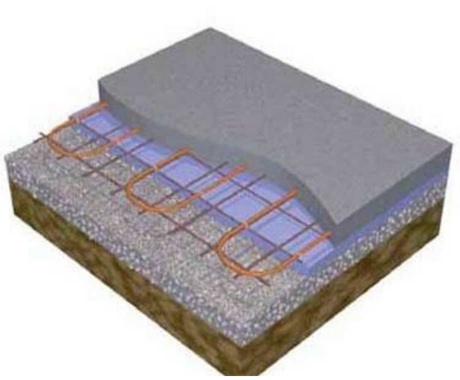
Installation Guide

Snowmelting

A better approach to snowmelting systems



Radiant Heating and Snowmelting products

ComfortPro Systems

AquaHeat

Snowmelting Systems

General Overview

ComfortPro Systems combines the most advanced pex pipe technologies with time proven distribution and control options helping to design, construct, and deliver outdoor radiant applications promoting safety, security, accessibility, reliability, and extended surface wear life.

Applications include sidewalks and access ramps, loading docks and stairwells, parking lots and garages, aircraft storage and landing pads, vestibules and causeways, bridges and catwalks, quarry and mining roads, or any area that is difficult or inconvenient to maintain using conventional snow and ice removal methods.

Chemicals ordinarily used to melt ice and snow not only damage pavement surfaces but surrounding landscapes requiring replacement each spring. This savings may be combined with reduced liability insurance premiums, indoor floor cleaning and maintenance, carpet service and replacement, and other costs related to the corrosive nature of these agents.

Properly designed snow and ice melt systems require low temperature supply water that may already be present in existing heating systems in the form of residual or waste heat. Many agricultural and industrial sites produce waste gases which must be burned as part of a required remediation process.

Snow melting systems must be very carefully designed. Whether you are doing residential or commercial snow melting, the specific project objective must be considered during the design phase. Factors to consider; outdoor temperature, wind speed, area to be melted, local climate, rate of removal, cost of operation, and local codes. No area is too small or too large to be snow melted! It is essential for each project to be engineered to meet the specific requirements for the geographical area and the project's objective in rate of snow removal.

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Project Considerations

GROUND INSULATION IS IMPERATIVE: Insulation should be used underneath all areas, not for energy conservation (it does not substantially reduce the load)! What it does, it decouples the slab from the earth underneath. The benefits are: reduced back losses and warm up time, and quicker melting once the system is started. It is important to use ridgid structural insulating material (blue) to support the slab that is not affected by moisture.

SnowMelting Performance Chart

Outdoor Temp.	Wind Speed	System Flowrate	Required Supply Temp.*	1000 sq. ft. req. /input*
(°F)	(mph)	(US gpm)	(°F)	(Btu/h)
14 ° F	0	6.4	92	72,000
- 10 ° C	5	9.0	110	100,000
	10	11.5	128	128,000
5 ° F	0	7.0	97	80,000
- 15 ° C	5	10.4	120	118,000
	10	13.8	144	156,000
-4 ° F	0	7.7	101	87,000
- 20 ° C	5	11.9	130	133,000
	10	16.1	160	184,000
- 13 ° F	0	8.3	105	94,000
- 25 ° C	5	13.3	140	151,000
	10	16.3	176	209,000
-22 ° F	0	8.9	109	101,000
- 30 ° C	5	14.7	150	167,000
	10	20.6	191	234,000

Note: * Items are based on 9" spacing

The abovesnowmelting chart uses the following parameters:
Area = 1000 square feet
SnowMelt Efectiveness Ratio = 0.75
Relative Humidity (at all temperatures) = 85%
Snowfall Rate = 0.75 inches / 1 hour
2.5 inches of concrete over 5/8" PEX pipe with 1.5 inches of polystyrene insulation (R-7) under tubing
Temperature Drop = 30 ° F (17 °C) (between supply and return water)
Loop Leader Length (distance between snowmelt area and manifold) = 10 feet
System Fluid = 50/50 glycol/water

Project Considerations

DENSITY OF SNOW: Is very important when determining how much energy is needed to melt it. Unfortunately, the density of snow fall to snow fall can be dramatically different. Snow most commonly forms at temperatures between +40°F and -10°F. Depending on at what temperature it forms, snow can be very dense or less dense.

TEMPERATURE OF SNOW: The temperature of new fallen snow is not much different than the outside temperature, or 30°F, which ever is colder. Outside temperature can vary widely as well. Without knowing the outside temperature in advance, it is impossible to determine how much snow can be melted with a given amount of energy in a given time period.

WIND CONDITIONS: Are critical to the performance of the snowmelt system. Sometimes there is no wind present during a snow fall; sometimes winds are gusting at 30 to 40 mph. Strong winds steal BTU's from a slab faster than outdoor air temperature. The presents of buildings, landscaping or even snow fences reduces the negative effect of wind on a snowmelt slab. Even the control strategy plays a role in the effect of wind. If the system is controlled by an on/off system, the effect of the wind is often reduced because snow accumulates on the slab and shields the slab from the wind.

SITE: Proper site preparation along with an accurate engineered design allows many different types of materials to be snow melted; concrete, asphalt, interlocking brick pavers to flagstone. If additional surface material is used (asphalt, gravel, paving stones) the supply water temperature must be increased to compensate for the additional heat losses.

INSULATION: It is very critical to system performance to make sure that a minimum of 2 inches of closed cell structural high density (blue) ground insulation barrier to ensure quicker slab response time and optimum energy usage.

DRAINAGE: It is critical have good drainage to prevent ice build ups. These drains always should be located in warm zones. Ice formations may occur if drains are placed in border or cold zones.

PIPE INSTALLATION: Pex pipe has minimal structural strength and must be accounted for in any structural calculations. The load bearing capacity of a heated slab must be calculated to ensure proper reinforcement by local building standards.

FROST PROTECTION: Is a must! eg. Dowfrost or equivalent must be used.

Outdoor temp.	Outdoor temp.	Anti-freeze %
(°F)	(°C)	(%)
5	-15	26
-4	-20	32
-13	-25	37
-22	-30	42

Hydronic SnowMelt Systems

Controlling of slab temperatures prohibiting the accumulation of snow and ice leaving water to be drained away or moisture evaporation resulting in safer surfaces during and after snowfalls and freezing rain conditions.

Design, installation, and operation of ComfortPro snow and ice melt systems for sidewalks, stairways, ramps, driveways, landing pads, emergency roads, bridges, roofs, gutters and drains that meets or exceeds local or national standards requiring specific definition of objective and precise application of engineering and construction standards.

PERFORMANCE AND LIMITATIONS

While every possible condition must be considered to insure proper design, installation, and performance of ComfortPro snow and ice melt systems, extreme temperatures, excessive wind, blowing and drifting snow, and unusually high snowfall rates may cause the best systems to fall short of their goal of total snow and ice removal.

HYDRONIC DESIGN REQUIREMENTS

Total BTU loads are determined by ASHRAE standards based on local weather conditions combined with construction considerations including slab and edge insulation, tube spacing, flow rates, and fluid temperatures both input and return insuring predictable performance characteristics for the slab, tubing, and heating plant.

DURING INSTALLATION

AFTER INSTALLATION

SnowMelt System s by Class

Class 1 systems:
This class of system is generally accepted as sufficient for most residential walkway and driveway areas. The rate of heat delivery to the surface in generally in the range of 80 to 125 Btu/hr/square foot depending on location. Class 1 systems often allow a layer of snow to accumulate during a heavy snowfall, especially if the system is manually controlled and starts from cold. This snow layer is actually beneficial because it acts as an insulator between the heated pavement surface and the outside air reducing both evaporation and convective losses. Evaporation of the melt water requires much higher heat input.

