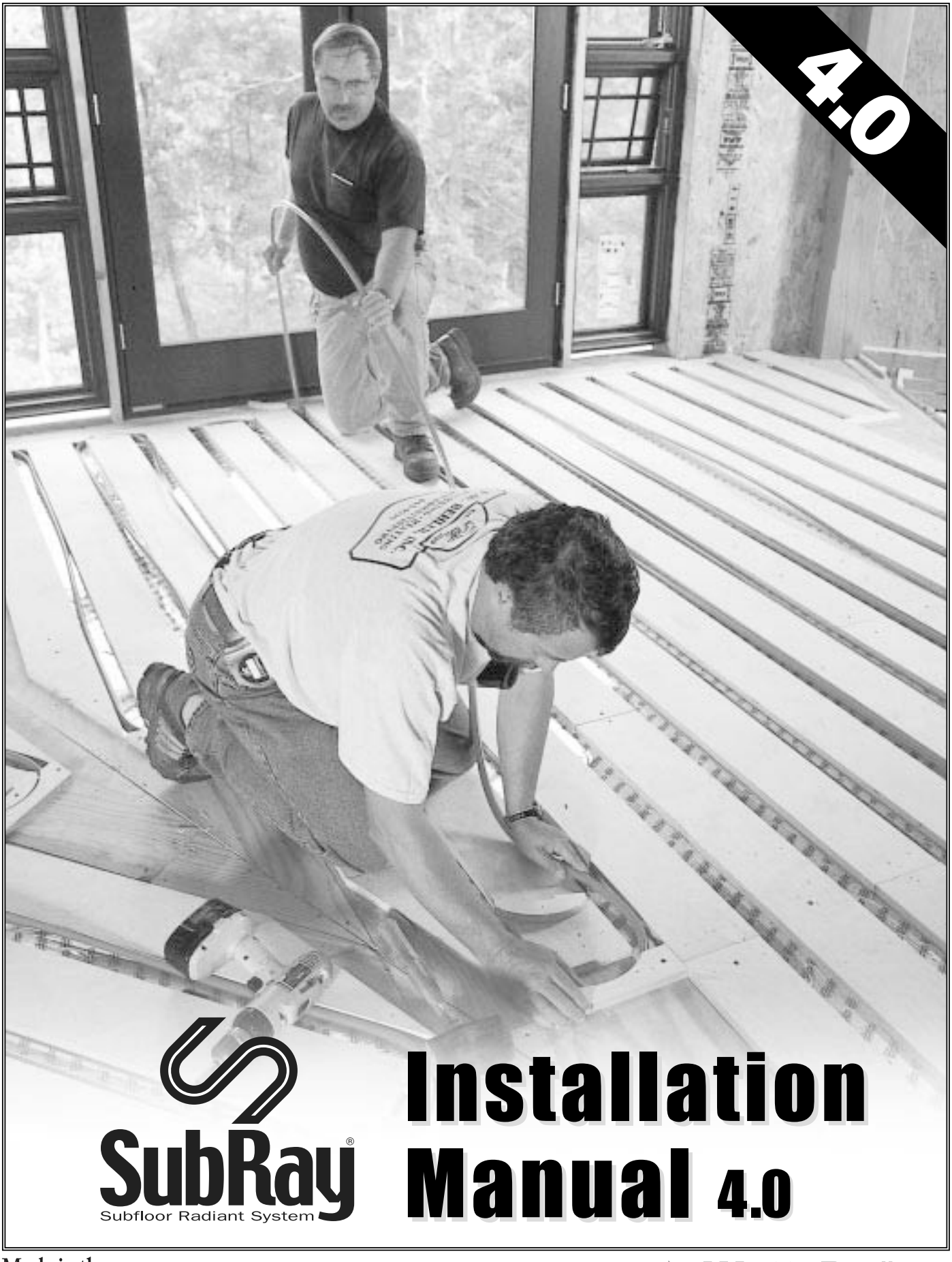



SubRay®
Subfloor Radiant System

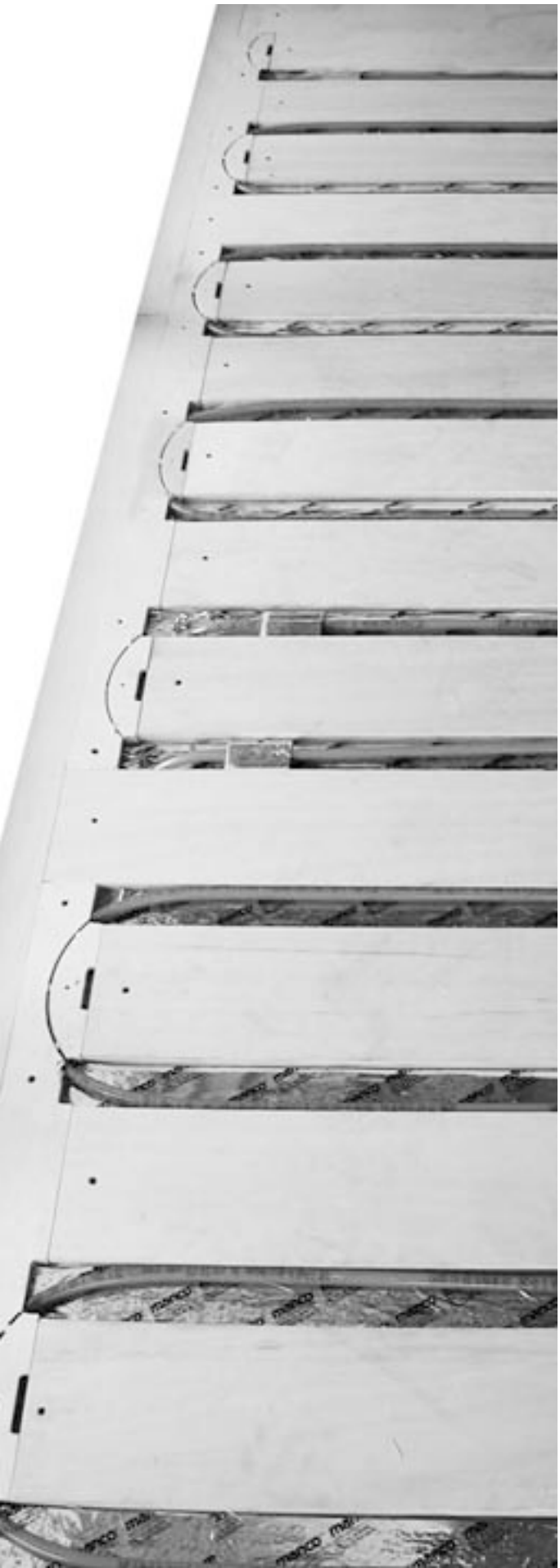
# Installation Manual 4.0

Made in the USA

WattsRadiant
Floor Heating & Snowmelting

A subsidiary of Watts Water Technologies, Inc.

# Benefits of the SubRay® System



**SubRay** is a safe, practical, and easy way to install radiant floor heating over frame or slab floors. SubRay can be installed as a whole-house heating system, or used to heat a basement or room addition.

See the Watts Radiant Product Catalog or visit us on the Web at www.wattsradiant.com for an entire list of hydronic and electric radiant heating/snowmelting equipment.

## Features of the SubRay System

- *FAST* — Quick and easy installation.
- *CLEAN* — No messy silicone needed.
- *BIGGER ZONES* — Twice the flow-rate of 5/16" PEX.
- *SILENT* — Silent floating RadiantPEX®/Onix™ design.
- *THIN* — Less than 5/8" thick (with 3/8" RadiantPEX).
- *THREE PIPES* — 3/8" and 1/2" RadiantPEX, and 3/8" Onix.
- *COMFORTABLE* — The best heat there is.
- *FLEXIBLE* — Accommodates odd-sized rooms.
- *LIGHTWEIGHT* — Easy-to-carry parts.
- *QUALITY* — High quality, 7-ply, Douglas Fir, boat grade plywood and cabinet grade Group 1 Baltic Birch that meets the specs of all wood flooring manufacturers.
- *ECONOMICAL* — Does not require constant circulation. Uses standard pipes and fittings.

## Tools Required

- Saw
- Flat-blade screwdriver
- Hammer
- Rubber mallet
- Tape measure
- RadiantPEX Unwinder or Onix Unwinder
- Radiant Tubing Cutter
- Chalk line

## FREE Design

Call 1-800-276-2419 for free design assistance on any SubRay installation.

WattsRadiant
Floor Heating & Snowmelting
A subsidiary of Watts Water Technologies, Inc.
(NYSE WTS)

4500 E. Progress Place
Springfield, MO 65803-8816
800-276-2419 (USA and Canada)
417-864-6108 (phone)
417-864-8161 (fax)
www.wattsradiant.com

# Quality Construction

European Baltic Birch is kiln dried, won't splinter or crack, and holds nails and screws better than any construction-grade plywood. Sleepers are made from a high quality, 7-ply, Douglas Fir, boat grade ply wood that is finished and sanded on both sides. Both Birch and Douglas Fir compnents are made of multiple thin laminations for dimensional stability. Order 15 mm components for use with 3/8" RadiantPEX; order 18 mm components for 1/2" RadiantPEX and 3/8" Onix piped systems. All SubRay products are made of either Baltic Birch or Douglas Fir.

*Note:* Ends of 15-mm Birch parts are color-coded red; 18-mm parts are color-coded blue.

# SubRay Component and Accessory List

*Header Sticks* (Fig. 1).
Header Sticks hold radiant pipe at each end of the room and spaces it on 8" centers. When installing hardwood strip flooring, you must run header sticks parallel to the flooring at both ends of the room. If using other flooring types, run header sticks along both short sides of the room.

*Sleepers* (Fig. 2).
Sleepers are 6" wide and are installed 2" apart. They support the finish floor and provide a radiant channel for the piping to be safely installed. Allow about 30 Sleepers per 100 sq. ft. of floor.

**Grippers** (Fig. 3).
Grippers are used to hold RadiantPEX where it enters or exits the floor so that the pipe will not rub against floor penetrations. Allow two for each RadiantPEX circuit. *Not needed for Onix installations.*

**Radiant Tape** (Fig. 4).
Radiant Tape is applied to the bottom of each radiant channel to reflect the radiant energy upward to the floor. Use a tape dispenser; allow one roll for every 240 sq. ft.

**Aluminum Conduction Rolls** (Fig. 5).
Aluminum Conduction Rolls are installed over the top of the Sleepers, and help disperse the heat more evenly. Use one roll for each 70 sq. ft. of floor.

**Corner Sweeps** (Fig. 6).
Corner Sweeps help RadiantPEX make a 90° turn. Most simple rectangular rooms will need two sweeps per pipe circuit; most cut up complex rooms will need 5–15 sweeps per circuit. *Not needed for Onix installations.*

**C-Covers** (Fig. 7).
C-Covers are heavy steel "U" guards that protect pipe from nails, and are used to support tile backer board. Most commonly they are used to protect supply/return lines that run parallel to strip flooring.

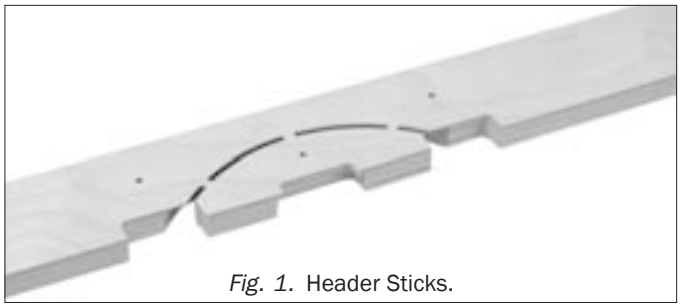


*Fig. 1.* Header Sticks.

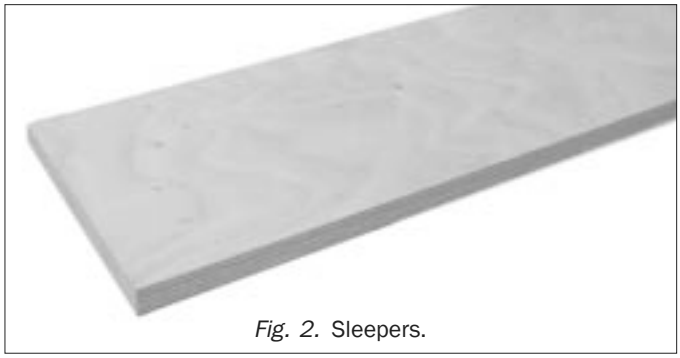


*Fig. 2.* Sleepers.

*Fig. 3.* Grippers.

*Fig. 4.* 2" Radiant Tape.

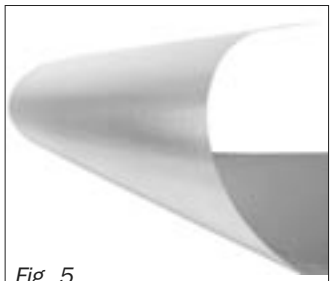


*Fig. 5.* Aluminum Conduction Roll.

