Snowmelt

Installation Guide

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Table of Contents

Introduction

Snowmelt design is considerably different than heating system design. Many factors must be considered when designing a snowmelt system, including: rate of snowfall, air temperature, humidity, wind speed near the heated surface, and apparent sky temperature. Other factors include slab construction, material, depth and spacing of tubing as well as back and edge heat losses. These factors require precise and sometimes tedious calculations. Following, however, is a condensed method that will provide satisfactory results.

Due to the high flow rates and high BTU requirements of snowmelt systems, *using the High-Capacity manifolds and ¾" Infloor tube is generally recommended.* However, smaller diameter tubing may be used for systems with short tubing circuits, and larger diameter tubing may be used when extremely high flow rates or longer tube circuits are required.

Control strategy may consist of manual controls, and automatic controls, which includes snow detection controls, or idling controls. With automatic controls it is possible to maintain slab temperature, supply water temperature, and boiler return water temperature at optimum operating conditions. However, as more automatic features are added to the system controls, there is an increase in initial system cost but generally will result in a lower operating cost.

Manual controls systems are the least expensive. The manual control requires the operator to turn the system on and off as desired. Response time will be affected especially if snow has accumulated prior to establishing a warm slab. Manual systems may be used in residential applications where the home owner recognizes and accepts the limitations of this type of control strategy.

Snow detection controls are used to activate the system when the temperature is cold enough to snow and precipitation is detected on the sensor. It also turns the system off after a specific time interval if moisture is no longer present on the sensor. The sensor is warmed continuously and melts the snow as it strikes the sensor's surface. The detection of moisture combined with the measurement of air temperature turns on the system when it starts to lightly snow thus preventing accumulation of snow prior to coming on.

The sensor must be installed in an area representative of the overall drainage and temperature of the slab. If installed where it would be submerged in standing water, the system could run much longer than actually desired. If installed in an unusually dry area, it may cause the system to shut down before the snowmelt job is completed. There are several types of controls, including sensors that mount flush in the slab or sensors that mount above the slab. Consult the various control manufacturers for specific control information.

Idling controls maintain a slab at a pre-selected temperature and increases the slab temperature when "instructed" by the snow detector.
A microprocessor adjusts the supply fluid temperature as required to meet the needs of the snowmelt area. This procedure allows the system to be more energy efficient than a manually operated system. Water temperature control can be done through the use of a Modulating 4-Way Mixing Valve. This provides an added advantage by controlling the return water temperature to the boiler. If unchecked, this water could be quite cold, particularly on initial startup. Should this cold water be introduced into a hot boiler, it could thermally shock the boiler causing cracking or separating of metal parts in cast iron and copper tube boilers. *The use of Modulating Condensing Boilers is recommended for snowmelt applications* since these boilers will not be affected by thermal shock.

Two primary criteria comprise the snow melting load:

- Amount of BTU/hr necessary to bring the slab up to the snow melting temperature (pick-up load)
- Amount of BTU/hr needed to actually melt the snow

Factors that affect the snow melting load include the rate of snowfall, air temperature, and the snow density. (When

Introduction *Continued*

the air temperature is low, snow is much lighter than when the air temperature is near freezing.)

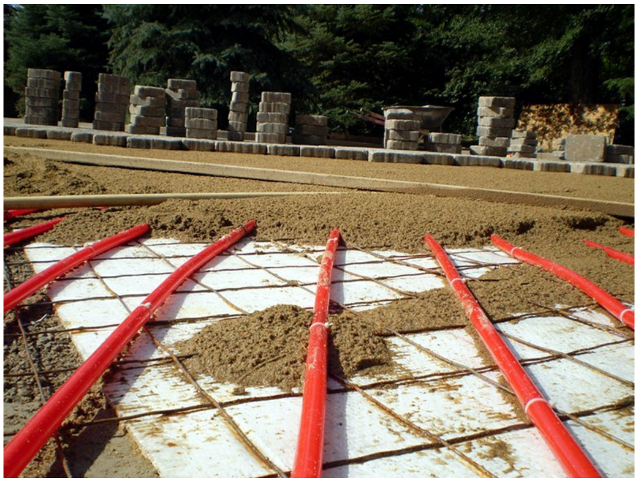
The snowmelt system must meet either the pick-up load or the snow melting load, whichever is greater. Therefore, both requirements must be calculated. Also, the system must be designed for the type of application:

►Type A Level I (Residential Systems)

Includes residential walkways, patios, and driveways, with the minimum capacity necessary. Slight accumulation of snow may occur during heavy snowfall. (Snow-free ratio ranges from 0 - where snow accumulates on the snow melting surface, to .5 - where *partial* snow accumulates on the snow melting surface, to 1 - where *no* snow accumulates on the snow melting surface.) Communication with the Residential owner on how the system needs to respond is best to determine the right ratio for the project. 0 to .5 would result in a lower *initial* cost of the system.

►Type B Level II (Commercial Systems)

Includes commercial sidewalks, driveways, and steps. These applications usually require melted snow and can accept wet slabs. (Snow-free ratio ranging from .5 - where *partial* snow accumulates on the snow melting surface, to 1 - where *no* snow accumulates on the snow melting surface.) Communication with the Commercial property



owner on how the system needs to respond is best to determine the right ratio for the project .5-to-1 would be a common design application for these commercial project.

►Type C Level III (Industrial Systems)

Includes toll booths, airport aprons, loading areas, hospital emergency entrances, helicopter pads, and other areas where the slabs must be free of snow and also dry. (Snow-free ratio of 1 - where *no* snow accumulates on the snow melting surface.)

A Snowmelt Design Form is included in the Appendix to assist in designing a snowmelt system. *The numbers in parentheses throughout this installation guide refer to the corresponding line number on the design form.* This design form will differ from the Snow-free ratios used in our LoopCAD design program, as the design form is based on previous standards set forth in our previous guide.

STEP 1

Design Information

Determine the area to be treated as snowmelt (1) and the construction material of the snowmelt area, i.e.: concrete, asphalt, brick pavers (2).

The snowmelt load will depend on the snow melting result desired. An immediate melt in a severe snowstorm will take considerably more energy than melting the snow over a few hours after the snowfall has subsided. Melting one inch of snow per hour is usually acceptable for a residence (Snow-free ratio of 0 to .5), but may be unacceptable for a sidewalk in front of a store (Snow-free ratio of .5 to 1). Hospital entrances and parking ramp inclines need to be free of snow and ice at all times (Snow-free ratio of 1).

From the **Heat Capacity Table,** select the glycol solution desired (3), the freeze protection provided (4), and the fluid temperature drop for the system design (5).

Heat Capacity Table

Propylene Glycol Solution	Freeze Temperature	Heat Capacity of Fluid, Btu/gpm Fluid Temperature Drop 20 F	30 F	40 F
0%	32 F	10,000	15,000	20,000
10%	23 F	9,900	14,850	19,800
20%	15 F	9,600	14,400	19,200
30%	2 F	9,300	13,950	18,600
40%	-14 F	9,000	13,500	18,000
50%	-37 F	8,700	13,050	17,400

Select the temperature drop (5) between the supply fluid to the snowmelt area and the return. 30 F is most commoly used in snowmelt systems.

NOTE: THE TABLES IN THIS INSTALLATION GUIDE ARE BASED ON THE TUBES BEING **2 INCHES** (2") FROM THE SURFACE.

INFLOOR HEATING SYSTEMS

Slab Load Tables

The **Slab Load Table** allows the choice between three different results depending on how critical the snow melting process is. A residence is generally designed as a Type A, where as a helicopter landing pad would be designed as a Type C.

Choose the type of snowmelt results desired (6):

Type A

Use 32°F instead of actual outdoor design temperature. (Snow-free ratio of 0-.5) There may be some snow accumulation for short periods, particularly in severe weather.

Type B

Use outdoor design temp. or 20°F, whichever is higher. (Snow-free ratio of .5 to 1) Snowmelt area remains free of snow and ice most of the time.

Type C

Use outdoor design temp. or 0°F, whichever is higher. (Snow-free ratio of 1) Snowmelt area is kept free of snow and ice at all times.

