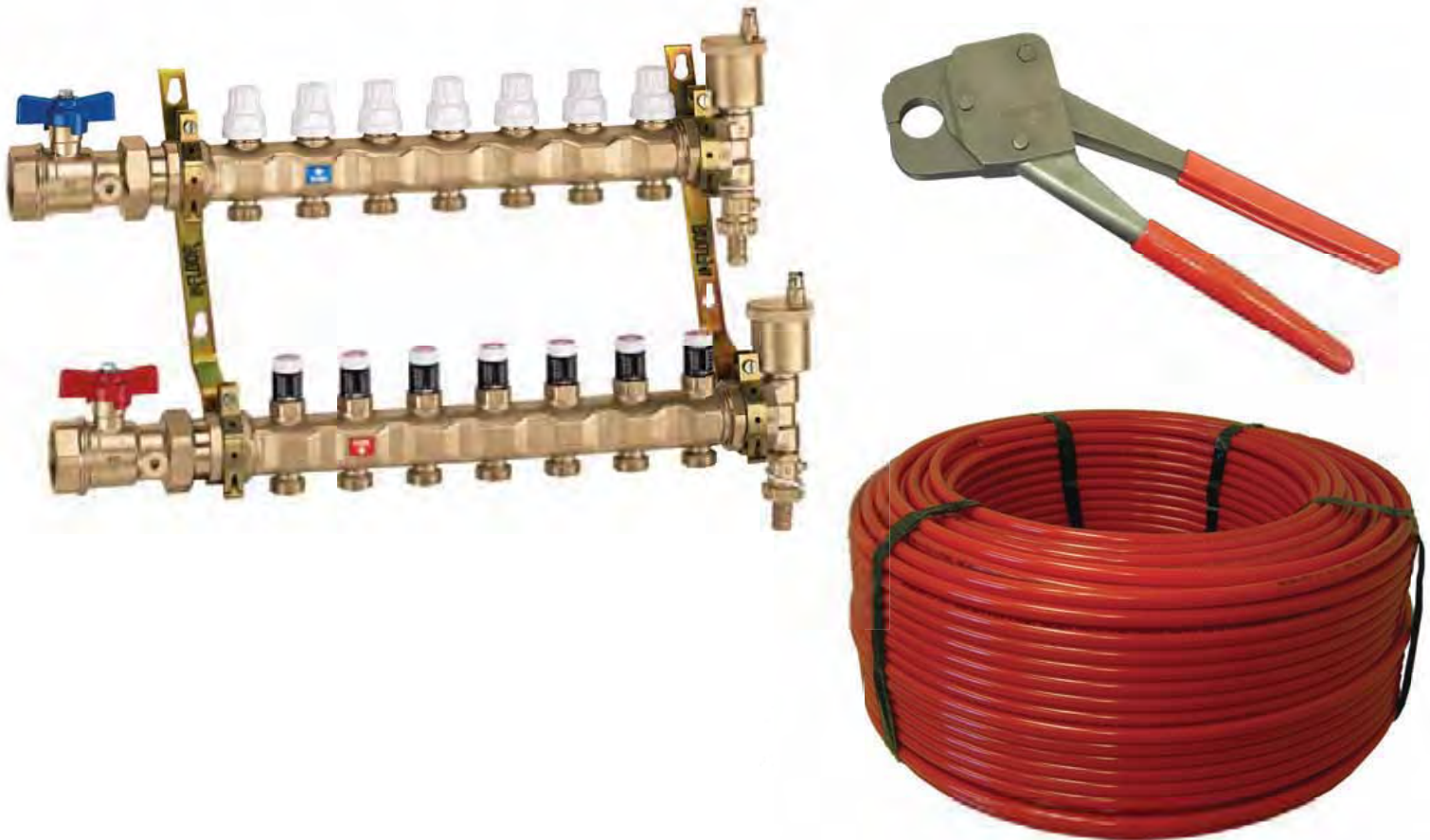




INFLOOR

HEATING SYSTEMS

DESIGN & INSTALLATION GUIDE



Just because it's "in the floor" doesn't mean it's INFLOOR®

INFLOOR[®] RESIDENTIAL/
LIGHT COMMERCIAL
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Chapter

1

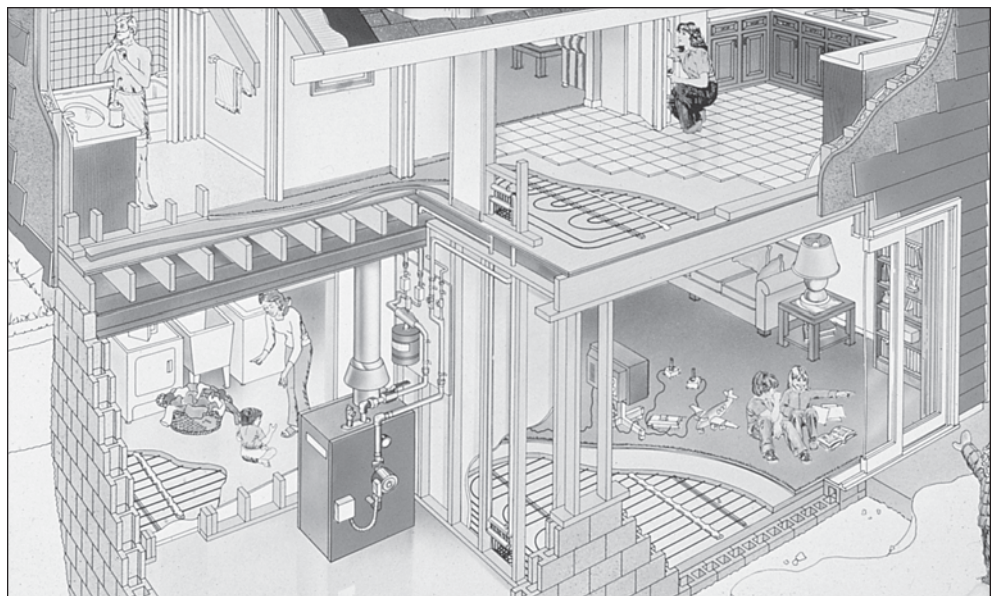
INTRODUCTION

Radiant floor heating isn't a new concept. The ancient Romans used crude wood fires built under their floors to heat their structures. Using warm floors to heat their homes proved very effective.

Nearly everyone now agrees that a radiant floor is the world's most comfortable heating system. That makes floors wonderfully warm. The system does not circulate dust or allergens. The system operates more efficiently than conventional systems. These types of benefits aren't only limited to specific kinds of structures. Today, radiant heating systems are capable of heating homes, custom and standard residential, businesses, warehouses, commercial hangars, and snowmelt systems.

Infloor[®] Heating Systems offers hot water systems that are perfect for homes... high-rises... hospitals... warehouses. Any residential, commercial or industrial building can now take advantage of all the benefits radiant floor heating has to offer. These projects can be new construction, remodel, small additions, retrofit, industrial and snowmelting applications.

Infloor residential system components may be used for space heating or warm floor applications. Each different type of application has a very specific design criterion. This manual has been provided to assist the designer/installer with the necessary guidelines to design, select, and install the proper Infloor components for residential/ light commercial applications.



ADVANTAGES OF AN INFLOOR HEATING SYSTEM

Infloor® Heating Systems offer the customer and dealer various options when selecting a radiant heating system. Infloor's Residential / Light Commercial Systems include copper manifolds, brass manifolds, mixing valves and related controls, zoning controls with domestic hot water priority, pre-piped and wired control panels, hydraulic separators, pumping stations, emission plates, and Infloorboard. Infloor offers all the related components for a complete system with the exception of the heat source. Infloor has provided general diagrams to include several heat plant options. Manufacturers specifications of the heat source should be followed.

When selecting tubing, it is important to compare pressure and temperature ratings as well as the wall thickness for heat transfer and durability. The application environment or method of installation, the need for barrier or non-barrier tubing, flexibility and weight are additional considerations. Whether the installation method requires PEX tubing or AL PEX tubing for proper installation. Infloor has all of these products available to meet all the different types of installation practices found in radiant today.

TUBING LAYOUT



Chapter

2

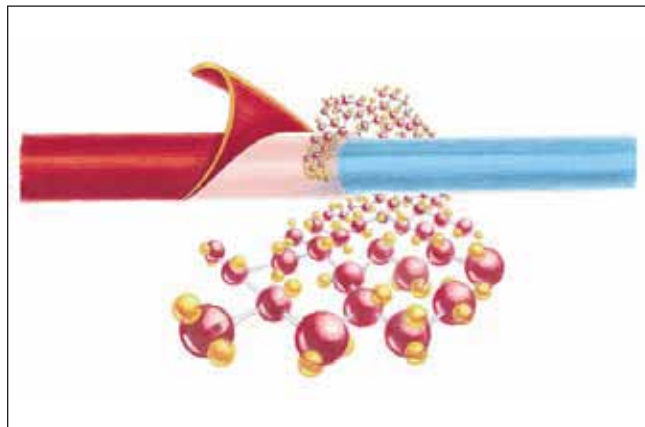
TUBING

Infloor® tubing is available in 3 configurations: non-barrier tubing from cross-linked polyethylene (PEX), oxygen barrier tubing from cross-linked polyethylene (BPEX), and pex aluminum pex tubing from cross-linked polyethylene (PEX-AL-PEX). These tubes provide excellent performance in radiant applications and provide the system designer with the greatest options for component selection to best fit the application.

All Infloor tubing is rated for 100 psi (689 kPa) at 180 °F (82 °C). These conditions far exceed those normally found in radiant heating applications

where system operating pressures are usually 12 to 20 psi (82 to 138 kPa) with maximum temperatures usually reaching 140 °F (60 °C). When oxygen diffusion barriers are required, Infloor tubing meets the German DIN 4726 specification of less than 0.1 gram of oxygen per cubic meter per day.

Chemical compatibility varies with the various tubing. While all tubes are not affected by normal system fluids and additives, some operating environments may indicate a need for a specific tube preference.

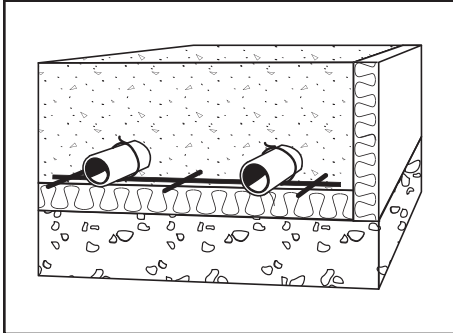


CROSS - LINKING CREATES BONDS BETWEEN INDIVIDUAL MOLECULAR STRANDS , GREATLY ENHANCING THE TUBE 'S TEMPERATURE AND CHEMICAL RESISTANCE .

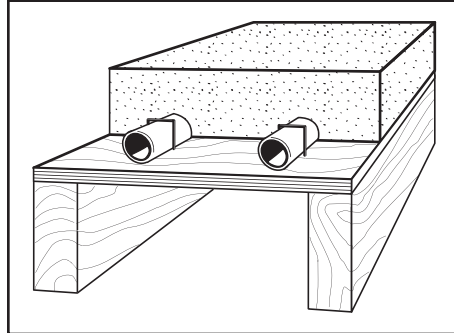
SPECIFICATIONS

Type	Part#	Size L	I.D.	O.D.	Press.	Temp.	ASTM	DIN	Length	Weight
PEX	25050	3/8" (10mm)	3/8" (10mm)	1/2" (13mm)	100 psi (689 kPa)	180° F (82 °C)	F-876		600' (180m)	27 lbs
	25060	1/2" (13mm)	1/2" (13mm)	5/8" (16mm)	100 psi (689 kPa)	180° F (82 °C)	F-876		900' (270m)	50 lbs
BPEX	25000	3/8" (10mm)	3/8" (10mm)	1/2" (13mm)	100 psi (689 kPa)	180° F (82 °C)	F-876		600' (180m)	27 lbs
	25010	1/2" (13mm)	1/2" (13mm)	5/8" (16mm)	100 psi (689 kPa)	180° F (82 °C)	F-876	4726	900' (270m)	50 lbs

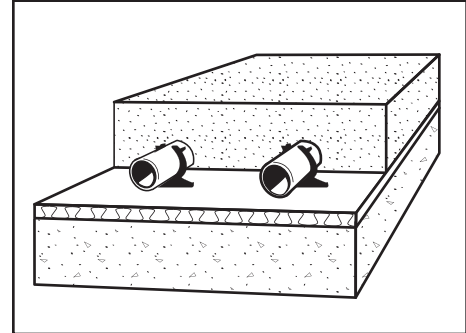
CONCRETE SLAB



THERMA -FLOOR™ OVER WOOD SUBFLOOR



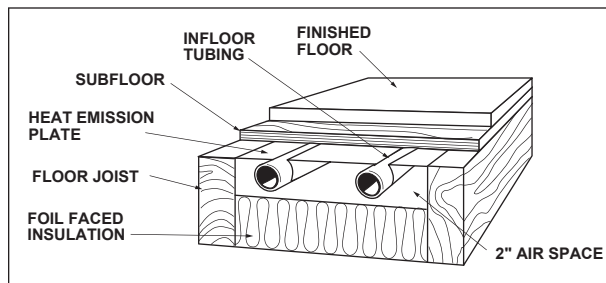
THERMA -FLOOR™ OVER CONCRETE



Infloor tubing may be installed in the concrete slab, on top of a sub floor and embedded in Therma-floor, a light weight gypsum cement that provides excellent thermal mass while adding sound control and fire protection to the floor assembly, on top of an existing slab with a layer of insulation between the slab and the gypsum cement encased tubing, attached to a wood sub floor by using Infloorboard, and Warmboard applications requires our AL PEX products. Retrofit applications staple up with emission plates may be used, however close attention needs to be paid actual room heat loss and supplemental heat may still be required in colder climates.

UNDERFLOOR APPLICATIONS MAY BE USED IN RETROFIT APPLICATIONS BUT REQUIRE CLOSE ATTENTION TO DESIGN AND INSTALLATION PARAMETERS FOR PROPER SYSTEM PERFORMANCE

UNDER FLOOR DIAGRAM

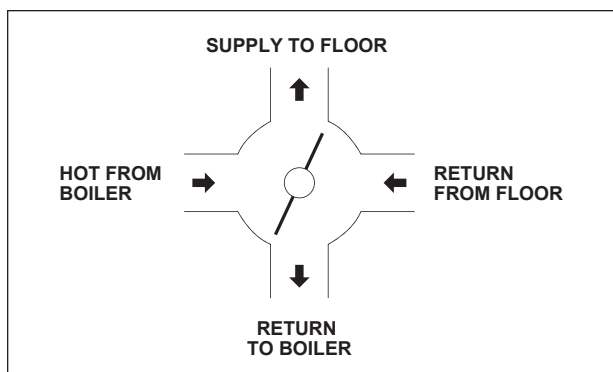


4-WAY MIXING VALVES

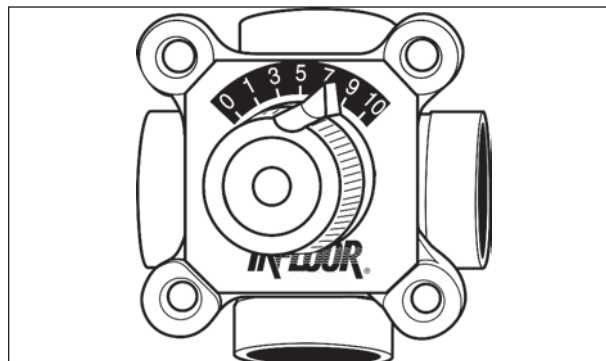
These valves provide tempering of water to the radiant zones. While there are variations in the use of these components, their main purpose is to provide the proper temperature to the radiant zone when the water temperature from the heat source is higher than the required water temperature for the radiant zone. Four-way valves are typically used to temper water for the whole radiant system.

Multiple valves may be used in a system that requires multiple water temperatures. These valves may be controlled by set point control that will modulate the valve, or can be controlled by an actuator motor that has indoor/outdoor reset control which will base the delivery water temperature to the floor on outdoor actual temperature.

MIXING VALVE DIAGRAM



MIXING VALVE



COPPER MANIFOLDS

Copper Manifolds provide a low-cost manifold option for use with Infloor Heating Systems. These manifolds are offered in many configurations. These manifolds consist of 1" (25mm) mains with 1/2" (13mm) outlets, and are available in valved and non-valved configurations of 2 and 3 outlets. The valved version include 1/2" (13mm) brass full port ball valve with stainless steel ball, for positive shut off on the outlets. (1-1/4" and 1-1/2" mains with 3/4" outlets and with and without valves are available as custom order items.)

The manifolds are standard 1" (25mm) copper pipe size and may be joined using a standard 1" copper coupling to increase the number of outlets per manifold assembly. A 1" (25mm) copper cap is used to seal the end of the manifold, or a purge 90 with vent end piece (#28400) may be used instead for easier purging. The tube outlets are brazed to the mains to allow for soldering of adjoining manifolds and fittings. Ball Valves are soldered to the branches.

COPPER MANIFOLDS TUBING CONNECTIONS

Fittings are PEX crimp or PEX compression. These fittings are available in 1/2" (13mm) male copper sweat x either 3/8" (10mm) or 1/2" (13mm) crimp or compression. Compression fittings require no special tools for tightening onto tubing. PEX crimp tool or Oetiker crimp system must be used with PEX crimp fittings. Solder fittings to the outlets on the manifolds before attempting to attach tubing.



BRASS MANIFOLDS

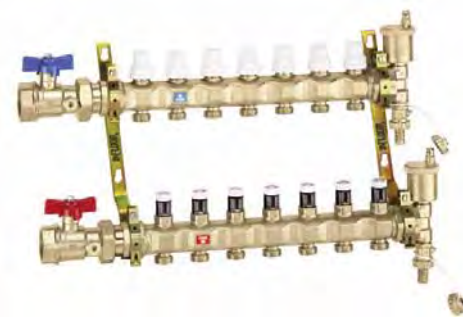
For residential and commercial heating systems Infloor Brass manifolds provide complete control over each loop and will precisely regulate the flow and allow for individual loop control as well as isolation, air elimination, and purging capabilities.

These manifolds consist of a supply and return manifold with mounting brackets completely assembled. Supply manifold complete with micrometric balancing valves with flow curve indicator. Return manifold complete with shutoff valves that can utilize thermo actuators. Pair of shut off valves one on the supply manifold and one on the return manifold with color-coded handles for supply and return. End fitting assembly, which consist of a drain valve fitting and an automatic air vent. The supply and return manifolds have a main trunk size that will accommodate either 1" or 1-1/4" fittings. These manifolds are available in loop configurations from 3 loops to 13 loops completely assembled ready to install.

Infloor brass manifolds are brass body. EDPM Seals. 1" threaded female connections, 3/4" male outlet connections for tubing. Compatible with water, water glycol solutions with a maximum glycol concentration of 50%. Maximum working pressure 150 psi. Temperature range from 41 degrees F to 180 degrees F.

BRASS MANIFOLDS TUBING CONNECTIONS

Fittings are designed to adapt to both PEX and AL PEX for a variety of sizes. Select the fitting size to match the size of PEX or AL PEX that is being installed. Slide Nut over tubing, then slide the olive over the tubing and then slide the adapter fitting into the end of the tubing. Tighten down fitting onto manifold 3/4" ports for final connection. This adapter offers a high resistance to pull out due to the special configuration of this fitting.



Chapter

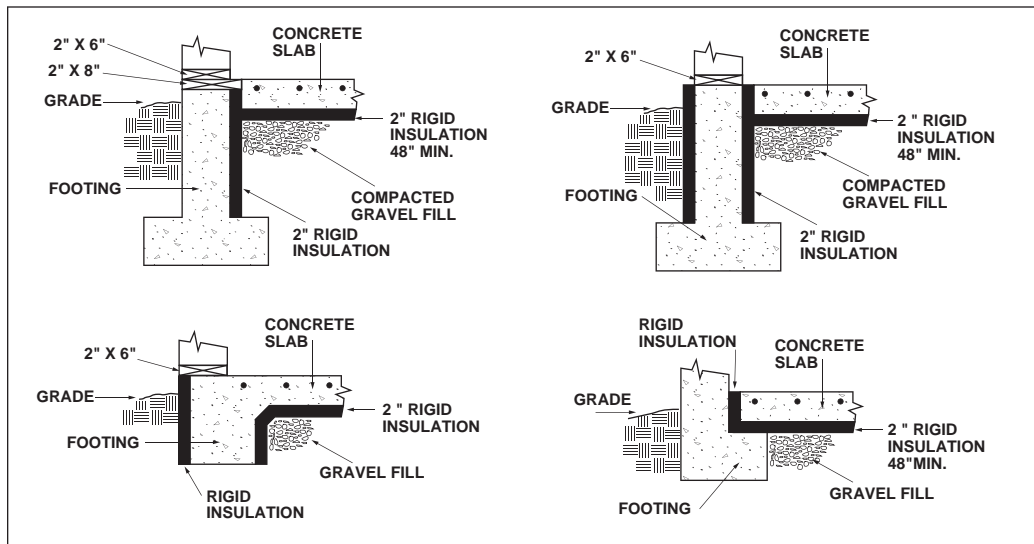
3

SITE PREPARATION

A properly prepared site is essential for optimum radiant system performance. The key to a good installation is a well planned out installation. Radiant systems that are installed on sites that are not well drained, sit on bedrock, or clay subsoil can conduct considerable heat away from the system and limit the system performance. It is essential that slab edge insulation of 1" (R-5) to 2" (R-10) be installed in all radiant systems,

and that under-slab insulation be installed up to the edge, and under the entire slab. This will provide better system control and response time will be greatly enhanced. Using insulation will reduce the overall mass of earth under the slab that will need to be heated to respond to changes in temperature. Use 2" foundation approved insulation board (R-10) with a minimum density of 2 pounds per cubic foot (32 kg/m3) or ½" Insul-tarp under the entire slab (reflective R-Value of 10.77).

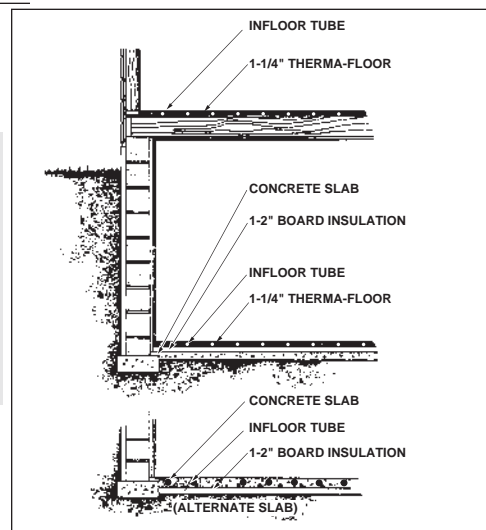
SLAB INSULATION DETAIL



BELOW -GRADE WALL INSULATION DETAILS

SLABEDGE AND PERIMETER INSULATION ARE CRITICAL TO PROPER RADIANT HEATING PERFORMANCE. ELIMINATION OF THIS INSULATION MAY PRODUCE UNSATISFACTORY RESULTS

ESPECIALLY WHEN HIGH WATER TABLES ARE PRESENT OR RESTRICTIVE FLOOR COVERINGS ARE USED

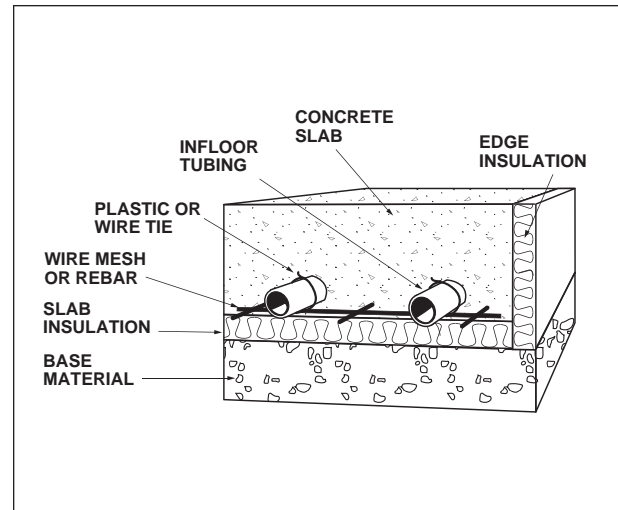


CONCRETE SLABS

All plumbing and electrical work inside the slab area should be completed and inspected prior to installation of the radiant system. All trenches should be back filled and slab area should be raked flat and compacted prior to installation of the under slab insulation. Vapor barrier a minimum of 6 mil polyethylene should be used if using foundation-approved insulation such as polystyrene. Using products such as Insul-tarp would not require the additional vapor barrier and installs rather easily. Insulation should run underneath the entire slab and tie horizontally into slab edge insulation. All seams in insulation should be taped. Next, lay 6" x 6" reinforcing mesh over all the insulation in which radiant will be installed. Adjoining sections should overlap by 6 to 9 inches and be securely fastened together. The wire mesh is for securing tubing in place and use as a grid guideline for tubing attachment. All sharp edges of wire mesh should face away from tubing.

Layout with spray paint on top of the insulation all, rooms, walls, non heated areas, stairways, toilets and tubs and showers. Then refer to heat loss calculation for layout of tubing based on radiant heating design.

CONCRETE SLAB



IT MAY BE NECESSARY TO RECESS THE INITIAL EXCAVATION TO ALLOW FOR THE ADDITION OF INSULATION UNDER THE SLAB

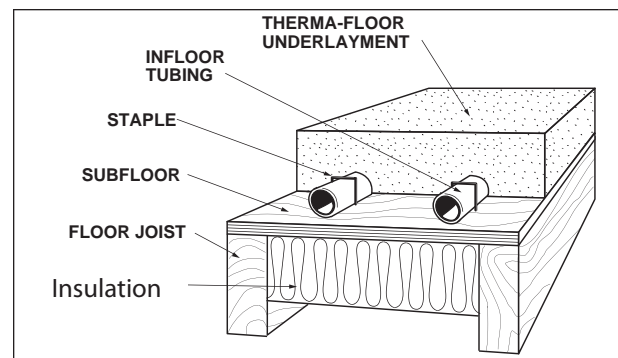
WOOD SUBFLOORS WITH GYPSUM

The subfloor must be clean, structurally sound and contaminant free. Repair any weak or delaminated areas. Remove studwall base plates in doorways and other areas to accommodate tubing layout.

Account for the change in floor elevation caused by the addition of a Therma-floor system, normally 1-1/2". By using a double sill plate, the floor height is adjusted and window and door elevations remain the same. Be sure to adjust stair risers and floor drains to match finished floor height. Planning of finished floor goods will help to determine height restrictions.