*Fig. 6.* Corner Sweep.

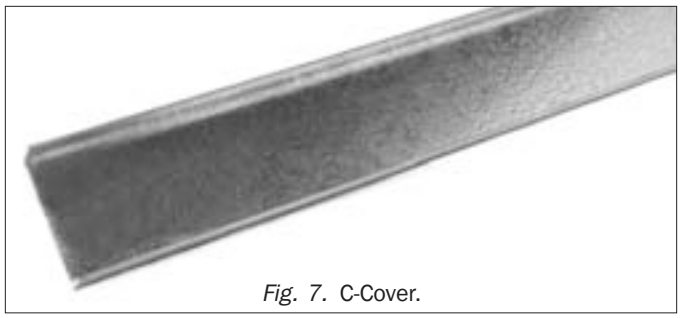


*Fig. 7.* C-Cover.

**Manifolds** (Figs. 8 and 9).
Manifolds distribute hot water to the radiant circuits in the floor. Manifolds are installed as pairs. We suggest using manifolds with shut off and/or individual circuit balancing valves. Manifolds can be installed in walls, under frame floors, in utility closets, mechanical rooms, inside cabinets, or in any other accessible spot.

**Zones**
Zones are areas controlled by a shared thermostat or other control. A zone may be one room or several rooms, but all the radiant heating circuits for a zone will usually originate and return to a single manifold location.

**Radiant Tubing** (Figs. 10 and 11).
Radiant Tubing transfers hot water or glycol/water through the radiant channels in a SubRay system. The red-coded 15-mm SubRay system is designed for 3/8" ASTM Watts Radiant RadiantPEX radiant tubing. The blue-coded 18-mm SubRay system is designed for use with both Watts Radiant 1/2" RadiantPEX, or 3/8" Onix radiant tubing.

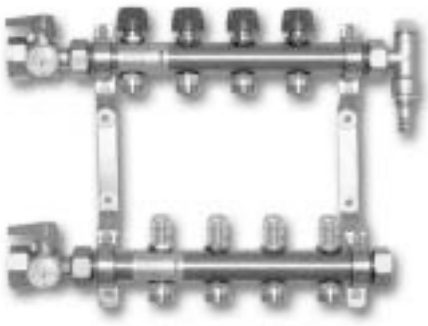


**Fig. 8.** Watts Stainless Steel manifolds with circuit balancing and circuit flow indicators.

**Fig. 9.** Manifold Box.

**Fig. 10.** Onix radiant hose.

**Fig. 11.** RadiantPEX tubing.

## The SubRay Radiant System Installs Fast and Easy.

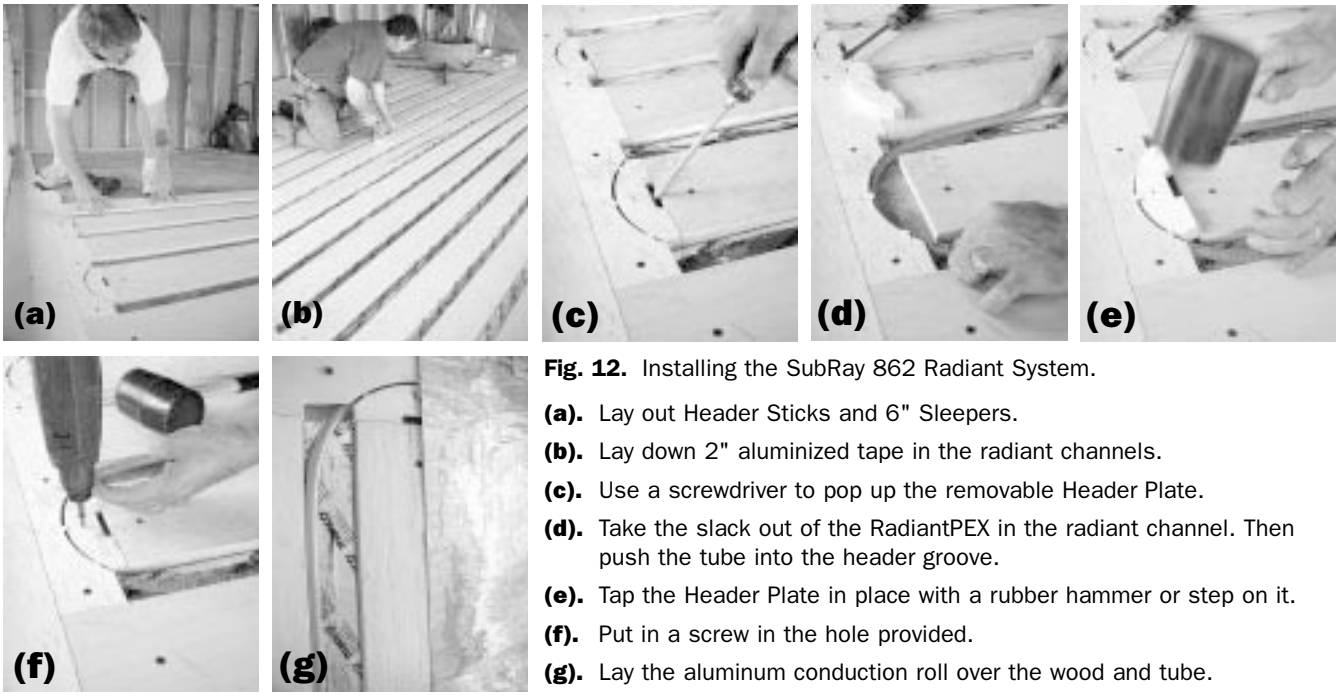



**Fig. 12.** Installing the SubRay 862 Radiant System.

**(a).** Lay out Header Sticks and 6" Sleepers.

**(b).** Lay down 2" aluminized tape in the radiant channels.

**(c).** Use a screwdriver to pop up the removable Header Plate.

**(d).** Take the slack out of the RadiantPEX in the radiant channel. Then push the tube into the header groove.

**(e).** Tap the Header Plate in place with a rubber hammer or step on it.

**(f).** Put in a screw in the hole provided.

**(g).** Lay the aluminum conduction roll over the wood and tube.

# Important SubRay Design Requirements

**1.** SubRay components are not structural, and must be installed on top of structurally sound subfloors or slabs.

**2.** Unless you protect the pipe with C-Covers or nail-guards, do not install SubRay piping immediately next to walls, in doorways, thresholds, or areas where you might expect nails to be driven by flooring, trim, or carpet installers. Be sure to allow for a perimeter strip around the edge of the room.

**3.** Locate manifolds as close to the area to be heated as you can. Supply and return manifolds can be installed under floors, or in walls, but make sure they are accessible.

**4.** Avoid running supply/return lines or manifolds in exterior walls. Freeze damage may result.

**5.** Hardwood floors can be installed directly over the SubRay system. Other floor finishes will require a minimum 1/4", 3/8", or 1/2" plywood to be installed over the SubRay components. Read this manual's directions for your particular floor covering before proceeding. This will ensure your finish floor heights will match.

**6.** Ask Watts Radiant or its professional reps to perform a RadiantWorks™ heat loss calculation to ensure the boiler, pumps and system design meet the structure's heat load. This will include a list of radiant pipe, manifolds, SubRay components and other materials required for each zone. After you have done a few jobs you will probably feel comfortable doing your own take-offs.

# Planning the Installation

## Planning Your Tubing Layout

Here's a good rule of thumb: Once you have located your supply and return manifolds, run your tubing circuit to the far corner of the room and then build your SubRay floor back to the manifolds. This is especially important when you have a manifold above the SubRay floor and there are multiple circuits of tubing in the zone. Figure 13 shows this design practice, and if you plan accordingly you can always get back to your manifold from any place in the room. Figures 14 and 15 are not recommended because if you build your SubRay floor from the manifold or toward the middle of the room, you will not have the space to return the end of the tubing circuit(s) back to the manifold location.

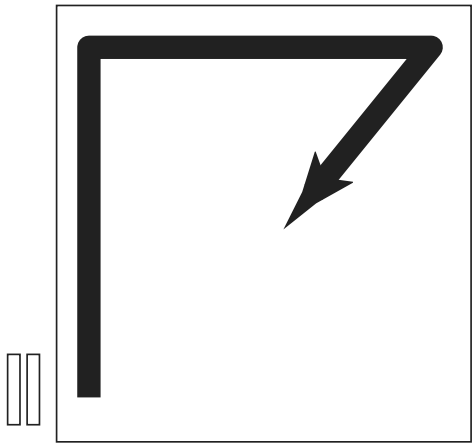


**Fig. 13.** Run your tubing to the far corner of the room and build your SubRay floor back to the manifolds. **Recommended.**

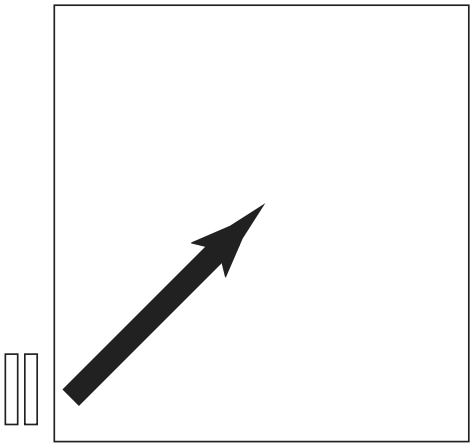


**Fig. 14.** Building your SubRay floor from the manifolds. **Not Recommended!**

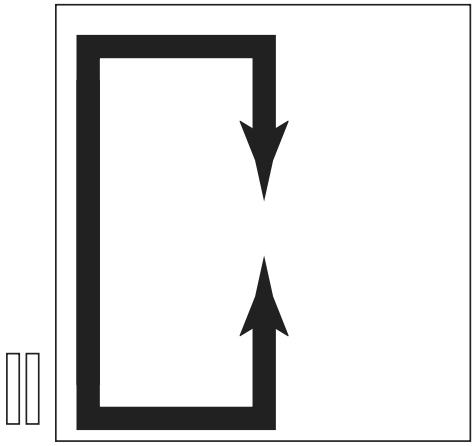


**Fig. 15.** Building your SubRay floor to the center of the room. **Not Recommended!**

## Manifold and Circuit Selection

Using 3/8" Onix or RadiantPEX, most contractors will run 200' circuits, although longer lengths are possible. Using standard 8" spacing, and allowing for manifold connections, a single 200' circuit will heat about 125 sq. ft.

Using 1/2" RadiantPEX, most contractors will run 300' circuits, which can heat about 200 sq. ft. Therefore, if you are heating a 375 sq. ft. room, you could select (3) 200' circuits, or (2) 300' circuits. You'll need to select a supply/return manifold set with the correct number of branches to service the circuits you're using for each zone. Remember that you'll need to use red-coded 15-mm SubRay components if you're using 3/8" RadiantPEX, and blue-coded 18-mm components if you're using 1/2" RadiantPEX or 3/8" Onix. We recommend Header Sticks if you're using Onix, but you won't need to secure the removable Header Plate as shown in Fig. 12e. See Watts Radiant's RadiantPEX or Onix Radiant Design and Installation manuals for more information regarding tubing and manifold selection.

**Note:** We suggest using manifolds with individual circuit shut-off valves on both supply and return circuits. If your circuits are cut to special lengths, you should use balancing valves if any circuit within a single zone is more than 10% longer than the shortest circuit in that zone.

## Manifold Location

The location of the manifolds can change the pipe layout, so this section of the manual gives you some ideas regarding manifold placement. Remember that manifolds must be accessible. The radiant tubing in the floor begins and ends at the manifolds, so piping access from the manifolds to the radiant floor is key. Although there are many possible ways to install manifolds we will show you three popular methods.

## Manifold Below the Floor

In Fig. 16 the radiant tubing enters the floor at one end of the room and exits at the other end. The manifolds may be located under the floor, or at some remote location. You can run one, two, or more circuits in the same room using this method. Wherever you enter/exit the floor, cut a minimum 2"–3" long slot so that the radiant pipe will make a gentle upward bend, and not kink, where it enters the floor. Use a Gripper at each entry/exit slot to firmly hold the pipe in place, if you are using RadiantPEX (Fig. 16).

