mm] hole for 3/8" RAUPEX, 7/8" [22 mm] hole for 1/2" RAUPEX). A 1" hole will make installation easier.
- Running several pipe tails through a common hole is acceptable.
- REHAU's PE protection sleeve should be used when passing through joists or other structural members to reduce abrasion caused by expansion and contraction. Pipe must not rub against the side of a hole.
- Allow for expansion and contraction of RAUPEX pipe, typically by ensuring the ends of all pipe runs (bends) are free, and not restricted.

Insulation

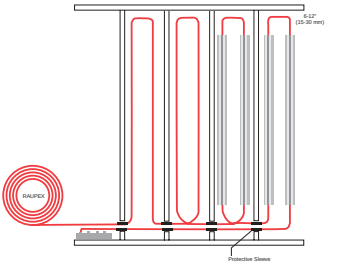
- Leave a 2" to 4" (5 to 10 cm) air gap between the bottom of the pipes and the top of the insulation.
- Ideally, a reflective surface of foil should be installed on the top of the insulation layer to reflect radiant heat to the bottom of the subfloor.
- In joist space installations over a heated space, the R-value of insulation below the pipe should be 4-5 times greater than the total R-value of the floor structure and coverings above. Recommended minimum R-value over a heated space is R-11.
- Joist space installations over an unheated space should use insulation with a minimum value of R-30 below this air gap. This may be a combination of a reflective “bubble foil” insulation closest to the pipe, with fiberglass or PS (polystyrene) board insulation below to achieve the required R-value.



Pipe Talons/Locking Clips

- Secure RAUPEX pipe to the underside of the subfloor at least every 2-3 feet (60-90 cm).
- Allow for expansion and contraction of RAUPEX pipe by ensuring that the ends of all pipe runs (180° bends) are free, and not secured.
- Prevent contact between pipe and sharp objects such as metal pipes or ductwork, screws, or nails. If pipe is close to any of these items, cover the pipe with PE protection sleeve to prevent abrasion.
- If a floor covering such as hardwood will be installed over the RFH pipes, make sure that the flooring installer is notified of the pipe locations. The flooring installer should not use nails that could pass through the subfloor and potentially damage or come into contact with the pipe.
- If nails or screws are present on the bottom of the subfloor, use the locking clips (or other approved method) to drop the pipe below these hazards.

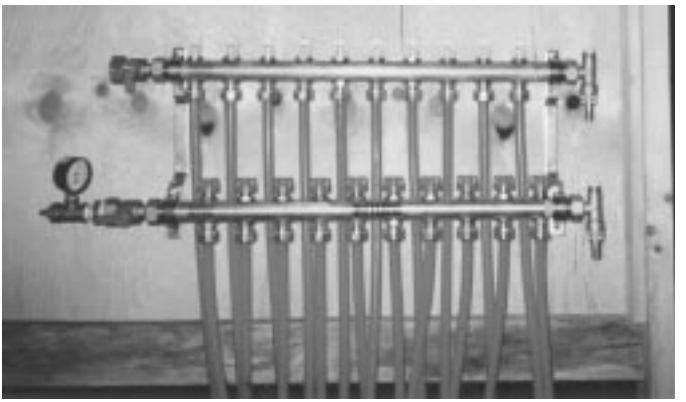
Heat Transfer Plates



Pull RAUPEX pipe down the length of each joist cavity before installing plates. You can use pipe talons or locking clips to position the pipe temporarily. Starting at the last joist cavity (farthest from the manifold), begin installing the plates over the pipe using the following method:

- To begin, simply snap the pipe into each plate.
- Fasten the plate to the subfloor using 1/2" (12 mm) screws, three on each side of the plate. Screws prevent the plates from coming loose. It is important to remember that these plates will be holding the weight of the pipe filled with fluid, which will be expanding and contracting for thousands of cycles.
- Allow a minimum 1" (25 mm) gap between consecutive plates.
- Do not cut plates at the end of joist cavities. If a full plate will not fit over the remaining pipe, use pipe talons to hold the pipe against the subfloor for the last several feet or inches. *Note: Plates are 24" (60 cm) long.*
- Allow for expansion and contraction of RAUPEX pipe, typically by ensuring the ends of all pipe runs (180° bends) are free and unrestricted.