Layout grid on the floor using a tape measure and a lumber crayon, measure in 6" from all walls and place a mark. This mark will be the closest the tubing will need to be to the walls. Determine from the heat loss the tubing spacing for that particular area, normally 6" or 9", then layout your grid in the room either 6" on center grid or a 9" on center grid. This grid will assist as a guideline for installing the tubing.

THERMA-FLOOR™ OVER WOOD SUBFLOOR



WOOD SUBFLOOR WITH INFLOORBOARD

The subfloor must be clean, structurally sound and contaminant free. Repair any weak or delaminated areas. Remove studwall base plates in doorways and other areas to accommodate tubing layout.

Non-structural Infloorboard is designed specifically for subfloor applications. Infloorboard is constructed of a dense composite board with an aluminum that spreads the heat evenly and quickly from the hydronic tubing. Infloorboard is a low profile product, which is only 5/8" thick. This makes it an excellent choice for new construction or retrofit applications. Infloorboard is manufactured from MDF (medium density fiber board).

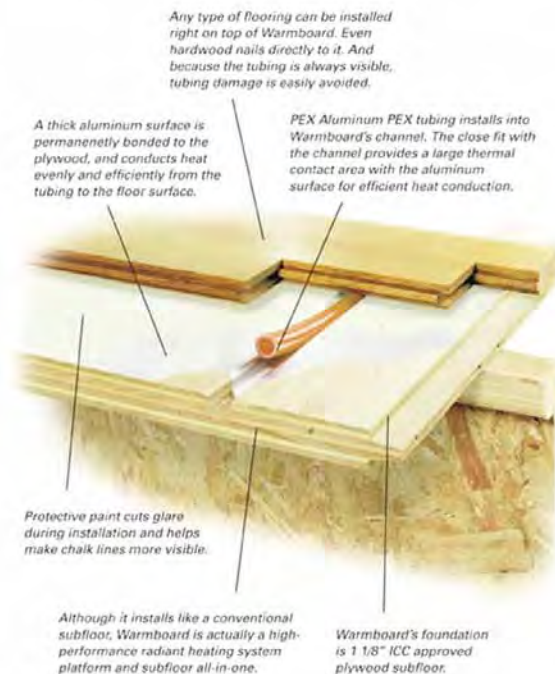
Infloorboard is typically glued and screwed or stapled to the wood subfloor. Tubing spacing is 8" on center and will accommodate 3/8" PEX or BPEX tubing. Infloorboard responds quickly, with almost no overheating since there is no "thermal lag" to overcome. Infloorboard is great for small retro fit applications as well as complete homes. Infloorboard has its own complete installation guide.



WARMBOARD

Warmboard combines a structural subfloor and a thermodynamically sophisticated radiant panel into one simple component of your radiant heating system. Warmboard begins with a stiff, strong, 1-1/8" thick, 4' X 8' sheet of tongue and groove, weather-resistant plywood. A modular pattern of channels is cut into the top surface. A thick sheet of aluminum is stamped to match the channel pattern and is permanently bonded to each panel.

As Warmboard panels are installed, they automatically create a uniform pattern for tubing, making installation of 1/2" AL PEX tubing more streamlined. Less tubing means lower cost more efficient installations. Fast response is one of the most important characteristics of this type of radiant heating system. The amount of heat required by a home or an individual room changes over time and the changes can be fairly rapid. Cloud cover can clear in just a few minutes causing rapid changes in the warmth provided by the sun. The outside temperature can change significantly in just one hour due to normal daily variations. Infloor heating system components are recommended with this type of system as well.



WOOD SUBFLOOR WITH STAPLE UP WITH EMISSION PLATES

This type of system is often used as a retrofit application or in new construction homes where the floor height cannot be changed to accommodate gypsum type product or Infloorboard. A radiant designer should design this type of system, in many cases these types of systems still require supplemental heat. Infloor does not recommend this type of installation without the use of emission plates.

Area must be clean of any nails or staples protruding from subfloor. Infloor emission plates (#39501) for ½" tubing. Plates are 4" wide x 4' long predrilled for acceptance of screws. Screw emission plates up to subfloor using screws that will not penetrate other side of subfloor. Plates should be placed 8" on center the entire length of the joist bay leaving approximately 12" at each end of the bay. Plates can be placed with ½" to 1" gap between the emission plates. Infloor side groove plate, grooves should be facing each other for ease of installation.

These systems require higher water temperatures than any of the other radiant type systems mentioned. Insulation must be placed under this system, using reflective insulation is recommended. Insulation under this system must be 4 times greater than the insulation R-value of the subfloor, floor covering plus any additional throw rugs.

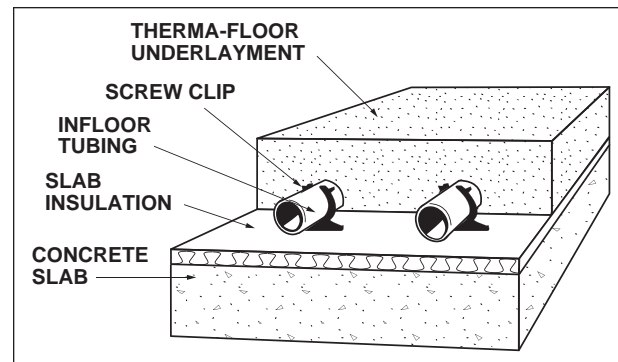


PRECAST CONCRETE SUBFLOORS

The subfloor must be clean and contaminant free. In cold climates it is highly recommended that some insulation be placed on top of the existing slab to enhance the response time and reduce the amount of downward loss to the existing slab. Mechanically fasten 6" x 6" wire welded mesh to the concrete subfloor using concrete screws. Fasten the wire mesh tightly to floor to prevent the floating of tubing.

Attach the tubing to the wire mesh using Infloor wire ties (#26001) or plastic ties (#26005). When 1" or thicker insulation is installed over the existing concrete subfloor, Infloor screw clips (#26015) may be used. The screw clip will secure Infloor 3/8" (10mm) and ½" (13mm) tubing. Infloor also offers the insulation tacker tool (#26085), which allows for installation of plastic staples (#26081) into the insulation for tube attachment.

THERMA -F LOOR® OVER CONCRETE



Chapter

4

HEAT LOSS

The Maxxcalc Radiant Design Software (#85070) performs all the necessary calculations for designing an Infloor[®] Heating System, or you can use any industry-standard heat loss calculation guide. Pay special attention to areas with potential for high heat loss. When properly insulated, downward heat loss is not significant in slab-on-grade applications. However, it is critical the slab edge be insulated to prevent excessive heat losses. In general, good insulating techniques are a major factor contributing to the success of any radiant heating system. A significant reduction in heat loss may be expected with a radiant heating system due to the decreased effect of air infiltration losses. Since radiant heating systems warm objects and not the air, the infiltration losses are minimized. Usually 0.5 Air Changes per Hour (ACH) to a height of 8 to 10 feet (3 m) is sufficient for calculating infiltration heat loss.

To determine the amount of heat required to provide comfort in a room or a house, it is necessary to calculate the amount of heat lost (in Btu per hour) when winter conditions outdoors are at the Outside Design Temperature (ODT). ODT is the normal coldest temperature reached 97.5% of the time for that area (to convert Btu/h to W, multiply by 0.293).

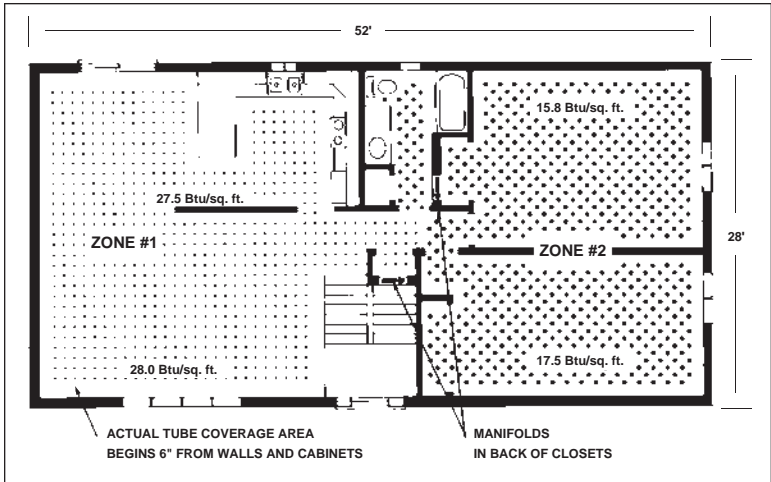
Heat is transmitted through all surfaces that will be warm on the inside and cold on the outside. This includes walls, ceilings, floors, windows and doors. If a room on the other side of a wall or ceiling is to have normal heating, that wall is not considered "cold".

In addition to the outward transmission losses, the infiltration of cold air must be added. However, this effect is minimized by radiant heating systems. Transmission plus infiltration equals the Total Heat Loss, which must be replaced by the heating equipment.

The amount of heat lost is directly related to the Temperature Difference (TD) between the desired Indoor Design Temperature (IDT) and the Outside Design Temperature (ODT). It is usually desirable to maintain 70 °F (21 °C) inside the room when the outside temperature is at its normal low point. The ODT for each major city is determined by long-range weather readings, and is fixed by the engineering profession. Subtracting ODT from the usual 70 °F (21 °C) gives the Temperature Difference for that locality.

REQUIRED FLOOR OUTPUT

The heat lost from an area must be replaced by heat from the floor. The Total Heat Loss divided by the Adjusted Gross Floor Area (do not include cabinet areas or other areas that do not generate heat) will produce the Required Floor Output in Btu/(h-ft²). (To convert to W/m², multiply by 3.15.)



FLOOR COVERINGS

Floor coverings have a pronounced effect on the performance of radiant floors due to their insulating qualities. A floor covering with high insulating properties (carpet and pad, for example) needs a hotter Supply Water

Temperature to achieve the Required Floor Output. The table below lists the R-values of various floor coverings and carpet pad underlayments.

R-VALUE TABLE
R-VALUES OF VARIOUS FLOOR COVERINGS

R-Value	Floor Covering	Tufts/ Sq. In.	Depth (Inches)
0.20	Bare floor	-	-
0.21	Linoleum or vinyl sheet goods	-	-
0.22	Ceramic tile	-	-
0.54	Hardwood	-	3/8
0.55	Nylon level loop	86	1/8
0.65	Nylon level loop	48	1/8
0.67	Nylon level loop	67	3/16
0.68	Nylon level loop	80	1/8
0.78	Acrylic level loop	80	3/16
0.93	Hardwood	-	3/4
0.95	Polyester plush	54	1/4
1.03	Acrylic level loop with foam back	80	1/4
1.12	Nylon plush	88	1/4
1.33	Nylon high low tip sheared	55	varies
1.51	Nylon shag	28	1
1.66	Polyester high low tip sheared	54	varies
1.71	Acrylic plush	44	1/2
1.83	Nylon plush	80	7/8
1.90	Acrylic plush	58	11/16
1.96	Nylon Saxony	29	9/16
2.19	Wool plush	45	1/2
2.46	Nylon shag	22	1-1/4



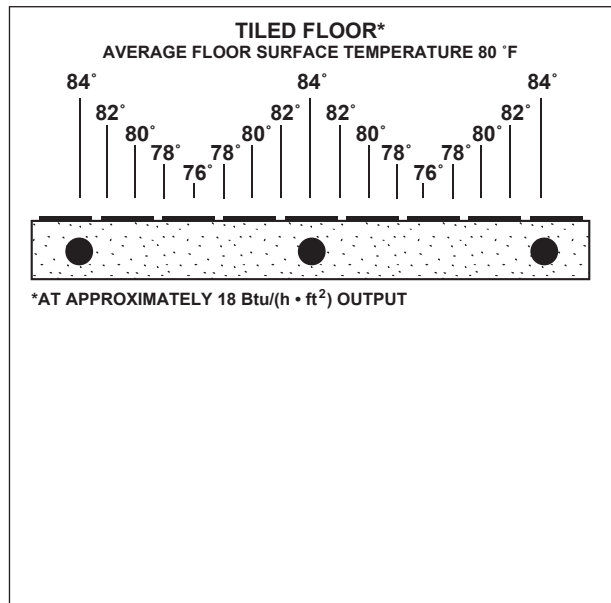
R-Value	Carpet pad underlayments	Depth (Inches)
0.31	Acoust-Mat *	1/4
0.62	Slab rubber	-
0.78	Waffled sponge rubber	-
1.61	Prime urethane 2.2 lbs. density	3/8
1.71	Coated combined hair and jute 56 oz.	-
2.09	Bonded urethane 4 lbs. density	1/2
2.15	Prime urethane 2.2 lbs. density	1/2



Total R-Value _____

While it may be most desirable to have a uniform surface temperature across the entire floor, it is not economically possible to embed tubing in every inch of floor space. As tubes are spaced further apart, the floor surface temperature varies depending on the distance between the tubes. When tubes are spaced too far apart, warm and cold spots may be felt across the floor. This is not only less comfortable, but also impedes the ability of the floor to transfer heat and may result in unwanted temperature swings in the room. Wide tube spacing also requires higher water temperatures to effectively heat the room.

TEMPERATURE DISTRIBUTION DUE TO WIDE TUBE SPACING



*AT APPROXIMATELY 18 BTU/(H•FT)² OUTPUT

ACTUAL FLOOR OUTPUT AND DELIVERY WATER TEMPERATURE

The Infloor[®] distribution water temperature is limited to 140 °F (60 °C). Generally 85 °F (29 °C) is accepted as the maximum surface temperature for comfort where there is prolonged foot contact with the floor. Perimeter areas outside normal traffic areas can operate with higher surface temperatures.

With these limits in mind, use the Output Chart to find the required Floor Surface Design Temperature and Delivery Water Temperature. These numbers are based on a 70 °F (21 °C) inside design temperature. The Floor Surface Temperature is increased or decreased 1 °F (0.5 °C) for every degree the Indoor Design Temperature is above or below 70 °F (21 °C).

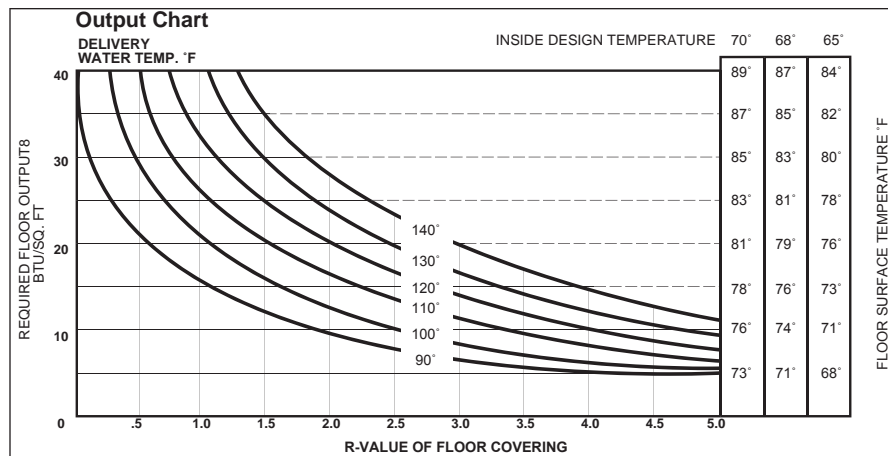
Supplemental heat, if needed, may be used to make up the difference between the Required Floor Output and the Actual Floor Output.

Varying floor outputs can be averaged in a room to achieve a higher overall Btu per square foot output. High-output tile floors under windows may be used to compensate for low-output carpeted floor areas. (When designing for floor warming only, plan a floor output of 20 Btu/(h•ft²) [63 W/m²].)

RECOMMENDED 6" (150MM) SPACING FOR 3/8" (10MM) TUBE 9", (230MM) SPACING FOR 1/2" (13MM) TUBE DEPENDING ON THE HEAT LOSS ANALYSIS WIDER OR NARROWER SPACING MAY BE USED

1. Find the Required Floor Output on the left side of the chart and extend a line to the right to read the Floor Surface Temperature.
2. Locate your selected floor covering R-value on the bottom of the chart (R-value from R-value Table). Extend a line up to your first line.
3. Read the Delivery Water Temperature at the intersection of the two lines.
4. If the lines intersect beyond the 140° line, do one or more of the following:
 - a. Select a floor covering with a lower R-value
 - b. Reduce the heat loss of the area to lower the Required Output.
 - c. Figure supplemental heating.
 - Extend a line up from your Floor Covering R-value until it intersects the 140° line.
 - From that point, extend the line to the left to find the actual output of the floor.
 - Subtract the actual output from your required output to find the amount of supplemental heat needed.

For further information, see 1987 ASHRAE Handbook, HVAC System and Applications, chapter 7.



TUBE SPACING AND TOTAL TUBE REQUIRED

The Tube Spacing and Total Tube Required varies due to the Required Floor Output and the size of the tubing being used. Larger diameter tubing can deliver the same Btu at wider spacing than smaller diameter tubes.

Locate the tube size and the spacing under the Floor Output column. Find the spacing factor for the spacing used. Multiply the Tube Coverage Area (Adjusted Gross Floor Area minus the 6 inches (150 mm) around all perimeter walls) by the Spacing Factor. That number is the Total Tube Required.

NUMBER AND LENGTH OF TUBE CIRCUITS

If you are not using the MaxxCalc Radiant Design Software, the recommended length of any given circuit depends on the tube and manifold system used.

Determine the total number of circuits by dividing the Total Tube Required by the maximum length allowed. Round up fractional numbers to the next highest whole number. Divide the Total Tube Required by the Number of Circuits to obtain the Actual Circuit Length. To simplify balancing, make all the circuits on a given manifold the same length.

The actual layout of tubing on a plan is usually unnecessary. The designer need only identify the controls and manifold locations, number and length of circuits and tube spacing. The layout can be done in the field quickly and accurately.

TUBE SPACING

Tube Size	FLOOR OUTPUT		
	10-20 Btu/(h·ft ²) (31.5-63 W/m ²)	20-30 Btu/(h·ft ²) (62-94.5 W/m ²)	30-40 Btu/(h·ft ²) (94.5-126 W/m ²)
3/8" (10 mm)	9" (230 mm)	6" (150 mm)	4" (100 mm)
1/2" (13 mm)	12" (300 mm)	9" (230 mm)	6" (150 mm)
3/4" (19 mm)	15" (380 mm)	12" (300 mm)	9" (230 mm)

SPACING	FACTOR
4" (100 mm)	3.0 (9.8)
6" (150 mm)	2.0 (6.6)
9" (230 mm)	1.3 (4.2)
12" (300 mm)	1.0 (3.2)
15" (380 mm)	0.8 (2.6)

RECOMMENDED TUBE LENGTH

RESIDENTIAL MANIFOLDS
3/8" tube – 200 ft. (10 mm/60 m)
1/2" tube – 300 ft. (13 mm/90 m)

SYSTEM DESIGN GUIDELINES

Design Factor	Residential	Light Commercial
Room Temp.	65-72 °F (18-22 °C)	60-72 °F (15-22 °C)
Water Temp.	95-140 °F (35-60 °C)	90-140 °F (32-60 °C)
Surface Temp.	75-85 °F (23-29 °C)	75-85 °F (23-29 °C)
Heat Output	15-30 Btu/(h·ft ²) (47-95 W/m ²)	10-30 Btu/(h·ft ²) (47-95 W/m ²)
Temp. Drop	15-20 °F (8-11 °C)	15-20 °F (8-11 °C)
Flow/Loop	≈ 0.3 gpm (≈ 0.02 L/s)	≈ 0.7 gpm (≈ 0.04 L/s)
Pressure Drop	2-5 ft. H ₂ O (6-18 kPa)	3-10 ft. H ₂ O (9-30 kPa)
Loop Length	200 ft. (60 m)	300 ft. (90 m)
Tube Size	3/8" (10 mm)	1/2" (13 mm)
Tube Centers	4-9" (100-230 mm)	6-12" (150-300 mm)

Note: These design factors are dependent upon each other. Do not use these values as a basis for a system design. All numbers are averages only. A heat loss analysis is required for an actual system design.

WATER FLOWS

To calculate the total water flow for the heating system, divide the Total Heat Loss by 10,000. (A water flow rate of 1 gallon per minute produces approximately 10,000 Btu/hr with a 20 °F (-7 °C) temperature drop between the supply and return manifolds.) Then divide the System Water Flow by the Number of Tube Circuits to determine the flow rate for the individual tubes. (If a water/glycol solution is used, divide the Total Heat Loss by the heat capacity of the glycol concentration desired.)

If more than one manifold assembly is needed, determine the water flow rate for that assembly using the same procedure, but substitute the Total Heat Loss by the heat loss

SYSTEM FLUID HEAT CAPACITY IN BTU / (H • GPM) [KW / (L • S)]

Glycol Solution	Freeze Temp.	Fluid Temperature Drop		
		20 °F	30 °F	40 °F
0%	32 °F (0 °C)	10,000 (46.4 kW)	15,000 (69.6 kW)	20,000 (92.8 kW)
10%	23 °F (-5 °C)	9,900 (46.0 kW)	14,850 (69.0 kW)	19,800 (91.9 kW)
20%	15 °F (-9 °C)	9,600 (45.5 kW)	14,400 (66.9 kW)	19,200 (89.1 kW)
30%	2 °F (-16 °C)	9,300 (43.2 kW)	13,950 (64.8 kW)	18,600 (86.4 kW)
40%	-14 °F (-25 °C)	9,000 (41.8 kW)	13,500 (62.7 kW)	18,000 (83.6 kW)
50%	-37 °F (-38 °C)	8,700 (40.4 kW)	13,050 (60.6 kW)	17,400 (80.8 kW)

of the zone being served. Repeat this procedure for each manifold, then add the water flows of each zone to determine the System Water Flow.

CIRCUIT HEAD PRESSURE

Circuit Head Pressure is affected by the water flow rate, diameter of tube, addition of additives such as glycol, and delivery water temperature. The appendix contains Pressure Drop Charts for the Infloor tubing (PEX/BPEX,) with plain water and a 50% glycol solution.

Do not add the individual head pressures from each zone. Each zone is plumbed in parallel and the circulator pump only needs to produce the System Water Flow at the highest head pressure in any given zone on that parallel circuit.

One circulating pump may be used to supply

HEAD LOSS CHART FOR WATER AT 140°F

(FT H₂O PER 100 FEET OF TUBE)
PEX/BPEX

	3/8"	1/2"	3/4"
GPM Ft H ₂ O	Ft H ₂ O	Ft H ₂ O	
0.1	0.29	0.07	0.01
0.5	4.78	1.12	0.22
1.0	16.06	3.77	0.73
2.0	54.02	12.67	2.45
3.0		25.75	4.99

NOTE: SEE APPENDIX (PAGE 40) FOR DETAILED CHARTS

(Ft H₂O ÷ 2.31 = psi)

(Ft H₂O x 2.99 = kPa)

all the radiant zones, or a circulating pump may be dedicated to each radiant zone. When using multiple circulators, calculate only the flow rate and head pressure for the zone being serviced and select a circulator capable of meeting the zone requirements. (A primary circulator pump must be capable of providing the Total System Flow and overcome the head loss in the primary distribution piping.)

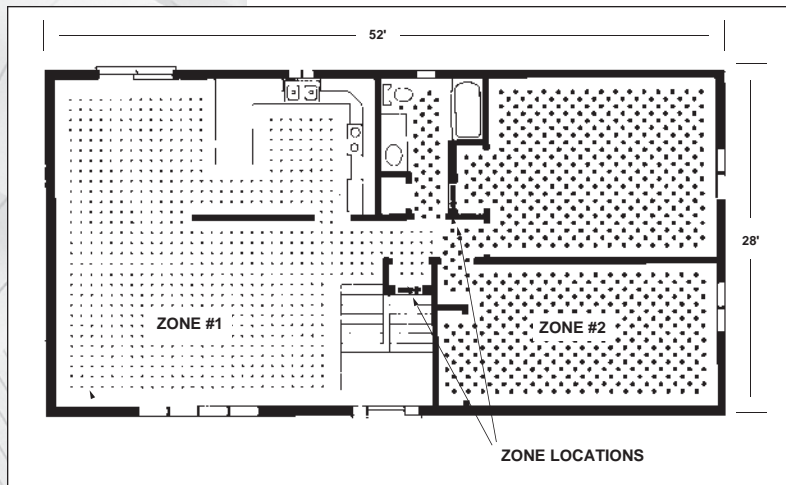
Chapter

5

MANIFOLD INSTALLATION

Determine how zoning is to be done. Locate manifolds as centrally as possible within the zone. Manifolds may be installed in a split

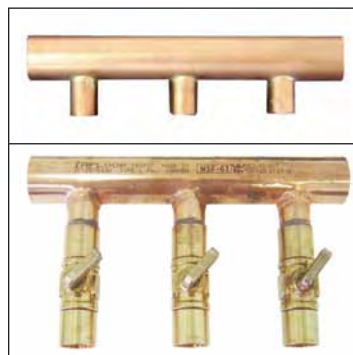
FLOOR PLAN WITH MANIFOLD LOCATIONS



MANIFOLD MOUNTING BRACKETS



COPPER MANIFOLDS



configuration to provide better access to the areas within the zone and to prevent congestion of tubing in front of the manifolds.

COPPER MANIFOLDS

Prepare location for the manifold. These manifolds may be installed in a wall cavity of a 2" x 6" wall, with mounting brackets (#28360) or surface mounted. Locate the lowest manifold about 24" above the finished floor height (minimum). This height is needed to reduce the possibility of side load stress on the tubing.

Manifolds should be located in areas that will be hidden from normal sight, such as closets. Infloor does not recommend installing manifolds in areas that will not be accessible in the future. Plan the width of the manifold location to accept the manifold assembly. Each manifold outlet is space 2-1/2" on center. The 2-loop manifold is 5-1/4" (134mm) long and the 3-loop manifold is 7-3/4" (197mm) long. Allow additional 8" (150mm) for system piping. Cut out sill plate if the manifold is installed in the wall cavity to allow tubing to enter. Manifold covers will need to be created if installed within the wall cavity. Manifold cabinets are available.

RECOMMENDED: NO MORE THAN 8 CIRCUITS PER MANIFOLD TO PREVENT CROWDING OF TUBE AND HIGH FLOOR TEMPERATURE AT MANIFOLD LOCATION AND TO ENSURE MORE EFFECTIVE USE OF TUBE TAILS.

WALL CAVITY WIDTH

Number of Circuits	Width
4	16 1/2" (420 mm)
5	19" (500 mm)
6	21 1/2" (550 mm)
7	24 1/4" (620 mm)
8	26 3/4" (680 mm)
9	29 1/4" (745 mm)
10	32" (815 mm)

MAIFOLD/TUBING CONNECTION

To connect tubing, begin with a clean square cut. When using crimp fittings, slide crimp ring over the tubing and then push the tubing onto the fitting until it bottoms. Place crimp ring approximately 1/8" (3mm) from the end of the tube and secure crimp ring with crimp tool. Make a good square crimp to assure a leak free installation. Do not re-crimp. Use go / no go tool to determine if crimped all the way. When using Infloor compression fittings slide nut over the tubing. Then put insert fitting into the tubing and press all the way down until the insert fitting is seated all the way. Put tubing with insert fitting into the receiver on the manifold, slide nut up and tighten down the compression nut.