Class 2 systems:
Generally accepted as sufficient for most retail and commercial paved areas that must be kept clear of accumulating snow during a heavy snow fall, although the pavement will often remain wet. The rate of heat delivery to the surface in typically in the range of 125 to 250 Btu/hr/square foot, depending on location.

Class 3 systems:
Used for high priority areas such as helicopter pads, toll plazas, sloped pavements in parking areas, pavements adjacent to hospital emergency rooms. Class 3 systems are designed with the ability to melt all snow as fast as it falls and quickly evaporate the melt water from the surface. They generally require heat delivery rates of 250 to as high as 450 Btu/hr/square.

DESSIGN REQUIREMENTS BY CLASS AND LOCATION

CITY	CLASS 1	CLASS 2	CLASS 3
Albuquerque, NM	71	82	167
Amarillo, TX	98	143	241
Boston, MA	107	231	255
Buffalo - Niagra Falls, NY	80	192	307
Burlington, VT	90	142	244
Caribou - Limestone, ME	93	138	307
Cheyenne, WY	83	129	425
Chicago, IL	89	165	350
Colorado Springs, CO	63	63	293
Columbus, OH	52	72	253
Detroit, MI	69	140	255
Duluth, MN	114	206	374
Falmouth, MA	93	144	165
Great Falls, MT	112	138	372
Hartford, CN	118	254	260
Lincoln, NB	67	202	246
Memphis, TN	134	144	212
Minneapolis - St Paul, MN	95	155	254
Mt. Home, ID	50	90	140
Bew York, NY	121	298	342
Ogden, UT	98	216	217
Oklahoma City, OK	66	81	350
Philadephia, PA	97	229	263
Pittsburg, PA	89	157	275
Portland, OR	86	97	111
Rapid City, SD	86	102	447
Reno, NV	98	154	155
St. Louis, MO	122	152	198
Salina, KS	85	120	228
Sault Ste. Marie, MI	78	144	213
Seattle - Tacoma, WA	92	128	133
Spokane, WA	87	127	189
Washington, D.C.	117	121	144

DESIGN TEMPERATURES AND FLOWS

System flow rates are based on a 25 to 30 degree temperature differential (delta T) unless otherwise specified by a design engineer or professional engineer (P.E.) Specific heat and density of the fluid used at the desired delta T must be considered.

DELTA T VS. FLOW

TYPICAL RADIANT SYSTEMS USING 1/2" PEX 300' ON 12" CENTERS

BTUH = (DT) X (GPM) X 500 — 1 GAL. (8.34LB) 1 DEGREE

10 X 1GPM X 500 — RADIANT APPLICATION

BTUH = 5000 / HOUR — IN 300 SQ. FT. — 16.7 BTU / SQ. FT.

TYPICAL SNOW MELT SYSTEMS USING 5/8" PEX 300' ON 9" CENTERS

30 X 1.5 X 500 — SNOWMELT DELTA-T

BTUH = 22,500 / HOUR — IN 210 SQ. FT. — 107 BTU / SQ. FT.

TYPICAL SNOW MELT SYSTEMS USING 5/8" PEX 500' ON 9" CENTERS

30 X 2.5 X 500 — SNOWMELT DELTA-T

BTUH = 37,500 / HOUR — IN 350 SQ. FT. — 107 BTU / SQ. FT.

TUBE SIZING LENGTH AND SPACING

Tubing size and length of loop is dependent on keeping the fluid velocity below 4.2 feet per second with head losses that can be easily managed with standard pump configurations while accounting for head loss of all other components in the heating system. Tube spacing should be selected from the following table or consult your ComfortPro Systems design professional or a professional engineer (P.E.)

Size	Gal./FT.	Length FT.	Flow GPM
3/8"	0.00505	200-250	0.5
1/2"	0.00928	250-325	1.0
5/8"	0.01344	300-450	1.3
3/4"	0.01848	500-600	1.7
1"	0.03053	500-750	3.0
11/4" (40MM)	.06721		
11/2" (50MM)	.10527		
2" (63MM)	.13264		

O.C.	FACTOR
12"	1
10"	1.2
9"	1.33
8"	1.5
6"	2

TUBE SIZING LENGTH AND SPACING

Note: Velocities above 4.00 FT./SEC are not reccomended.

FLOW US g/min	CAPACITY BTUH	VELOCITY FT/SEC	PRESSURE PSI/FT	VELOCITY FT/SEC	PRESSURE PSI/FT	VELOCITY FT/SEC	PRESSURE PSI/FT
		5/8"		3/4"		1"	
0.47	8573	0.49	0.001	0.30	0.000		
0.554	10002	0.56	0.001	0.36	0.000		
0.633	11432	0.66	0.002	0.39	0.001		
0.713	12861	0.73	0.002	0.46	0.001		
0.792	14290	0.81	0.003	0.52	0.001	0.30	0.000
0.871	15719	0.90	0.003	0.56	0.001	0.33	0.000
0.950	17147	0.98	0.004	0.59	0.001	0.36	0.000
1.029	18576	1.06	0.004	0.66	0.001	0.39	0.000
1.108	20005	1.14	0.005	0.69	0.001	0.43	0.000
1.188	21434	1.22	0.005	0.75	0.002	0.46	0.000
1.267	22863	1.31	0.006	0.79	0.002	0.49	0.001
1.346	24292	1.39	0.007	0.85	0.002	0.52	0.001
1.425	25721	1.47	0.007	0.92	0.002	0.56	0.001
1.504	271474	1.55	0.008	0.95	0.002	0.59	0.001
1.583	28579	1.64	0.009	1.02	0.003	0.62	0.001
1.900	34295	1.97	0.012	1.21	0.004	0.72	0.001
2.217	40011	2.30	0.016	1.41	0.005	0.85	0.001
2.533	45726	2.62	0.020	1.61	0.006	0.98	0.002
2.850	51422	2.95	0.025	1.80	0.008	1.08	0.002
3.167	57158	3.25	0.030	2.00	0.009	1.21	0.003
3.483	62874	3.58	0.036	2.20	0.011	1.36	0.003
3.800	68590	3.90	0.042	2.40	0.011	1.48	0.004
4.117	74305	4.23	0.049	2.62	0.015	1.57	0.004
4.434	80021	4.56	0.056	2.82	0.017	1.71	0.005
4.750	85737	4.89	0.064	3.02	0.019	1.84	0.006
5.067	91453	5.22	0.072	3.22	0.022	1.94	0.006
5.384	97169	5.54	0.080	3.41	0.024	2.07	0.007
5.700	102885	5.87	0.089	3.61	0.027	2.20	0.008
6.017	108600	6.20	0.099	3.81	0.030	2.30	0.009
6.334	114316	6.53	0.109	4.00	0.033	2.43	0.010
6.650	120032			4.20	0.036	2.56	0.011
6.967	125748			4.43	0.039	2.69	0.012
7.284	131464			4.63	0.042	2.79	0.013
7.600	137179			4.82	0.046	2.92	0.014
7.917	142895			5.02	0.050	3.05	0.015
8.709	157185			5.51	0.059	3.36	0.017
9.500	171475			6.04	0.069	3.64	0.020
10.292	185764			6.53	0.080	3.97	0.024
11.084	200054					4.27	0.027