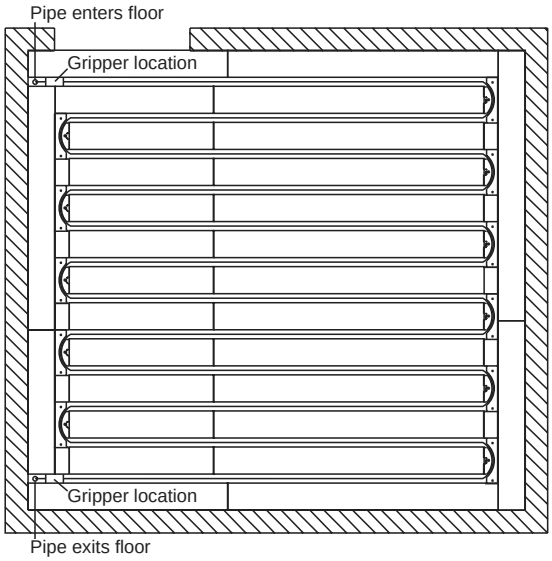



**Fig. 16.** Loop configuration with manifolds below the floor (manifolds not shown).

## Manifolds Above the Floor

Manifolds may be installed in wall cavities, under vanities, in mechanical closets, or adjoining rooms. In Fig. 17 you'll see a manifold in the wall, near a room corner.

## Tubing in Wall Studs

This approach keeps your floor layout very simple, and is useful if you can run radiant piping through the walls. The radiant tubing leaves the supply manifold, runs through the wall studs and then to the far corner of

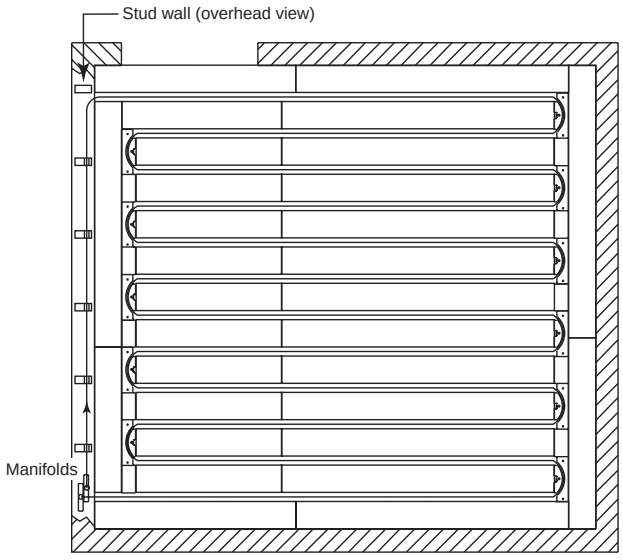



**Fig. 17.** Loop configuration with manifolds above the floor with radiant tubing running through adjacent studs.

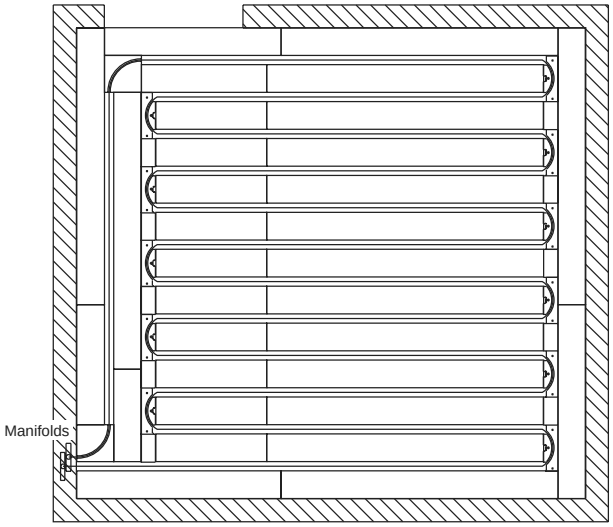



**Fig. 18.** Loop configuration with manifolds above the floor and tubing in radiant channels.

the room. Then build your SubRay floor back to the return manifold.

Don't run piping through exterior walls, unless frost-proofed with antifreeze. Cover the piping where it enters/exits the wall with nail plates to protect it against tack strips and trim nails.

### Tubing in the Floor Only

You may not have the option of running piping through a wall, so locate your supply/return manifolds and cut a slot or drill a hole in the wall base plate to form an entry point for the radiant tubing. Install nail plates as needed to protect tubing from base trim and carpet tack strips. Form a radiant pathway for the tubing by installing a second sleeper, just after the perimeter sleeper strip on the left wall. Run the radiant tubing up this pathway (Fig. 18) along the left wall. If you are installing hardwood strip flooring you will want to install a protective C-Cover over the tubing because hardwood flooring will be running lengthwise over this pathway. Run your radiant channel to the far end of the room and build your Subray floor back to the return manifold. (See also Fig. 35.)

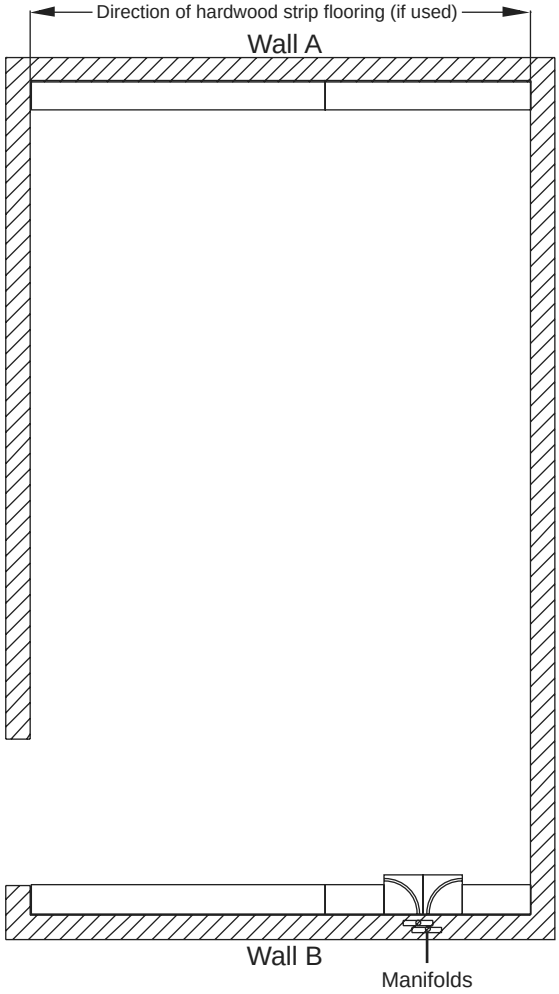



**Fig. 19.** Planning the SubRay layout.

# Installation Steps

### How to Begin

**1.** Select the two opposing walls of the room that the Header Sticks will be installed next to (labeled Wall A and Wall B in Fig. 19). Headers Sticks are normally installed on the two short walls of a rectangular room. If you are installing strip hardwood, the Header Sticks must be installed parallel to (running with) the flooring. Each Header Stick is 42" long and will hold three pipe bends. The radiant circuits begin at the manifold and are installed to run back and forth between the two sets of Header Sticks.

**2.** Screw or nail standard SubRay 6" Sleepers in a continuous strip along the two Header Stick walls (A/B) (see Fig. 19).

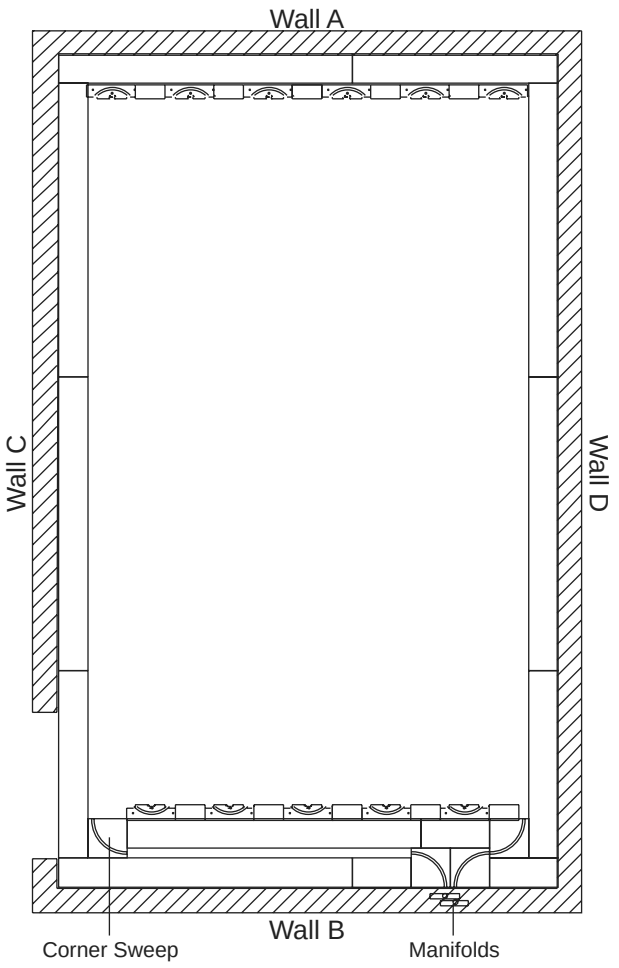



**Fig. 20.** Installing Perimeter Strips and Header Sticks.

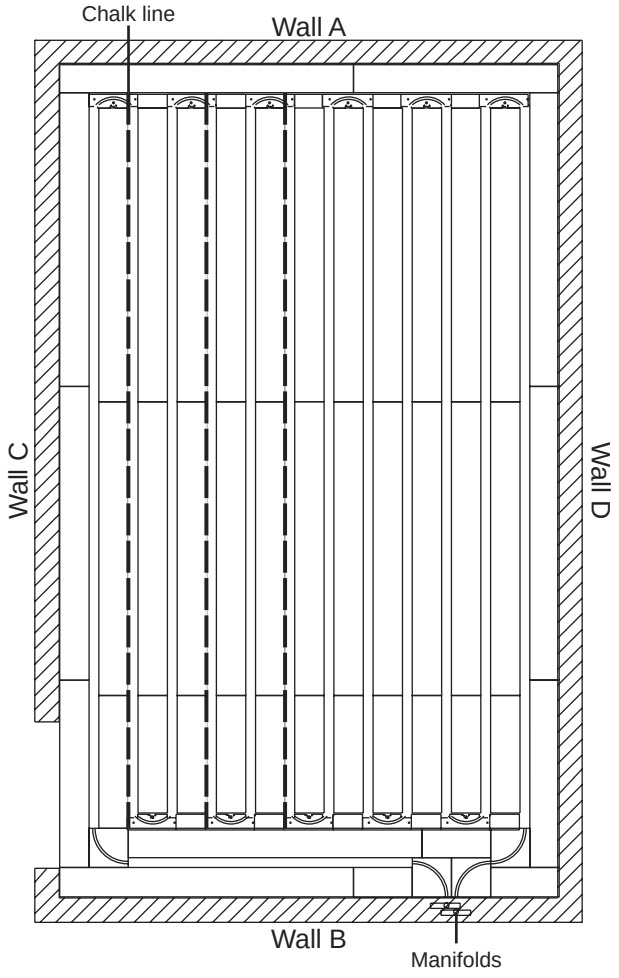



**Fig. 22.** Installing Sleepers and Radiant Tape.

## Installing Perimeter Strips and Header Sticks

**3.** Measure the width of the room, between the two walls that do not have Header Sticks (labeled Wall C and Wall D in Fig. 20). Take this width (in inches) to Appendix B (page 20) and see which width of perimeter strips matches with your room width. In the example, a 120"-wide room (see span wall width in Appendix B, Fig. 43, page 20) will require 7" perimeter strips along walls C and D. Rip up SubRay Sleepers as needed to make up correct width and install the perimeter strips along walls C and D.

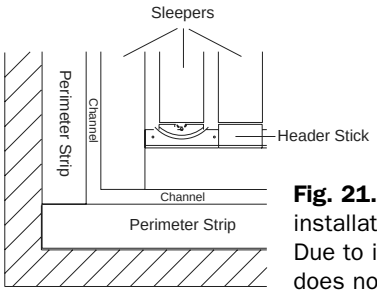



**Fig. 21.** Detail of corner for Onix installation without Corner Sweep. Due to its greater flexibility, Onix does not require Corner Sweeps.

**4.** Fasten down the Header Sticks along the Header Stick walls (A,B), add Corner Sweeps (see Fig. 20) as needed. Corner Sweeps are not needed for Onix tubing; see Fig. 21 for detail. **Note:** Fasten the removable Header Plate only after radiant tubing is installed.

**Important Note:** Look ahead to Fig. 22 and see how the Header Stick on wall B will always be offset by one radiant channel (8") compared to the Header Stick on wall A.

## Installing Sleepers and Radiant Tape

**5.** Fill in Sleepers as shown in Fig. 22, maintaining a 2" space between the Sleepers.

**Note:** Spacing of Sleepers is based on the Header Sticks. It is recommended that a chalk line be made between the opposing Header Sticks for the first Sleeper and for every third or fourth Sleeper afterward to make sure that the Sleepers are installed with the 2" spacing between them (see Fig. 22). Do not use Grippers as spacers.