BRASS MANIFOLDS

Prepare location for the manifold. These manifolds may be installed in a wall cavity of a 2" x 6" wall. Locate the lowest manifold about 18" above the finished floor height (minimum) unless using a manifold mounting cabinet. This height is needed to reduce the possibility of side load stress on the tubing. If using a manifold mounting cabinet mount the cabinet 10" to 12" above finished floor level. Manifolds should be located in areas that will be hidden from normal sight, such as closets. Infloor does not recommend installing manifolds in areas that will not be accessible in the future. Plan the width of the manifold location to accept the manifold assembly.

MANIFOLD CABINETS TUBING CONNECTION

Manifold cabinets are a painted steel cabinet with locking door and can be ordered for complete protection of the manifolds and to provide a clean connection for tubing with the PEX or AL PEX fittings, begin with a clean, square cut. Slide nut over tubing, then slide the olive over the tubing and then slide adapter fitting into the end of the tubing. Tighten down fitting onto manifold 3/4" ports for final connection. This adapter has high resistance to pull out due to the special configuration of this fittings

WALL CAVITY

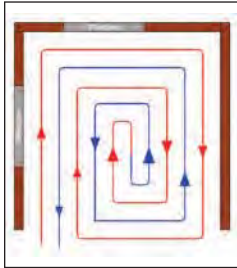
Number of Circuits	Width
3	15 3/16"
4	17 1/8"
5	19"
6	21"
7	23"
8	25"
9	28 1/8"
10	30 1/8"
11	32 1/16"
12	34 1/16"
13	36"

MANIFOLD CABINET

Number of circuits	Height x Width x Depth
3	18" x 16" x 5 1/2"
6	18" x 24" x 5-1/2"
10	18" x 32" x 5-1/2"
13	18" x 40" x 5-1/2"
17	18" x 48" x 5-1/2"

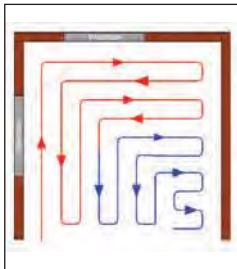
TUBE LAYOUT

COUNTERFLOW SPIRAL



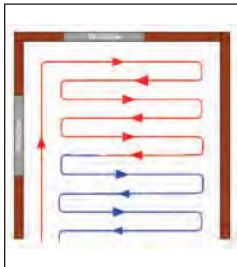
This tube layout pattern provides the most even distribution of heat. The supply and return lines run next to each other, creating an average temperature between the tubes.

DOUBLE SERPENTINE



This pattern is used when there is significant heat loss along two adjacent exterior walls. The water temperature decreases as it flows inward, toward the area of lower heat loss.

SINGLE SERPENTINE

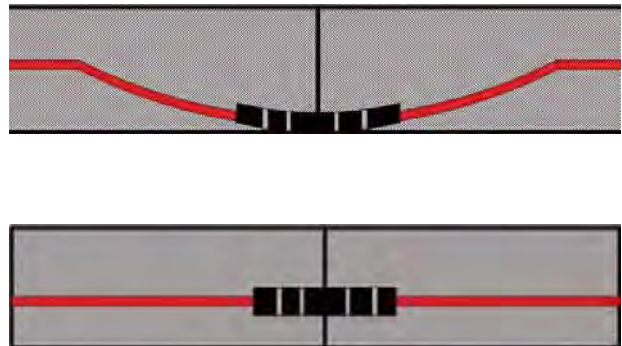


This pattern is used when most heat loss occurs along one wall. The water temperature decreases as it flows through the tube. Use this layout when hotter water needs to be concentrated in areas of high heat loss. An example is an exterior wall with an overhead door.

INSTALL TUBE

To make installation easier, Infloor[®] tube has foot markings so it can be installed without actually measuring its length. All tubing should be 6" (150 mm) away from walls and cabinets. Do not place tubes in areas where equipment will be bolted to the floor. Do not make bends tighter than 6" (150 mm) for 3/8" (10 mm) tube; or 9" (230 mm) for 1/2" (13 mm) tube. Protect any tubes passing through expansion joints or control joints by running tubing to the bottom of the slab and place a "sleeve" of pipe insulation or larger diameter tubing around the Infloor tubes at the expansion joint. Also use a protective sleeve when tubes exit the slab. For installation over wood subfloors or precast planks, group tubes together when passing through doorways and cover with a nail guard.

SLEEVING DETAIL



"SLEEVE" TUBING AT EXPANSION JOINTS
ROUTE TUBING TO THE BOTTOM OF SLAB AND SLEEVE THROUGH EXPANSION JOINTS

DO NOT ALLOW TUBING TO CROSS OVER ITSELF AS THIS MAY PROVIDE INSUFFICIENT THERMAL MASS COVERAGE AND MAY CREATE CRACKS IN THE CONCRETE SLAB

CALCULATIONS

These calculations apply for all tube layout patterns. If you are not using the MaxxCalc computer program to calculate circuit length, use the recommended length as shown below. Start at one end of the manifold and plan to work from one extreme side of the space toward the other with each successive circuit.

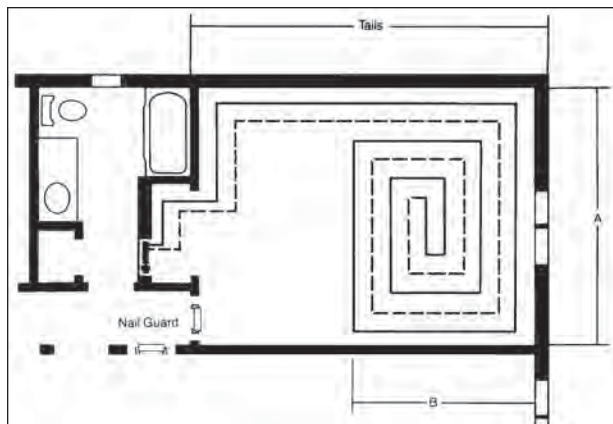
RECOMMENDED:
 200' (60M) FOR 3/8" (10MM) TUBE
 300' (90M) FOR 1/2" (13MM) TUBE

Determine the amount of tube needed to get from the manifold to the far corner of the zone and back. This length of tube is called the "tails." Subtract the tails from the overall circuit length. The result is the amount of tube available for the tube pattern.

Calculate the tube coverage by dividing the remaining tube by the spacing factor. This determines the square feet to be covered by the circuit. Measure the width of the zone (Dimension A) and subtract 1 foot (for the 6-inch setback from each wall). Then subtract 2 times the tube spacing (the distance taken by the tails). This adjusted width is the dimension available after the tails are run.

Divide the adjusted width into the number of square feet the circuit will cover. This is Dimension B of the tube pattern. Measure from the outside wall (or adjacent circuit lay-

FLOOR PLAN WITH COUNTERFLOW SPIRAL



SAMPLE LAYOUT CALCULATION

CALCULATING TUBE COVERAGE	
DESIGN CIRCUIT LENGTH	194 FT. (59 M)
MINUS	
COMBINED TAILS	48 FT. (15 M)
TUBING FOR SPIRAL	
DIVIDED BY	
SPACING FACTOR	2 (6.6)
TUBE COVERAGE	73 SQ. FT. (6.7 M ²)
CALCULATING DIMENSIONS FOR SPIRAL	
DIMENSION A	12 FT. (3.6 M)
MINUS	
DISTANCE FROM WALL TO TUBE	
2 X 6 INCHES	1 FT. (0.3 M)
MINUS	
TUBE SPACING	
2 X 6 INCHES	1 FT. (0.3 M)
ADJUSTED WIDTH	10 FT. (3.0 M)
DIVIDED INTO	
TUBE COVERAGE	73 FT. (6.7 M ²)
DIMENSION B	7.3 FT. (2.2 M)



Start by cutting the end of the tube clean and square using an Infloor [®] plastic tube cutter (#26035). Fasten the tube down about 4 feet (1 m) from the manifold. In concrete construction, use nylon wire ties (#26005), or Infloor wire ties (#26001) to fasten the tubing directly to the reinforcing mesh. Over wood subfloors, use an Infloor staple gun (#26045) and wide-crown staples (#26046) to fasten the tube directly to the subfloor. Over pre-cast concrete, tie tubes to wire mesh or snap tubes into tube rails (#26071) attached to the subfloor.

Unroll the tube, fastening it down every 12" to 18". When installing a counterflow spiral follow the outside dimensions of the coverage area and spiral towards the center while maintaining the double-tube spacing between tubes. Once in the center, reverse and spiral out between the tubes of the original spiral.

When laying tube in a serpentine pattern, begin at the farthest point of the tube area and place the supply portion of the loop at the outside walls. "Snake" the tubing across the tube area maintaining the desired spacing. This pattern allows the hottest water to be delivered to the outside wall.

As each circuit is run, write the number of loop and supply or return on the tubing with a black marker and the length and identify which area each tube circuit services.

Do not exceed a bend radius of 6 times the outside diameter of the tubing as this can cause excessive restriction to fluid flow.

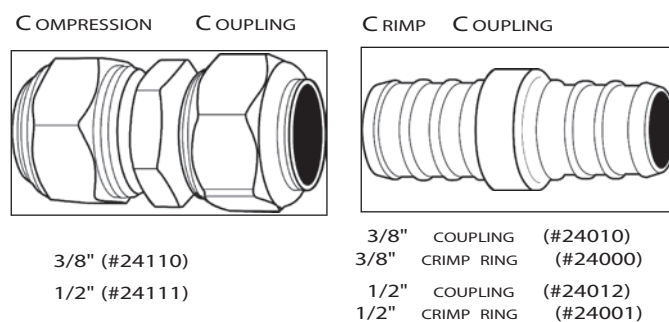
TUBE PRESSURE TEST

Once all the tube is installed and connected, Secure the tubes in front of the manifolds. Then pressure-test the system to 60 psi or local codes. If the system won't hold pressure, find and repair the leak. Tubing must be pressure tested with documentation or proof of pressure test, such as digital picture or regular picture with date and time prior to installation of concrete or gypcrete. If it is necessary to protect the system from freezing, use propylene glycol.

(Never use automotive antifreeze.)

SPLICE INSTRUCTIONS

To repair tubing damaged after installation, use a repair splice. Make a clean, square cut on the tubing. If necessary, remove the damaged section and replace with a new section of tubing. Use either a compression coupling or a crimp coupling. Once all connections have been made, pressure test the system to check the splice. If the splice will be buried in a thermal mass, wrap the splice with tape or insulation to prevent direct contact with the concrete or patching material. Patch the area around the splice with a suitable patching compound. Mark on the prints where the splice has been placed. Infloor recommends only using a crimp coupling in concrete or gypsum applications.



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Chapter

6

CONTROL STRATEGY

The type of heat source is very critical in determining the type of control strategy to use. Every heat source has different operating efficiencies and will vary in cost depending upon the model. Higher efficiency equipment costs are higher initially, but operate at a much lower cost. Traditional equipment such as cast iron boilers typically cost less, but operational cost is higher.

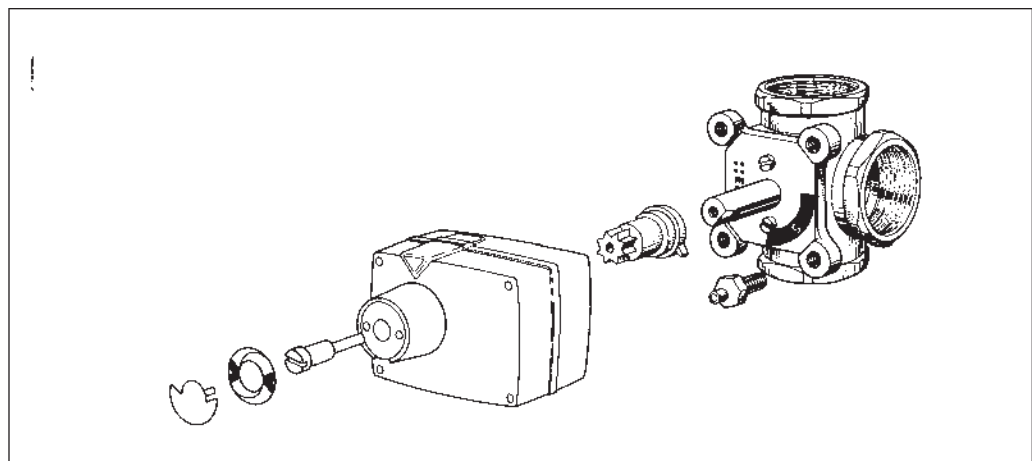
CAST-IRON BOILERS

Cast-iron boilers typically operate at much higher temperatures than normally required for radiant heating. This is a requirement of the boiler's operating conditions to prevent condensation of flue gases and potential reduced service life. However, these boilers can effectively be used when the water to the radiant system is tempered. The use of Infloor 4-Way Mixing Valves, variable speed injection pumps, or 3-Way Thermostatic

Infloor[®] Heating Systems can operate very effectively using cast-iron boilers, high-efficiency condensing boilers, water heaters, ground source heat pumps, wood or coal fired boilers, solar thermal systems and virtually any component that can produce sufficient hot water. However, each of these heat sources require a different control strategy.

Mixing Valves are used to accomplish this.

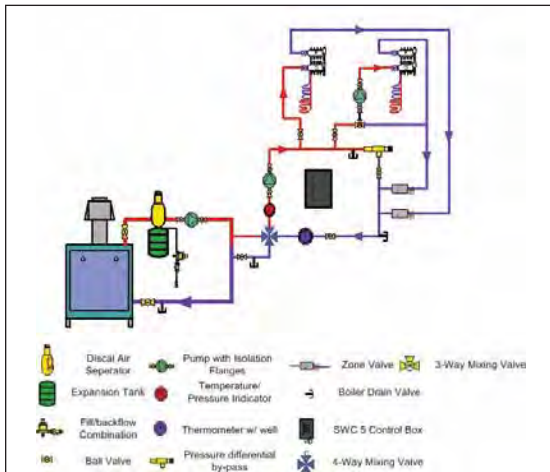
The mixing valves may be manually set, or connected to automatic modulating controls which change the supply water temperature in relation to changes in the outdoor temperature. So, as it gets colder outside, the water being supplied to the radiant floor gets hotter. These valves mix the hot boiler water with cooler return water from the radiant floor to provide the proper temperature water for delivery to the floor. All valves should be piped in by using closely spaced tees



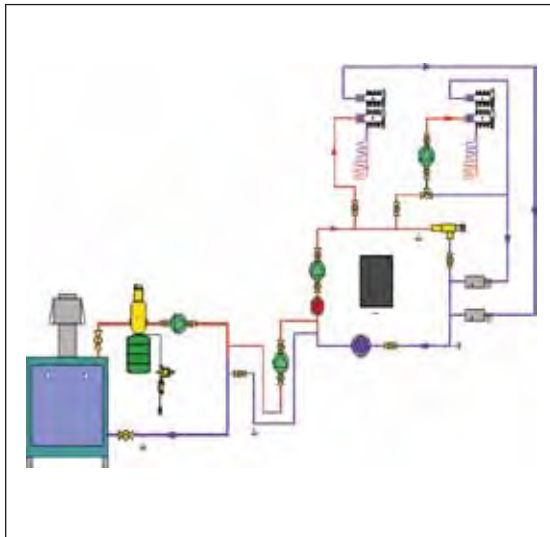
Mixing valves are primarily used to modulate the water temperatures required by the different installation methods used in the system. However, sub-zones may be further modulated by using a 3-way thermostatic mixing valve.

Injection pumps are controlled by a reset controller that varies the speed of the pump which provides necessary hot water to the secondary loop to maintain the desired delivery water temperature. The reset control adjusts the secondary loop water temperature in relation to changes in the outdoor temperature. Boiler return temperature sensing and control is also available.

3-WAY MULTI-ZONE SYSTEM DIAGRAM



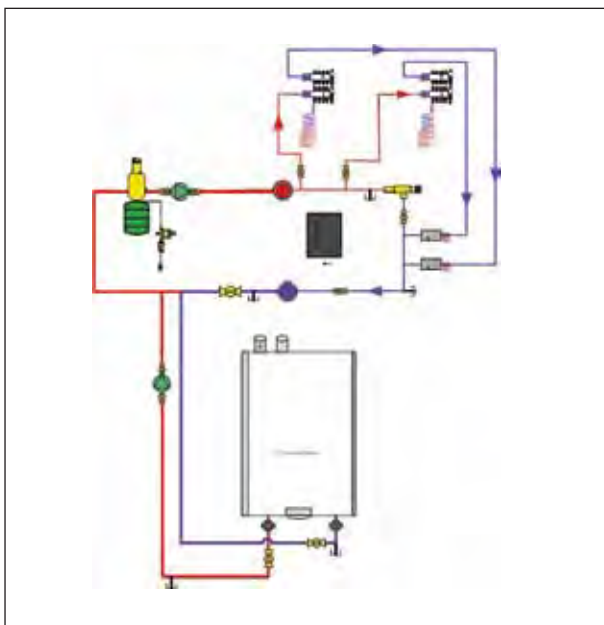
INJECTION PUMP SYSTEM DIAGRAM



HIGH-EFFICIENCY CONDENSING BOILERS

These boilers contain low mass and non-corrosive materials so it is possible for them to operate at temperatures within the range of radiant floor requirements. Since the modulating condensing boiler can be set to deliver the proper water temperature, mixing valves are not required unless a multiple temperature system is needed. These boilers can be operated with on-demand controls, such as a thermostat, most come with outdoor reset controls, which turn on the boiler according to changes in the outdoor temperature. Since these boilers are low mass, they require proper flow to operate effectively. Some require high head pumps for proper flow rates.

HIGH-EFFICIENCY CONDENSING BOILER



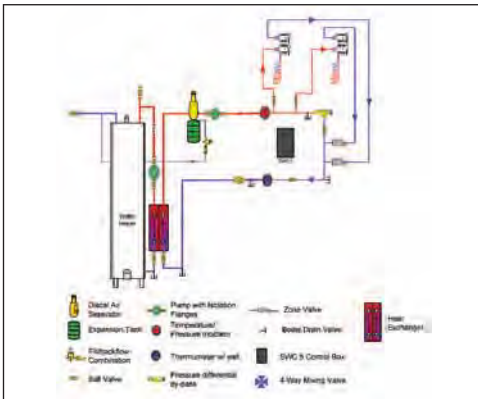
WATER HEATERS

Water heaters provide a low-cost alternative to a heat source for radiant heating systems. They provide proper water temperatures without mixing valves; do not corrode; are efficient; and are available in natural gas, propane, and oil. Infloor does not recommend using electric models unless using an electric boiler. Generally, water heaters are sufficient for renovations and small heating zones only. High heating loads are usually not recommended for water heater applications.

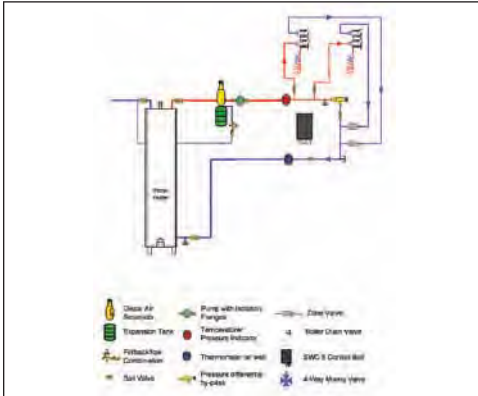
GROUND-SOURCE HEAT PUMPS

Ground-source heat pumps (GSHP) provide a very efficient heat source option for radiant heating systems. GSHPs provide high operating efficiency, and, when used with a radiant heating system, can provide high heat distribution efficiency. Care must be taken when using GSHPs because their temperature output is limited, usually to 120 °F (50 °C) or less. This temperature is normally sufficient for radiant heating systems except in zones that have high heat loss and/or highly insulative floor coverings. Also, a buffer water storage tank is required to prevent short cycling of the GSHP. Size the buffer tank to the manufacturers installation instructions.

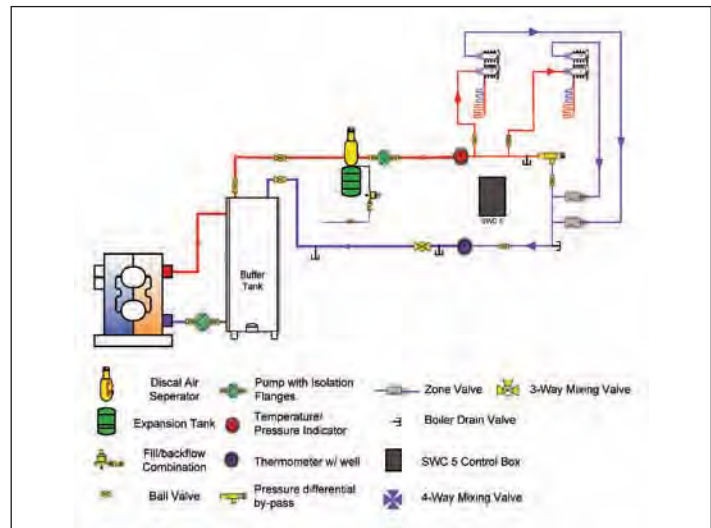
WATER HEATER HEAT-EXCHANGER MULTI-ZONE



WATER HEATER CLOSED-LOOP MULTI-ZONE



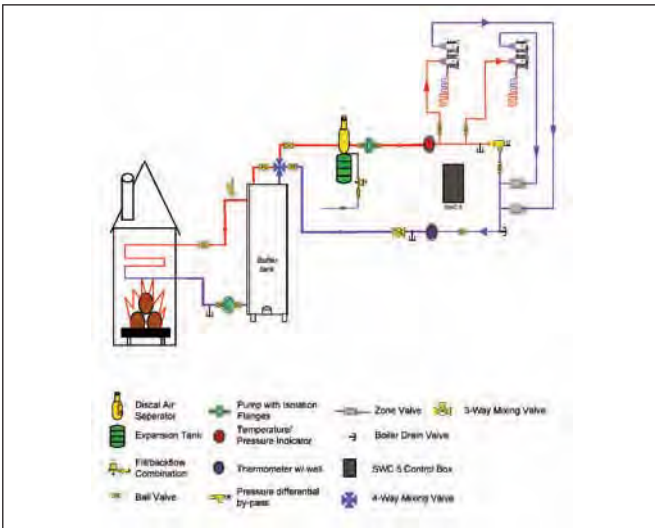
GROUND SOURCE HEAT PUMP MULTI-ZONE



WOOD/COAL FIRED BOILERS

These units require the use of Infloor 4-Way Mixing Valves for the radiant zones, and a buffer water storage tank for the boiler. Since these types of units can produce high water temperatures, the 4-way mixing valve controls the temperature to the radiant zones. The water tank acts as a heat sink to prevent over-temperature conditions in the boiler.

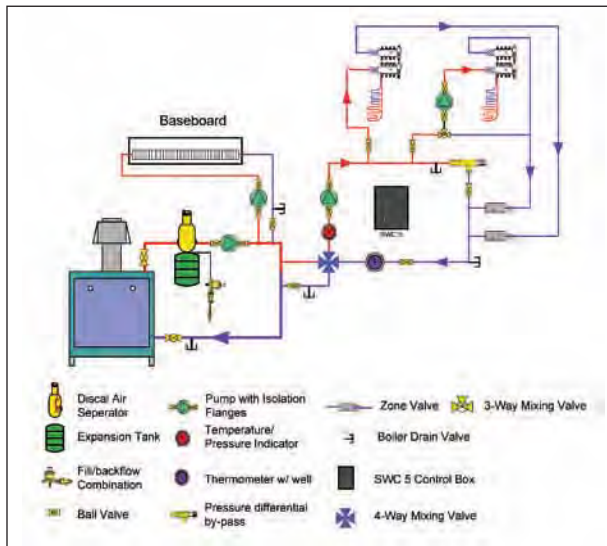
WOOD/COAL BOILER MULTI-ZONE WITH 4-WAY MIXING VALVE



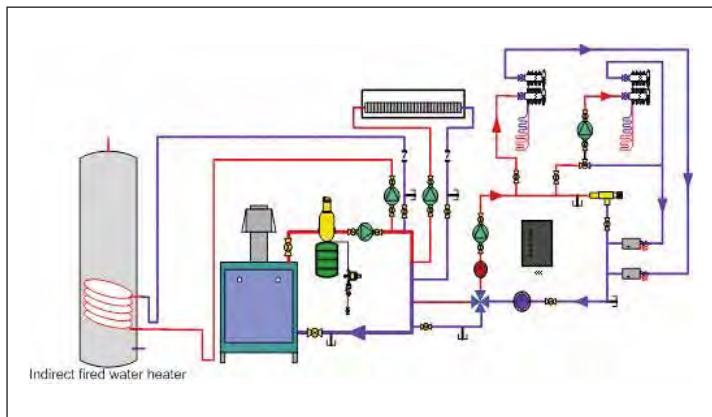
ALTERNATIVE SYSTEMS

Use of a mixing valve allows other heat transfer devices to be used in combination with a radiant heating system. These devices may be used when supplemental heat is needed, such as beneath large windows, or when heating non-radiant zones such as a work area or garage. Radiators, baseboard convectors and fan coils may be run directly off the boiler while the mixing valve tempers water to the radiant floor. All these devices should be piped using primary and secondary piping arrangements with the use of closely space tees or hydraulic separators..

NON-CONDENSING BOILER HIGH/LOW TEMP ZONES WITH 4-WAY MIXING VALVE



NON-CONDENSING BOILER HIGH/LOW TEMP ZONES AND DHW WITH 4-WAY MIXING VALVE

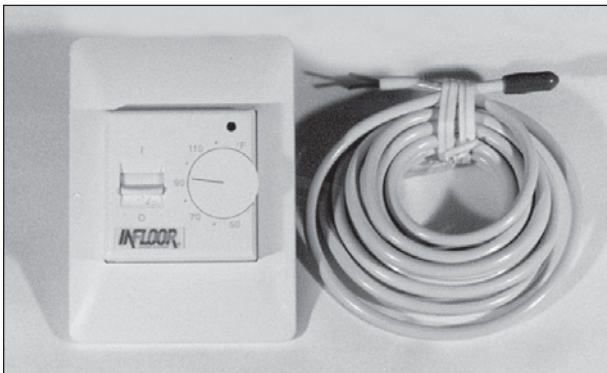


SOLAR GAIN

In zones with a large amount of solar gain, there is a tendency for the radiant mass to discharge its heat during the day and then be slow to respond when the sun sets. To help counter this problem, use an Infloor dual-sensing thermostat (#29002). Set the dual-sensing remote sensor to maintain a mass temperature lower than that required for heating. The air sensor will control the required zone temperature. This will prevent the mass from totally discharging its heat and reduce the time required to heat up again.