Step Five: Pressure Tests



General Recommendations

- A pressure test must always be performed on the system prior to and during the installation of the thermal mass to ensure that RAUPEX pipe and connections are leak-free. For dry systems such as joist space applications, a pressure test must be performed after installation and up to the time that the system is put into operation.
- Tests of hydronic heating systems shall comply with local codes and where required, shall be witnessed by the building official.
- Pressure tests must be done with all circuit valves on the RFH manifold fully open. All pipes and the manifold must be tested together.
- Pressure gauges must show pressure increments of 1 PSIG and should be located at or near the lowest points in the distribution system.
- Use an air test if water could potentially freeze in the system.
- Do not exceed 150 PSIG (pounds per square inch gauge) [1030 kPa].

Air Test

An air test can be performed by installing REHAU's Air Pressure Tester into the 1" FPT supply valve on a PRO-BALANCE, HKV or HLV brass manifold. A standard air chuck will connect to the schrader valve on the end of the air pressure tester. For copper manifolds, a similar connection is required.

- Perform a preliminary pressure test pressurizing the system to the greater of 1.5 times the maximum operating pressure, or 100 PSIG (690 kPa), for 30 minutes.
- As the piping expands, restore pressure, beginning at 10 minutes, and again at 20 minutes.
- At the end of the 30 minute preliminary test, pressure must not fall by more than 5 PSIG (34 kPa) from the maximum, and there shall be no leakage.
- After performing the preliminary test, perform the main pressure test immediately. The main pressure test shall last at least 2 hours. The test pressure should be restored and must not fall more than 3 PSIG (20 kPa) after 2 hours. No leakage should be detected. Use liquid gas detector or soap solution to check for leakage at manifold connections.
- Air temperature will affect the gauge pressure, so perform all pressure checks at a constant temperature.
- Pressure shall be maintained and monitored during installation of the thermal mass. If any leak is detected during installation of thermal mass the leak must be found immediately and the area cleared for repair using an EVERLOC coupling. Retest before covering the repair.

Complete all inspection and test reports as required.

Water Test

Preparation

A water test can be performed using REHAU's Liquid Pressure Tester that attaches to the air vent/fill port on a PRO-BALANCE or HKV brass manifold. Other connections can be made to the supply valve on any brass or copper manifold. The water fill and purge procedure must be performed prior to the water pressure test. Take necessary precautions to prevent water from freezing.

Fill and Purge Procedure for HKV, HLV, PRO-BALANCE and Copper Manifolds

All air must be purged from the system to ensure proper testing and operation. This is done on each element of the system individually (circuits, then manifolds).

HKV Manifolds

1. Close all circuit supply and return valves, and 1" isolation supply and return valves.
2. Open the fill ports by turning the upper knurled nuts counter-clockwise at least one full turn. Fill the manifold with liquid through the upper (supply) port, pumping fluid from a bucket or tank. Use the lower (return) port as a drain line into the same bucket or tank being used to fill the system. Keep the drain line within the liquid.
3. Municipal or well water supply can also be used for pressure, as long as minimum pressure requirements are met.
4. To fill, attach a hose to the barbed fitting. Or, if preferred, remove the barbed fitting by turning the smaller, lower knurled nut counter-clockwise until it separates, and connect a hose to the 1/2" MPT connection using a threaded adapter or drain valve.
5. Begin filling the manifold with water through the supply fill port.

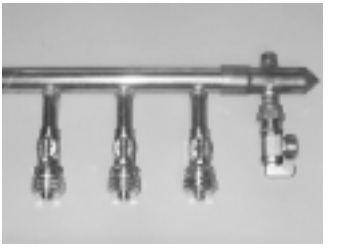
6. Open the first set of circuit valves, and let water flow through until no air comes out. This may take several minutes. When the first circuit is purged, close its return valve first, then its supply valve.
7. Repeat this process for the rest of the circuits until all have been purged of air and the manifold and pipes are filled with liquid. Close the lower (return) fill port first, then the upper one. To close the fill port, tighten by hand. To prevent tampering, you may tighten slightly with a wrench. Do not overtighten.

A similar procedure is used for copper manifolds that have ball valves on all circuit connections. With copper manifolds, use a standard “boiler drain” valve instead of the fill port.