Back Loss

	Add to total load depending on the amount of insulation
No Insulation	20%
Perimeter Insulation	15%
Slab and Perimeter Insulation	4%

Slab Load Formula

NO WIND CONDITION
+ WIND ADJUSTMENT
+ BACK LOSS

= TOTAL LOAD

No Wind Condition Slab Load Table

Outdoor Design Temperature F	No Wind Condition Slab Load in Btu/(h*ft2)						
	Snowfall in Inches of Water						
	0.05	0.10	0.15	0.20	0.25	0.30	0.35
0	70	110	150	190	230	270	310
5	65	105	145	185	225	265	305
10	60	100	140	180	220	260	300
15	55	95	135	175	215	255	295
20	50	90	130	170	210	250	290
25	45	85	125	165	205	245	285
30	40	80	120	160	200	240	280
32	38	78	118	158	198	238	278

Wind Speed Adjustment Table

Outdoor Design Temperature F	Wind Speed Adjustment Additional Slab Load in Btu/(h*ft2)						
	Wind Speed in MPH						
	2.5	5.0	7.5	10.0	12.5	15.0	18.5
0	28	55	83	110	138	165	204
5	24	48	71	95	119	143	176
10	20	40	60	80	100	120	148
15	16	33	49	65	81	98	120
20	13	25	38	50	63	75	93
25	9	18	26	35	44	53	65
30	5	10	15	20	25	30	37
32	1	3	4	5	6	8	9

STEP 2

Snowmelt Load Requirements

Determine from the local weather station the maximum snowfall rate (7) that might be expected each year and the outdoor design temperature (8). Also obtain the average wind speed (9) in the snow melting season. Snowfall data should be expressed in the equivalent inches of water remaining when the snow is melted. Equivalent inches of water is preferred because the density of snow can vary considerably. Two inches of light fluffy snow could easily have the same amount of water as one inch of heavy, dense snow.

Climate Data

City		Wind Speed	Design	Snowfall
Albuquerque	NM	8.5	16	
Amarillo	TX	13.3	11	
Anchorage	AK	10	-18	
Boston	MA	14.2	9	0.16
Buffalo-Niagara Falls	NY	10.8	7	0.16
Burlington	VT	10.8	-7	0.08
Caribou-Limestone	ME	10	-13	0.16
Cheyenne	WY	15.3	-1	
Chicago	IL	11.5	0	0.08
Colorado Srpings	CO	11.5	2	
Columbus	OH	10	5	
Detroit	MI	10.6	6	0.08
Duluth	MN	12	-16	
Great Falls	MT	14.4	-15	
Hartford	CT	8.2	7	0.23
Lincoln	NB	10.1	-2	
Memphis	TN	11.5	18	
Minneapolis-St. Paul	MN	11.1	-12	0.08
Mt. Home	ID	9.5	12	
New York	NY	11.8	15	
Ogden	UT	9.4	5	
Oklahoma City	OK	15.8	13	0.16
Philadelphia	PA	9.7	4	0.16
Pittsburgh	PA	11.6	7	0.08
Portland	OR	8.4	23	
Rapid City	SD	12.9	-7	
Reno	NV	5.6	10	
Salina	KS	10.9	5	
Sault Ste. Marie	MI	9.4	-8	
Seattle-Tacoma	WA	5.9	26	
Spokane	WA	10.7	2	
St. Louis	MO	11.5	6	0.08
Washington	DC	9.6	17	0.16

*wind speed when 32 F or below
This chart would apply to the manual design in this manual and does not correspond with our LoopCad design program for snowmelt applications

Snowmelt Load Requirements

If this information cannot be obtained locally, from the National Climatic Data Center in Asheville, North Carolina, or from the table in this guide, use a location with a similar climate. This information may also be available from ASHRAE.

The wind speed may be modified to reflect an area that is protected by buildings or trees. Wind speed for weather reporting purposes is generally taken approximately 30 feet above the ground in an open area.

Using the **No Wind Condition Slab Load Table** (Pg. 6), read the instructions beside the appropriate type of snowmelt system (Type A, B, or C). Move down the No Wind Condition Slab Load Table and find the temperature under the Outdoor Design Temp. Column, which corresponds with the Type of system (A, B, or C). Move to the right and read the BTU/hr * ft^2 (10) under the Snowfall Column.