While this control strategy will not prevent temperature overshoot due to a sudden influx of solar energy, it will help to accelerate the recovery of the thermal mass and lessen the lag time.

DUAL-SENSING THERMOSTAT (#29002)



ZONING

Zoning the radiant system may be a desired option. Valves may be used to provide room or area "sub-zoning." Zone valves are used to control the entire manifold assembly. This allows for zoning by room usage, floor coverings, floor levels, etc. Individual loop control can be achieved by using brass manifolds and thermal actuators. This is a common practice when reducing manifold locations and using larger manifolds. Radiant heating systems provide very stable temperature environments and over-zoning produces added expense with minimal energy savings.

When using zone valves, match the thermostat anticipator with the valve manufacturer's instructions. Then adjust for longer or shorter operation to achieve desired boiler cycling.

When used with a boiler, always incorporate a mixing valve device such as a 4-way mixing valve, a pressure differential bypass valve, or use bypass piping to assure proper flow through the boiler.

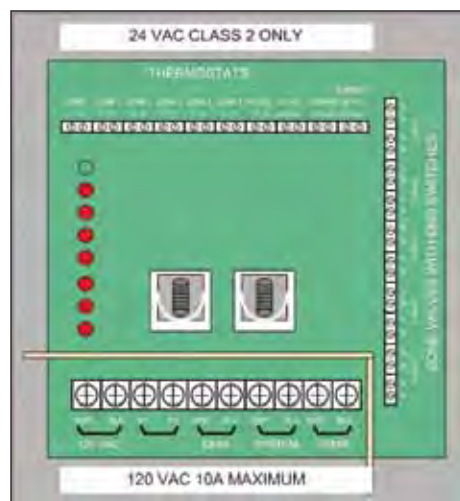
Chapter

7

ELECTRIC CONTROL BOX

An Infloor[®] SWC 5 Control Box (#30058) provides easy system wiring. Included are isolation relays for controlling domestic hot water pump and secondary pump. This control also provides a domestic hot water (DHW) priority and an end switch for use in operating a boiler.

SWC 5 CONTROL BOX (#30058)



The SWC 5 Control Box will allow up to 5 zone valves to be operated by 5 individual thermostats. The control box can also be configured to expand to another SWC 5 for 10 zones with a thermostat on each zone.

There are also terminals for adding a domestic hot water priority pump. The DHW terminals on the upper left corner of the circuit board connects to tank aquastat. A transformer is required for the operation of this control box.

Whenever there is a call from the DHW priority, the domestic hot water pump turns on and the secondary heating pump turns off. The end switch terminals will continue to operate the boiler. The control will return to domestic heating when the domestic water demand is satisfied.

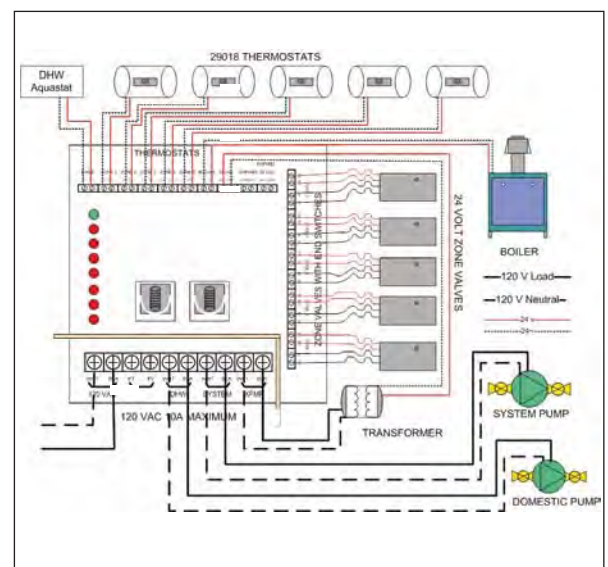
LEDs provide a visual indication of the control status: Green - power on,

Red Indicator light per pump and zone valve.

Zone valve end switches activate call for heat to boiler. 4 wire zone valves which are power open spring return must be used with this control.

If additional zones or pumps are needed another SWC 5 Control Box can be added.

WIRING DIAGRAM SWC 5 CONTROL BOX WITH DOMESTIC HOT WATER PRIORITY



WIRING OPTIONS

The Infloor[®] SWC 5 Control Box may be used to control a variety of devices in a variety of configurations. Each zone terminal is 24 VAC powered, so any low-voltage zone device may be used with the control box. All power is provided by a 24 VAC transformer, 100 VA maximum.

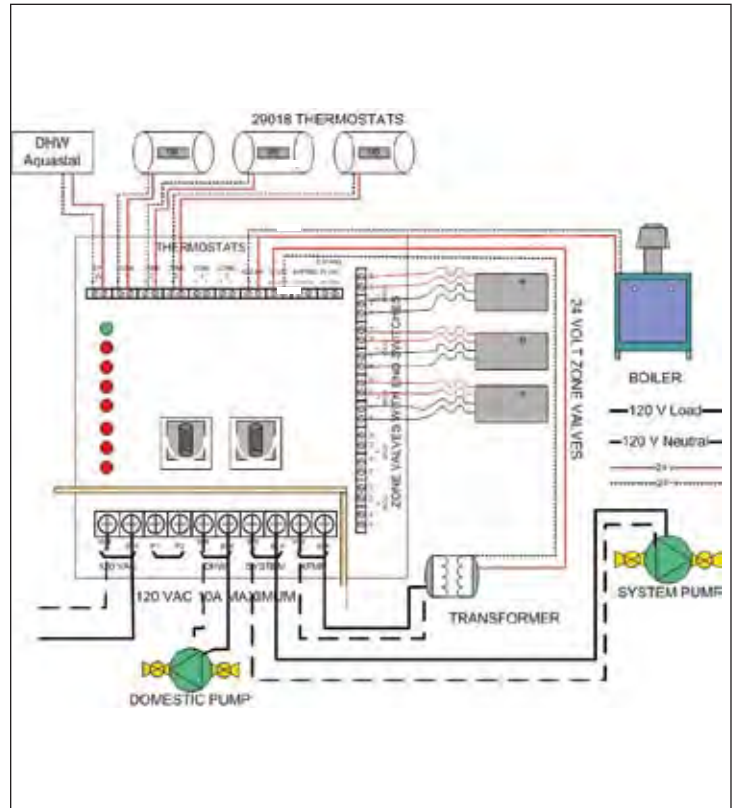
Standard 4-wire motorized zone valves are connected directly to the zone terminals. Infloor thermostats (#29018 or #29002) are connected to the thermostat terminals. The control box has an end switch to activate the boiler. Also included are terminals for a domestic water priority aquastat and terminals for domestic hot water pump.

In systems using multiple heating elements, such as baseboard heaters or fan coils, the control box may be used to interface all components.

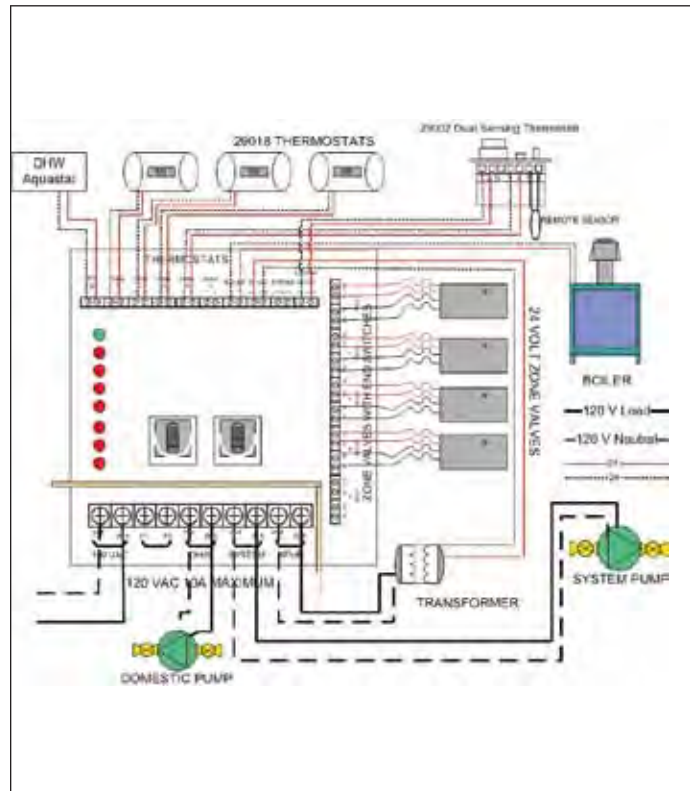
Alternative thermostat: a dual-sensing thermostat (#29002) may be used. However, the wiring diagram is different since the dual-sensing thermostat needs power to the operate and provides a dry contact for zone operation.

See diagram at right and in appendix. (Use 18-4 gauge wire to connect the thermostat to the transformer and to the zone valves.)

M U L T I P L E Z O N E V A L V E S



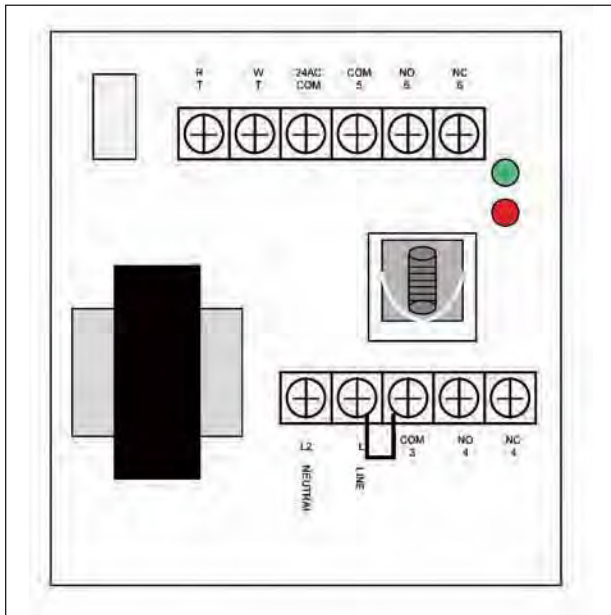
M U L T I P L E Z O N E V A L V E S A N D D U A L - S E N S I N G T H E R M O S T A T S



INFLOOR SINGLE ZONE SWITCHING RELAY

Use the Infloor single zone switching control (#31040) in simple systems when a circulator pump is used. The control is UL/CSA listed and allows a low-voltage thermostat to switch a line voltage circulator pump. The relay also contains an end switch for switching low-voltage components. Infloor thermostats (#29018) and (#29002) may be used with this control.

INFLOOR SINGLE ZONE SWITCHING RELAY



THERMOSTATS

Heating System Applications

The Infloor air-sensing thermostats provides very precise control over room temperature. Using a temperature differential of less than 1 °F allows the thermostat to react rapidly to changes in the indoor temperature. The thermostat may be mounted on a horizontal switch box or directly to the wall. Install the thermostat about 5 feet (1500 mm) above the floor, away from direct sunlight, fireplaces, and air-conditioning ducts. Run 18-4 (heating only) or 18-6 (heating/cooling) gauge wire from the thermostat location directly to the mechanical room, to the Infloor zone control.

24 VAC DIGITAL HEAT /COOL THERMOSTAT (#29018)



120/240 VAC DIGITAL DUAL - SENSING HEAT/C OOL THERMOSTAT (#29002)



Warm Floor Applications

When using the Infloor Remote Sensing Thermostat (#29030), install a single vertical switch box about 5 feet (1500 mm) above the floor. Run 3/4" (19 mm) conduit from the switch box to the floor with a standard-radius 90-degree turn at the bottom. Extend the conduit 3 feet (1 m) away from the wall. This conduit will contain the thermostat's remote sensor. Place the cap provided with the thermostat over the end of the conduit. Use 18-4 gauge to connect the remote sensing thermostat to the control system.

REMOTE SENSING THERMOSTAT (#29030)



DUAL-SENSING THERMOSTAT (#29002)

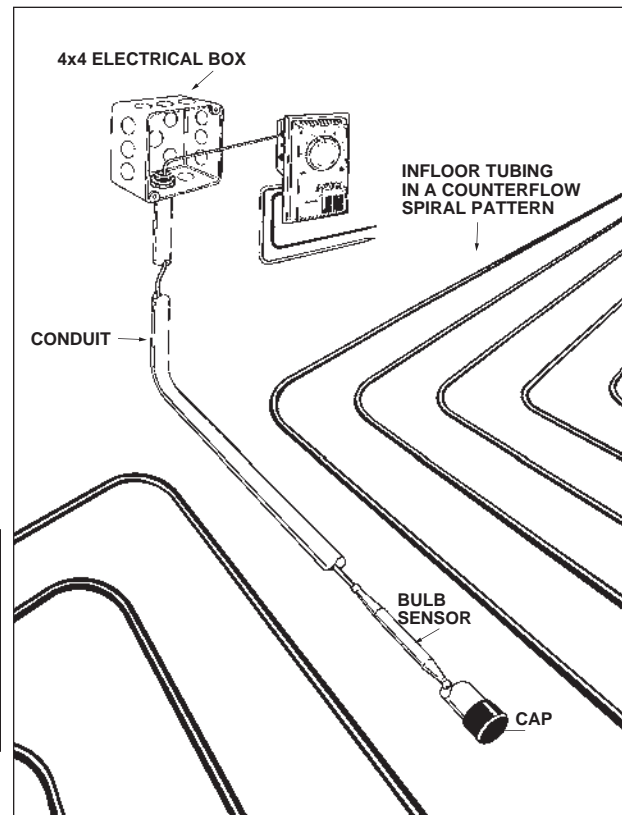


Optional Thermostat
An optional control for a warm floor application is the Dual-Sensing Thermostat (#29002).

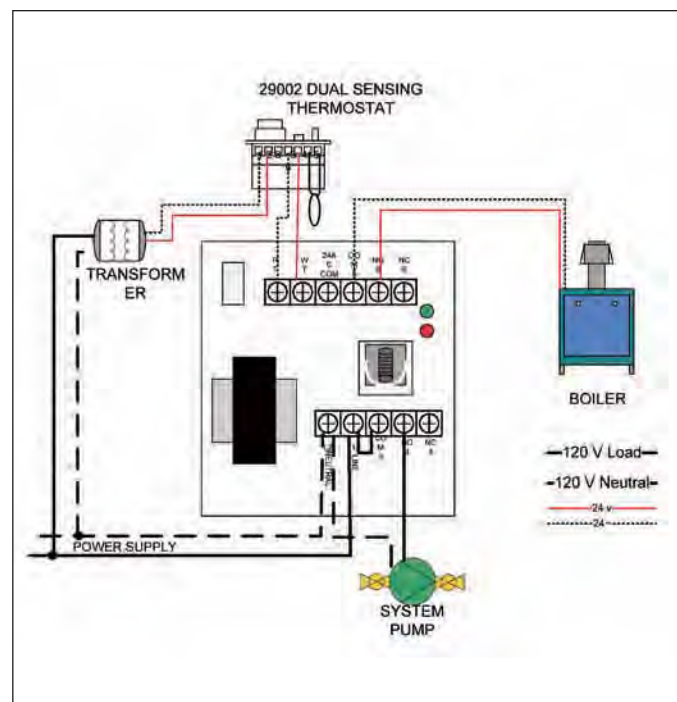
The electric box and conduit installation is the same as the illustration above right, however do not cap the conduit. For multiple zones, use the wiring guide for the SWG 5 Control Box and follow the wiring detail for the Dual-Sensing Thermostat.

For a single zone, the thermostat may be used to directly control a circulator. Use the 120 VAC version of the Dual Sensing Thermostat [#29031] with terminals 1 and 2 wired directly to 120 VAC, and terminals 3 and 4 wired directly to the circulator. Terminals 5 and 6 are for the remote sensor. Terminal "S" is not used.

REMOTE SENSING THERMOSTAT FOR FLOOR WARMING



DUAL-SENSING THERMOSTAT FOR FLOOR WARMING



Chapter

8

PURGING

Make sure the boiler, controls and other system electrical components are "off." After checking all connections, fill the system with water and pressurize to 20 psi (210 kPa). Bleed air from the manifold vents, air vents, and the primary loop air vent. Check the entire system for leaks.

It is important to remove all air from the system to assure proper operation. Air trapped in tubing or manifolds may prevent circulation of water through isolated tubes. Air trapped in circulator pumps could cause pump to fail. It is best to use available city water pressure to force the initial air out of the system. A purge valve should be installed in the system to assist in removal of air. An air eliminator installed in the system will remove residual air. It is suggested that a micro-bubble air eliminator be installed as these are the most efficient air eliminators available.

IMPORTANT: THE USE OF AN AUTOMATIC FILL VALVE IS NOT RECOMMENDED AND MAY RESULT IN WATER DAMAGE TO THE BUILDING. IF THE SYSTEM WILL NOT HOLD PRESSURE, FIND THE LEAK AND REPAIR IT.

Use a pressure-reducing fill valve with a manual shut-off valve for adding water to the system. Occasionally, after initial start-up, system pressure will drop. Add water to the system until pressure stabilizes, then turn off the fill valve.

SYSTEM TREATMENT

All hydronic heating systems benefit from a water treatment program. Infloor[®] offers Formula 10™ or Infloor Closed System Treatment to prolong the life of system components. Calculate the total volume of water in the system, including all the water in the tubing. See the chart for tube capacities. Add the proper dosage for the treatment used.

TUBE CAPACITY

Tube Size	Gallon per foot (L/m) PEX/BPEX
3/8" (10 mm)	0.0050 (0.07)
1/2" (13 mm)	0.0092 (0.11)
3/4" (19 mm)	0.0184 (0.23)
1" (25 mm)	0.0304 (0.38)

Tubing Size & Type	Volume gal/ft
1/2" typ m copper	.01319
3/4" typ m copper	.02685
1" typ m copper	.0454
1-1/4" typ m copper	.06804
1-1/2" typ m copper	.09505
2" typ m copper	.1647

INFLOOR SYSTEM TREATMENT

Infloor System Treatment (#27000) is a non-chromate based treatment that must be maintained in proper concentration to prevent system corrosion. The concentration may be checked with a Sodium Nitrite Test Kit.

Initial treatment may require more or less system treatment depending upon water quality. Test concentration during initial application. Propylene glycol may be added if freeze protection is desired.

Check concentration after several weeks of system operation and adjust concentration level if necessary. Proper dosage is one gallon (3.79 L) of Infloor System Treatment for every 50 gallons (190 L) of water in the system. [One quart (0.9L) of Infloor System treatment for every 12.5 gallons (47 L) of water]



FORMULA 10™

Formula 10™ (#27005) is a silicate-based system treatment capable of protecting all metals in the system with a single application. Proper dosage is one quart (0.9 L) of Formula 10 for every 50 gallons (190 L) of system water.

Note: Formula 10 may not be used with glycols or other chemicals.

Chapter

9

THERMAL MASS

A radiant floor system should be designed to use the lowest water temperature possible for heating. This means that the conductivity of the floor itself is very important. Any thermal resistance between the embedded tubing and the floor surface requires higher water temperatures. Therefore, a floor that spreads the heat uniformly with little resistance is the most desirable. Additionally, any flooring structure that stores some of the heat will help to even out short term heating demands. With this in mind, Therma-Floor[®] for suspended or capped floors, and concrete for slab floors are ideally suited. Tubing embedded in either of these materials will work as an excellent heat exchanger.

Under-slab heat loss may severely affect system performance. Insulate

under the entire slab when there are high water tables, when restrictive floor coverings are used, and when the area being heated has a high heat loss.



NOTE: THE MINIMUM DEPTH OF THERMA-FLOOR IS 3/4" (25MM) OVER THE TOP OF THE TUBE

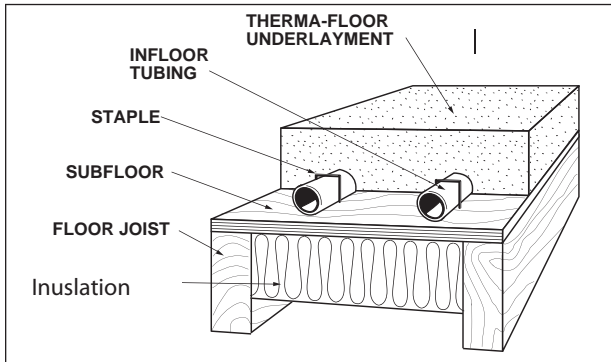
SUSPENDED FLOORS

Infloor tubing is stapled to the subfloor using the Infloor staple gun (#26045) and wide crown staples (#26046). Staple the tubing every 12" to 18" and place five staples at each turn, two at the beginning and end of the turn and one in the middle of the turn. Do not allow the tubing to be severely indented by the staple.

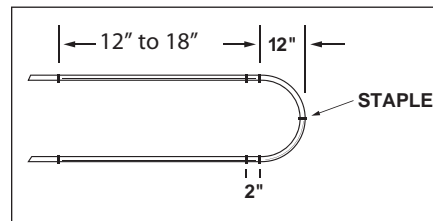
Caution: In freezing weather, warm tubing before stapling to prevent damage to tubing.

Insulation must be placed under the floor, between the joists on all applications, to prevent downward heat transfer. A higher R-Value insulation is required under the floor if there is unheated space below, such as a crawl space or unheated garage.

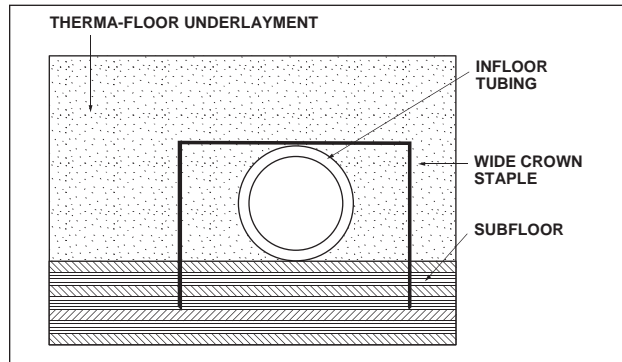
WOOD SUB-FLOOR / THERMA-FLOOR DIAGRAM



S TAPLING PATTERN



S TAPLING DETAIL

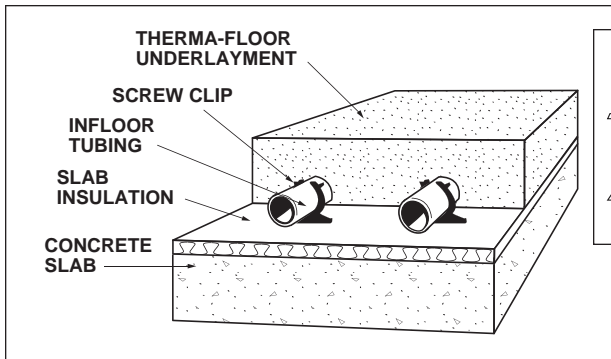


EXISTING CONCRETE SLAB

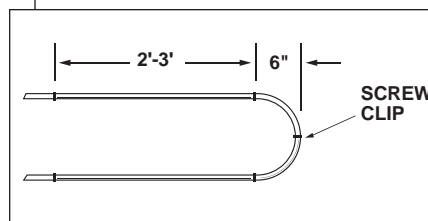
In renovation projects, or where more precise system control is desired, the existing concrete slab may be capped. Secure high density insulation (1.8 to 2.0 pounds per cubic foot [32 kg/m³]) to the existing slab. When 1-inch

(25 mm) insulation board is used, tubing may be fastened using Infloor screw clips (#26015). Install a clip every 2 feet (1 m) and place three clips at each turn, one at the beginning and end of the turn, and one in the middle of the turn.

CONCRETE SLAB / THERMA-FLOOR DIAGRAM



CLIP PATTERN



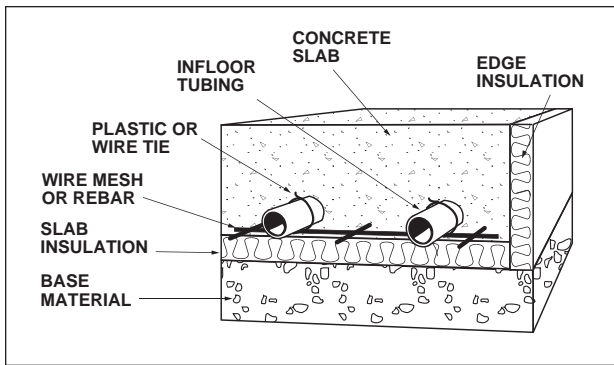
S CREW CLIP (#26015)



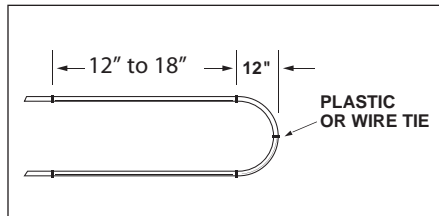
CONCRETE SLAB ON OR BELOW GRADE

High density insulation or Insul-Tarp is placed under the slab and at the edge. It is critical to insulate the perimeter and edge of the slab for optimum system performance. Prepare a smooth base and place the insulation board. Tubing may be secured to the insulation

CONCRETE SLAB DIAGRAM

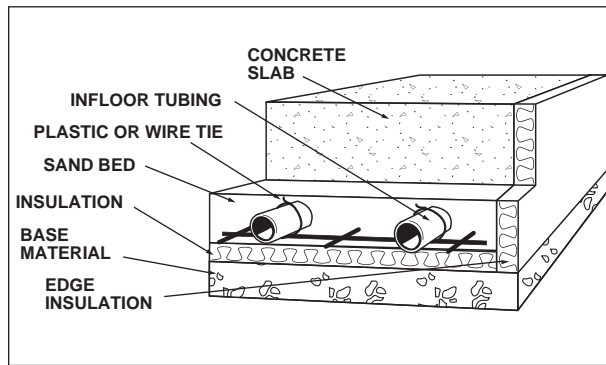


FASTENING PATTERN



with Infloor screw clips (#26015) if fiber reinforced concrete is poured. If rebar or wire mesh is used, tie the tubing to the reinforcement wire using plastic ties (#26005) or wire ties (#26001). Clip or tie the tubing every 12" to 18" and place three clips or ties at each turn, one at the beginning and end of the turn and one in the middle of the turn.