**6.** Lay in radiant Reflective Tape in the 2" space.

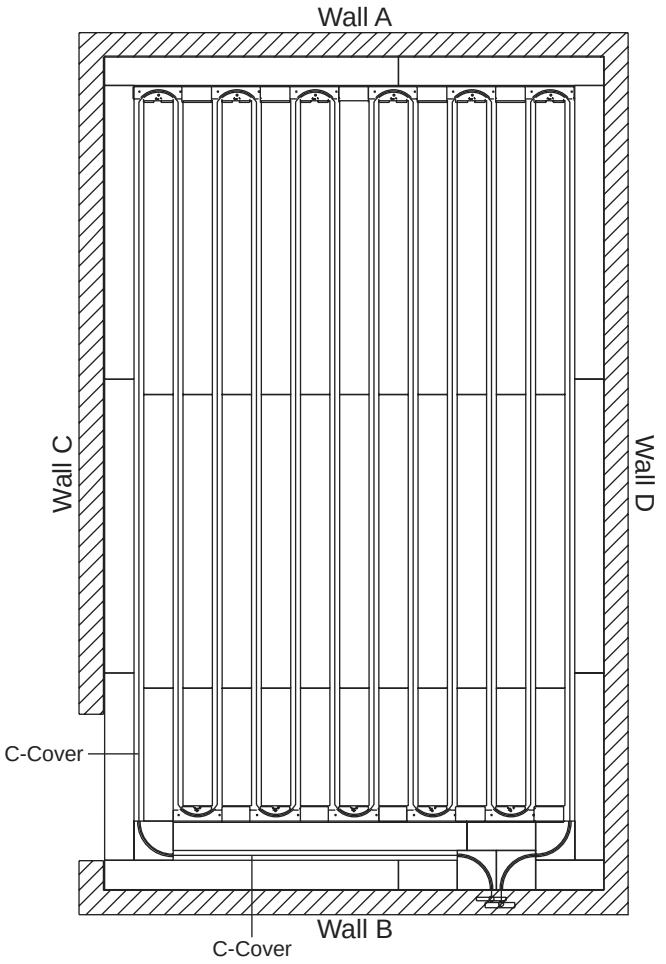



**Fig. 23.** Installing Radiant Tubing.

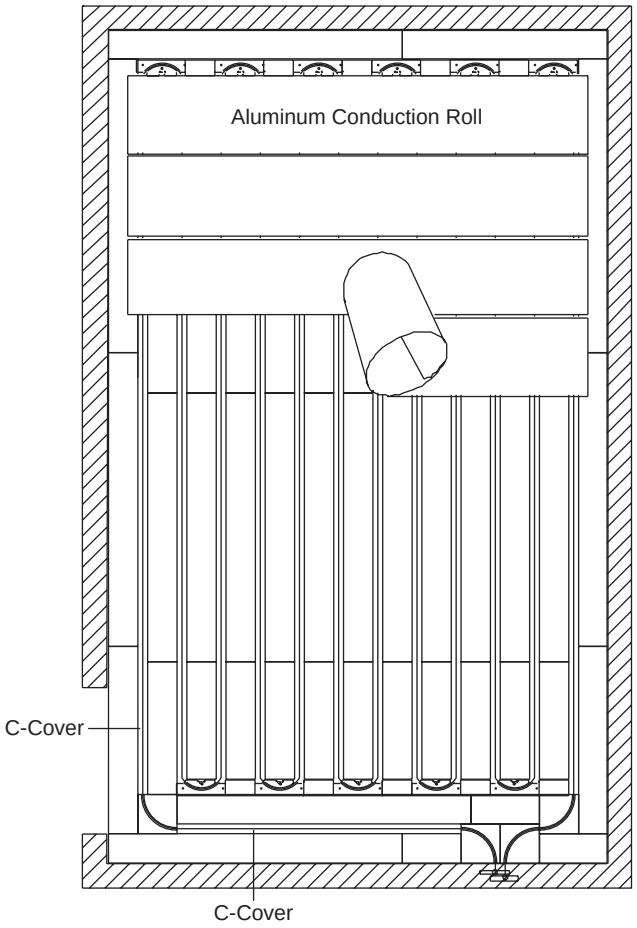



**Fig. 25.** Installing Aluminum Conduction Layer.

## Running Radiant Tubing

**7.** Beginning at the manifolds, run the radiant tubing in the radiant channels (see Fig. 23). Try to avoid field splices. Use Grippers where RadiantPEX enters or leaves the floor, as necessary.

**8.** Cover vulnerable areas of radiant tubing with C-Covers (Figs. 7 and 23) or nail guards as needed. Use C-Covers anywhere radiant tubing is running parallel to hardwood strip flooring. Because Onix is slightly thicker than PEX, C-Covers over Onix may need to be secured by driving roofing nails between the C-Cover and the Sleepers (see Fig. 24).

**9.** When the piping in each zone is installed, connect it to the manifolds. Use a Watts Radiant pressure test kit, or equivalent, to pressurize each SubRay zone to 100 psi or as local codes require. If possible, pressurize the system for 24 hours before rolling out the Aluminum Conduction Rolls. You must pressurize the system for a minimum of 24 hours before covering it with a permanent floor. After a 24-hour initial test, the system should experience no more than a 10% loss of pressure.

Maintain a pressure in the system continuously until the finish floor is installed and the base trim is installed. Check the system frequently while other tradespeople are working on the job to minimize the chance of concealed damage. Read the Watts Radiant RadiantPEX or Onix manuals for essential pressure test procedures and cautions before pressure testing. If a leak is suspected, check all connections and locations of possible pipe damage before retesting the system. If you are not sure how to proceed, please call Watts Radiant or your local technical support person for advice.

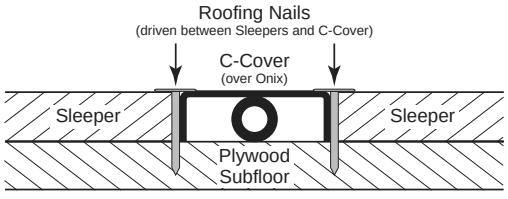



**Fig. 24.** Securing C-Covers over Onix radiant tubing.

## Installing Aluminum Conduction Layer

**10.** Roll out the first Aluminum Conduction Roll (see Fig. 25). Leave the Header Sticks exposed if you will be nailing a finish floor down and need to see where the radiant pipe is installed.

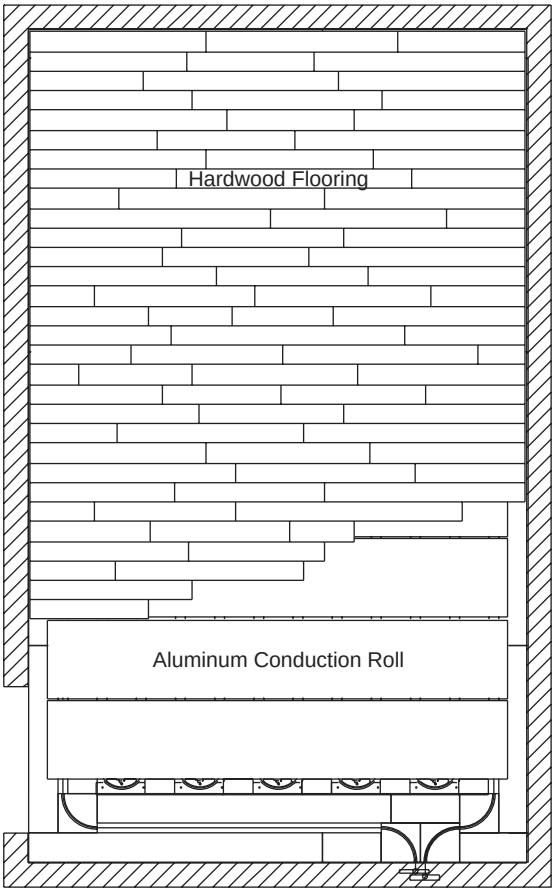



**Fig. 26.** Installing hardwood flooring.

**11.** Roll out the rest of the rolls, but leave a 1/2" gap between them, so that you will be able to clearly see where the pipes are located underneath.

### Installing Finish Flooring

**12.** After consulting the section(s) of this manual that apply to your finish flooring, cover the SubRay System with the correct subfinish and finish flooring materials (Fig. 26), as outlined in this manual and required by the finish flooring manufacturer.

# Insulation

Adequate insulation will reduce fuel bills and increase comfort. When SubRay is installed over a frame floor, it is highly desirable to insulate under the floor, unless it is physically impossible. If the lower floor is heated, you should use a minimum R-13 batt under the floor. If the area below is unheated, then use a R-19 to R-38 batt under the floor. See following figures for illustrations of various ways to insulate under floors.

If SubRay is installed over a new slab, the slab, especially the slab perimeter, should be insulated to at least the standards of the local building code, although most builders will add additional insulation. If installed over an old slab, 1" to 3" of perimeter insulation should be retrofitted.

If it is impossible to insulate under the floor consult with Watts Radiant before proceeding.

# Operating Guidelines

The SubRay system does not require costly or complex constant circulation systems to maintain even floor temperatures. You may wish to use a Watts Radiant dual-sensing stat that measures both air and floor temperature, an outdoor reset system, or other control option. Consult with your Watts Radiant representative for technical assistance.

For maximum comfort, ASHRAE Guidelines suggest that floor surface temperatures should not exceed 85°F in most living areas. Most floors will warm to between 75° and 80° to meet the heat loss, perhaps more during cold weather, or where a building is not well insulated.

Some types of finished flooring are made of glues, laminates, or polymers that may react adversely to higher temperatures. When in doubt, check with the flooring manufacturer regarding temperature limits for their materials.

The water and surface temperatures can be controlled with a combination of Watts dual-sensing stats (air/floor), preassembled HydroControl® Panels (see Fig. 27) or other combinations. Always use the lowest temperature necessary to maintain comfort. Do not allow inlet water temperatures to exceed 160°F.

**Fig. 27.** A Watts Radiant HydroControl maintains control over the water temperature entering the SubRay zone.

# SubRay Installation and Floor Surfaces

## Natural Hardwood Flooring

**Preparation of Slab.** Secure Sleepers and Header Sticks to the underlying slab on 8" centers. Concrete nails may spall some concrete, and cause rocking. If so, use concrete screws or bolts (see Appendix A for details). We recommend you predrill the Sleepers before drilling into the concrete. The slab must have a vapor barrier installed underneath it to prevent ground moisture from coming up into the floor. If the slab is less than six months old, or contains residual moisture, it must first be aged or heated to drive out the moisture. Tape down a 2' x 2' square of plastic over a section of the slab and wait 24 hours. If there is no moisture present on the plastic sheet after this test, the concrete is suitably dry for a wood floor to be installed over it. If in doubt as to moisture content of the slab, or if installing over an existing older slab; you must install a thick (eight mil or better) vapor barrier over the slab. Overlap and tape the edges of the barrier to prevent residual concrete moisture from damaging the wood flooring.

The slab beneath must be insulated according to local code and practices. In a retrofit of an existing slab, it may not be possible to insulate the slab. See your Watts Radiant representative for additional design and installation concepts if you cannot insulate the slab.

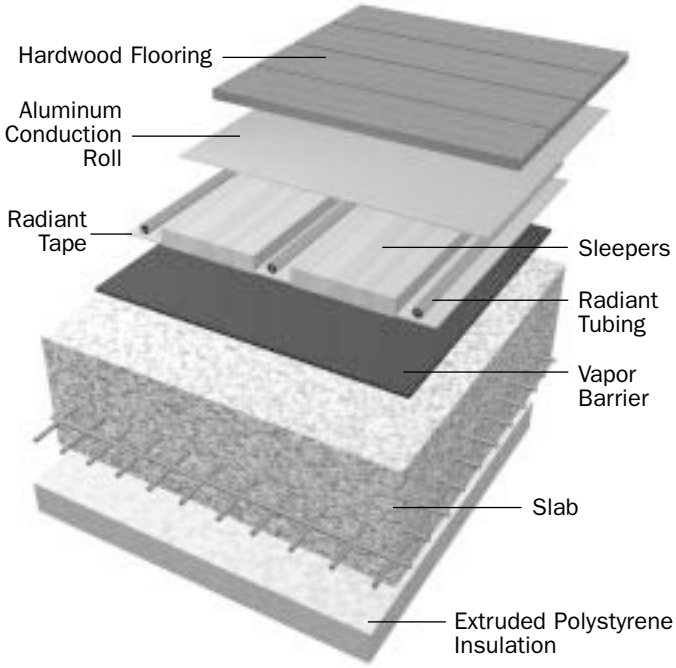



**Fig. 28.** Hardwood over SubRay system, over slab.

**Preparation of Subfloor.** Secure Sleepers and Header Sticks to the underlying subfloor on 6" to 8" centers. Preferentially use screws. Do not install a vapor barrier over a subfloor if the space below is unconditioned, as this could trap moisture in the floor.