TUBE SIZING LENGTH AND SPACING

Glycol not only limits heat transfer of the fluid, it adds head losses and cuts available GPM. As a rule subtract 15% on both for 40% glycol mixture.

$$f = \frac{q}{k \times \Delta T}$$

where:

f – required flow rate (gpm)

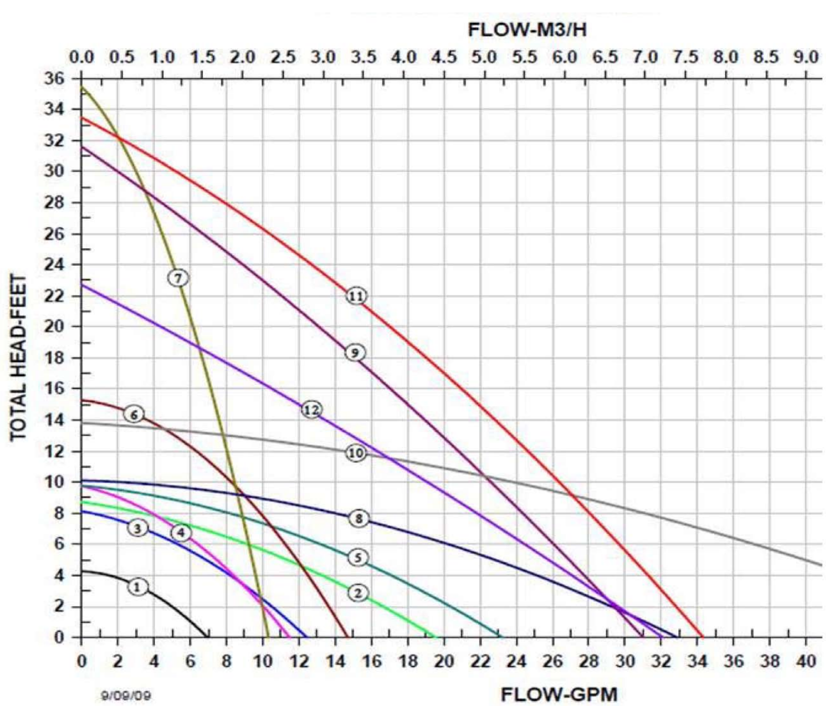
ΔT – temperature drop on the loop(degF)

q – rate of heat output required (Btu/hr)

k – a constant based on the concentration of antifreeze used (see chart below)

100% water	30% Propylene glycol	40% Propylene glycol	50% Propylene glycol
k=500	K=477	K=465	K=449

PUMP SELECTION CRITERIA: Once pressure drop (pump head pressure) and GPM of the longest loop have been calculated, add the GPM requirements of all the loops to determine total GPM and head pressure of the longest loop. Pump performance is most efficient in the center third portion of the pump curve below the line. For best results a flow balancing valve, circuit setter, or triple duty valve should be added to the pump discharge line to set total calculated flow.



EXAMPLE: Pump number 6 is the best choice for an application 8 GPM at 8’ head. Pumps 5 and 8 are at the low end of their performance curves and may lose the ability to maintain 8’ head with normal wear

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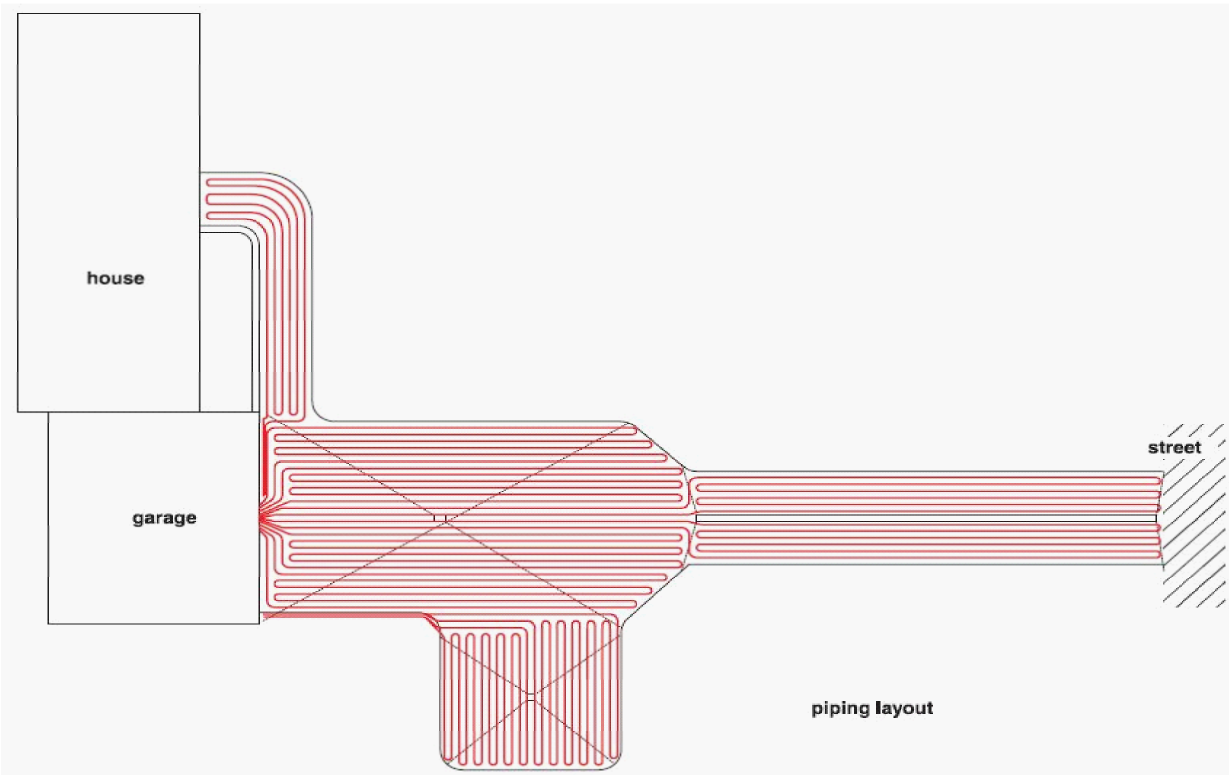
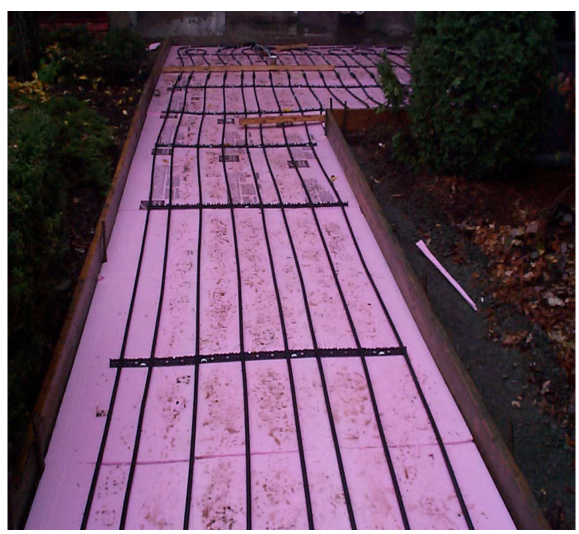
TYPICAL RESIDENTIAL LAYOUT