To determine the additional wind speed load, look at the **Wind Speed Adjustment Table** and find the temperature under the Outdoor Design Temp. Column, which corresponds with the type of system (A, B, or C). Move to the right and read the BTU/hr * ft^2 load increase (11) under the Wind Speed Column. Add this to the slab load (12).

Back losses (13) also increase the load to the snow melting area. Insulating under the snowmelt area is recommended. The total load should be increased by 20% if no insulation is present. Use a 4% increase if there is insulation beneath the snowmelt area. If only the perimeter of the snowmelt area is insulated, increase the total load by 15%.

To get the total adjusted snowmelt load per square foot of snowmelt area (14), add together the no wind load, wind adjustment load, and back loss adjustment.

Response Time Table

Response Time	Pick-up Load Beginning Slab Temperature					
	Beginning Slab Temperature					
	30 F	20 F	10 F	0 F	-10 F	-20 F
0.3 hr	60	367	677	980		
0.5 hr	36	220	406	588	772	956
1.0 hr	18	110	203	294	386	478
1.5 hr	12	73	135	196	257	319
2.0 hr	9	55	102	147	193	239
2.5 hr	7	44	81	118	154	191
3.0 hr	6	37	68	98	129	159
based on a tube depth of 2" below the surface						

If the slab is kept at 32°F at all times there would be no pick-up load. If the slab is turned on only when snow is present, the Outdoor Design Temperature should be used. The system may also be designed to idle at 32°F until the temperature drops below 10°F and then shut off because snow seldom falls at outdoor temperatures below 10°F. If this is the case, the beginning slab temperature would be 10°F.

Snowmelt Load Requirements

Choose the response time (15) desired in the left hand column of the **Response Time Table** (pg. 8). Move to the right and read the pick-up load under the appropriate beginning slab temperature.

To find out what the response time would be at the adjusted snow load, find the adjusted snow load under the appropriate beginning slab temperature column and move left to the response time column.

Choose the adjusted snow load (14) or the pick-up load (16) as the design snowmelt load (17). If adjusted snow load is greater than the pick-up load use this number as the design snowmelt load.

If the pick-up load is larger than the adjusted snow load and response time is important, use the pick-up load as the design snowmelt load.

Determine the system BTU/hr requirement (18) by multiplying the design snowmelt load (17) by the snowmelt area (1). This provides the BTU/hr needed for the system.

Calculate the system flow rate using the heat capacity of fluid (19) from the **Heat Capacity Table** (pg. 5). This table displays the heat carrying capacity of various propylene glycol solutions at a flow of 1 gpm. Enter the table at the appropriate percentage in the Propylene Glycol Solution Column (4) and move to the right to find the heat capacity under the desired fluid temperature drop (6). To find the total system flow rate (20) divide the system BTU/hr requirement (18) by the fluid heat capacity (19).

Pictured above is an aerial-mounted remote sensor for an automatic snowmelt control system. When snow accumulates on the sensor, it activates the system. A pavement-mounted version is also available (shown on page 15).

Are you using LoopCAD?

With advanced features, Infloor's OEM LoopCAD design program is our recommended method for designing snowmelt systems. It will improve your installation process by automatically calculating flow rates and head pressures for your application, import data from worksite pictures, and more.