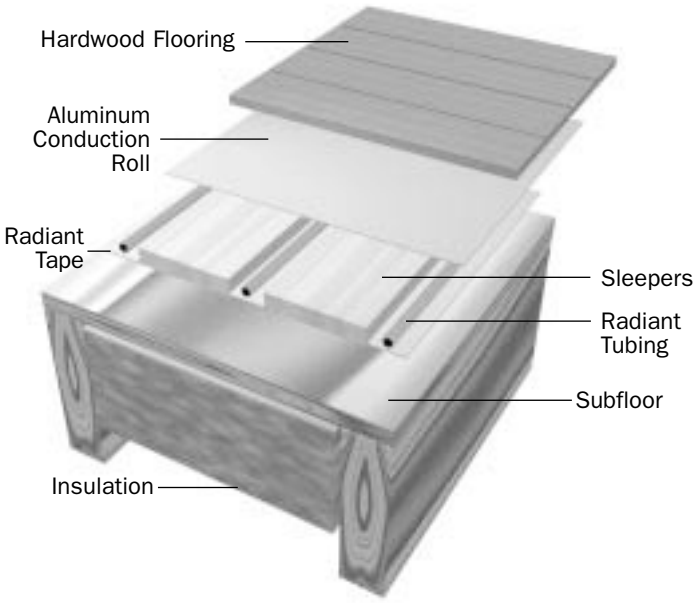



**Fig. 29.** Hardwood over SubRay system, over frame floor.

**Wood Selection.** Use only kiln-dried 3/4"-thick hardwood flooring. Widths up to 3-1/4" are acceptable. The wood must be site tested to ensure that its moisture content does not exceed 8% when installed. Follow all installation recommendations of the wood flooring manufacturer and the National Oak Flooring Manufacturer's Association.

**Special Considerations.** Hardwood strip flooring can be installed directly over the SubRay aluminum conduction layer. Stagger all joints; if a length of flooring ends over the 2" radiant channel, it is not necessary to trim it so that it ends over a sleeper. Hardwood strips can easily span this channel.

When you install hardwood strips parallel to a radiant channel, such as for a supply/return line, cover the radiant channel with a C-Cover. The C-Cover protects the tubing underneath from nails and staples. Use adhesive, instead of nails, to hold down the flooring installed directly over the C-Cover.

If drywalling or painting after the flooring is installed, provide suitable ventilation to prevent wood from absorbing excess moisture.

**Additional Sources of Information.** Contact The Hardwood Council at www.hardwoodcouncil.com or The National Oak Flooring Manufacturer's Association at www.nofma.org or call 901-526-5016.

## Tile, Ceramic, and Stone

**Preparation of Slab.** Secure Sleepers and Header Sticks to the underlying slab on 6" to 8" centers. Concrete nails may spall some concrete, and cause rocking. If so, use concrete screws or bolts. We recommend predrilling the Sleepers before drilling into the concrete. The slab must have a vapor barrier installed underneath to prevent ground moisture from coming up into the floor. If installing over an existing older slab, lay a thick (8 mil or better) vapor over the slab to keep ground moisture out. Overlap and tape the edges of the barrier to prevent residual concrete moisture from coming up.

The slab beneath must be insulated according to local code and practices. When retrofitting over an existing slab, it may not be possible to insulate to modern practices. See your Watts Radiant representative for additional design and installation concepts if you cannot insulate the slab. Always consult with your Watts Radiant representative for a design analysis when installing over an existing slab.

**Preparation of Subfloor.** Secure Sleepers and Header Sticks to the underlying subfloor on 6" to 8" centers. Preferentially use screws. Insulate under the subfloor according to local standards for radiant floors, or consult with Watts Radiant. A subfloor must be designed to hold the weight of the flooring without excessive deflection or bending of the floor. Generally, subfloor deflection must not exceed L/360 when the floor is exposed to the combined design dead and live loads.

**General Guidelines.** All tile floors should be installed according to the guidelines of the TCA or ANSI specifications. The following steps are illustrative, and provided for general guidance only. Local codes, customs, or good engineering or contractor experience may dictate other procedures. Consult with Watts Radiant for further advice or suggestions.

**Bridge the Channel.** Tile, ceramic, or stone flooring will not bridge the two inch wide radiant channel where the radiant tubing is installed. There are at least three ways you can proceed.

**1.** Some installers will fill the radiant channel with "mud," and cover the Sleepers, channels, and Header Sticks with the aluminum conduction roll. Leave 1/2" gaps between the rolls for radiant channel visibility, and screw down cement board (TCA Guideline) or plywood over the aluminum (not illustrated).

**2.** Where keeping the floor height to a minimum is important, fill the radiant channels using C-Covers, and then roll out the aluminum. Screw down the cement board (TCA Guideline) or plywood over the SubRay assembly, covering the aluminum sheet (see Fig. 30).

**3.** A third choice is to roll out the aluminum over the Sleepers, and then bridge over the radiant channels with

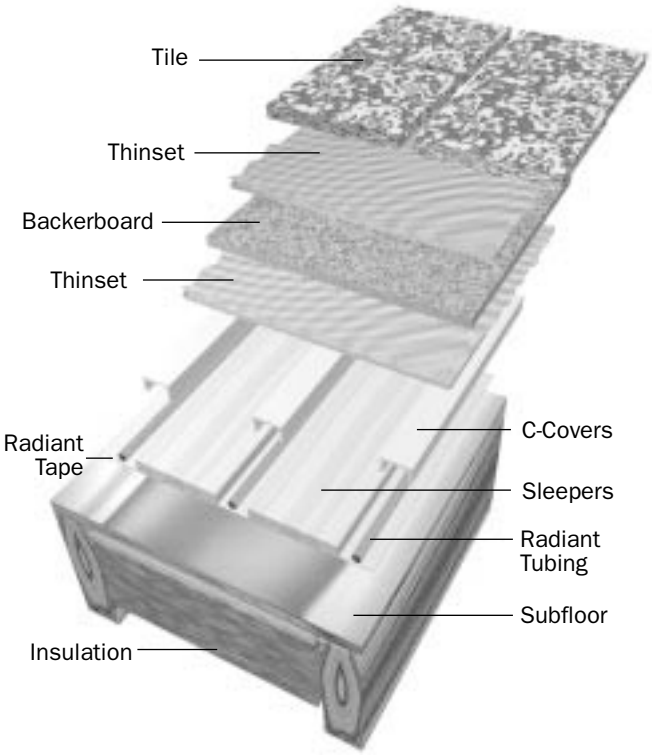



**Fig. 30.** Tile over SubRay system, over frame floor.

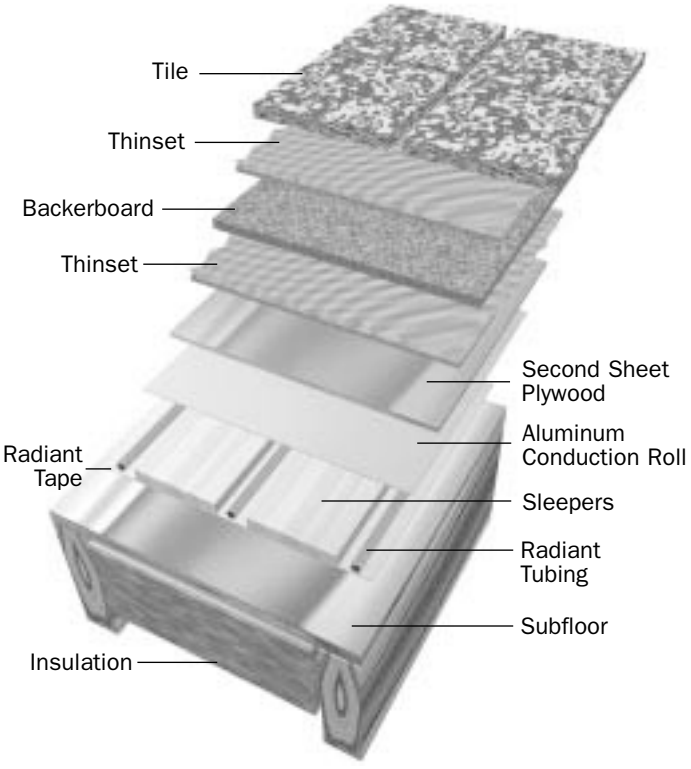



**Fig. 31.** Tile over SubRay system, over frame floor.

3/8" plywood. Screw the second sheet of plywood down carefully to avoid damaging the radiant tubing. If you are following TCA/ANSI practice of installing tile backerboard over plywood, you'll need to snap chalk lines on the plywood. Use these chalk lines to mark the Header Sticks and radiant channel locations, so that you can safely screw the cement board over the plywood (Fig. 31).

**Caution:** Cementious adhesives used in thinset or mortar could cause the aluminum to surface oxidize, breaking the bond between the aluminum and tile/stone directly above. Use screws on 6" to 8" centers to mechanically fasten the overlay sheets to the subfloor and SubRay materials.

The recommended fastener is a corrosion-resistant 1-1/4" No. 8 by .323" head diameter ribbed screw with countersunk head. The screw must be long enough to reach through the SubRay materials to the bottom of the supporting subfloor.

**Install Tile or Stone Floor.**

**Caution:** Always cover the aluminum conduction sheet with cement board or plywood before setting tile or stone. Do not apply thinset or mortar directly to the aluminum sheet.

Using a 1/4" notched trowel, apply a layer of latex or acrylic modified thinset mortar (complying with ANSI A118.4) to the surface of the cement board or plywood. Alternatively use thickset mortar as local custom or codes may require.

**Caution:** The system must always be pressurized during construction. Check the pressure gauges frequently while you are using screws or nails near the radiant tubing. Use approved Watts Radiant field splices as needed.

Consult with thinset or mortar supplier before applying heat. Most cementious materials will require at least 7 to 28 days to reach design strength. Premature application of heat will cause weakening of thinset and mortar.

## Carpet

If properly designed, most combinations of carpet and pad may be installed over a SubRay radiant floor. Due to the insulating value of carpet and pad, all SubRay installations should be designed by an authorized Watts Radiant representative using the latest version of RadiantWorks®, Watts Radiant's design software.

RadiantWorks software calculates the heat loss of each zone based on the specific building design and local climate. The software calculates the insulating value of the floor coverings to determine the required radiant fluid temperature. If necessary, RadiantWorks will tell the designer if supplemental sources of heat may be required. In most cases the radiant system is capable of satisfying the heat load.

After laying out the SubRay components and installing the radiant tubing, roll out the aluminum conduction roll. Leave a 1/2" space between each roll so that the flooring contractor can see where the radiant channels are located. Screw or nail a minimum of 3/8" plywood, or equivalent structural subflooring product, over the SubRay components. Observe care near the Header Sticks (see Fig. 32).

Always maintain a minimum 3" perimeter strip around the room. This perimeter strip should not have any radiant tubing installed in it, unless the tubing is protected against nails and carpet tack strips. If any tubing runs from one room to another, the threshold area should have nail guards installed to protect the tubing against tack strips.

**Caution:** The system must always be pressurized during construction. Check the pressure gauges on your manifold test kit frequently anytime you are using screws or nails near the radiant tubing, and for at least 24 hours afterward. Use approved Watts Radiant field splices if the tubing is damaged.

According to industry guidelines, the radiant system should be designed so that the surface of the carpet does not exceed 85°F.

Advice about carpet installation is available at the Carpet and Rug Institute in Dalton, Georgia. Call 706-428-2106 or contact the Institute at www.carpet-rug.com.

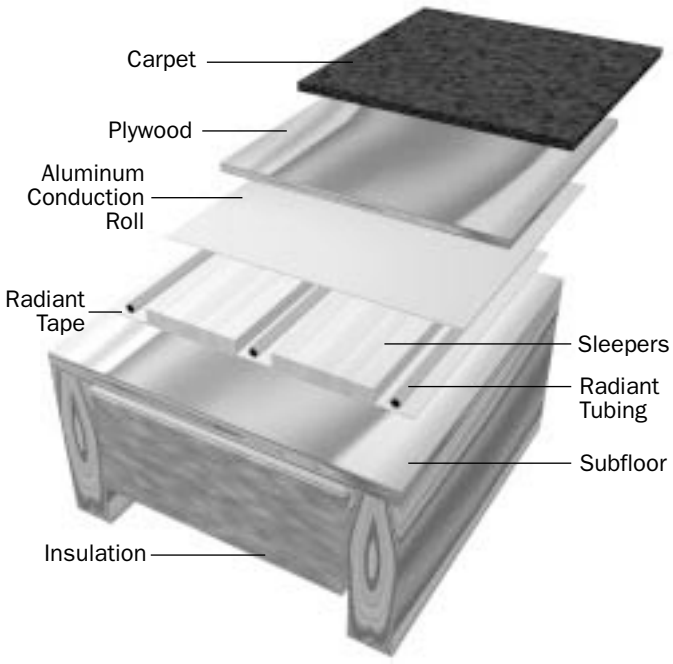



**Fig. 32.** Carpet over SubRay system, over frame floor.

## Pergo® Laminate

**Installation Requirements.** Pergo floors can be installed over a SubRay system, as long as the following Pergo requirements are observed. All SubRay installations should be designed by an authorized Watts Radiant representative using the latest version of RadiantWorks, Watts Radiant's design software.