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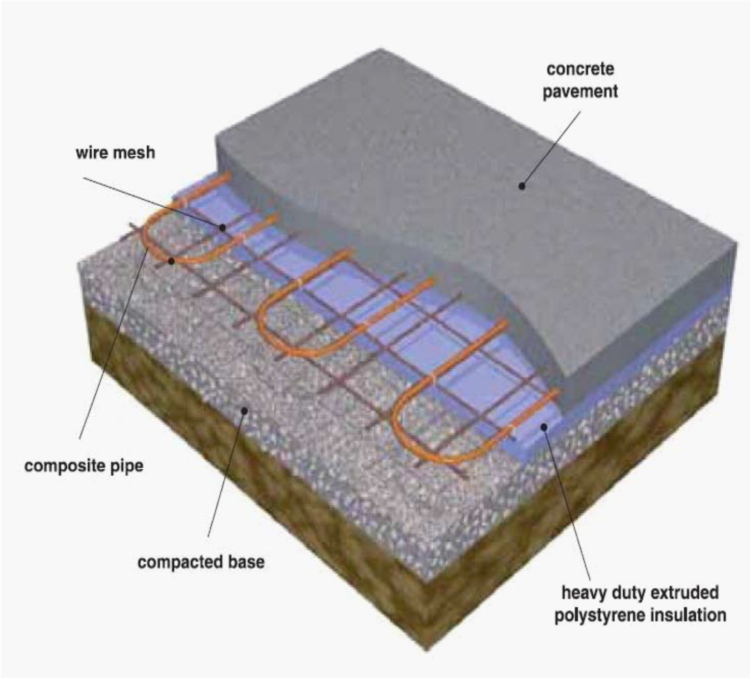
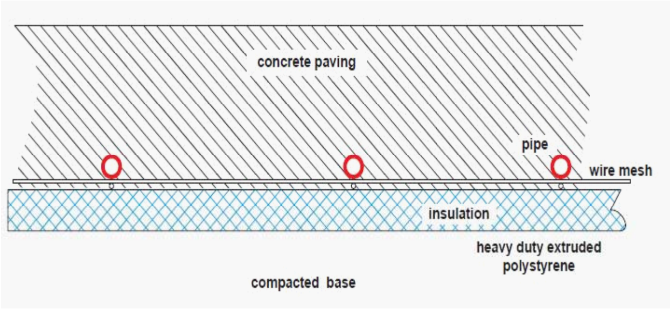
SNOWMELT CONCRETE SLAB



Cement poured over compacted soil or fill. PEX tubing is installed using wire mesh or rebar to hold the tubing in place untill embedded. High density insulation should be installed beneath the slab to stop the downward loss of energy. Vertical insulation should be installed along the length of the exposed slab edge.

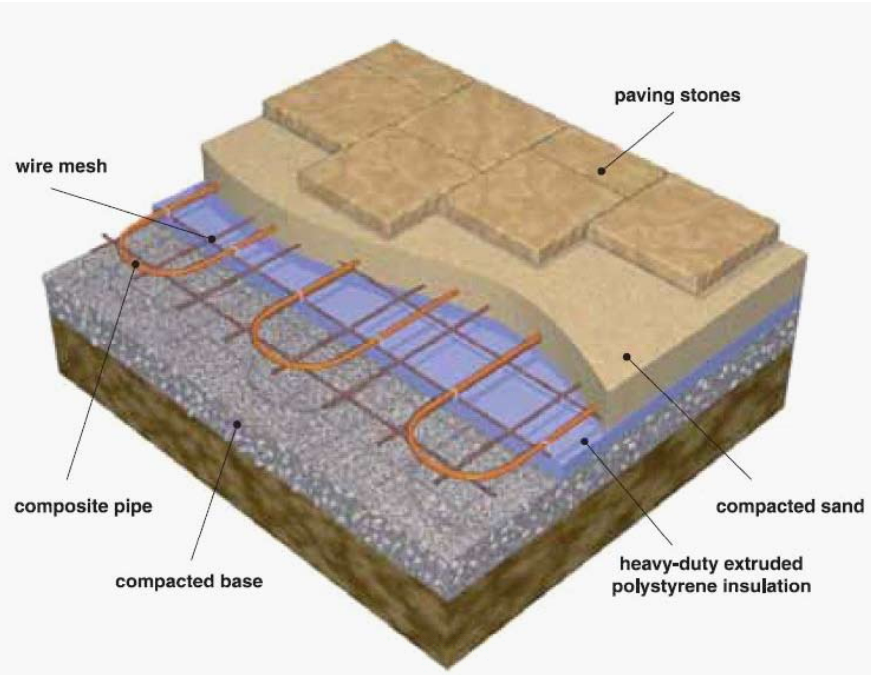
In concrete overpour situations pex tubing can be secured with our tracking or flat mesh to the pre-stressed concrete plank or structural sub slab. The tubing is then imbedded in the overpour. It is always wise to install high density insulation board on top of the original concrete before tracking and tubing is installed to reduce downward losses.



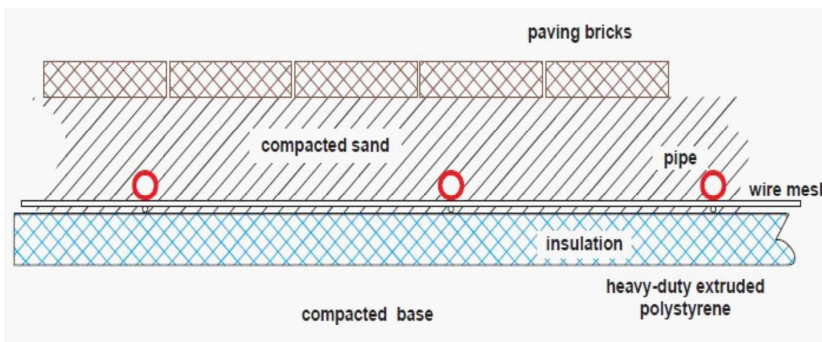
Using 89122 tracking eliminates many installation issues and saves on labor.