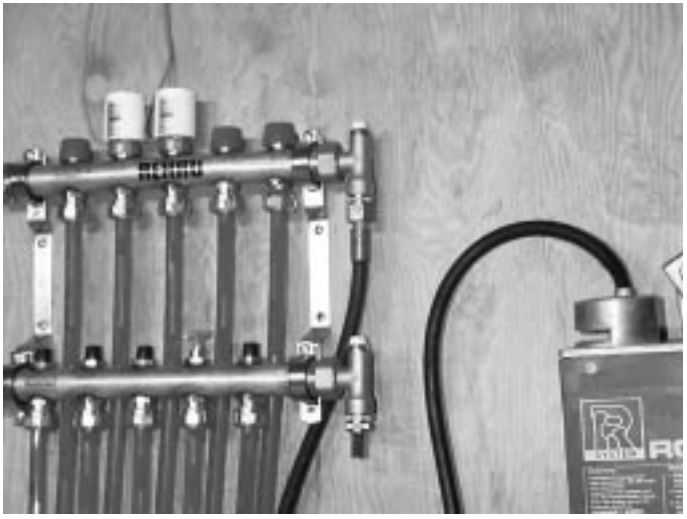
PRO-BALANCE Manifold with Gauges/HLV Manifolds

These styles of manifolds do not allow closing of circuit valves, so all circuits must be purged at the same time. This means a longer purging time with water flowing through all circuits. For PRO-BALANCE manifolds, use the circuit balancing valves to adjust each circuit to have the same flow during purging. Follow other steps as applicable.

Copper Manifolds



A similar procedure is used for copper manifolds that do not have ball valves on circuit connections. Use a standard "boiler drain" valve attached to the End Cap Vent Drain (ECVD) attachment (sold as an accessory for copper manifolds).



Water Pressure Test

- Keep 1" isolation valves on the manifold closed to prevent water from leaving the manifold, as this will introduce air.
- Open all circuit valves (if present).
- Check for air again through the manual air vents (PRO-BALANCE/HKV/HLV).
- Perform a preliminary pressure test pressurizing the system to the greater of 1.5 times the maximum operating pressure, or 100 PSIG (690 kPa) for 30 minutes.
- As the pipe expands, restore pressure, first at 10 minutes into the test and again at 20 minutes.
- At the end of the 30 minute preliminary test, pressure must not fall by more than 5 PSIG (34 kPa) from the maximum, and there shall be no leakage.
- After performing the preliminary test, perform the main pressure test immediately. The main pressure test shall last 2 hours. The test pressure should be restored and must not fall more than 3 PSIG (20 kPa) after 2 hours. No leakage should be detected. Use liquid gas detector or soap solution to check for leakage at manifold connections.
- Pressure shall be maintained and monitored during installation of the thermal mass. If any leak is detected during installation of thermal mass, leak must be found immediately and the area cleared for repair using an EVERLOC coupling. Retest before covering the repair.

Complete all inspection and test reports as required.

Step Six: Installation of the Thermal Mass

Site Inspection

Before installation of the thermal mass, the RFH pipes must be inspected to ensure that:

- The pipe is free of kinks and punctures.
- The pipe is fastened as described in this guide to prevent floating too close to the top of the thermal mass. If pipes have moved due to expansion, additional fasteners may need to be added.
- EVERLOC couplings are wrapped with two layers of PVC tape or sleeved in heat shrink, and locations are noted on plans.
- PE Protection sleeve is installed at expansion or movement joints, and anywhere that the pipe could rub against an abrasive surface.
- Nailing plates are installed above the pipe where required.
- Pipe is still under pressure from the test, with no loss.

Precautions

The possibility exists that the pipe could be cut or gouged by rakes or other tools used during the pour of the thermal mass. To help prevent this:

- Notify the thermal mass installer before the pour that RFH pipes have been installed. This will help the installer choose the most appropriate equipment for the job.
- Instruct the thermal mass installer to make wooden “bridges” for transporting wheelbarrows over pipes.
- Maintain pressure on the system and monitor the gauge(s). If the pipe is punctured, it will be visible as air bubbles (air test) or a wet spot (water test).
- Keep EVERLOC couplings, sleeves and installation tools on the job site in case repair is necessary. If the pipe is damaged and these items are not available, isolate the damaged area (at least 12" [30 cm] in length) by building a dam or bond-out so that a coupling can be installed later.
- A scrape in the oxygen diffusion barrier of RAUPEX O_2 Barrier does not necessitate repair with a coupling. However, a gouge into the pipe wall must be repaired with a coupling.