**Preparation of Slab.** Secure Sleepers and Header Sticks to the underlying slab on 8" centers. Concrete nails may spall some concrete, and cause rocking. If so, use concrete screws or bolts (see Appendix A). We recommend you predrill the Sleepers before drilling into the concrete. The slab must have a vapor barrier installed underneath it to prevent ground moisture from coming up into the floor. If the slab is less than 6 months old, or contains residual moisture, it must first be aged or heated to drive out the moisture. Tape down a 2' x 2' square of plastic over a section of the slab and wait 24 hours. If there is no moisture present on the plastic sheet after this test, the concrete is suitably dry for the finish flooring to be installed over it. If in doubt as to moisture content of the slab, or if installing over an existing older slab, you must install a thick (eight mil or better) vapor over the slab. Overlap and tape the edges of the barrier to prevent residual concrete moisture from damaging the flooring.

The slab beneath must be insulated according to local code and practices. In a retrofit of an existing slab, it may not be possible to insulate the slab. See your Watts Radiant representative for additional design and installation concepts if you cannot insulate the slab. Always consult with your Watts Radiant representative for a design analysis when installing over an existing slab.

**Preparation of Subfloor.** Secure Sleepers and Header Sticks to the underlying subfloor on 6" to 8" centers. Preferentially use screws. Do not install a vapor barrier over a subfloor if the space below is unconditioned, as this could trap moisture in the floor. Always insulate under the subfloor in accordance with local codes. If in doubt as to the recommended insulation, consult with Watts Radiant for design assistance.

RadiantWorks software calculates the heat loss of each zone based on the specific building design and local climate. The software calculates the insulating value of the floor coverings to determine the required radiant fluid temperature. If necessary, RadiantWorks will tell the designer if supplemental sources of heat may be required. In most cases the radiant system is capable of satisfying the heat load.

After laying out the SubRay components and installing the radiant tubing; roll out the aluminum conduction roll. Leave a 1/2" space between each roll so that the flooring contractor can see where the radiant channels are located. Screw or nail a minimum of 1/2" plywood over the SubRay components. Observe care near the Header Sticks.

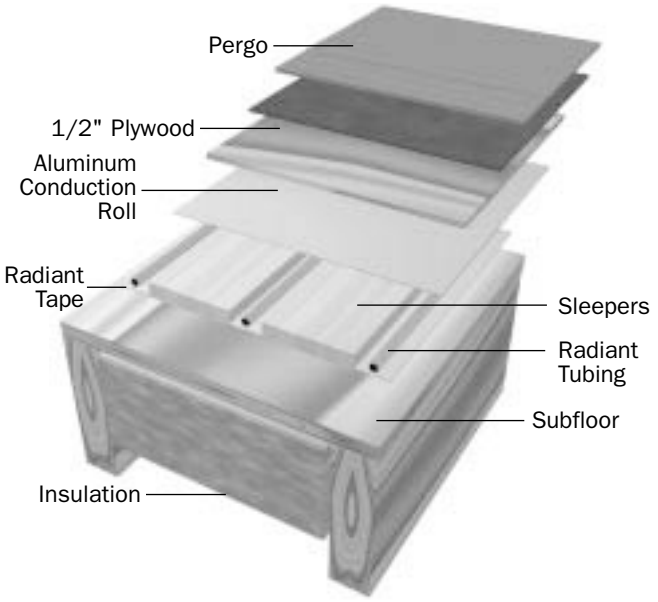



**Fig. 33.** Pergo over SubRay system, over frame floor.

Always maintain a minimum 3" perimeter strip around the room. This perimeter strip should not have any radiant tubing installed in it unless the tubing is protected against trim nails/staples and possible future carpet tack strips. If any tubing runs from one room to another, the threshold area should have nail guards installed to protect the tubing against possible future tack strips.

**Caution:** The system must always be pressurized during construction. Check the pressure gauges on your manifold test kit frequently anytime you are using screws or nails near the radiant tubing, and for at least 24 hours afterward. Use approved Watts Radiant field splices if the tubing is damaged.

According to Pergo guidelines, the radiant system should be designed so that the surface of the Pergo flooring does not exceed 84°F. A Watts Radiant DualTemp thermostat is available with this floor limit feature.

Advice about Pergo specifications and installation instructions is available at www.pergo.com.

## Wilsonart®

**Installation Requirements.** Wilsonart floors can be installed over a SubRay system, as long as the Wilsonart requirements are observed. All SubRay installation should be designed by an authorized Watts Radiant representative using the latest version of RadiantWorks, Watts Radiant's design software.

**Preparation of Slab.** Secure Sleepers and Header Sticks to the underlying slab on 8" centers. Concrete nails may spall some concrete, and cause rocking. If so,

use concrete screws or bolts (see Appendix A). We recommend you predrill the Sleepers before drilling into the concrete. The slab must have a vapor barrier installed underneath it to prevent ground moisture from coming up into the floor. If the slab is less than 6 months old, or contains residual moisture, it must first be aged or heated to drive out the moisture. Tape down a 2' x 2' square of plastic over a section of the slab and wait 24 hours. If there is no moisture present on the plastic sheet after this test, the concrete is suitably dry for the finish flooring to be installed over it. If in doubt as to moisture content of the slab, or if installing over an existing older slab, you must install a thick (8 mil or better) vapor over the slab. Overlap and tape the edges of the barrier to prevent residual concrete moisture from damaging the flooring.

The slab beneath must be insulated according to local code and practices. In a retrofit of an existing slab, it may not be possible to insulate the slab. See your Watts Radiant representative for additional design and installation concepts if you cannot insulate the slab. Always consult with your Watts Radiant representative for a design analysis when installing over an existing slab.

**Preparation of Subfloor.** Secure Sleepers and Header Sticks to the underlying subfloor on 6" to 8" centers. Preferentially use screws. Do not install a vapor barrier over a subfloor if the space below is unconditioned, as this could trap moisture in the floor. Always insulate under the subfloor in accordance with local codes. If in doubt as to the recommended insulation, consult with Watts Radiant for design assistance.

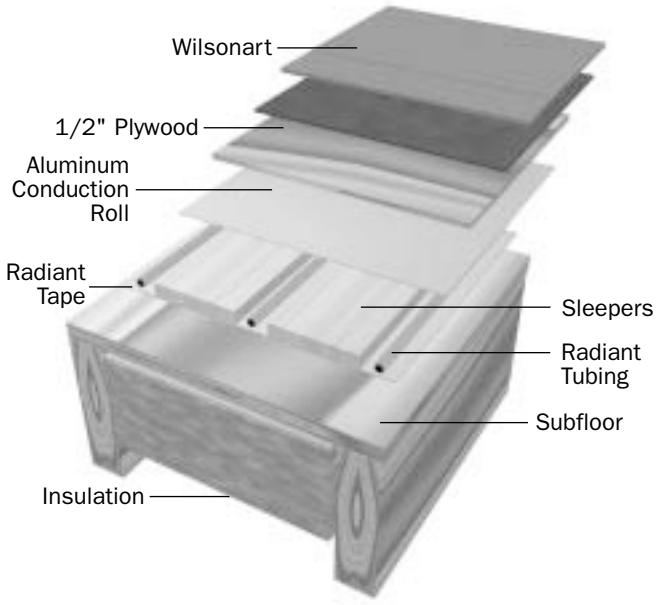



**Fig. 34.** Wilsonart over SubRay system, over frame floor.

RadiantWorks software calculates the heat loss of each zone based on the specific building design and local climate. The software calculates the insulating value of the floor coverings to determine the required radiant fluid temperature. If necessary, RadiantWorks will tell the designer if supplemental sources of heat may be required. In most cases the radiant system is capable of satisfying the heat load.

After laying out the SubRay components and installing the radiant tubing; roll out the aluminum conduction roll. Leave a 1/2" space between each sheet so that the flooring contractor can see where the radiant channels are located. Screw or nail a minimum of 1/4" plywood over the SubRay components. Observe care near the Header Sticks.

Always maintain a minimum 3" perimeter strip around the room. This perimeter strip should not have any radiant tubing installed in it, unless the tubing is protected against trim nails/staples, and possible future carpet tack strips. If any tubing runs from one room to another, the threshold area should have nail guards installed to protect the tubing against possible future tack strips.

**Caution:** The system must always be pressurized during construction. Check the pressure gauges on your manifold test kit frequently anytime you are using screws or nails near the radiant tubing, and for at least 24 hours afterward. Use approved Watts Radiant field splices if the tubing is damaged.

According to Wilsonart guidelines, the radiant system should be installed so that the surface of the Wilsonart flooring does not exceed 84°F. A Watts Radiant DualTemp thermostat is available with this floor limit feature.

Advice about Wilsonart specifications and installation instructions is available at www.wilsonart.com, or call 1-800-710-8846.

## Other Flooring Options

Other flooring options may be heated with a SubRay system. Consult with Watts Radiant and the flooring manufacturer for written application instructions before proceeding. Some vinyl floors are very temperature sensitive and may fade when exposed to normal floor warming conditions.

Watts Radiant can make no representations regarding color stability of all vinyl floors. We suggest you consult with the flooring manufacturer to verify that their product is temperature stable.

The use of a Watts Radiant DualTemp thermostat provides for a safe and easy way to limit the floor surface temperature. Simply dial in the maximum floor temperature you want and this control will not permit your floor to rise above the limit you have programmed.