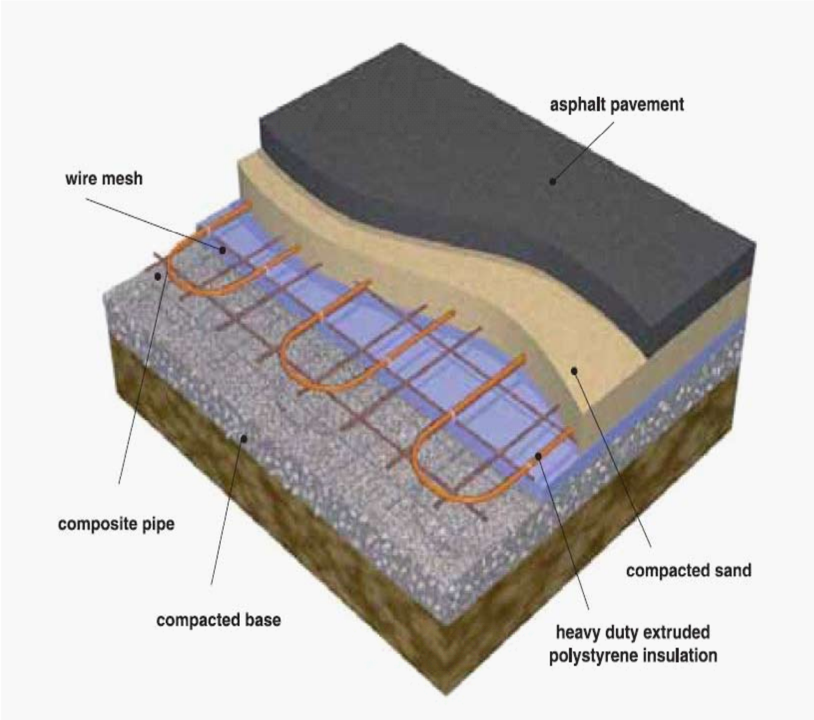
Snowmelting

SNOWMELT PAVING STONES



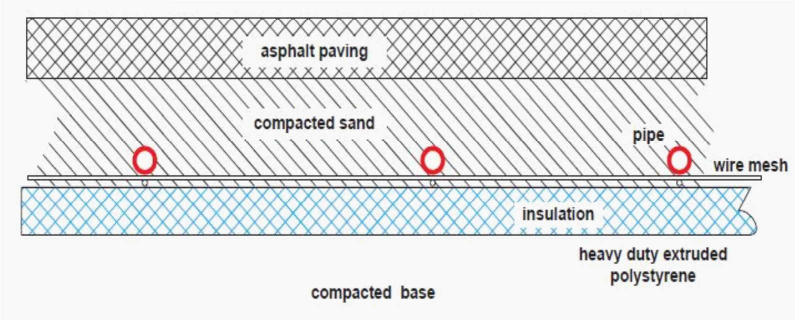
Concrete, brick or stone pavers are laid over a sand bed. The PEX tubing is installed in the sand bed, held in place with wire mesh or rebar. A minimum of two inches of sand cover should be over the tubing. High density insulation board should be installed vertically along the edge of the heated slab.





Cold pour asphalt PEX tubing is installed using wire mesh or rebar to hold the tubing in place until embedded in the first lift of asphalt. This first asphalt lift is back filled manually over the tubing. If the asphalt temperature of this lift is in excess of 240 F, then cool water should be circulated through the tubing-cooling it during the pour. The final lift is applied by a paving machine.

Hot pour asphalt PEX tubing is installed using wire mesh or rebar to hold the tubing in place in a sand bed. Minimum of two inches of sand should be over the top of the tubing. A paving machine then lays the asphalt in the usual manner.



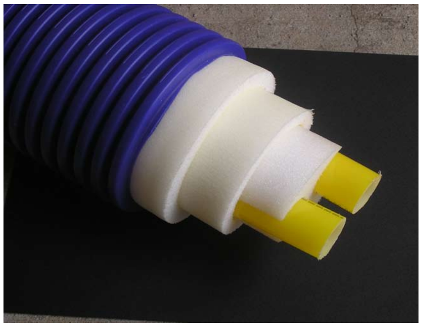
MANIFOLD LOCATION AND SUPPLY

Manifolds are to be located near snowmelt area to minimize loop leader length while providing access and service.

2013 Manifold - 12 GPM Total

2015 Manifold - 17 GPM Total

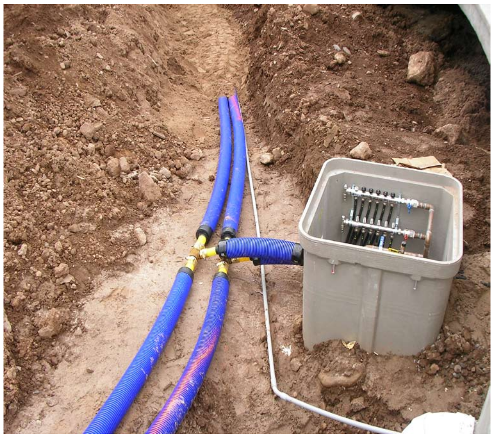
2016 Manifold - 26 GPM Total



Microflex Product Properties

HDPE Outer Jacket
This corrugated high density polyethylene casing provides the necessary mechanical protection and water sealant properties, and is shock-resistant, even at sub-zero temperatures

Insulation Properties
The insulation of Microflex pipes is fully composed of micro-cellular cross linked polyethylene foam with a closed cellular structure, permitting low water vapor diffusion, good insulation and resistance to extreme temperatures and is not water soluble like competition using polyure



SUPPLY & RETURN PIPING

Outdoor manifold stations shall be supplied with MicroFlex underground insulated pex to and from the power plant.

For systems exposed to freezing temperatures the addition of glycols with built-in inhibitors (that are approved for hydronic heating systems) to the heating fluid is required. A minimum of a 30%-35% (maximum 50%) glycol/water mixture is required for the combined protection against freezing and system corrosion. For calculation of system water content in the particular PEX piping chosen for the project.

Note: A water analyis should be performed annually (i.e. check corrosion inhibitor and glycol levels) to ensure the warranty for ComfortPro Systems components, and for the longevity of the system.

CONTROL STRATEGIES

AUTOMATIC : This strategy is the most common in critical access applications such as hospital emergency ramps. Under automatic operation, the slab area of the snow melt is never allowed to freeze. Controls are employed to maintain the slab above freezing whenever the ambient temperature drops below 40°F. Additionally, whenever the moisture is present below 32°F, the controls will accelerate the slab to a higher operating temperature by increasing system fluid temperature.

IDLING: This strategy is most common in car wash applications. Idling is used to maintain the slab surface at a constant temperature above freezing. Sensors in the slab will cycle pumps on or off depending on the slab temperature.

ON/OFF This strategy is most common in residential applications. The slab is isolated from the frozen ground by high density insulation board. By utilizing a series of components, the system can be turned on or off by the owner through a single switch. The majority of heat is focused toward the slab and surface, not toward the frozen ground beneath the slab.

MANUAL: This strategy is most common in applications. using waste heat such as a cooling tower or distric power plant. The system is turned on in the fall and off in the spring. Flow is consttant and temperature is adjusted only when performanc degreadation is noted.

33570 snowmelt relay with 10ft. remote sensor

33565 snowmelt relay with inegrated sensor

The 33565 & 33570 low voltage controlers are designed for hydronic snow melting applications and feature a new Trigger Sensitivity Adjustment gives very reliable rain and snow detection with a replaceable percipation sensor. The automatic activation feature equals lower deicing costs.

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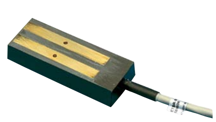
AUTOMATIC SNOWMELT CONTROL STARTUP AND SHUTDOWN Automatic snowmelt controls provide relay contacts for pump activation, mixing valve setting, and boiler call for heat. Temperature and moisture thermistors provide the initial system start with timed off feature for additional heating after sensor satisfaction. Manual over ride option may be used for testing.