Step Seven: System Start-Up

Pre-charging the system

After the thermal mass is installed, visually examine exposed pipes for kinking or other damage.

The heating system should not be put into operation until the poured concrete thermal mass has cured a minimum of 28 days, unless otherwise specified and approved by the thermal mass supplier. If it is necessary to operate the heating system to prevent freezing of the thermal mass, a maximum flow temperature of 72°F (22°C) must not be exceeded while the thermal mass is curing. After curing, gradually increase the flow temperature by no more than 10°F (6°C) each day until system reaches the required operating temperature.

During start-up of the heating system, take care to increase water temperature gradually as noted above. Take precautions to prevent damage such as thermal shock or condensation to the heating “plant” (boiler) from cold return water temperatures.

Eliminating Air

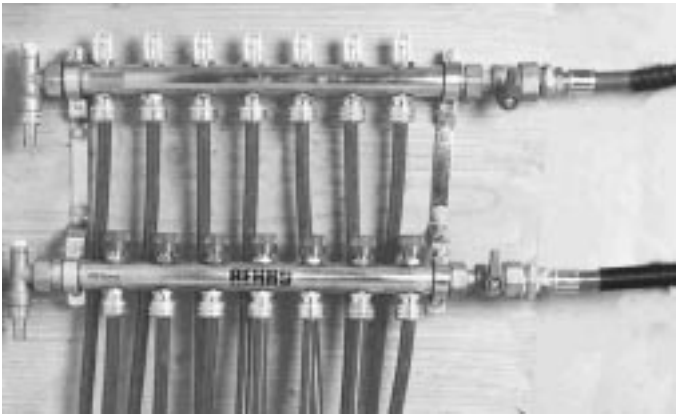
- Monitor flows and temperatures throughout the heating system to check for air pockets that will prevent flow.
- If air pockets are found, adjust valves where possible to redirect the flow of the heating fluid to introduce fluid into these areas.
- If air is suspected at a heating manifold, you may operate the manual air vents installed on PRO-BALANCE, HKV and HLV brass manifolds, to eliminate the air.
- Excessive air may require re-purging of the system.
- As air is eliminated, additional heating fluid may need to be added.

Step Eight: System Balancing

After air has been eliminated and all equipment is verified to be operational, this is the time to balance individual RFH circuits for flow, as per the original design. Balancing is necessary to ensure that each circuit gets correct flow. Too much flow into a circuit will cause an area to overheat. Too little flow will cause an area to be not warm enough.

Balancing does not mean that all circuits get the same flow. Flow requirements are determined by heat loss. These calculations are described in manifold instruction booklets and in REHAU *RFH Technical Manual* 855.601.

Using the circuit flow requirements of the design (RFH WarmSource or other), follow the instructions that came with the manifold to adjust each circuit valve.



RAUPEX Pipe for Manifold Feeds

In most cases, 3/4" or 1" RAUPEX pipe can be used to supply RFH manifolds with hot water from the heat source. RAUPEX pipe is easier to install and performs better than metal pipes commonly used for this purpose. The pipe size should be based on the flow requirements of the manifold, and the acceptable pressure loss (head loss) that can be supplied by the circulator pump. REHAU offers pressure loss charts for these pipe sizes at various flow rates.

A variety of compression nut and EVERLOC fittings are available to connect RAUPEX pipes to the manifolds.

Since RAUPEX pipe will expand and contract with temperature changes, it must be supported and protected to prevent rubbing and abrasion against any fixed objects. Proper support is also necessary to prevent movement noises. There are several things you can do to prevent noise:

- When drilling holes through which to pass pipes, make sure they are at least 1/4" (6 mm) larger than the pipe OD to provide free space all around the pipe.
- Avoid bends that could force pipe against fixed objects.
- Use PE protection sleeve fixed over the pipe when passing through studs, joists, walls or floors.
- Use PVC bend guides or steel support bends to make tight radius 90° bends.
- Ensure that pipes will not contact any fixed objects such as metal pipes or ductwork, other plumbing pipes, or anything else that could cause abrasion and noise.

Installing Caution Labels

A caution label should be placed at each manifold and other locations as appropriate to act as notification that RAUPEX RFH pipes are installed in or under the floor.

ICBO ES ER-5200

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