## Bath Layout

1 circuit of tubing, 130' long

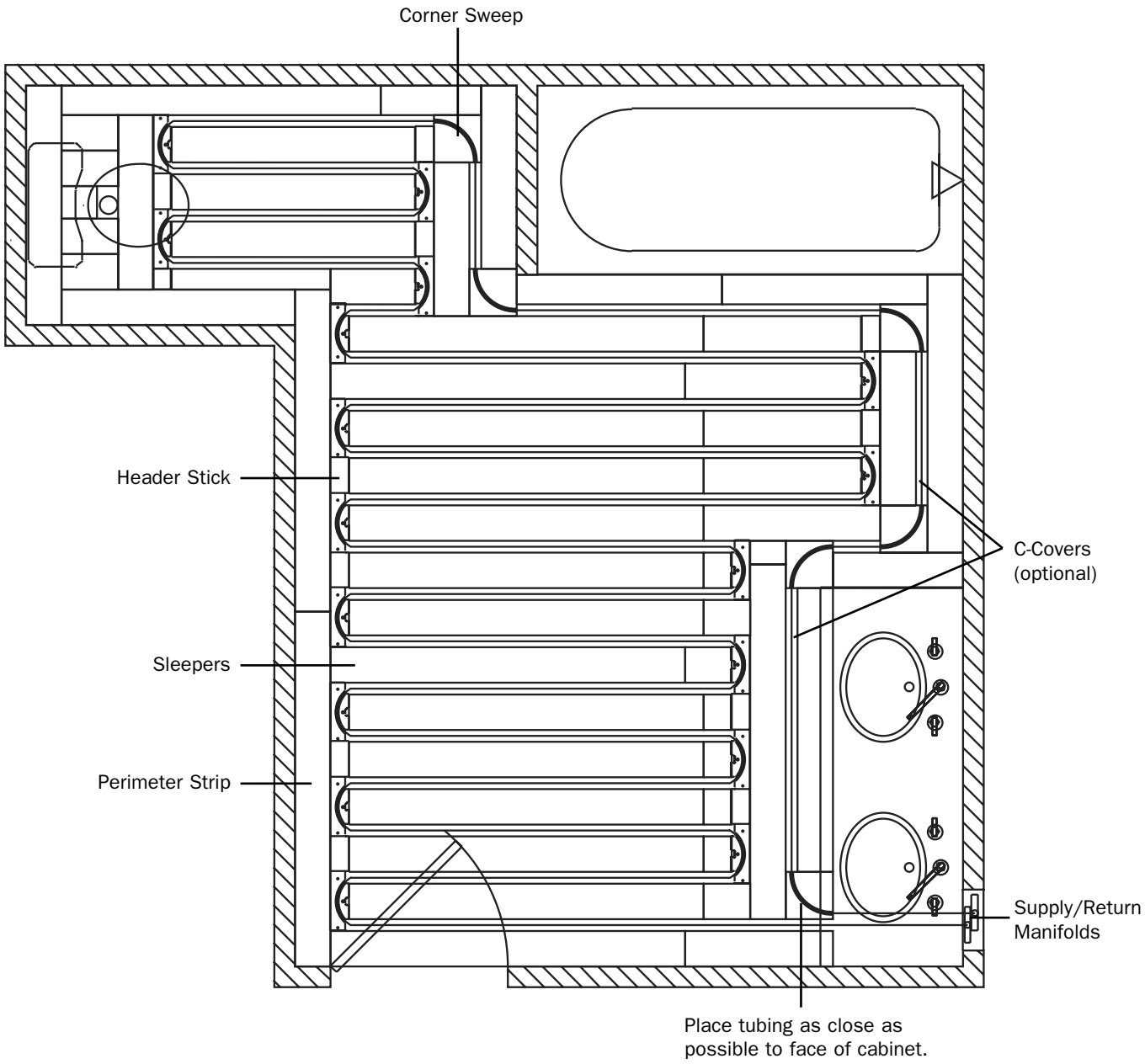



**Fig. 35.** SubRay system alternate layout: bathroom

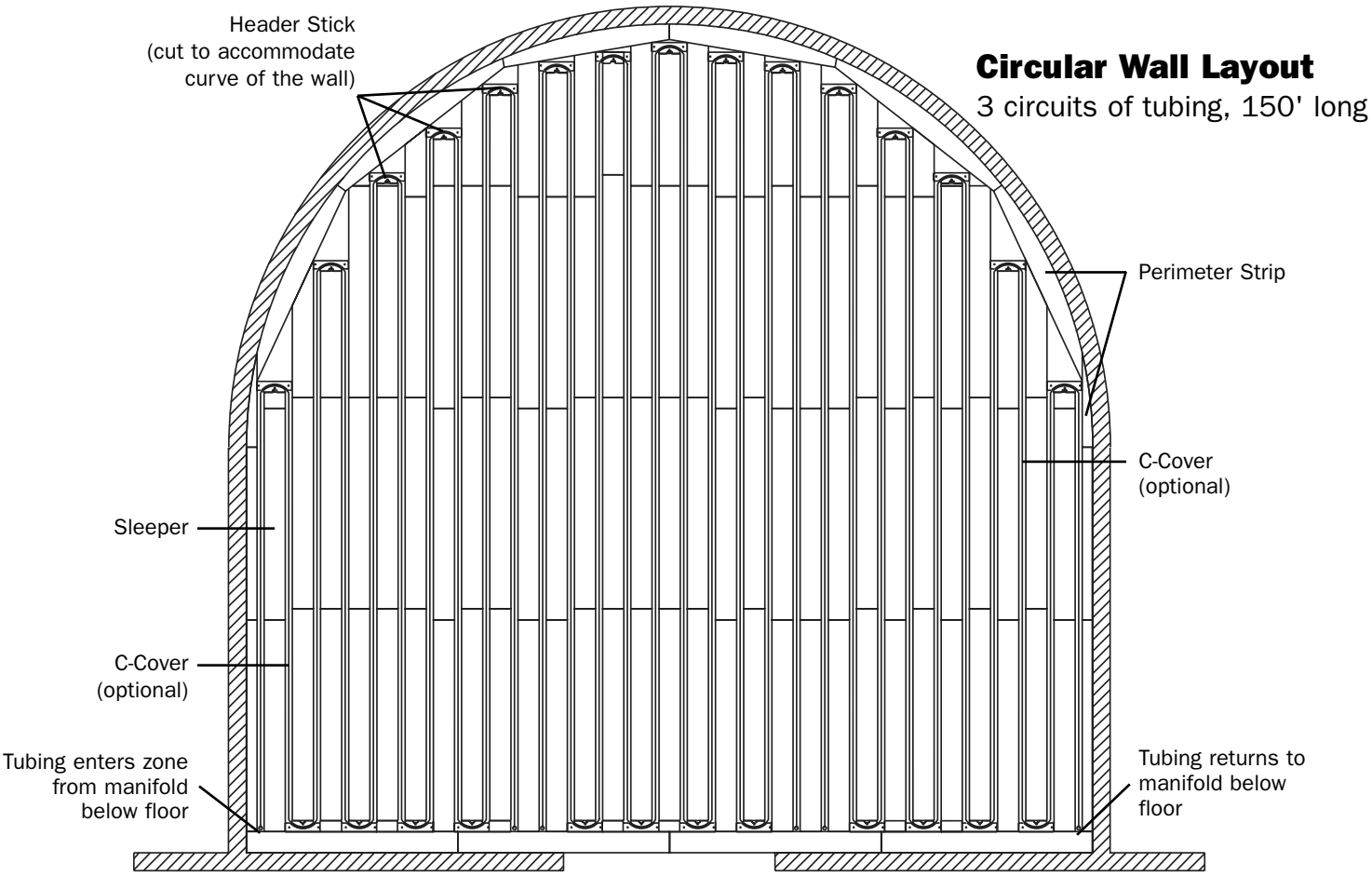



**Fig. 36.** SubRay layout: room with circular wall.

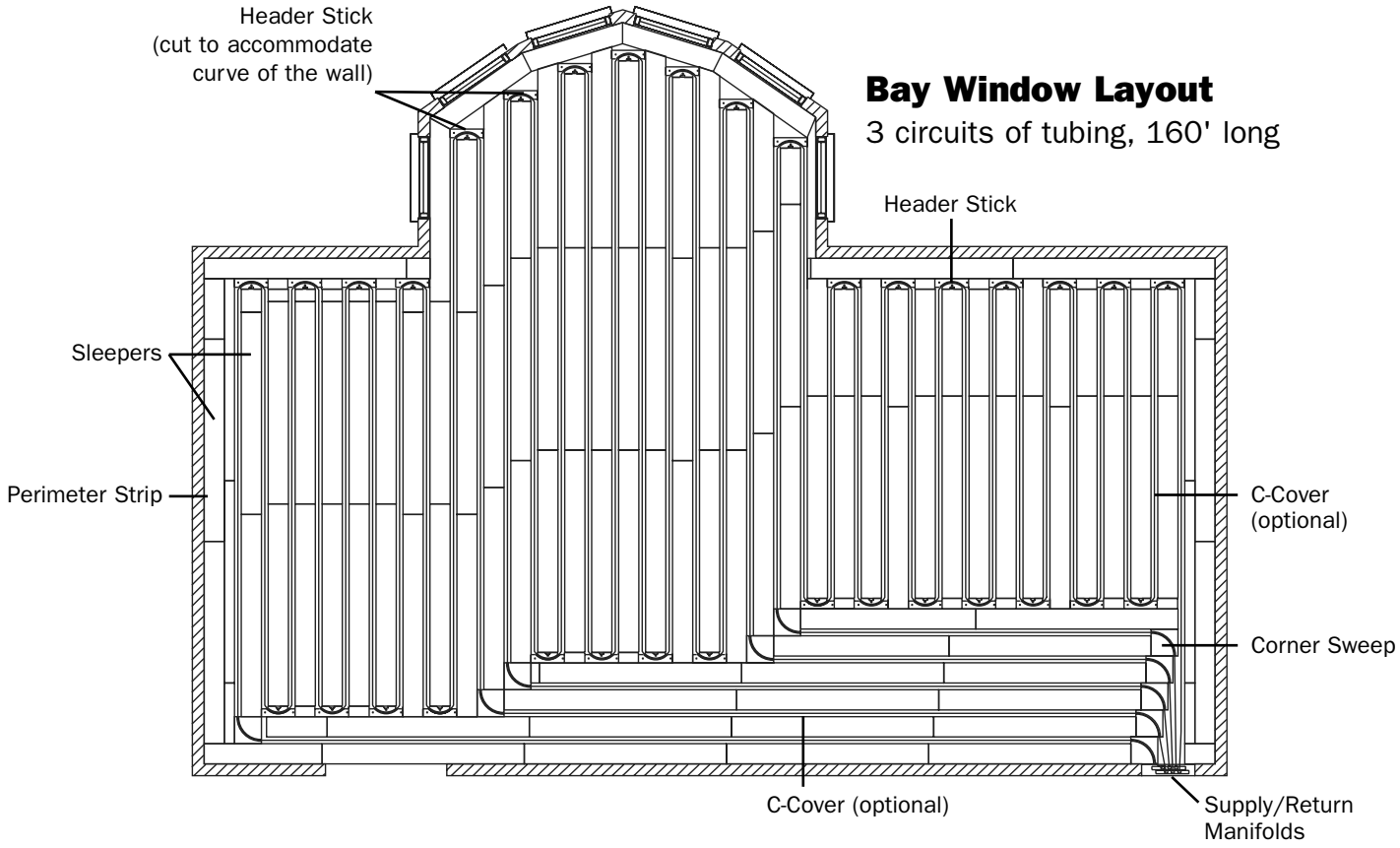



**Fig. 37.** SubRay layout: room with bay window.

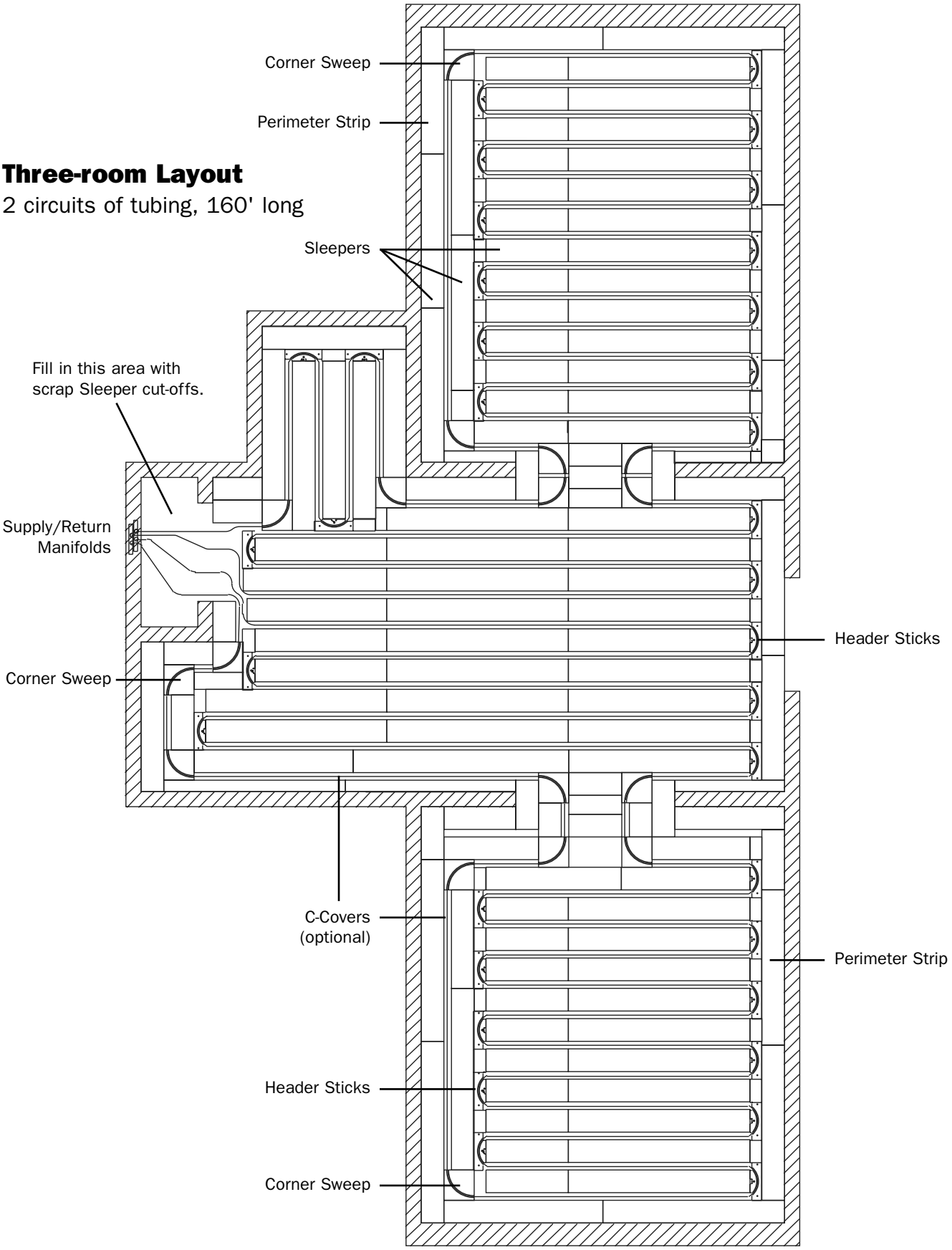



**Fig. 38.** SubRay layout: three rooms with central manifold.

# Appendix A

## Attaching the SubRay Components to Concrete

**Fig. 39.** If you need to secure the Header Sticks or Sleepers to a concrete slab, first lay out your components so you have a very good idea of where they will be permanently fastened. Use a hammer drill with a 3/16" carbide tipped masonry bit to drill a 1-3/4" deep hole through the Sleeper and into the concrete.