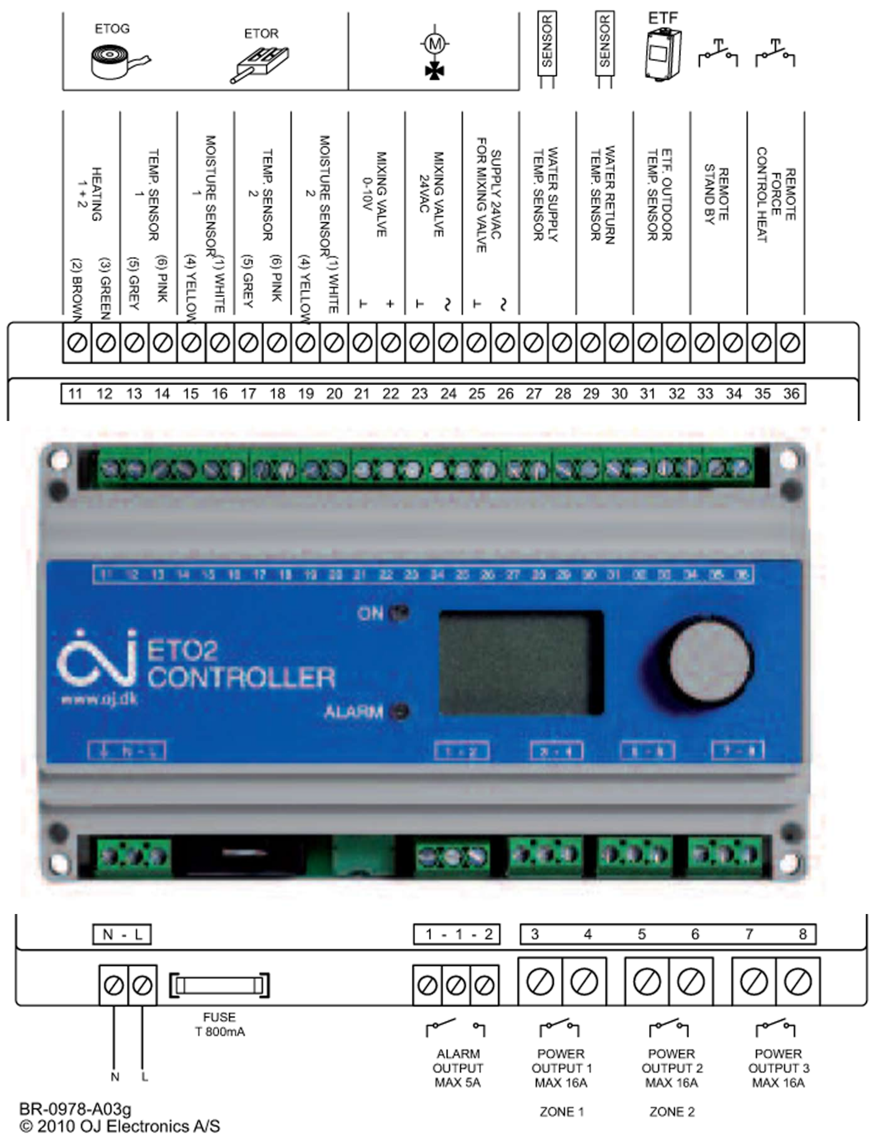
33550 Snowmelt sensor

33551 ground sensor

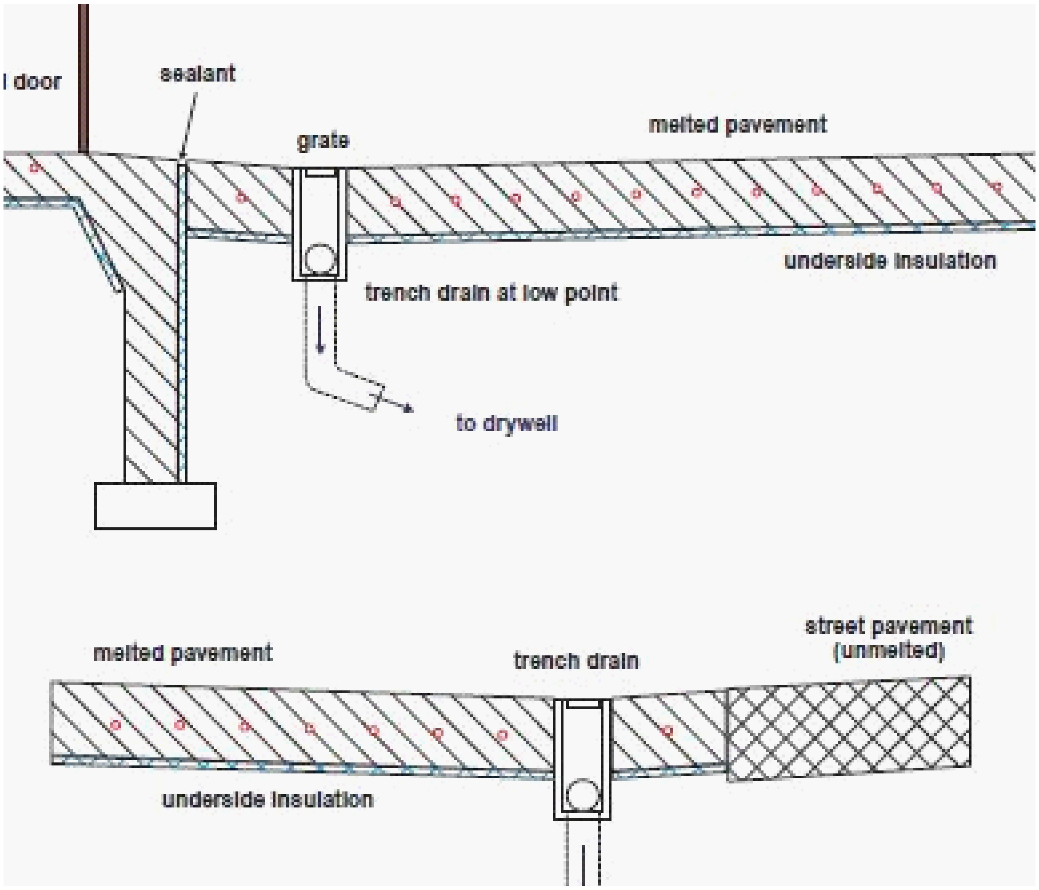
33552 Outdoor air sensor



33553 gutter sensor



DRAINAGE AND OTHER SITE CONSIDERATIONS Proper drainage must be considered against buildings and in front doors as well as driveways and sidewalks with varying elevations to keep potential run off from collecting and freezing once the system shuts down.

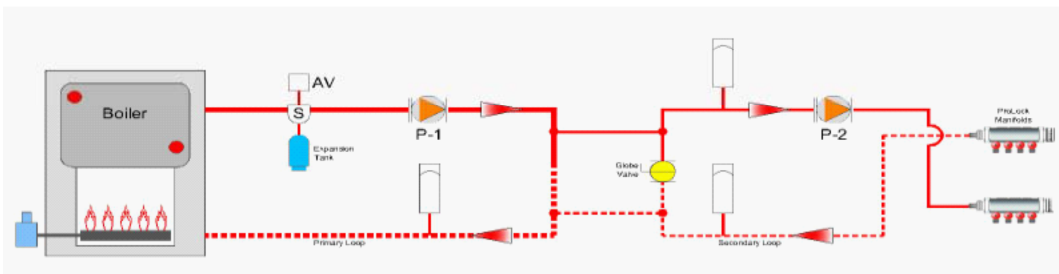


Trench drain during construction. Note the plywood covering put in place duriing the concrete pour to keep drain clean and free of deibris.