CONCRETE SLAB ON SAND BED DIAGRAM



RECOMMENDED: FOR BETTER SYSTEM CONTROL AND RESPONSE PLACE INSULATION UNDER THE ENTIRE SLAB

SLAB EDGE AND PERIMETER INSULATION ARE CRITICAL TO PROPER RADIANT HEATING PERFORMANCE. ELIMINATION OF HEATING PERFORMANCE. ELIMINATION OF THIS INSULATION MAY PRODUCE UNSATISFACTORY RESULTS, ESPECIALLY WHEN

HIGH WATER TABLES ARE PRESENT OR RESTRICTIVE FLOOR COVERINGS ARE USED

FLOOR COVERINGS

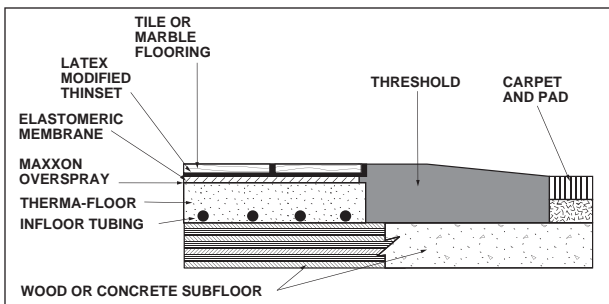
Virtually any type of floor covering can be used over an Infloor Heating System. With proper design, even plush carpet with pad can be used. The type of floor covering affects the performance of the heating system. Highly insulative floor coverings will require higher delivery water temperatures and/or tighter tube spacing.

The more conductive floor coverings, such as ceramic tile and marble, perform best. These coverings allow easy transfer of heat from the heating system. The Maxxon® publication "Procedures for Attaching Finished Floor Goods to Maxxon Underlayments" details how to attach a variety of floor goods to Therma-Floor® and other Maxxon underlayment products. This publication also contains information for tested adhesives.

INSTALLING TILE OR MARBLE OVER THERMA-FLOOR®

Follow the instructions in the Maxxon publication called "Procedures for Attaching Finished Floor Goods to Maxxon Underlayments." Once the Therma-Floor is dry, apply diluted Maxxon Floor Overspray® as per recommendations. After the Overspray is dry, apply an elastomeric membrane and thin-set tile or marble with latex-modified thinset. Important: Wait until the tile or marble installation is complete before turning on the Infloor system.

TILE /THERMA-FLOOR DETAIL



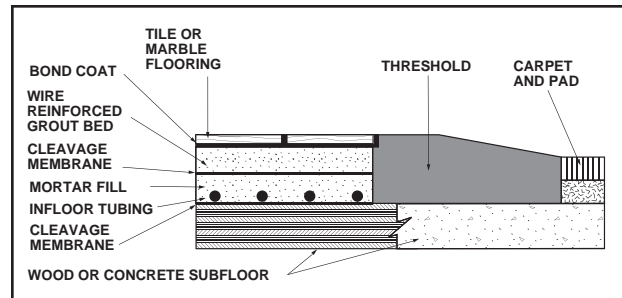
INSTALLING INFLOOR HEATING SYSTEMS IN MORTAR BEDS

Follow the Cement Mortar-Cleavage Membrane procedure F111-91 in the TCA 1991 Handbook for Ceramic Tile Installation. The primary steps are:

1. Place a cleavage membrane over the wood or concrete subfloor.
2. Install tubing and surround the tubing with a 3/4" (19 mm) layer of firmly packed mortar, and pressure test the tubing to 60 psi.
3. Place a second cleavage membrane over the mortar bed.
4. Install a wire-reinforced mortar bed system over the cleavage membrane.
5. Use a portland cement paste on a mortar bed that is still plastic for the bond coat. Use a dry-set mortar or latex-portland cement mortar on a cured bed.

6. Install a transition threshold between adjacent floor coverings.
7. Wait 48 hours after installing the tile or marble before turning on the Infloor system.

TILE /MORTAR BED DETAIL



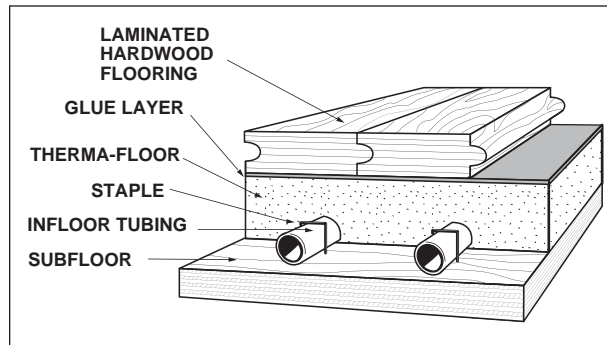
INSTALLING HARDWOOD FLOORS OVER INFLOOR HEATING SYSTEMS

Hardwood floors may be used with radiant heating systems. Since the floor is being heated, care must be taken to prevent the floor from becoming too hot and causing too much contraction and expansion of the wood. During the heating season, wood that is very moist will tend to be dried. This may cause gapping to occur. During the cooling season, wood will absorb moisture and expand. This may cause buckling if proper expansion is not planned. All hardwood floors should be acclimated to the radiant system prior to permanent attachment. The radiant floor under hardwood floor system should have a maximum floor surface temperature of 85 degrees F, this often requires the use of special mixing devices or dual sensing thermostats (#29002). When installing hardwood floors, it is recommended to use the following types of flooring systems.

GLUE-DOWN LAMINATED HARDWOOD

Glue-down laminated hardwood systems tend to be the most stable flooring systems for use with radiant heat. The cross-ply of the flooring boards make the flooring very stable and resistant to excessive expansion and contraction. Many wood flooring manufacturers produce pre-finished, square-edge laminated hardwood floors that are indistinguishable from nail-down systems. Since laminated systems are generally thinner than nail-down systems, the radiant system performance is improved due to lower resistance from the floor covering.

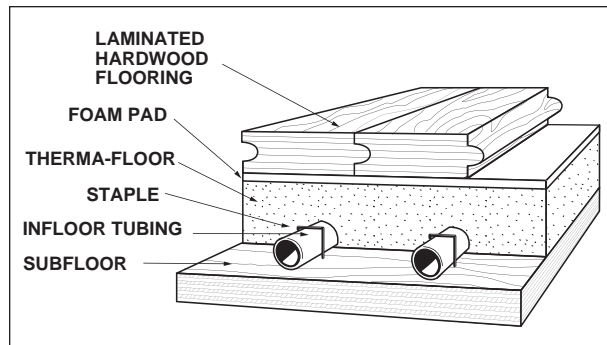
LAMINATED FLOOR DETAIL



FLOATING FLOOR

Floating floor systems are another alternative to the nail-down approach. Flooring boards are glued edge to edge or some are tongue and groove and floated on a 1/8" (3 mm) foam pad. Since the flooring is laminated, it is a very stable system. Performance is about as good as with glue-down laminate systems. The foam pad adds some additional resistance, but the floating floor laminates are generally thinner than glue-down laminates so the net performance effect is similar.

FLOATING FLOOR DETAIL



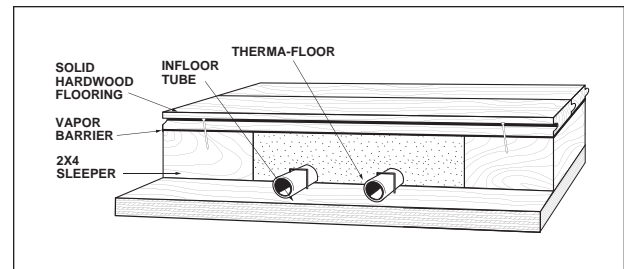
SOLID HARDWOOD

Solid hardwood may be installed in several ways. Since solid wood floors perform best when they are nailed, careful planning is required.

NAIL-DOWN SLEEPER SYSTEM

In this approach, the planning of this type system must happen at the beginning of the job. The direction of the way the hardwood floor is to be laid will have an effect on how the tubing is installed and which direction the sleepers will need to be installed. Sleepers and tubing should run perpendicular to the direction of the hardwood floor. Sleepers should be cut out of straight and flat boards that are not bowed or twisted. Now the 2 x 4 sleepers are installed directly on the subfloor and tubing is installed between the sleepers. The spaces are then filled with Therma-Floor[®] to provide a thermal mass. Once the Therma-Floor has dried, a vapor barrier is laid down. Now the after laying a vapor barrier, the flooring boards are nailed directly into nailing sleepers that were installed on the subfloor. The advantage of this system is that the flooring creates minimal insulation above the heating system. The disadvantage is that the flooring can only be nailed to a sleeper which may not provide enough fastening.

SLEEPER SYSTEM DETAIL



CARPET AND PAD

Selecting carpet and pad materials with low insulative (resistance) values is the key to keeping delivery water temperatures as low as possible. Carpet pads have perhaps the greatest impact on the thermal transfer of a radiant floor. The standard “prime” or “bonded” urethane pad is over three times more insulative than rubber pads. Selecting a thinner rubber pad instead of a thick urethane pad can make as much as a 50 °F (28 °C) difference in the required water delivery temperature. Infloor Carpet Cushion (# 34000) is an excellent pad for radiant applications, having an R-value of 0.31.

FLOOR COVERING R-VALUE

Floor Coverings	Depth	R-Value
Carpeting	1/8"	0.6
	1/4"	1.0
	1/2"	1.4
	3/4"	1.8
	1"	2.2
Acousti-Mat™	1/4"	0.3
Urethane Pad	1/4"	1.0
	1/2"	2.0
Vinyl or Tile		0.2
Hard Wood	3/8"	0.5
	3/4"	0.8
Soft Wood	1/2"	0.6
	3/4"	0.8
	1"	1.2
Carpet + Pad = Total R Value		

NOTE: TO ESTIMATE THE CARPET R-VALUE, MULTIPLY THE CARPET HEIGHT BY 2.6.

$$\text{CARPET R-VALUE} = \text{CARPET HEIGHT} \times 2.6$$

Chapter

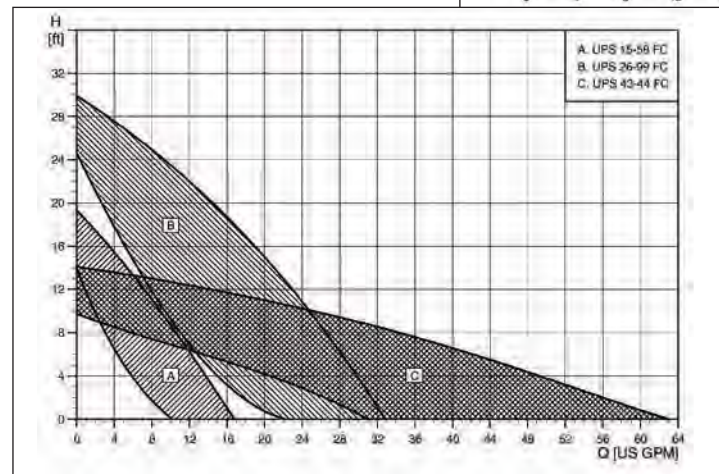
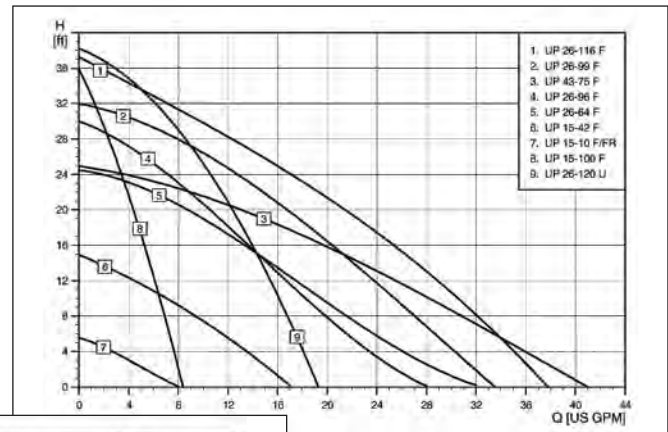
10

TUBE SPECIFICATIONS

Characteristics	PEX	BPEX
Performance Characteristic	ASTM F 876	ASTM F 876
SDR	9	9
Oxygen Barrier		EVOH
DIN		4726
PSI	100 (689 kPa)	100 (689 kPa)
Temperature	180 °F (82 °C)	180 °F (82 °C)
Linear Expansion	1.1 in./ (10 °F·100 ft)	1.1 in./ (10 °F·100 ft)
Thermal Conductivity	2.7 Btu·in./hr·ft ² ·°F	2.7 Btu·in./hr·ft ² ·°F
Quick Burst Strength @ 73°F	440 psi	440 psi
Sizes	3/8" (10 mm) 1/2" (13 mm) 3/4" (19 mm)	3/8" (10 mm) 1/2" (13 mm) 3/4" (19 mm)
Bend Radius		
3/8"	6 x o.d.	6 x o.d.
1/2"	6 x o.d.	6 x o.d.
3/4"	6 x o.d.	6 x o.d.
Warranty	25 yrs.	25 yrs.

Type	Part #	Size	I.D.	O.D.	Press.	Temp.	ASTM	DIN	Length	Weight
PEX	25050	3/8" (10 mm)	3/8" (10 mm)	1/2" (13 mm)	100psi (689 kPa)	180° F (82 °C)	F-876		600' (180 m)	27 lbs (12.2 kg)
	25060	1/2" (13 mm)	1/2" (13 mm)	5/8" (16 mm)	100psi (689 kPa)	180° F (82 °C)	F-876		900' (270 m)	50 lbs (22.7 kg)
BPEX	25000	3/8" (10 mm)	3/8" (10 mm)	1/2" (13 mm)	100psi (689 kPa)	180° F (82 °C)	F-876	4726	600' (180 m)	27 lbs (12.2 kg)
	25010	1/2" (13 mm)	1/2" (13 mm)	5/8" (16 mm)	100psi (689 kPa)	180° F (82 °C)	F-876	4726	900' (270 m)	50 lbs (22.7 kg)

GRUNDFOS PUMP PERFORMANCE CURVES



HEAD LOSS CHART

HEADLOSS/100 FT AT 100 °F								
GMP								
	3/8" PEX/BPEX	1/2" PEX/BPEX	3/4" PEX/BPEX	1" PEX/BPEX	3/8" PEX/BPEX	1/2" PEX/BPEX	3/4" PEX/BPEX	1" PEX/BPEX
0.10	0.47	0.11	0.02	0.01	0.31	0.07	0.01	0.00
0.20	1.57	0.37	0.07	0.02	1.04	0.24	0.05	0.01
0.30	3.19	0.75	0.15	0.04	2.11	0.49	0.10	0.03
0.40	5.28	1.24	0.24	0.07	3.49	0.82	0.16	0.05
0.50	7.81	1.83	0.35	0.11	5.16	1.21	0.23	0.07
0.60	10.74	2.52	0.49	0.15	7.10	1.66	0.32	0.10
0.70	14.07	3.30	0.64	0.19	9.30	2.18	0.42	0.13
0.80	17.77	4.17	0.81	0.25	11.74	2.75	0.53	0.16
0.90	21.84	5.12	0.99	0.30	14.43	3.38	0.66	0.20
1.00	26.27	6.16	1.19	0.36	17.35	4.07	0.79	0.24
1.20	36.14	8.47	1.64	0.50	23.88	5.60	1.08	0.33
1.40	47.33	11.10	2.15	0.65	31.27	7.33	1.42	0.43
1.60	59.79	14.02	2.72	0.83	39.50	9.26	1.79	0.55
1.80	73.47	17.22	3.34	1.02	48.54	11.38	2.21	0.67
2.00	88.35	20.71	4.01	1.22	58.37	13.69	2.65	0.81
2.20	104.38	24.47	4.74	1.44	68.97	16.17	3.13	0.95
2.40		28.50	5.52	1.68		18.83	3.65	1.11
2.60		32.78	6.35	1.93		21.66	4.20	1.28
2.80		37.32	7.23	2.20		24.66	4.78	1.45
3.00		42.11	8.16	2.48		27.82	5.39	1.64
3.20		47.14	9.14	2.78		31.15	6.04	1.84
3.40		52.42	10.16	3.09		34.64	6.71	2.04
3.80		63.69	12.34	3.76		42.08	8.16	2.48
4.20		75.88	14.71	4.47		50.13	9.72	2.96
4.60			17.24	5.25			11.39	3.47
5.00			19.95	6.07			13.18	4.04
5.40			22.83	6.95			15.08	4.59
5.80			25.87	7.87			17.09	5.20
6.20			29.07	8.85			19.21	5.84
6.60			32.43	9.87			21.43	6.52
7.00			35.95	10.94			23.75	7.23
7.40			39.62	12.06			26.18	7.97
7.80			43.45	13.22			28.71	8.73
8.60				15.68				10.36
9.40				18.32				12.11
10.20	Velocity rate exceeds 8 feet per second			21.14	Velocity rate exceeds 8 feet per second			13.97
11.00	Velocity rate exceeds 8 feet per second			24.13	Velocity rate exceeds 8 feet per second			15.94
11.80	Velocity rate exceeds 8 feet per second			27.28	Velocity rate exceeds 8 feet per second			18.02
12.60	Velocity rate exceeds 8 feet per second			30.60	Velocity rate exceeds 8 feet per second			20.22
13.40	Velocity rate exceeds 8 feet per second			34.08	Velocity rate exceeds 8 feet per second			22.52
14.20	Velocity rate exceeds 8 feet per second			37.72	Velocity rate exceeds 8 feet per second			24.92

(For pressure drop, divide head loss by 2.31)

HEAD LOSS CHART

HEADLOSS/100 FT AT 120 °F								
GMP								
	3/8" PEX/BPEX	1/2" PEX/BPEX	3/4" PEX/BPEX	1" PEX/BPEX	3/8" PEX/BPEX	1/2" PEX/BPEX	3/4" PEX/BPEX	1" PEX/BPEX
0.10	0.44	0.10	0.02	0.01	0.30	0.07	0.01	0.00
0.20	1.48	0.35	0.07	0.02	1.00	0.23	0.05	0.01
0.30	3.02	0.71	0.14	0.04	2.04	0.48	0.09	0.03
0.40	4.99	1.17	0.23	0.07	3.37	0.79	0.15	0.05
0.50	7.38	1.73	0.34	0.10	4.98	1.17	0.23	0.07
0.60	10.15	2.38	0.46	0.14	6.85	1.61	0.31	0.09
0.70	13.29	3.12	0.60	0.18	8.97	2.10	0.41	0.12
0.80	16.79	3.94	0.76	0.23	11.33	2.66	0.51	0.16
0.90	20.64	4.84	0.94	0.29	13.93	3.27	0.63	0.19
1.00	24.81	5.82	1.13	0.34	16.75	3.93	0.76	0.23
1.20	34.14	8.00	1.55	0.47	23.04	5.40	1.05	0.32
1.40	44.71	10.48	2.03	0.62	30.18	7.08	1.37	0.42
1.60	56.48	13.24	2.57	0.78	38.12	8.94	1.73	0.53
1.80	69.41	16.27	3.15	0.96	46.85	10.98	2.13	0.65
2.00	83.46	19.57	3.79	1.15	56.34	13.21	2.56	0.78
2.20	98.61	23.12	4.48	1.36	66.56	15.60	3.02	0.92
2.40		26.92	5.22	1.59		18.17	3.52	1.07
2.60		30.97	6.00	1.83		20.90	4.05	1.23
2.80		35.26	6.83	2.08		23.80	4.61	1.40
3.00		39.78	7.71	2.35		26.85	5.20	1.58
3.20		44.54	8.63	2.63		30.06	5.83	1.77
3.40		49.52	9.60	2.92		33.43	6.48	1.97
3.80		60.17	11.66	3.55		40.61	7.78	2.39
4.20		71.68	13.89	4.23		48.38	9.38	2.85
4.60			16.29	4.96			11.00	3.35
5.00			18.85	5.74			12.72	3.87
5.40			21.57	6.56			14.56	4.43
5.80			24.44	7.44			16.50	5.02
6.20			27.46	8.36			18.54	2.64
6.60			30.64	9.32			20.68	6.29
7.00			33.96	10.33			22.92	6.98
7.40			37.43	11.39			25.27	7.69
7.80			41.04	12.49			27.70	8.43
8.60				14.82				10.00
9.40				17.36				11.68
10.20	Velocity rate exceeds 8 feet per second			19.97	Velocity rate exceeds 8 feet per second			13.48
11.00				22.79				15.38
11.80				25.77				17.40
12.60				28.91				19.51
13.40				32.20				21.73
14.20				35.63				24.05

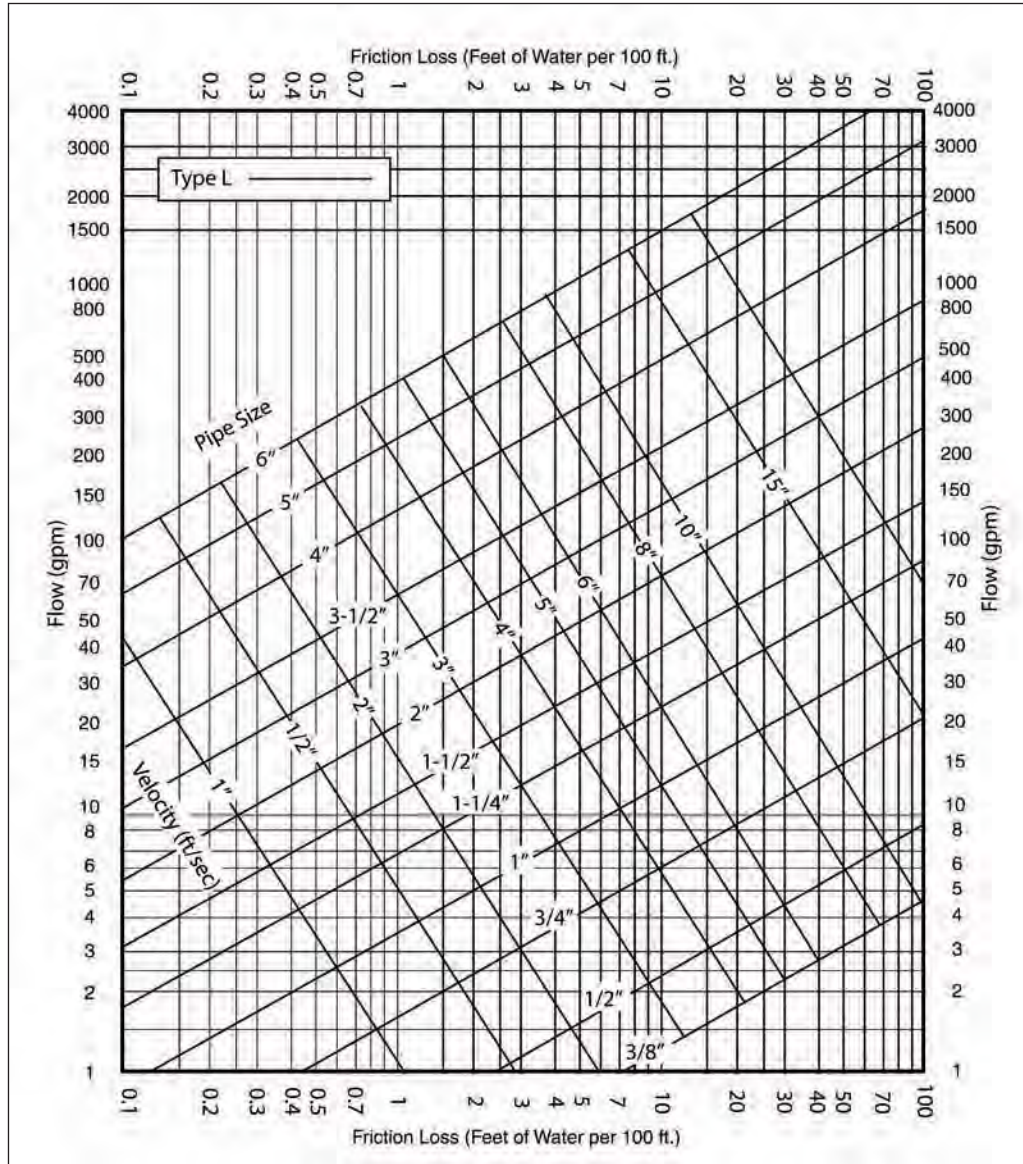
(For pressure drop, divide head loss by 2.31)

HEAD LOSS CHART

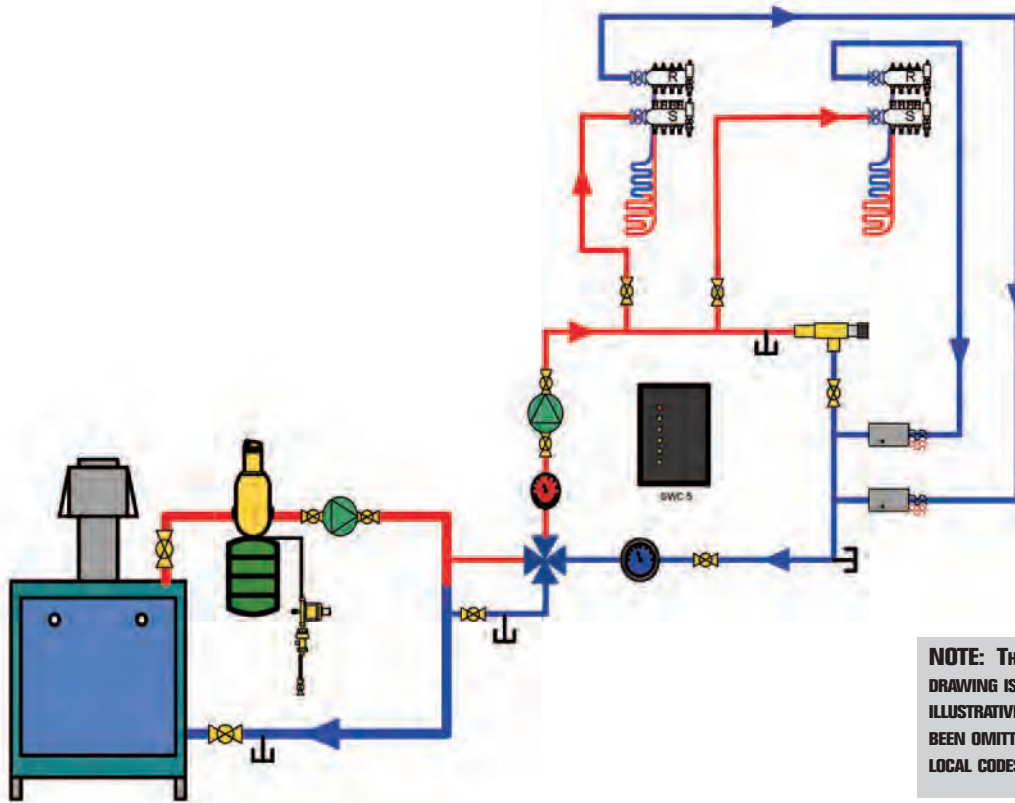
HEADLOSS/100 FT AT 140 °F								
GMP	with 50% Propylene Glycol				with Water			
	3/8" PEX/BPEX	1/2" PEX/BPEX	3/4" PEX/BPEX	1" PEX/BPEX	3/8" PEX/BPEX	1/2" PEX/BPEX	3/4" PEX/BPEX	1" PEX/BPEX
0.10	0.41	0.10	0.02	0.01	0.29	0.07	0.01	0.00
0.20	1.37	0.32	0.06	0.02	0.96	0.23	0.04	0.01
0.30	2.79	0.65	0.13	0.04	1.95	0.46	0.09	0.03
0.40	4.61	1.08	0.21	0.06	3.23	0.76	0.15	0.04
0.50	6.82	1.60	0.31	0.09	4.78	1.12	0.22	0.07
0.60	9.38	2.20	0.43	0.13	6.57	1.54	0.30	0.09
0.70	12.28	2.88	0.53	0.17	8.60	2.02	0.39	0.12
0.80	15.51	3.64	0.70	0.21	10.87	2.55	0.49	0.15
0.90	19.06	4.47	0.87	0.26	13.36	3.13	0.61	0.16
1.00	22.92	5.37	1.04	0.32	16.06	3.77	0.73	0.22
1.20	31.54	7.39	1.43	0.44	22.10	5.18	1.00	0.31
1.40	41.31	9.68	1.88	0.57	28.94	6.78	1.31	0.40
1.60	52.18	12.23	2.37	0.72	36.56	8.57	1.66	0.51
1.80	64.13	15.03	2.91	0.89	44.93	10.53	2.04	0.62
2.00	77.11	18.08	3.50	1.07	54.02	12.67	2.45	0.75
2.20	91.11	21.36	4.14	1.26	63.83	14.96	2.90	0.88
2.40		24.87	4.82	1.47		17.43	3.38	1.03
2.60		28.61	5.55	1.69		20.05	3.88	1.16
2.80		32.57	6.31	1.92		22.82	4.42	1.35
3.00		36.75	7.12	2.17		25.75	4.99	1.52
3.20		21.15	7.97	2.43		28.83	5.59	1.70
3.40		45.75	8.87	2.70		32.06	6.21	1.89
3.80		55.59	10.77	3.28		38.94	7.55	2.30
4.20		66.23	12.83	3.91		46.40	8.99	2.74
4.60			15.05	4.58			10.54	3.21
5.00			17.41	5.30			12.20	3.71
5.40			19.92	6.06			13.96	4.25
5.80			22.58	6.87			15.82	4.81
6.20			25.37	7.72			17.78	5.41
6.60			28.31	8.61			19.83	6.03
7.00			31.38	9.55			21.98	6.69
7.40			34.58	10.52			24.23	7.37
7.80			37.92	11.54			26.57	8.08
8.60				13.69				9.59
9.40				15.99				11.21
10.20	Velocity rate exceeds 8 feet per second			18.45	Velocity rate exceeds 8 feet per second			12.93
11.00				21.06				14.75
11.80				23.81				16.68
12.60				26.71				18.71
13.40				29.74				20.84
14.20				32.92				23.06