**Fig. 40.** Place a 1-1/2" Powers Mush Head Spike (or equivalent) in the hole and use a hammer to drive the spike so the head is flush or below the surface of the wood. Locate Spikes as needed along the Sleepers and Header Sticks. The Spikes are permanent and cannot be removed without destroying the wood, so plan your work carefully.

**Fig. 41.** You can also secure SubRay Sleepers and Header Sticks to a concrete slab using a powder actuated nailer. Be sure to use facial and ear protection when using this device.

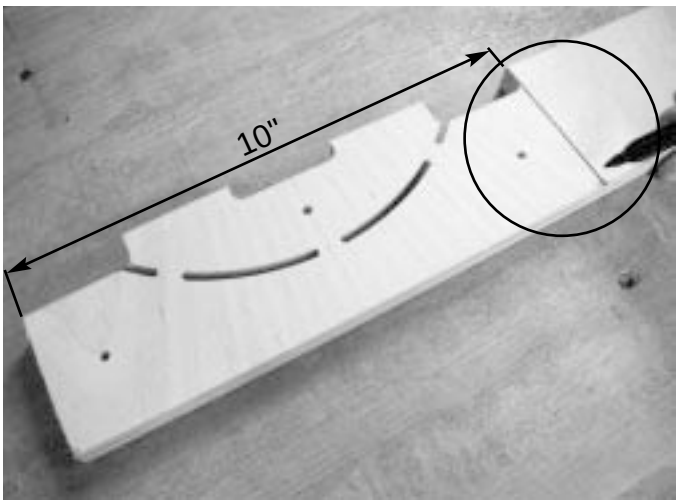



**Fig. 42.** When you must trim a SubRay Header Stick, cut it along line indicated by the circle to preserve the 2" radiant channel. **For more detailed information on properly cutting Header Sticks, see page 23.**

# Appendix B

## Selecting Perimeter Strip Widths to Center Header Sticks to Room

**Rip Perimeter Strips to this width for two sides of the room, according to room width.**

| 3" | 3.5" | 4" | 4.5" | 5" | 5.5" | 6" | 6.5" | 7" | 7.5" | 8" | 8.5" | 9" | 9.5" | 10" | 10.5" |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Width of Span Wall (inches)** | | | | | | | | | | | | | | | |
| 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 |
| 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 |
| 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 |
| 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 |
| 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 |
| 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 | 141 | 142 | 143 |
| 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 |
| 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 |
| 176 | 177 | 178 | 179 | 180 | 181 | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 190 | 191 |
| 192 | 193 | 194 | 195 | 196 | 197 | 198 | 199 | 200 | 201 | 202 | 203 | 204 | 205 | 206 | 207 |
| 208 | 209 | 210 | 211 | 212 | 213 | 214 | 215 | 216 | 217 | 218 | 219 | 220 | 221 | 222 | 223 |
| 224 | 225 | 226 | 227 | 228 | 229 | 230 | 231 | 232 | 233 | 234 | 235 | 236 | 237 | 238 | 239 |
| 240 | 241 | 242 | 243 | 244 | 245 | 246 | 247 | 248 | 249 | 250 | 251 | 252 | 253 | 254 | 255 |
| 256 | 257 | 258 | 259 | 260 | 261 | 262 | 263 | 264 | 265 | 266 | 267 | 268 | 269 | 270 | 271 |
| 272 | 273 | 274 | 275 | 276 | 277 | 278 | 279 | 280 | 281 | 282 | 283 | 284 | 285 | 286 | 287 |
| 288 | 289 | 290 | 291 | 292 | 293 | 294 | 295 | 296 | 297 | 298 | 299 | 300 | 301 | 302 | 303 |
| 304 | 305 | 306 | 307 | 308 | 309 | 310 | 311 | 312 | 313 | 314 | 315 | 316 | 317 | 318 | 319 |
| 320 | 321 | 322 | 323 | 324 | 325 | 326 | 327 | 328 | 329 | 330 | 331 | 332 | 333 | 334 | 335 |
| 336 | 337 | 338 | 339 | 340 | 341 | 342 | 343 | 344 | 345 | 346 | 347 | 348 | 349 | 350 | 351 |
| 352 | 353 | 354 | 355 | 356 | 357 | 358 | 359 | 360 | 361 | 362 | 363 | 364 | 365 | 366 | 367 |
| 368 | 369 | 370 | 371 | 372 | 373 | 374 | 375 | 376 | 377 | 378 | 379 | 380 | 381 | 382 | 383 |
| 384 | 385 | 386 | 387 | 388 | 389 | 390 | 391 | 392 | 393 | 394 | 395 | 396 | 397 | 398 | 399 |
| 400 | 401 | 402 | 403 | 404 | 405 | 406 | 407 | 408 | 409 | 410 | 411 | 412 | 413 | 414 | 415 |
| 416 | 417 | 418 | 419 | 420 | 421 | 422 | 423 | 424 | 425 | 426 | 427 | 428 | 429 | 430 | 431 |
| 432 | 433 | 434 | 435 | 436 | 437 | 438 | 439 | 440 | 441 | 442 | 443 | 444 | 445 | 446 | 447 |
| 448 | 449 | 450 | 451 | 452 | 453 | 454 | 455 | 456 | 457 | 458 | 459 | 460 | 461 | 462 | 463 |
| 464 | 465 | 466 | 467 | 468 | 469 | 470 | 471 | 472 | 473 | 474 | 475 | 476 | 477 | 478 | 479 |
| 480 | 481 | 482 | 483 | 484 | 485 | 486 | 487 | 488 | 489 | 490 | 491 | 492 | 493 | 494 | 495 |
| 496 | 497 | 498 | 499 | 500 | 501 | 502 | 503 | 504 | 505 | 506 | 507 | 508 | 509 | 510 | 511 |
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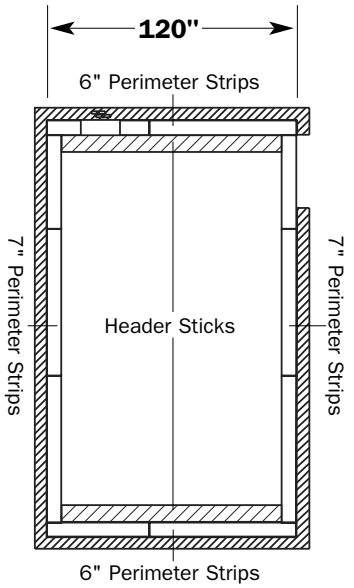



Use standard 6" Perimeter Strips behind Header Sticks. See chart for other Perimeter Strip widths.

Example: When width of room equals 120" (see chart at left for 120" width), look at top of chart to see Perimeter Strip width (7") for non-Header Stick walls.

**Fig. 43.** How to center Header Sticks.

# Appendix C

## SubRay Materials Estimating Guide

Figuring Notes:

***Introduction:*** Before using this quick SubRay material estimating sheet, read the SubRay design manual. Actual quantities of Header Sticks and Sweeps may vary, especially for complex or irregular rooms. The amount of Sleepers, Tape, Grippers, and Aluminum Rolls relates directly to room size.

The SubRay 862 system uses tubing on 8" centers, so 1' of tubing will heat .67 sq. ft. of floor. Typical lengths for 3/8" tubing are 200’ and for 1/2" tubing 300'.

Fill in the blanks to calculate your material requirements. See the Watts Radiant website for a simple automated SubRay quoting system.

**If using 3/8" RadiantPEX order 15 mm (coded red) wood parts and channels. If you are using 1/2" RadiantPEX or 3/8" Onix order 18 mm (coded blue) wood parts and channels.**

### Room Area

Calculate the room area (length x width) in square feet (sq. ft.) and enter below.

L _____ x W _____ = _____ sq. ft.

*Example: 20' x 40' room = 800 sq. ft.*

### Radiant Tubing

Divide room area by .67 to get feet of tubing.

_____ sq. ft./.67 = _____ total feet of radiant tubing.

*Example: 800 sq. ft./.67 = 1194 ft. of tubing.*

### Radiant Circuits

Divide feet of radiant tubing by typical circuit length.
We suggest 200' for 3/8" tubing, and 300' for 1/2" tubing.
Round the result up to the next largest whole number.

_____ ft. of tubing/200 = _____ circuits of 3/8" tubing.

_____ ft. of tubing/300 = _____ circuits of 1/2" tubing.

*Example: 1194 ft. tubing/200 = 5.97 circuits of 3/8" tubing.*
*Round this up to 6 circuits, each averaging about 199 ft.*

# Appendix C (continued)

## SubRay Materials Estimating Guide

Figuring Notes:

### Header Sticks

Add the lengths of the two opposing walls along which the Header Sticks will be installed. Normally, these are the two short walls in the room, but the finished orientation of a hardwood floor may dictate otherwise. See page 5 for example.

_____ Wall A + _____ Wall B = _____ Total Header Wall Length.

Example: 20' + 20' = 40' of Header Wall Length (HWL).

Divide this total by 3.5 to get the number of Header Sticks you'll need. Round up to the next largest number.

_____ (HWL)/3.5 = _____ Number of Header Sticks.

*Example: 40/3.5 = 11.4. Order 12 Header Sticks.*

### Sleepers

Take the room area and divide by 3.3 to get the number of Sleepers.

_____ (area)/3.3 = _____ Number of Sleepers.

*Example: 800 sq. ft./3.3 = 242 Sleepers*

**Corner Sweeps** (not needed for Onix installations)

Multiply number of radiant circuits in room by four for rectangular rooms. Multiply number of radiant circuits in room by twelve for complex rooms.

_____ (circuits) x _____ = _____ Sweeps Needed.

*Example: A square room with 6 circuits will need 6 x 4 = 24 Corner Sweeps.*

### Rolls of Radiant Tape

Divide room area by 240 and round up to next largest number.

_____ (area)/240 = _____ Number of Radiant Tape Rolls.

*Example: 800/240 = 3.33. Order 4 Radiant Tape Rolls.*

# Appendix C (continued)

## SubRay Materials Estimating Guide

Figuring Notes:

**Grippers** (not needed for Onix installations)

Multiply the number of radiant circuits by two.

_____ Radiant Circuits x 2 = _____ number of Grippers.

*Example: 6 circuits x 2 = 12. Order 12 Grippers.*

### Aluminum Conduction Rolls

Divide room area by 70 and round up to next largest number.

_____ room area/70 = _____ Number of Aluminum Rolls.

*Example: 800/70 = 11.4. Order 12 Rolls of Aluminum.*

### C-Covers

For most hardwood floors order enough C-Covers to run the length of the room.

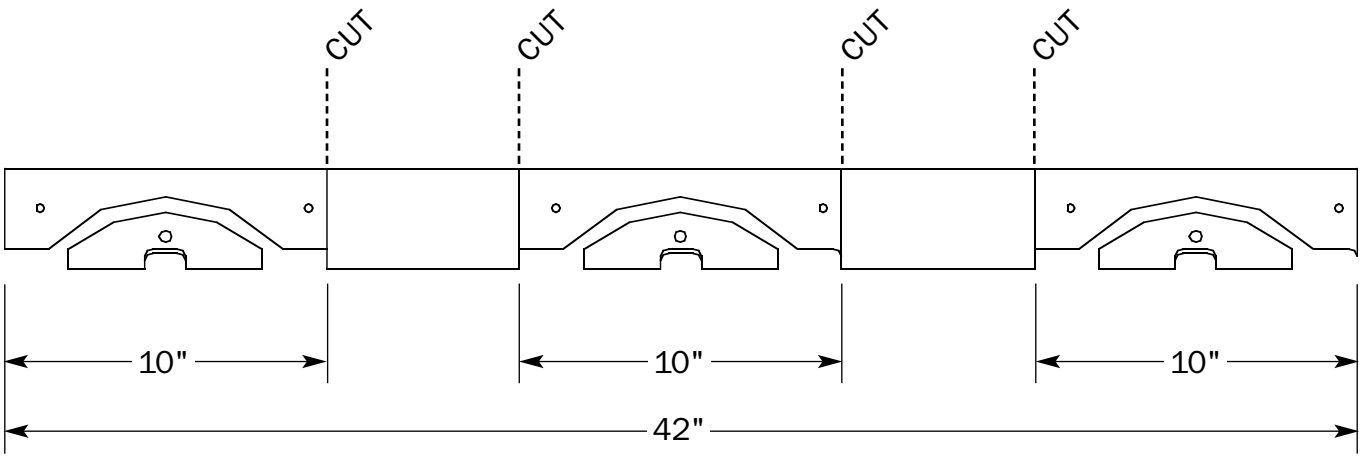
Divide room length by 4 to get number of C-Covers.

_____ room length/4 = _____ number of C-Covers.

*Example: The room is 40' long. 40/4 = 10. Order 10 C-Covers.*

***Note: Many projects may not need C-Covers. See Manual to see if you need them.***

**Header Stick cutting detail:**



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