BOILER PIPING AND CONTROL CONSIDERATIONS

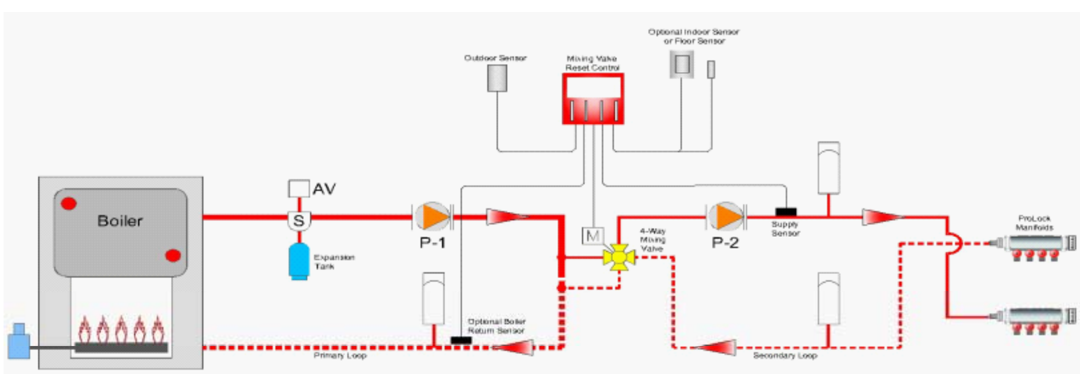
Mixing valves, injection piping, or primary secondary piping techniques must be employed when using a non-condensing boiler. Return fluid temperatures on these appliances must remain above 140 degrees to prevent condensation in the boiler heat exchanger and burners. Condensing boilers have no minimum water temperature restrictions but may require primary secondary piping to insure proper flow through the boiler heat exchanger. Consult manufacturer specifications for proper pump flow rates. Shell and tube as well as plate type heat exchangers may also be used to protect appliances provided a separate air separator and expansion device are used.

ONE TEMPERATURE PRIMARY SECONDARY PIPING

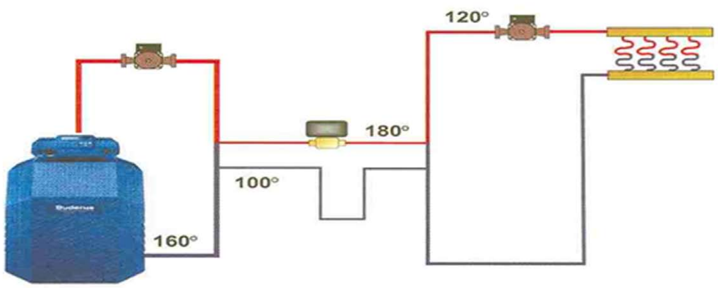


Primary loop and pump (P-1) are sized for full flow through the boiler insuring proper delta T per appliance specifications. A pair of closely spaced tees, five times the pipe diameter not more than one foot apart, allows a portion of the boiler water to be diverted to the secondary loop and pump (P-2) to be pumped through the snow melt zone. Return water from the zone is partially diverted back to the primary loop with a globe valve between the tees in the secondary loop leaving the rest to be mixed with new primary supply hot water. In non condensing appliance applications the globe valve must be set to keep the boiler return temperature above 140 degrees during operation protecting the heat exchanger and burners from condensation.

VARIABLE TEMPERATURE 4-WAY MIXING VALVE WITH 33550 SNOW MELT RELAY



Automatic snow melt relay operates a motorized mixing valve M (3-way or 4-way shown) providing exact mixing temperatures based on supply sensor feedback on secondary loop. Control can also protect a non condensing boiler heat exchanger and burners by monitoring minimum return water temperatures by adjusting the mixing valve to hold back enough supply hot water to remain above 140 degrees.

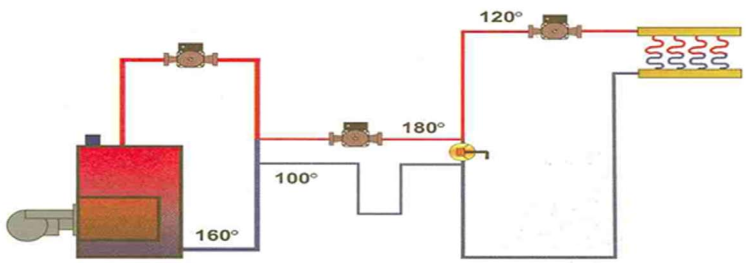


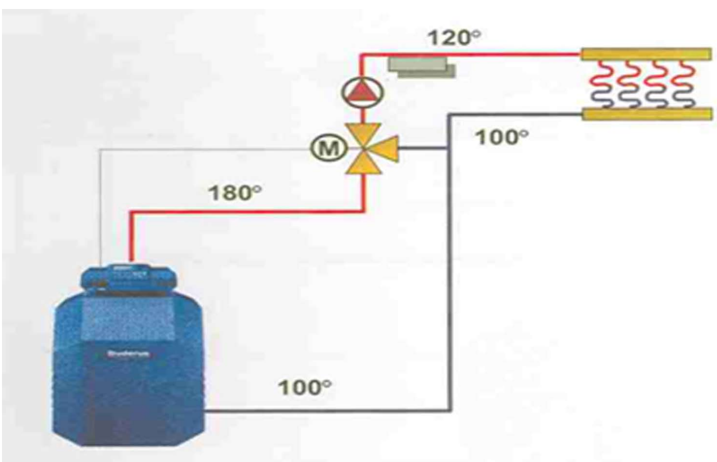
TWO WAY VARIABLE FLOW INJECTION PRIMARY SECONDARY PIPING

Capillary thermostatic injection valve monitors secondary supply water temperature and adjusts injection flow. Can also be accomplished electro mechanically with a modulating motorized valve operator and electronic control. Minimum boiler return temperatures must be monitored in non condensing boiler applications. (Courtesy of Buderus)

VARIABLE SPEED PUMP INJECTION PRIMARY SECONDARY PIPING

Injection pump with a temperature sensor on the supply of the secondary loop signals the pump to inject enough hot water to achieve snowmelt temperature. (Courtesy of Buderus)



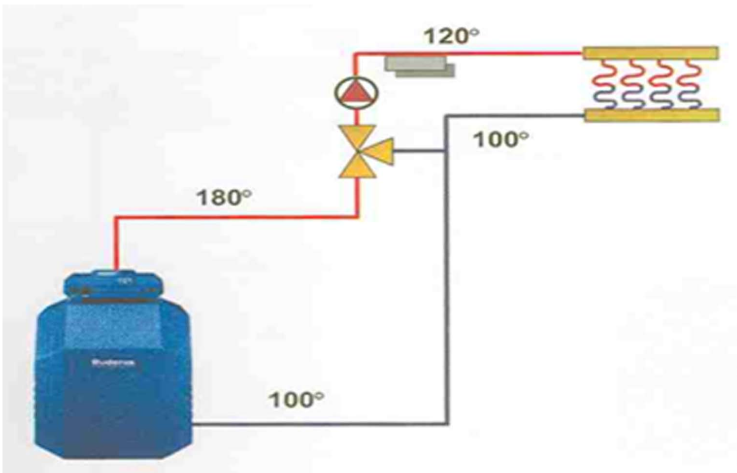


THREE –WAY MOTORIZED MIXING VALVE PRIMARY SECONDARY PIPING

Many newer design appliances have on board electronic controls capable of signaling a three way motorized mixing valve to provide fixed secondary supply temperatures as well as low temperature protection of the appliance. (Courtesy of Buderus)

THREE-WAY THERMOSTATIC MIXING VALVE PRIMARY SECONDARY PIPING

For small zones and residential applications a simple three-way thermostatic mixing valve provides predictable temperatures to the secondary supply line where minimum return temperatures are not an issue (condensing appliances or oversized non condensing appliances). (Courtesy of Buderus)