(For pressure drop, divide head loss by 2.31)














FRICITION LOSS CHART
(FEET OF WATER PER 100 FT.)
FOR COPPER PIPE



NON-CONDENSING BOILER MULTI-ZONE WITH 4-WAY MIXING VALVE

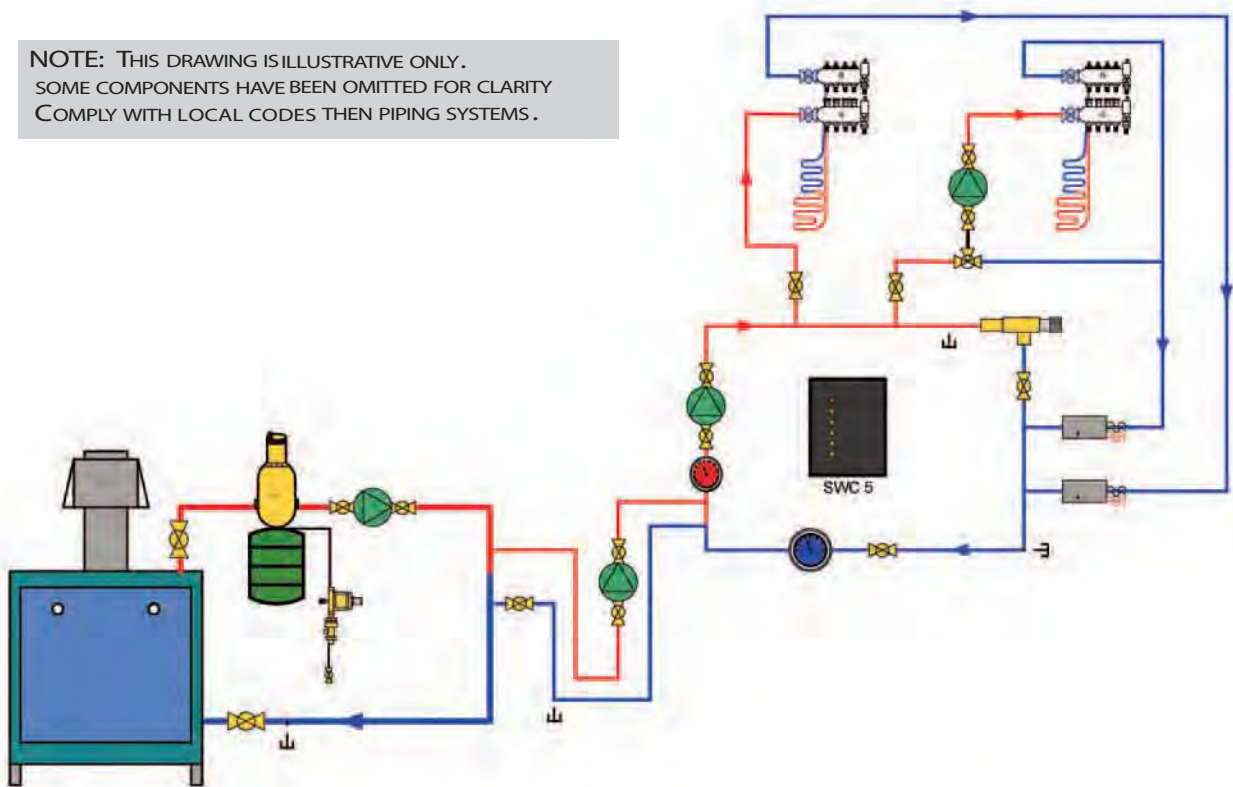















NOTE: THIS DRAWING IS ILLUSTRATIVE ONLY. SOME COMPONENTS HAVE BEEN OMITTED FOR CLARITY. COMPLY WITH LOCAL CODES WHEN PIPING SYSTEMS.

- | | | | | | | | |
|---|---------------------------|---|--------------------------------|---|--------------------|---|--------------------|
|  | Discal Air Separator |  | Pump with Isolation Flanges |  | Zone Valve |  | 3-Way Mixing Valve |
|  | Expansion Tank |  | Temperature/Pressure Indicator |  | Boiler Drain Valve |  | SWC 5 Control Box |
|  | Fill/backflow Combination |  | Thermometer w/ well |  | 4-Way Mixing Valve | | |
|  | Ball Valve |  | Pressure Differential Bypass | | | | |

NON-CONDENSING BOILER MULTI-ZONE WITH VARIABLE SPEED INJECTION PUMP

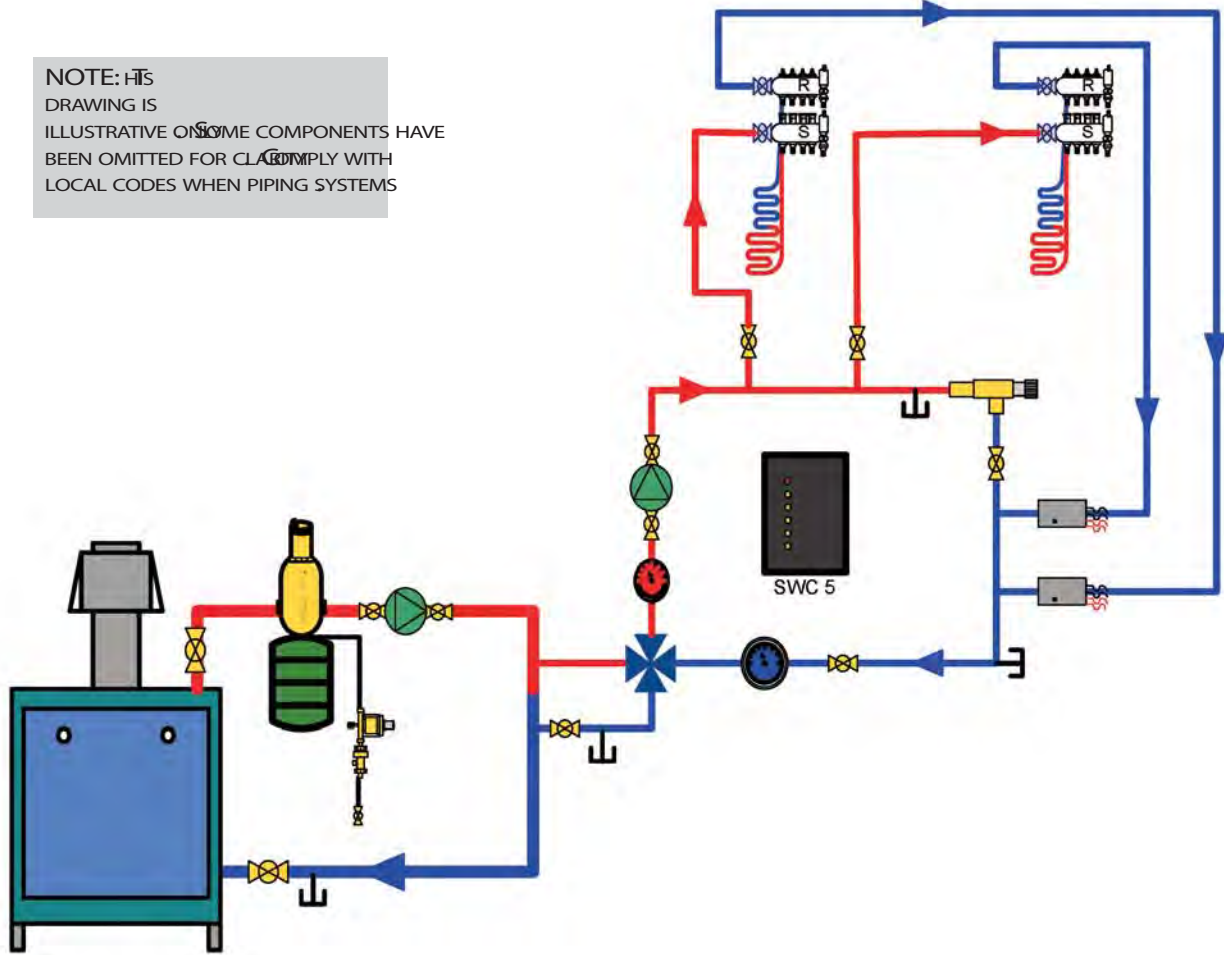
NOTE: THIS DRAWING IS ILLUSTRATIVE ONLY.
SOME COMPONENTS HAVE BEEN OMITTED FOR CLARITY
COMPLY WITH LOCAL CODES THEN PIPING SYSTEMS.















- | | | | | | | | |
|---|---------------------------|---|---------------------------------|--|--------------------|---|--------------------|
|  | Discal Air Separator |  | Pump with Isolation Flanges |  | Zone Valve |  | 3-Way Mixing Valve |
|  | Expansion Tank |  | Temperature/ Pressure Indicator |  | Boiler Drain Valve |  | SWC 5 Control Box |
|  | Fill/backflow Combination |  | Thermometer w/ well |  | 4-Way Mixing Valve | | |
|  | Ball Valve |  | Pressure differential by-pass | | | | |

NON-CONDENSING BOILER
 MULTI-ZONE WITH 4-WAY MIXING VALVE
 AND 3-WAY MIXING VALVE SUB-ZONE

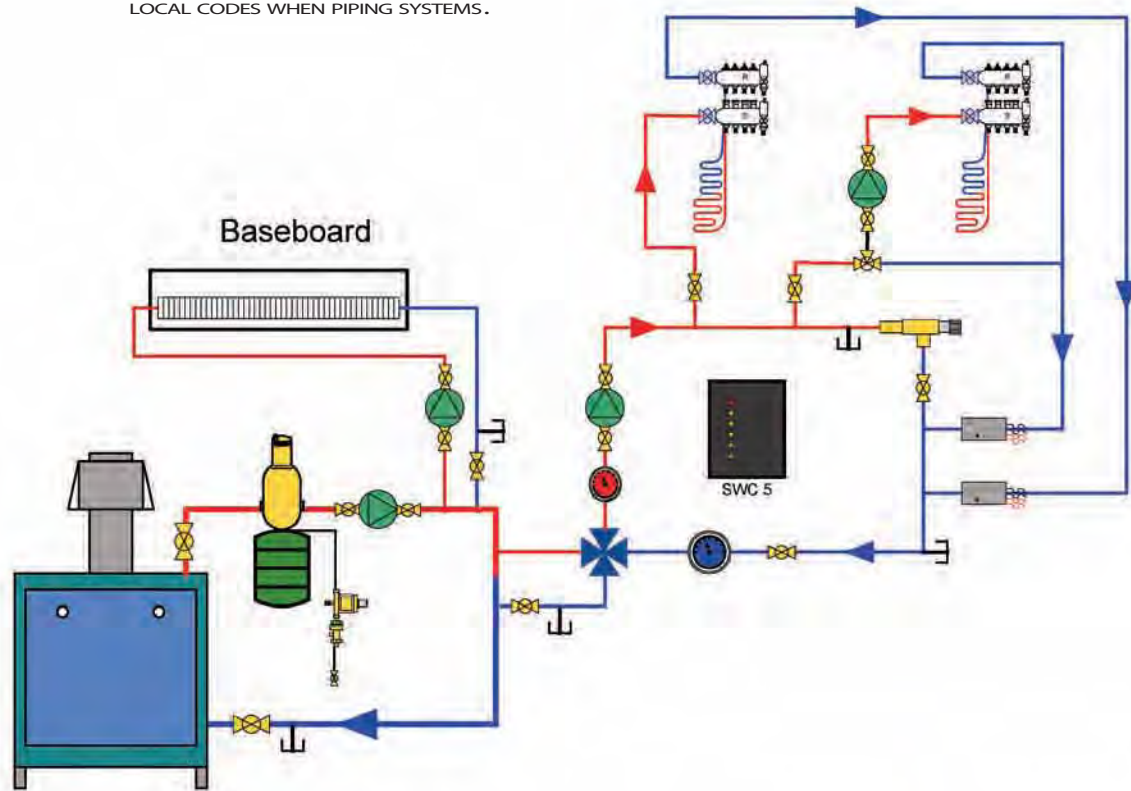
NOTE: THIS DRAWING IS ILLUSTRATIVE ONLY. SOME COMPONENTS HAVE BEEN OMITTED FOR CLARITY. COMPLY WITH LOCAL CODES WHEN PIPING SYSTEMS
















- | | | | | | |
|---|---------------------------|---|--------------------------------|---|--------------------|
|  | Discal Air Separator |  | Pump with Isolation Flanges |  | Zone Valve |
|  | Expansion Tank |  | Temperature/Pressure Indicator |  | Boiler Drain Valve |
|  | Fill/backflow Combination |  | Thermometer w/ well |  | SWC 5 Control Box |
|  | Ball Valve |  | Pressure differential by-pass |  | 4-Way Mixing Valve |

NON-CONDENSING BOILER HIGH/LOW TEMP ZONES WITH 4-WAY MIXING VALVE

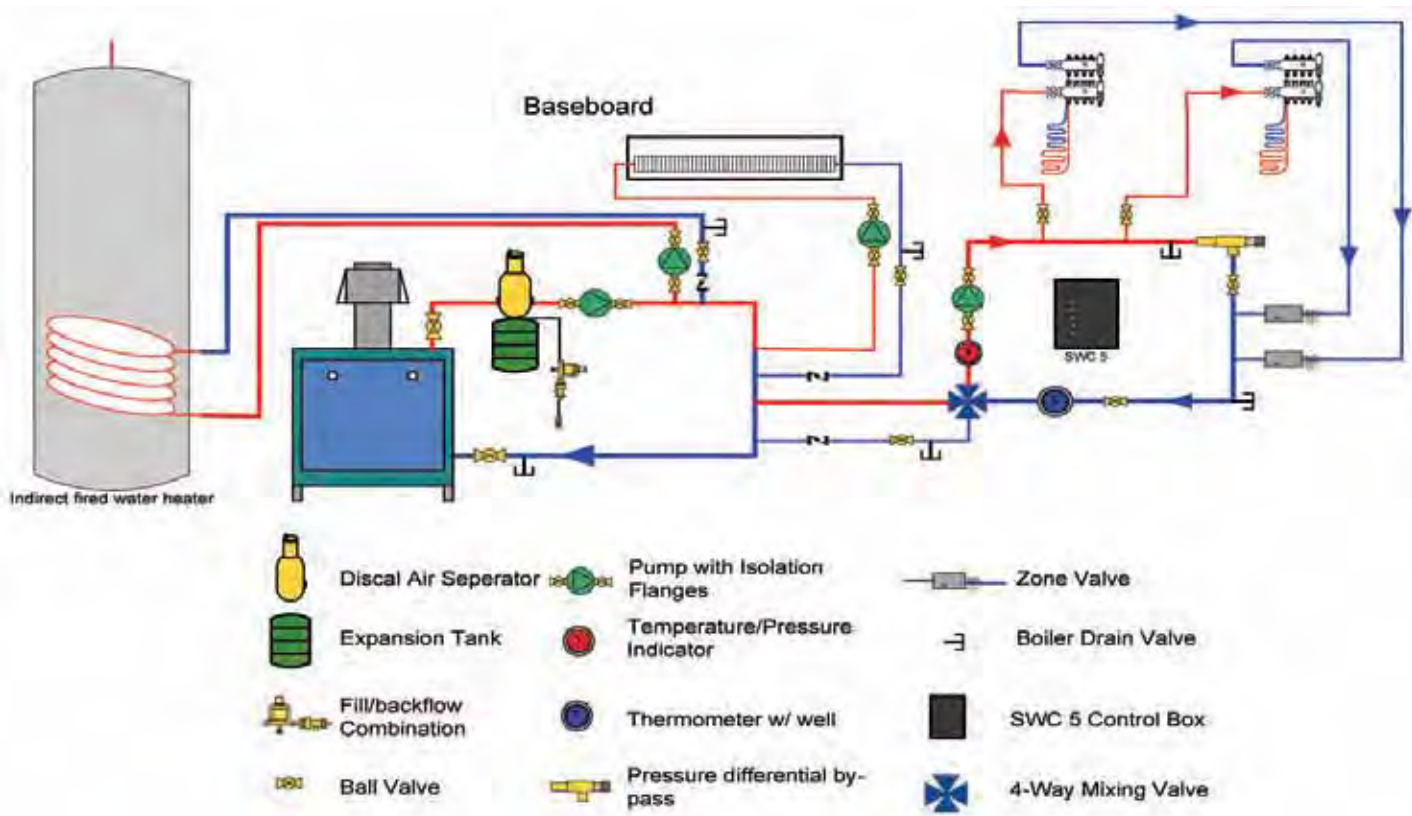
NOTE: THIS DRAWING IS ILLUSTRATIVE ONLY. SOME COMPONENTS HAVE BEEN OMITTED FOR CLARITY. COMPLY WITH LOCAL CODES WHEN PIPING SYSTEMS.



- | | | | | | | | |
|---|---------------------------|---|--------------------------------|--|--------------------|---|--------------------|
|  | Discal Air Separator |  | Pump with Isolation Flanges |  | Zone Valve |  | 3-Way Mixing Valve |
|  | Expansion Tank |  | Temperature/Pressure Indicator |  | Boiler Drain Valve |  | SWC 5 Control Box |
|  | Fill/backflow Combination |  | Thermometer w/ well |  | 4-Way Mixing Valve | | |
|  | Ball Valve |  | Pressure differential by-pass | | | | |

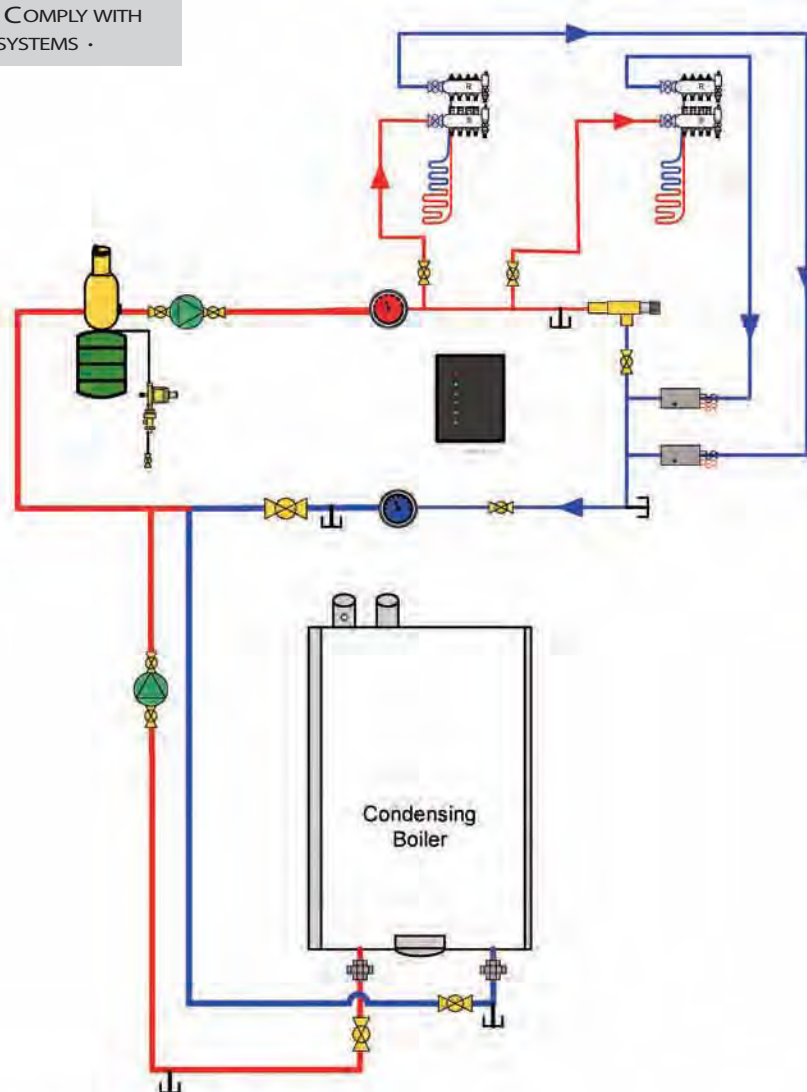
NON-CONDENSING BOILER HIGH/LOW TEMP ZONES AND DHW













NOTE: THIS DRAWING IS ILLUSTRATIVE ONLY. SOME COMPONENTS HAVE BEEN OMITTED FOR CLARITY. COMPLY WITH LOCAL CODES WHEN PIPING SYSTEMS.



CONDENSING HIGH-EFFICIENCY BOILER

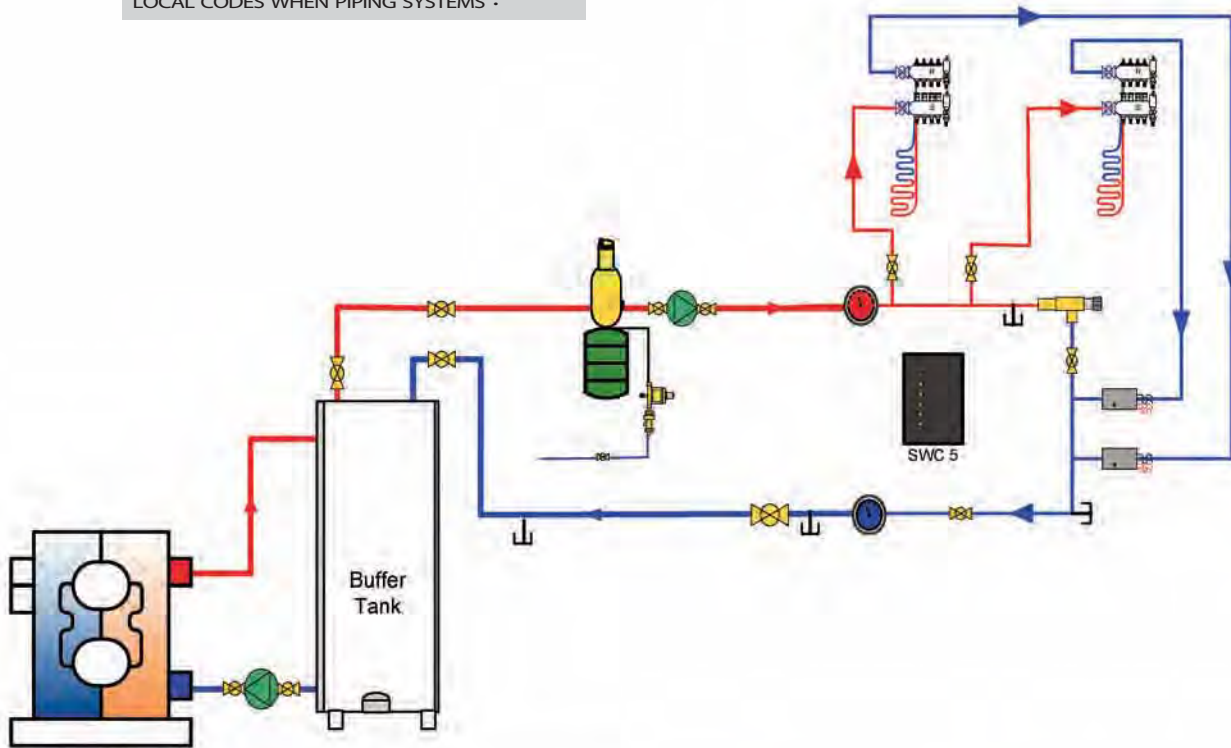
NOTE: THIS DRAWING IS ILLUSTRATIVE ONLY. SOME COMPONENTS HAVE BEEN OMITTED FOR CLARITY. COMPLY WITH LOCAL CODES WHEN PIPING SYSTEMS -



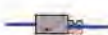












- | | | | | | |
|---|---------------------------|---|--------------------------------|---|--------------------|
|  | Discal Air Separator |  | Pump with Isolation Flanges |  | Zone Valve |
|  | Expansion Tank |  | Temperature/Pressure Indicator |  | Boiler Drain Valve |
|  | Fill/backflow Combination |  | Thermometer w/ well |  | SWC 5 Control Box |
|  | Ball Valve |  | Pressure differential by-pass |  | 4-Way Mixing Valve |

GROUND SOURCE HEAT PUMP MULTI-ZONE

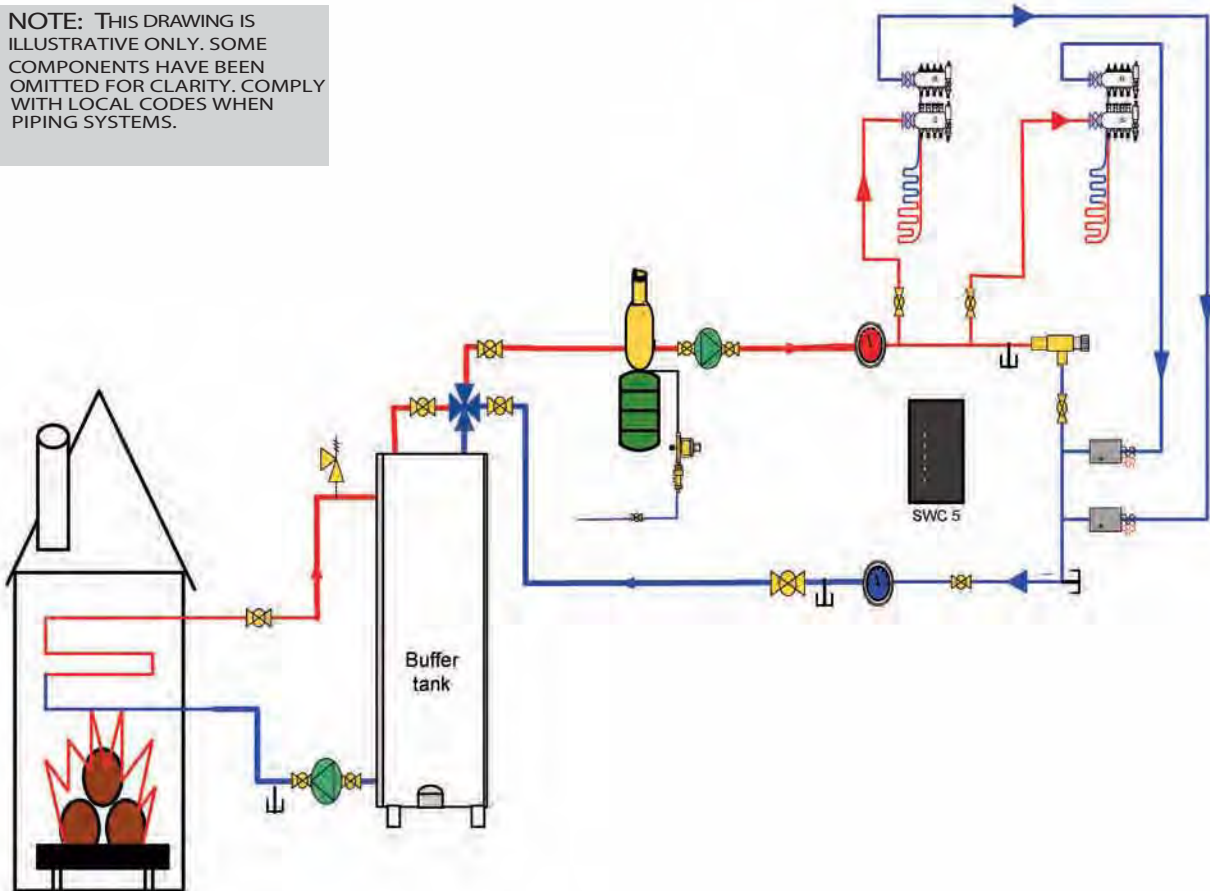
NOTE: THIS DRAWING IS ILLUSTRATIVE ONLY. SOME COMPONENTS HAVE BEEN OMITTED FOR CLARITY. COMPLY WITH LOCAL CODES WHEN PIPING SYSTEMS.
