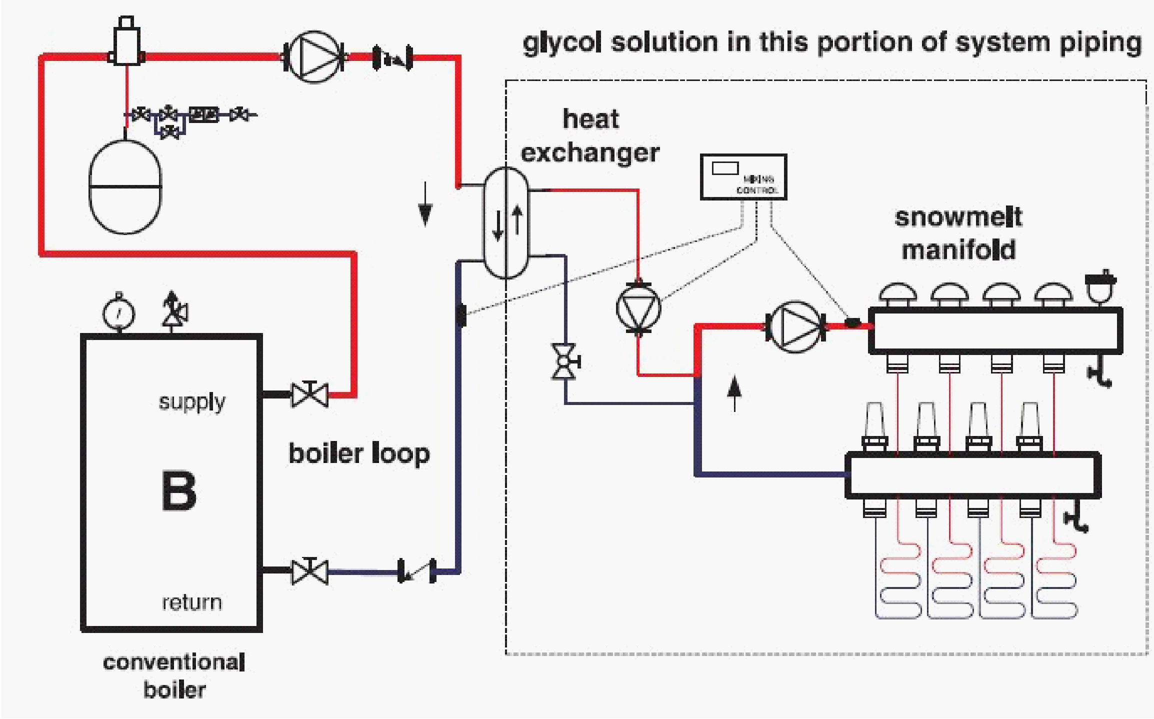
BOILER PIPING AND CONTROL CONSIDERATIONS

SHELL & TUBE Are typically used in commerical installations

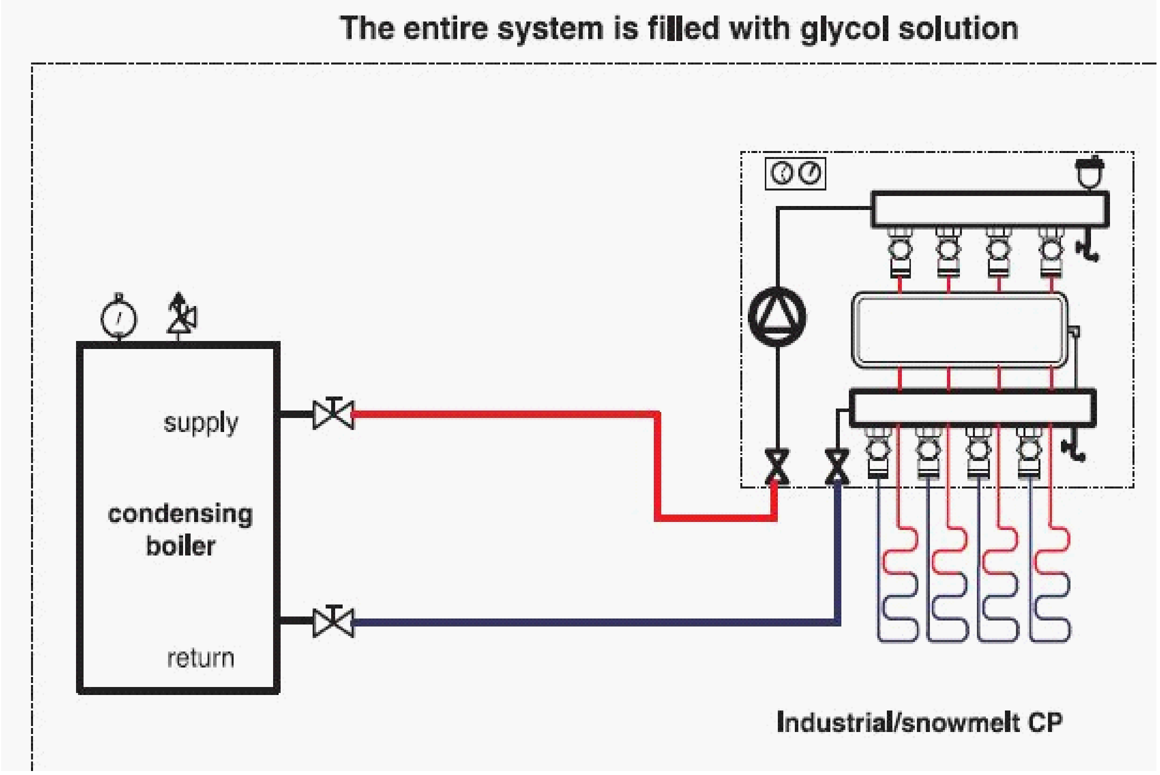
Shell and tube as well as plate type heat exchangers may also be used to protect appliances provided a separate air separator and expansion device are used.

BRAZED PLATE heat exchangers are typically used for residential installations.

Heat Exchanger Piping

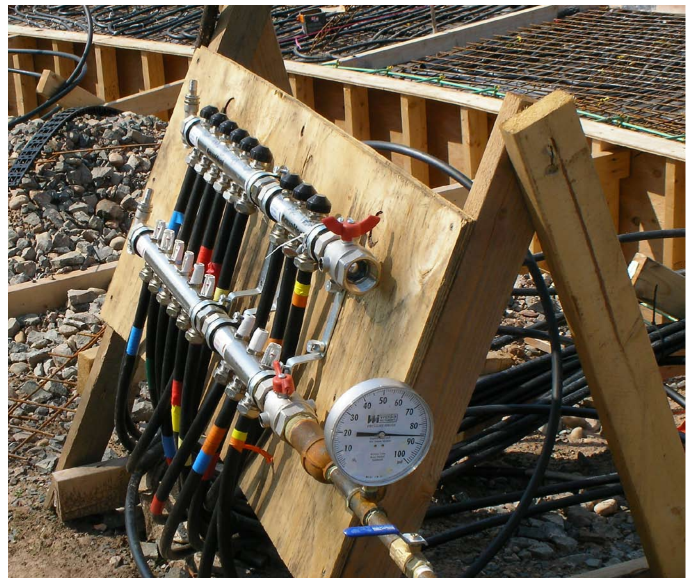


Commercial or Dedicated Snowmelt



TESTING AND STARTUP

Pressure testing of the system components should be performed before filling with fluid. Manifolds and tubing may be pressurized to 100 PSI with the boiler isolated. The boiler and near boiler piping will only be tested up to the rating of the boiler relief valve. Once filled with fluid loops may be bled one at a time to eliminate air. Supply lines may be purged next with the boiler and near boiler piping last. Test firing of the boiler will release suspended oxygen in the fluid to be released by the air separator and vent.



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