- | | | | | | | | |
|---|---------------------------|---|--------------------------------|---|--------------------|---|--------------------|
|  | Discal Air Separator |  | Pump with Isolation Flanges |  | Zone Valve |  | 3-Way Mixing Valve |
|  | Expansion Tank |  | Temperature/Pressure Indicator |  | Boiler Drain Valve |  | SWC 5 Control Box |
|  | Fill/backflow Combination |  | Thermometer w/ well |  | 4-Way Mixing Valve | | |
|  | Ball Valve |  | Pressure differential by-pass | | | | |

WOOD/COAL BOILER MULTI-ZONE WITH 4-WAY MIXING VALVE

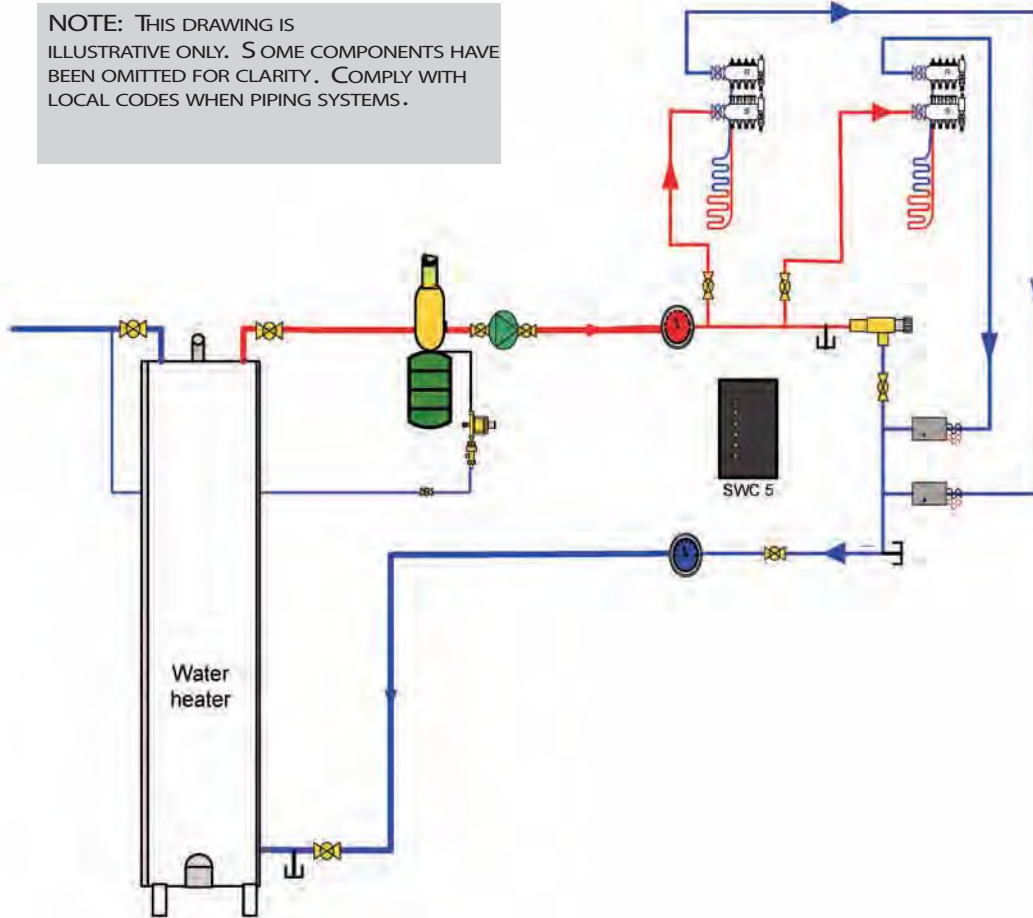
NOTE: THIS DRAWING IS ILLUSTRATIVE ONLY. SOME COMPONENTS HAVE BEEN OMITTED FOR CLARITY. COMPLY WITH LOCAL CODES WHEN PIPING SYSTEMS.















- | | | | | | | | |
|---|---------------------------|---|--------------------------------|--|--------------------|---|--------------------|
|  | Discal Air Separator |  | Pump with Isolation Flanges |  | Zone Valve |  | 3-Way Mixing Valve |
|  | Expansion Tank |  | Temperature/Pressure Indicator |  | Boiler Drain Valve | | |
|  | Fill/backflow Combination |  | Thermometer w/ well |  | SWC 5 Control Box | | |
|  | Ball Valve |  | Pressure differential by-pass |  | 4-Way Mixing Valve | | |

WATER HEATER CLOSED-LOOP MULTI-ZONE

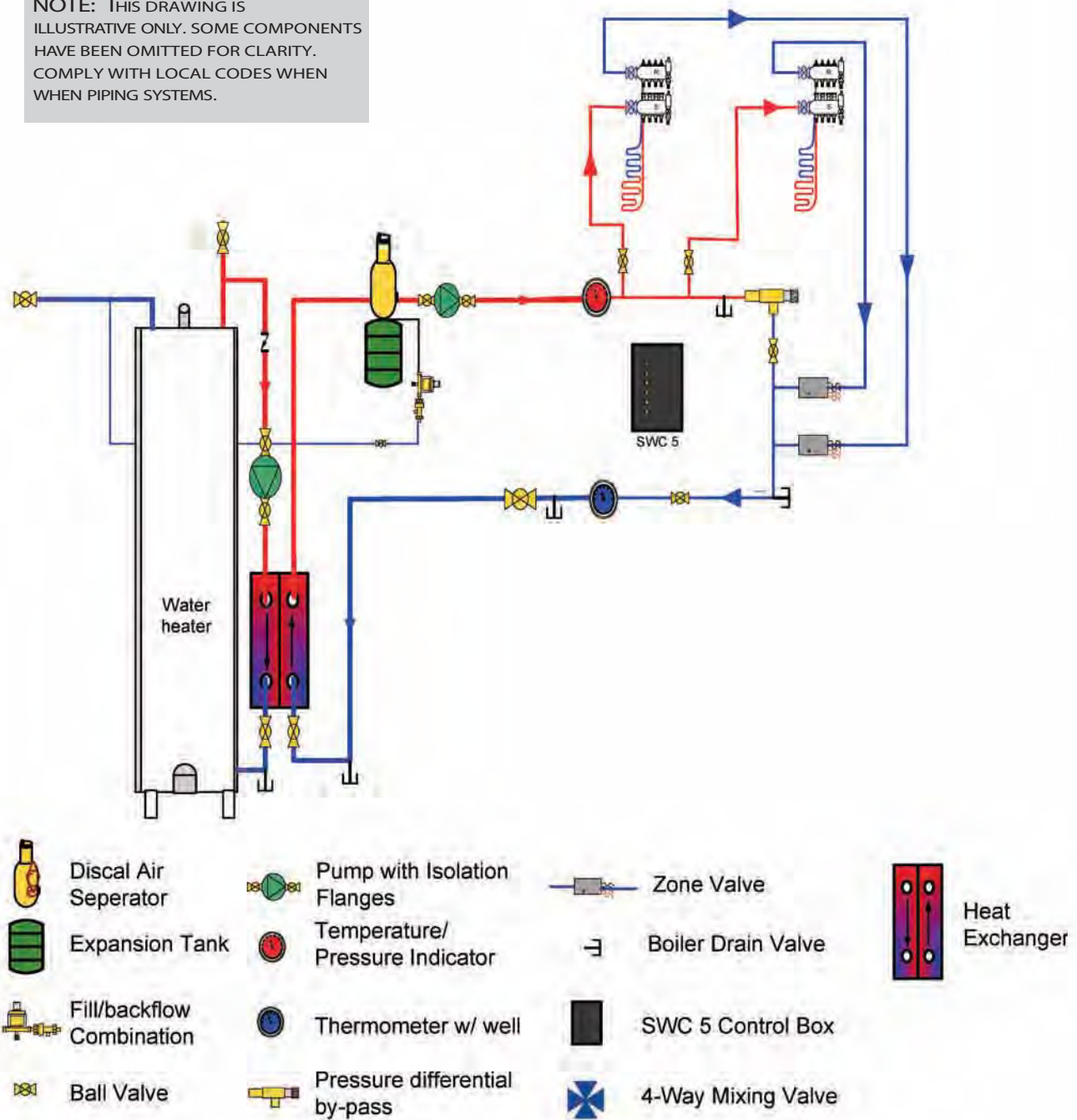
NOTE: THIS DRAWING IS ILLUSTRATIVE ONLY. SOME COMPONENTS HAVE BEEN OMITTED FOR CLARITY. COMPLY WITH LOCAL CODES WHEN PIPING SYSTEMS.



- | | | | | | |
|---|---------------------------|---|--------------------------------|--|--------------------|
|  | Discal Air Separator |  | Pump with Isolation Flanges |  | Zone Valve |
|  | Expansion Tank |  | Temperature/Pressure Indicator |  | Boiler Drain Valve |
|  | Fill/backflow Combination |  | Thermometer w/ well |  | SWC 5 Control Box |
|  | Ball Valve |  | Pressure differential by-pass |  | 4-Way Mixing Valve |

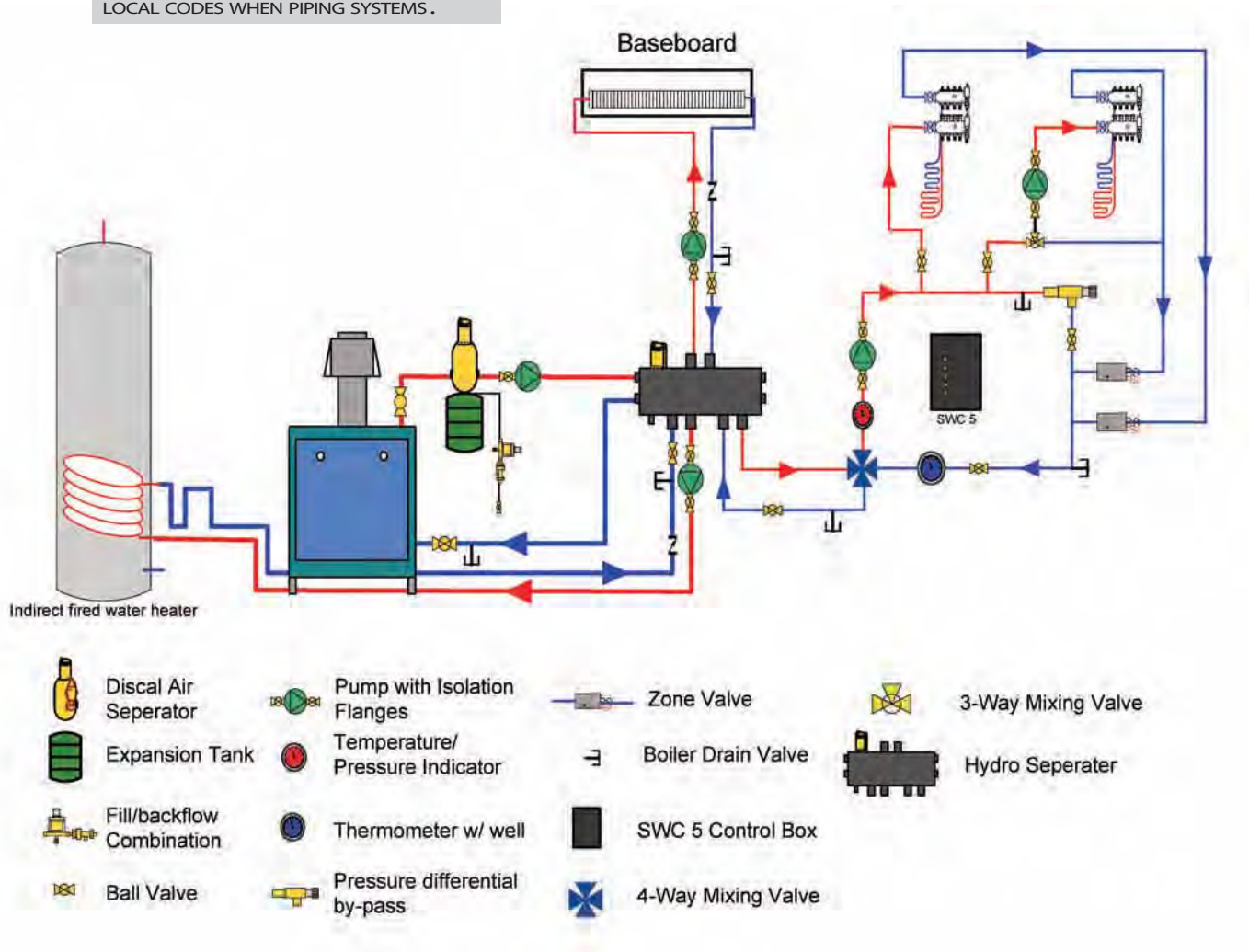
WATER HEATER HEAT-EXCHANGER MULTI-ZONE

NOTE: THIS DRAWING IS ILLUSTRATIVE ONLY. SOME COMPONENTS HAVE BEEN OMITTED FOR CLARITY. COMPLY WITH LOCAL CODES WHEN WHEN PIPING SYSTEMS.



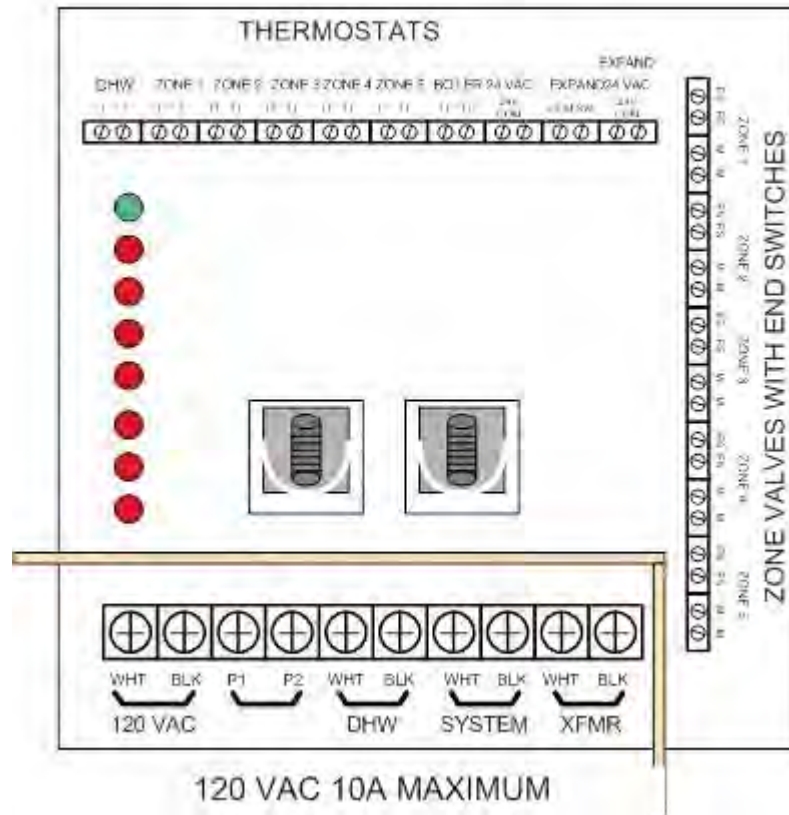
NON CONDENSING BOILER WITH HYDRO-LINK WITH, HIGH TEMP, LOW TEMP, SUB-ZONE MIXING, DHW, MULTI-ZONE

NOTE: THIS DRAWING IS ILLUSTRATIVE ONLY. SOME COMPONENTS HAVE BEEN OMITTED FOR CLARITY. COMPLY WITH LOCAL CODES WHEN PIPING SYSTEMS.

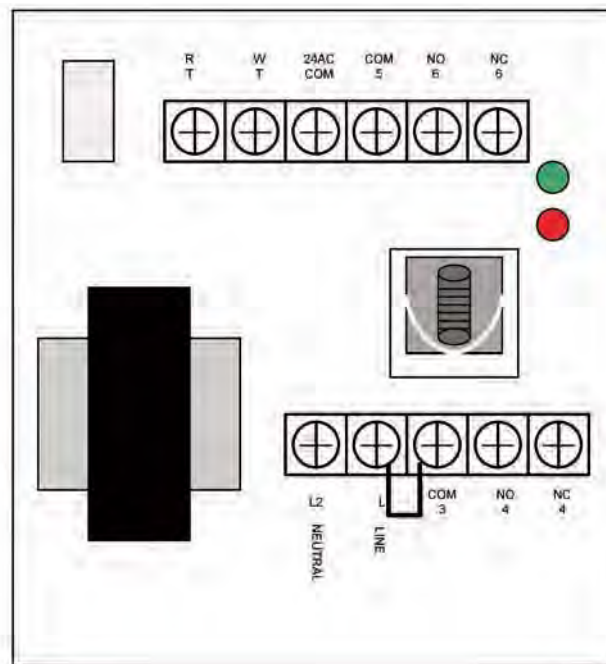


SWC 5 CONTROL BOX

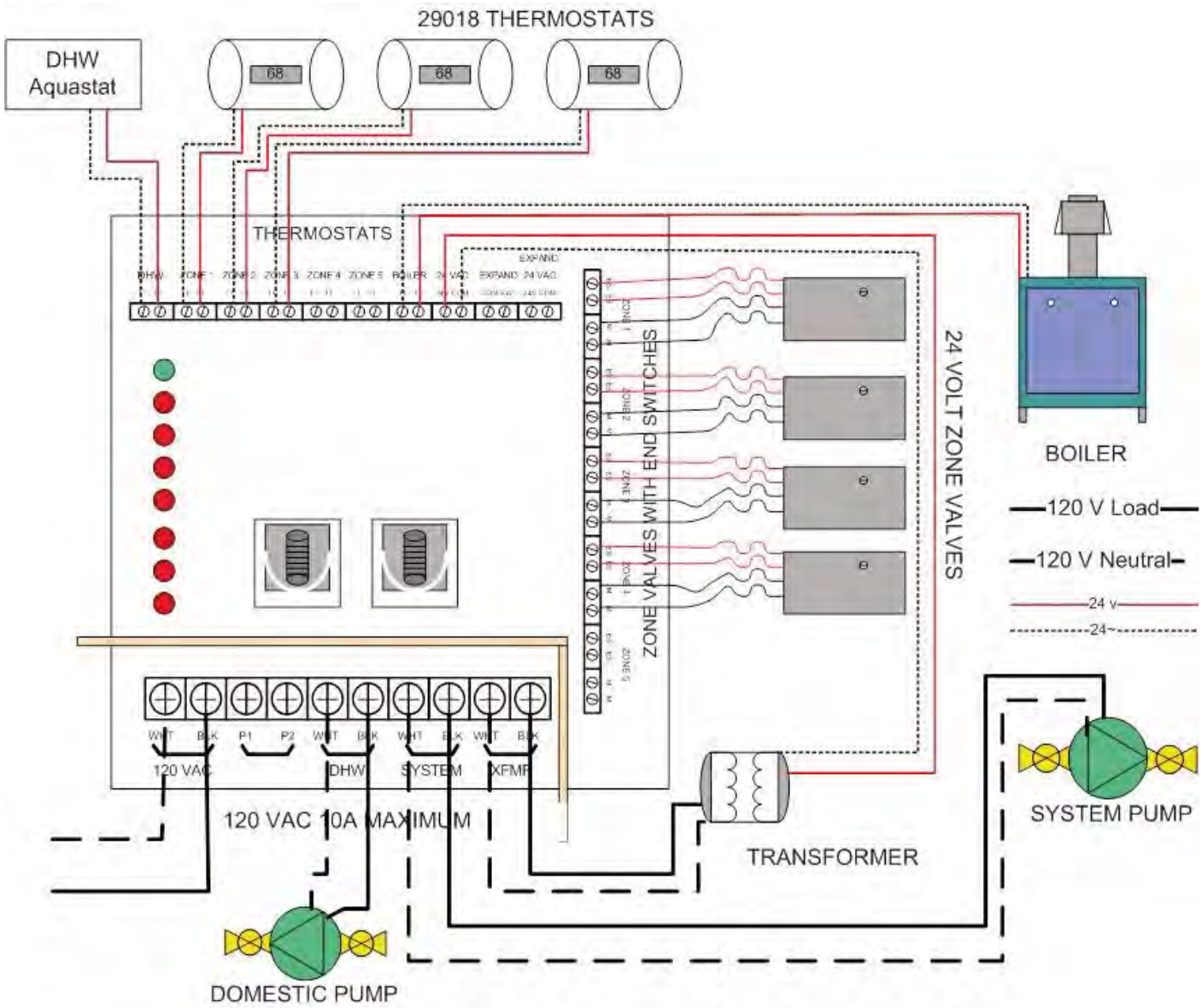
24 VAC CLASS 2 ONLY



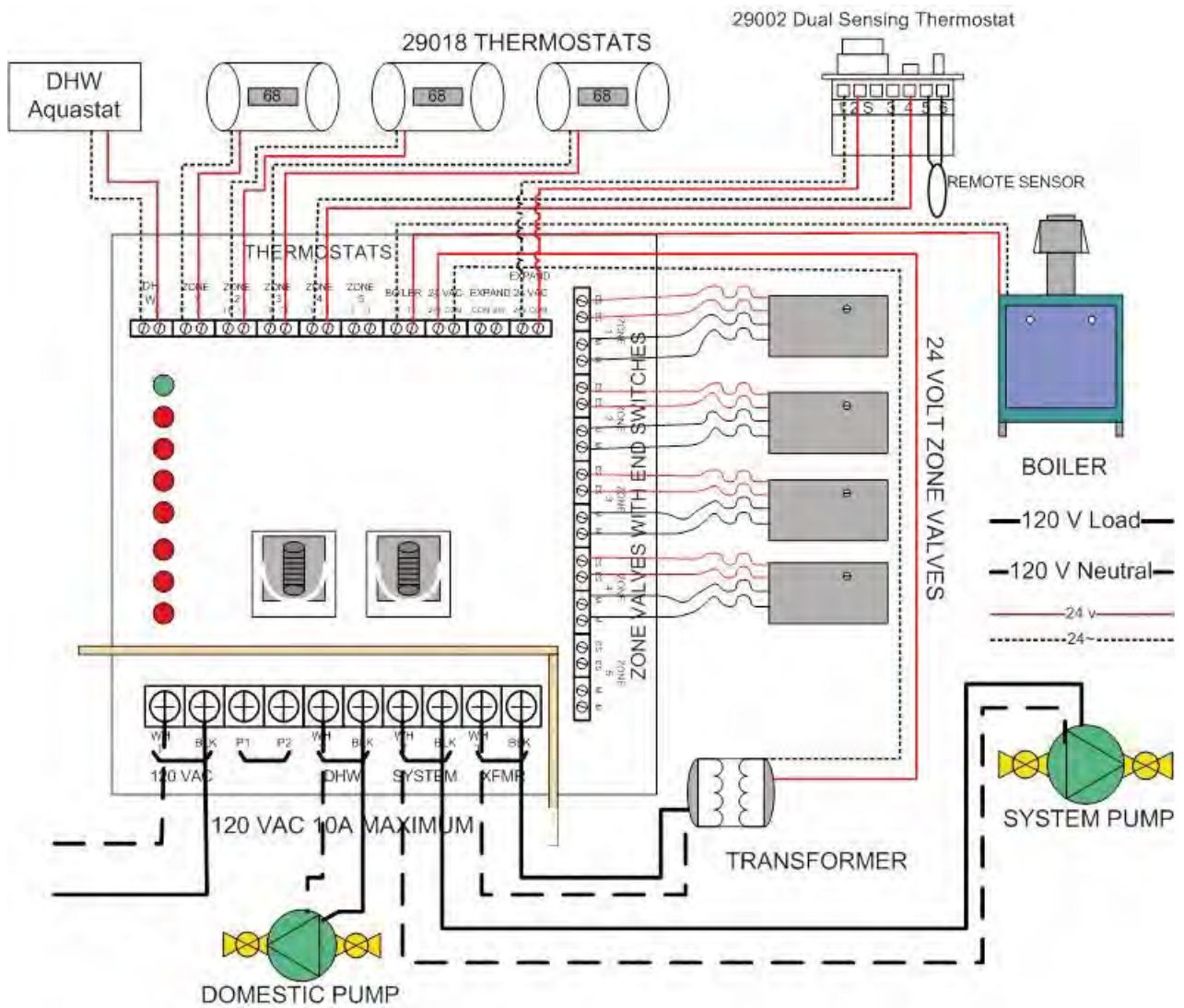
INFLOOR SINGLE ZONE SWITCHING RELAY



SWC-5 CONTROL BOX
WITH 29018 THERMOSTATS, DHW PUMP,
SECONDARY PUMP, AND BOILER



SWC-5 CONTROL BOX
WITH 29018 THERMOSTATS, WITH 29002 DUAL SENSING THERMOSTAT
DHW PUMP,
SECONDARY PUMP, AND BOILER



PRE-ASSEMBLED MECHANICAL BOARDS

Infloor offers 4 different styles of pre-piped and wired board configurations. All of these styles can range from 1 zone to 7 zone configurations for ease of installation and correct piping. Pipe sizing will vary based on the number of zones and required system flow rate.

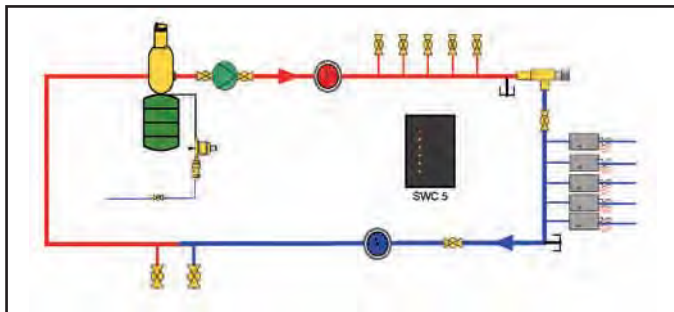
The first style is the Condensing Boiler Room Board, this board is configured to include; 2 closely spaced tees, air eliminator, fill/backflow preventer, expansion tank, system pump, from 1 to 7 supply side ball valves, pressure differential bypass, boiler drains, temperature / pressure indicator, return water temperature gauge, from 1 to 7 zone valves, and 1 to 2 SWC-5 zone valve control box. This style comes completely assembled and ready to pipe in primary loop circulator to closely spaced tees.

The second style is the Geo Thermal or Closed Loop Water Heater Board this board is configured to include; air eliminator, fill/backflow preventer, expansion tank, system pump, from 1 to 7 supply side ball valves, pressure differential bypass, boiler drains, temperature / pressure indicator, return water temperature gauge, from 1 to 7 zone valves, and 1 to 2 SWC-5 zone valve control boxes. This comes completely assembled, except the expansion tank, which is shipped separately.

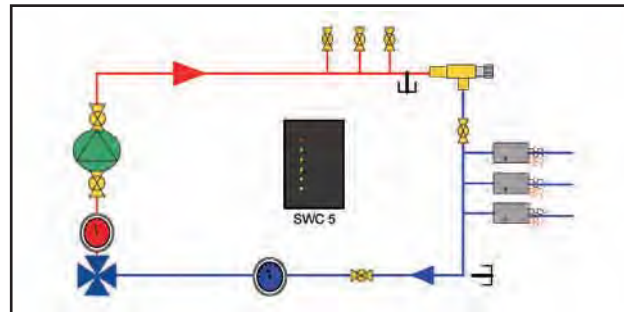
The third style is 4-Way Mixing Valve Board, this board is configured to include; system pump, from 1 to 7 supply side ball valves, pressure differential bypass, boiler drains, temperature / pressure indicator, return water temperature gauge, from 1 to 7 zone valves, and 1 to 2 SWC-5 zone valve control box. This board is designed, to be installed with a Primary Loop Board or installed in the primary loop where mixing is needed.

The fourth style is the Primary Loop Board, this board is configured to include; Hydro-link hydraulic separator, air eliminator, fill/backflow preventer, expansion tank, primary pump, Indirect-fired pump, temperature / pressure indicator, check valve, boiler drains, and attachment points for up to 2 secondary loops. This comes completely assembled, with exception of expansion tank shipped separately.

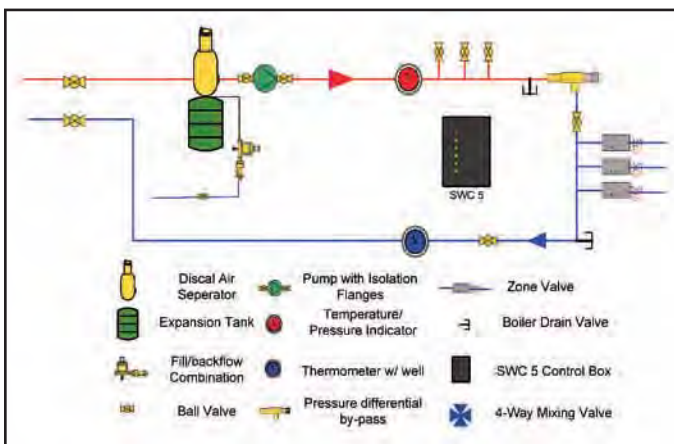
CONDENSING BOILER ROOM BOARD



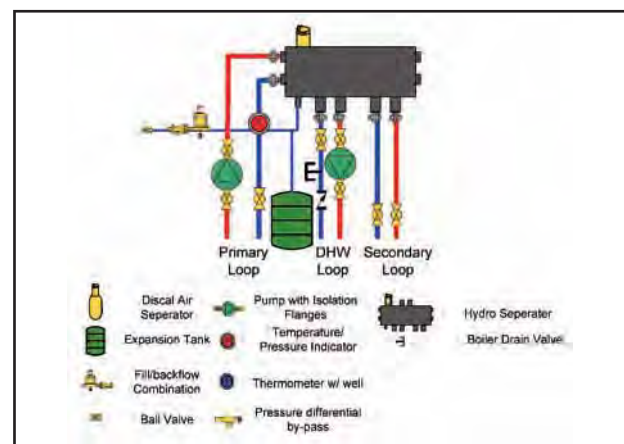
4- WAY MIXING VALVE BOARD



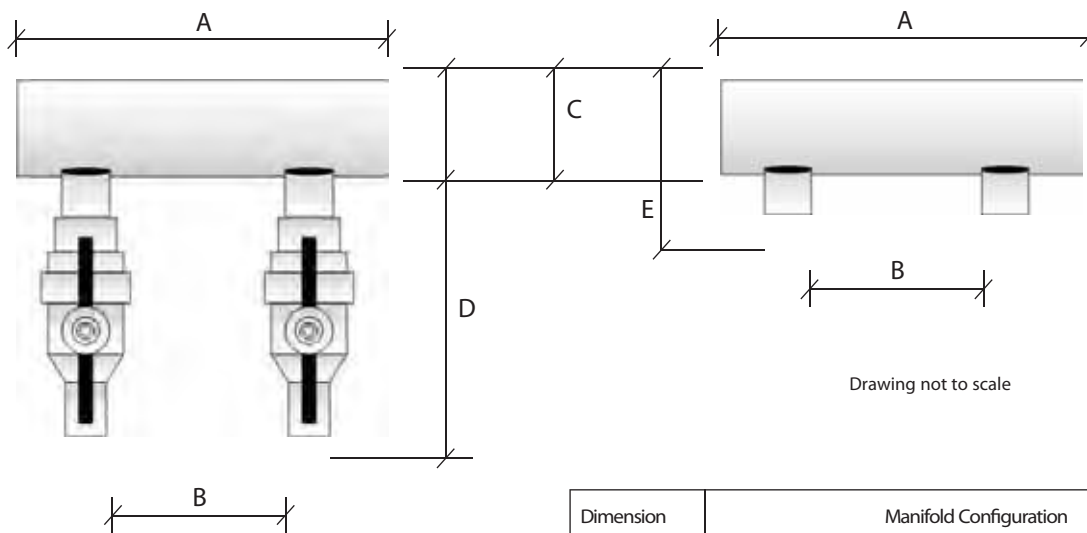
GEOTHERMAL OR CLOSED LOOP WATER HEATER BOARD



PRIMARY LOOP BOARD



COPPER MANIFOLD DIMENSIONS



Part #	Description (all outlets FSWT)
28100	2-Loop 1" x 1/2"
28101	2-Loop 1" x 1/2" w/cplg
28104	2-Loop 1" x 1/2" valve
28105	2-Loop 1" x 1/2" valve w/cplg
28125	3-Loop 1" x 1/2"
28126	3-Loop 1" x 1/2" w/cplg
28129	3-Loop 1" x 1/2" valve
28130	3-Loop 1" x 1/2" valve w/cplg
28200	2-Loop 1-1/4" x 1/2"
28201	2-Loop 1-1/4" x 1/2" w/cplg
28204	2-Loop 1-1/4" x 1/2" valve
28205	2-Loop 1-1/4" x 1/2" valve w/cplg
28225	3-Loop 1-1/4" x 1/2"
28226	3-Loop 1-1/4" x 1/2" w/cplg
28229	3-Loop 1-1/4" x 1/2" valve
28230	3-Loop 1-1/4" x 1/2" valve w/cplg
28250	2-Loop 1-1/4" x 3/4"
28251	2-Loop 1-1/4" x 3/4" w/cplg
28254	2-Loop 1-1/4" x 3/4" valve
28255	2-Loop 1-1/4" x 3/4" valve w/cplg
28275	3-Loop 1-1/4" x 3/4"
28276	3-Loop 1-1/4" x 3/4" w/cplg
28279	3-Loop 1-1/4" x 3/4" valve
28280	3-Loop 1-1/4" x 3/4" valve w/cplg
28300	2-Loop 1-1/2" x 3/4"
28301	2-Loop 1-1/2" x 3/4" w/cplg
28304	2-Loop 1-1/2" x 3/4" valve
28305	2-Loop 1-1/2" x 3/4" valve w/cplg
28325	3-Loop 1-1/2" x 3/4"
28326	3-Loop 1-1/2" x 3/4" w/cplg
28329	3-Loop 1-1/2" x 3/4" valve
28330	3-Loop 1-1/2" x 3/4" valve w/cplg
28350	5-Loop 1-1/2" x 3/4"
28351	5-Loop 1-1/2" x 3/4" w/cplg
28354	5-Loop 1-1/2" x 3/4" valve
28355	5-Loop 1-1/2" x 3/4" valve w/cplg

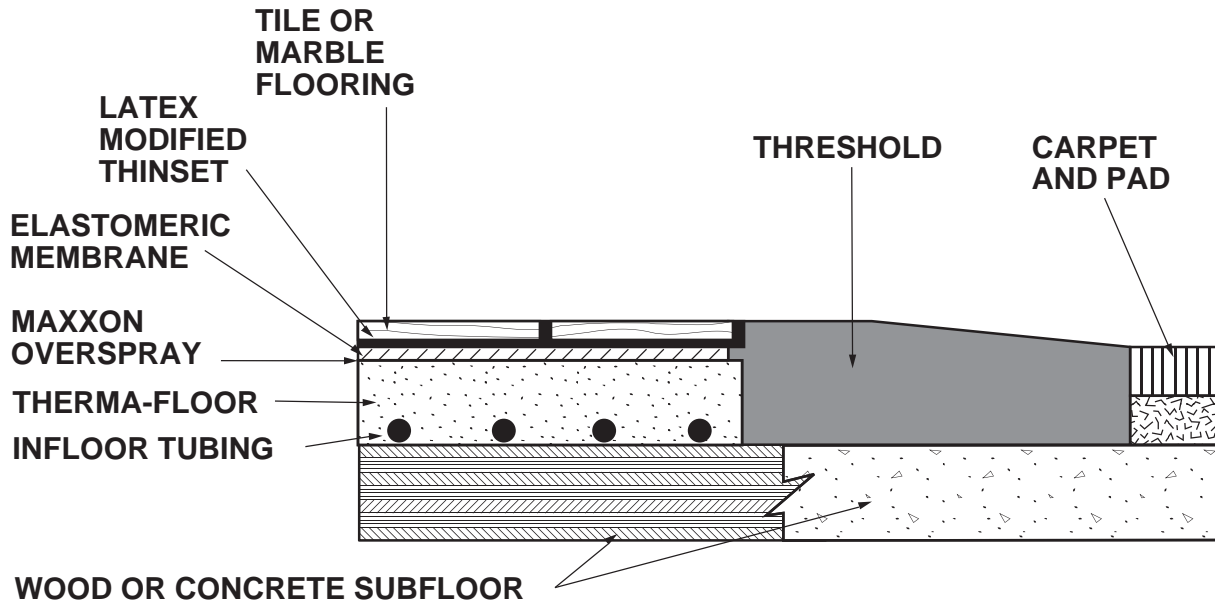
Dimension	Manifold Configuration			
	1" x 1/2"	1-1/4" x 1/2"	1-1/4" x 3/4"	1-1/2" x 3/4"
A	5-1/4"	6-3/8"	6-3/8"	7-1/8"
B	2-1/2"	3"	3"	3"
C	1"	1-1/4"	1-1/4"	1-1/2"
D	4"	4-1/4"	4-3/4"	5"
E	2"	2-1/8"	2-5/8"	2-7/8"
Add'l Loop w/Coupling	A + 2-1/2"	A + 3"	A + 3"	A + 3"
	A + 7/8"	A + 1-1/4"	A + 1-1/4"	A + 1-1/8"

Use these charts to determine size of the various copper manifold configurations. For example: to determine the size of a 5-loop 1-1/4" manifold with 3/4" ball valve outlets do the following:

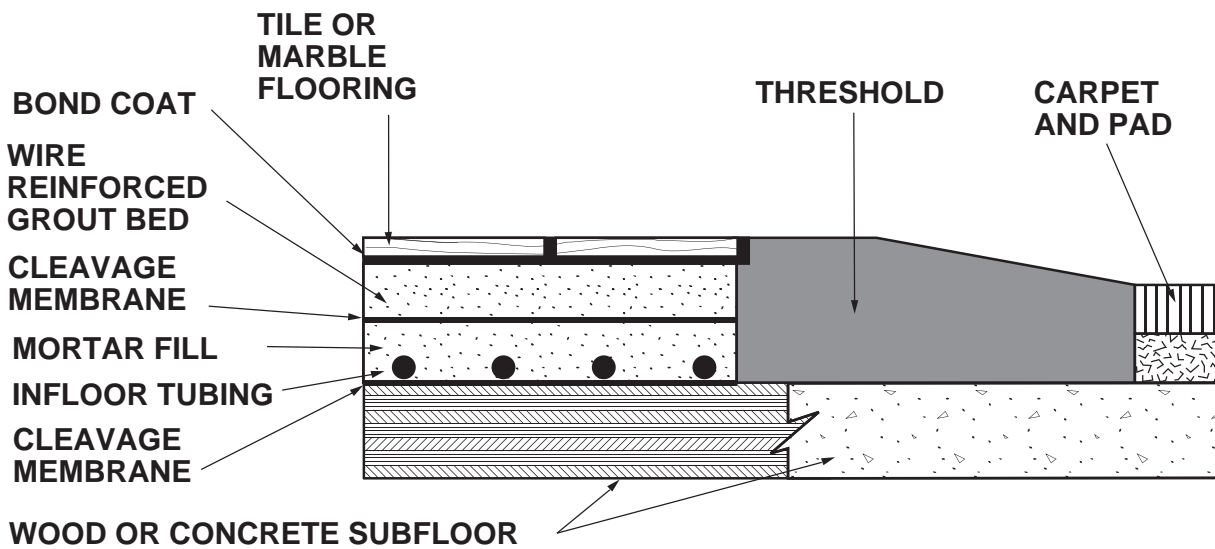
1. "A" dimension: 6-3/8"
2. "B" dimension: 3" on center
3. "C" dimension: 1-1/4" pipe size
4. "D" dimension: 4-3/4" top of mnfld to btm valve
5. "E" dimension: not applicable
6. "Add'l Loop: $A + (3 * 3") = 15-3/8"$
7. "w/Coupling: $15-3/8" + 1-1/8" = 16-1/2"$

NOTE ADD ANY ADDITIONAL LOOPS TO DETERMINE "A" DIMENSION BEFORE ADDING THE DIMENSION FOR THE COUPLING .

TRANSITION DETAIL FOR TILE WITH THERMA-FLOOR



TRANSITION DETAIL FOR TILE WITH MORTAR BED



DEFINITIONS

- ☒ British Thermal Unit (Btu) - A unit for measuring quantity of heat. It is approximately the heat required to raise the temperature of one pound of water one degree Fahrenheit.
- ☒ Btu per hour - A unit for measuring the rate of heat transfer.
- ☒ Conduction, thermal - Heat transfer through a material in which energy is transmitted from particle to particle without displacement of the particles.
- ☒ Convection - Heat transfer by movement of fluid. Natural convection is due to differences in density from temperature differences. Forced convection is produced by mechanical means.
- ☒ Degree day - A unit, based on temperature difference and time, used in estimating heating system energy consumption. For any one day for which the mean temperature is below 65 °F, the degree days for that day is the difference between 65 °F and the mean for that day. Degree days for any period is the sum of the degree days for each day in that period.
- ☒ Design temperature - The temperature an apparatus or a system is designed to maintain (inside design temperature) or operate against (outside design temperature) under the most extreme conditions to be satisfied. The difference between the inside and the outside design temperatures is the design temperature difference.
- ☒ Infiltration - Air flowing inward through a crack between the window and frame, or door and frame, or frame and wall, etc.
- ☒ Installed resistance, (R-) - The thermal resistance of insulation when applied according to the manufacturer's instructions in the building section that is described.
- ☒ Perm - The unit of measurement of permeance equal to 1 grain divided by (square feet x hour x inch of mercury vapor pressure difference).
- ☒ Permeance - The water vapor permeance of a material (or combination of materials between parallel surfaces) is the ratio of water vapor flow [grains divided by (square feet x hour)] to the vapor pressure difference (inches of mercury) between its surfaces.
- ☒ Radiation, thermal - The transmission of heat through space by wave motion. The passage of heat from one object to another without warming the space in between.
- ☒ Temperature - The thermal state of matter with reference to its tendency to communicate heat to matter in contact with it. If no heat flows upon contact, there is no difference in temperature.
- ☒ Thermal conductance, (C) - The number of heat units (Btu) that will pass through one square foot of nonuniform material in one hour for each degree of Fahrenheit temperature difference between the two surfaces of the material.
- ☒ Thermal conductivity (k) - The number of heat units (Btu) that will pass through one square foot of a uniform material one inch thick in one hour for each degree of Fahrenheit temperature difference between the two surfaces of the material.
- ☒ Thermal resistance, (R) - The ability of a material or combination of materials to retard or resist the flow of heat. It is the reciprocal of "U".
- ☒ Thermal resistivity, (r) - The ability of a unit thickness of a uniform material to retard or resist the flow of heat. It is the reciprocal of thermal conductivity (l/k).

- ☒ Transmission - A general term for heat travel (by conduction, convection, radiation, or any combination thereof) in thermal load calculations.

- ☒ "U" (Overall coefficient of heat transfer) - The amount of heat flow, expressed in Btu per hour x square feet x degree Fahrenheit temperature difference, between the air on the inside and the air on the outside of a building section (wall, floor, roof or ceiling). The term is applied to combinations of materials, and also to single materials, such as window glass, and includes the surface conductance on both sides. This term is frequently called the "U value". (For conversion, $U = 3.413W$)

- ☒ Vapor barrier - A material which retards the transmission of water vapor. (Permeance not more than 1 perm.)

- ☒ Ventilation - The process of supplying or removing air, naturally or mechanically, to or from any space.

- ☒ "W" - The U factor converted into electrical terms for calculations for electric heating. It is the amount of heat flow, expressed in watts per square foot x degree Fahrenheit temperature difference, between the air on the inside and the air on the outside of a building section (wall, floor, roof or ceiling). (For conversion, $W = 0.293 U$)

- ☒ Watt - The rate of flow of electrical energy (not the quantity, but the rate.) One watt is equivalent to 3.413 Btu/hr.

SECTION 15770
 (Manifold Version)
 HEAT TRANSFER UNITS
 RECOMMENDED SPECIFICATION FOR
 HYDRONIC INFLOOR HEATING SYSTEMS WITH CROSS-LINKED POLYETHYLENE BARRIER/NON-BARRIER TUBING AS THE EQUIPMENT FOR RESIDENTIAL/LIGHT COMMERCIAL RADIANT FLOOR HEATING

PART 1 GENERAL

1.01 SUMMARY

- A. Conditions of the Contract: The Conditions of the Contract (General, Supplementary and other Conditions) and the General Requirements (sections of Division 1) govern the provisions of this section. The articles contained in this section may modify, delete or add to the provisions of the Conditions of the Contract.

1.02 SECTION INCLUDES

- A. Infloor manifold
- B. Infloor tubing
- C. Primary boiler loop and circulating pump
- D. System treatment
- E. Therma-Floor underlayment

1.03 SUBMITTALS

- A. Product Data: Provide for manufactured products and assemblies including installation recommendations and rough-in dimensions.
- B. Operating and Maintenance Instructions: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts description.

1.04 WARRANTY

- A. Provide twenty-five (25) year manufacturer's warranty for Infloor tubing and one (1) year manufacturer's warranty for Infloor components.

1.05 QUALITY ASSURANCE

- A. Installer's Qualifications: Installation of Infloor Heating System shall be by a trained Infloor dealer authorized by Infloor Inc.
- B. Pressure Test: Provide hydrostatic test of primary loop, manifolds, and tubing to 100 psi (689.5 kPa) for 30 minutes.

1.06 DELIVERY AND STORAGE HANDLING

- A. General Requirements: Materials shall be delivered in their original, unopened packages, and protected from exposure to the elements. Damaged or deteriorated materials shall be removed from the premises.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Infloor manifold: Furnish and install a complete radiant heating system that includes modular copper manifolds containing supply and return outlets with balancing adjustment for each circuit. Balance each circuit to maintain even temperature in spaces. Infloor manifolds as furnished by Infloor Inc., Buena Vista, CO.

- B. Infloor tubing: Radiant tubing shall be _____ (Choose one of the following: Infloor barrier cross-linked polyethylene [BPEX, 3/8" {10 mm} or 1/2" {13 mm}], or Infloor cross-linked polyethylene [PEX, 3/8" {10 mm} or 1/2" {13 mm}]). Tubing to be furnished by Infloor Inc, Buena Vista, CO and is to be installed in complete accord to manufacturer's instructions.

1. Infloor barrier cross-linked polyethylene (BPEX) as provided by Infloor Inc, Buena Vista, CO: nominal 3/8" (inch) [10 mm] inside diameter with an nominal 1/2" (inch) [13 mm] outside diameter with a wall thickness of 0.059" (inch) [1.5 mm],

rated for 100 psig (689.5 kPa) at 180 degrees F (82.2 degrees C) with an external ethylene vinyl alcohol (EVOH) oxygen diffusion barrier allowing no more than 0.1 gram per cubic meter per day (0.1g/m³/d). Individual circuit length to be up to 300' (feet) [90 m] maximum.

2. Infloor barrier cross-linked poly ethylene (BPEX) as provided by Infloor Inc. , Buena Vista, CO:

nominal 1/2" (inch) [13 mm] inside diameter with an nominal 5/8" (inch) [16 mm] outside diameter with a wall thickness of 0.059" (inch) [1.5 mm], rated for 100 psig (689.5 kPa) at 180 degrees F (82.2 degrees C) with an external ethylene vinyl alcohol (EVOH) oxygen diffusion barrier allowing no more than 0.1 gram per cubic meter per day (0.1g/m³/d). Individual circuit length to be up to 300' (feet) [90 m] maximum.

3. Infloor cross-linked polyethylene (PEX) as provided by Infloor Inc. ,

Buena Vista, CO: nominal 3/8" (inch) [10 mm] inside diameter with an nominal 1/2" (inch) [13 mm] outside diameter with a wall thickness of 0.059" (inch) [1.5 mm], rated for 100 psig (689.5 kPa) at 180 degrees F (82.2 degrees C). Individual circuit length to be up to 300' (feet) [90 m] maximum.

4. Infloor cross-linked polyethylene (PEX) as provided by Infloor Inc. ,

Buena Vista, CO: nominal 1/2" (inch) [12.7 mm] inside diameter with an nominal 5/8" (inch) [15.87 mm] outside diameter with a wall thickness of 0.062" (inch) [1.575 mm], manufactured in accordance with ASTM standard D-3309 and rated for 100 psi (689.5 kPa) at 180 degrees F (82.2 degrees C). Individual circuit length to be up to 300' (feet) [90 m] maximum.

- C. Primary boiler loop and circulating pump: Primary circulating loop shall be supplied by others with sufficient system water flow to provide boiler supply temperature between 140 degrees F (60.0 degrees C) to 180 degrees F (82.2 degrees C) ,unless using condensing boiler or water heater,with a 20 degree F (11 degree C) maximum temperature drop between primary loop supply and return piping.

- D. System Treatment: Install

_____ (Choose one of the following: Formula 10 _____, or Infloor System Treatment.)

1. Formula 10, a silicate-based corrosion inhibitor in concentration of one (1) quart [0.95 liter] treatment per fifty (50) gallons [190 liters] water as provided by Infloor Inc. , Buena Vista,

CO NOTE: Not to be used with glycol additives.

2. Infloor system treatment, a borate-nitrite corrosion inhibitor in concentration of 1400 ppm (one [1] gallon {3.8 liters} treatment per fifty [50] gallons {189.3 liters} water) as provided by Infloor Inc. ,

Buena Vista, CO

- E. Therma-Floor Underlayment: Floor underlayment shall be Therma-Floor by Maxxon Corporation, Hamel, MN (see section 03540)

END OF SECTION



INFLOOR
HEATING SYSTEMS



RESIDENTIAL



SNOW & ICE MELT



COMMERCIAL

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