Design Data for Three Classes of Snowmelt Systems

City		Type A	Type B	Type C	Type A	Type B	Type C
		Design Output, Btu/h*sq.ft.			Annual Output, Btu/sq.ft.		
Albuquerque	NM	71	82	167	908	969	1,150
Amarillo	TX	98	143	241	2,150	2,520	2,770
Boston	MA	107	231	255	8,000	9,080	9,100
Buffalo-Niagara Falls	NY	80	192	307	11,800	14,600	14,900
Burlington	VT	90	142	244	11,800	13,500	13,800
Caribou-Limestone	ME	89	138	307	17,800	20,600	22,500
Cheyenne	WY	83	129	425	9,730	13,200	20,200
Chicago	IL	89	165	350	7,200	8,390	8,700
Colorado Srpings	CO	49	63	293	3,960	3,960	7,390
Columbus	OH	52	72	253	3,590	4,180	5,350
Detroit	MI	69	140	255	3,540	6,850	7,070
Duluth	MN	83	206	374	33,200	38,100	39,500
Falmouth	MA	93	144	165	3,830	4,250	4,290
Great Falls	MT	84	138	372	13,700	15,400	19,100
Hartford	CT	115	254	260	9,830	10,800	10,810
Lincoln	NB	64	202	246	4,750	8,350	8,520
Memphis	TN	134	144	212	702	721	792
Minneapolis-St. Paul	MN	63	155	254	14,200	17,600	18,400
Mt. Home	ID	50	90	140	1,260	1,530	1,590
New York	NY	121	298	342	4,180	4,690	4,710
Ogden	UT	98	216	217	7,050	7,370	7,370
Oklahoma City	OK	66	81	350	2,380	2,800	5,400
Philadelphia	PA	97	229	263	2,710	3,100	3,110
Pittsburgh	PA	89	157	275	9,050	10,700	11,100
Portland	OR	86	97	111	1,300	1,330	1,360
Rapid City	SD	58	102	447	7,450	8,250	13,400
Reno	NV	98	154	155	2,970	3,030	3,030
St. Louis	MO	122	152	198	2,190	2,290	2,380
Salina	KS	85	120	228	2,920	3,370	3,810
Sault Ste. Marie	MI	52	144	213	17,600	22,200	23,300
Seattle-Tacoma	WA	92	128	133	1,400	1,430	1,430
Spokane	WA	87	127	189	8,650	9,350	9,560
Washington	DC	117	121	144	1,650	1,660	1,690

This chart would apply to the manual design in this manual and does not correspond with our LoopCad design program for snowmelt applications

Operating Cost Estimate

To determine the annual operating cost, use the following formula Oc = AAoFo/[1 - (B1/100)]

Where:

Oc = operating cost, $/year
A = area sq. ft.
Ao = annual output, Btu/sq.ft.
Fo = fuel cost, $/Btu
B1 = back loss %

Example: Class III (Type C) system of 2000 sq. ft. in Chicago requires 8700 Btu/sq. ft. annually. With fuel cost of $8.00 per million Btu and 30% back loss cost would be:
Oc = (2000 x 8700 x 8)/[1 - (30/100)] 1,000,000)
Oc = $ 199/year

Note: back losses are included in snowmelt load requirements. With typical installation, and ground temperature of 40 F at a depth of 24 inches, back losses are approximately 20%. Higher losses would be expected with colder ground, more cover over the tubing, or exposed backs such as bridges or parking decks. For further information, see 1991 ASHREA Applications Handbook, Chapter 45

Snowmelt Table

The following table has been provided by the ASHRAE Applications Handbook 2014, Chapter 51 "Snow Melting and Freeze Protection." The table will correspond more with our LoopCAD Snowmelt design program, as it is based on 2009 ASHRAE Standards.

Frenquencies of Snow-Melting Surface Heat Fluxes at Steady State Conditions								
Location	Snowfall Hours Per Year	Snow-Free Area Ratio, Ar	Heat Fluxes Not Exceeded During Indicated Percentage of Snowfall Hours from 1982 through 1993, Btu/h *ft2: 75%	90%	95%	98%	99%	100%
		1	89	125	149	187	212	321
Albany, NY	156	0.5	60	86	110	138	170	276
		0	37	62	83	119	146	276
		1	70	118	168	191	242	393
Albuquerque, NM	44	0.5	51	81	96	117	156	229
		0	30	46	61	89	92	194
		1	113	150	168	212	228	318
Amarillo, TX	64	0.5	71	88	108	124	142	305
		0	24	46	62	89	115	292
		1	112	164	187	212	237	340
Billings, MT	225	0.5	64	89	102	116	128	179
		0	22	33	45	60	68	113
		1	151	199	231	275	307	477
Bismarck, ND	158	0.5	83	107	124	148	165	243
		0	16	30	39	60	73	180
		1	58	79	100	126	146	203
Boise, ID	85	0.5	38	52	66	80	89	164
		0	22	31	40	53	62	164
		1	96	137	165	202	229	365
Boston, MA	112	0.5	65	95	112	149	190	365
		0	37	75	93	121	172	365
		1	115	166	210	277	330	570
Buffalo, NY	292	0.5	68	97	127	164	188	389
		0	23	39	55	93	112	248
		1	91	130	154	184	200	343
Burlington, VT	204	0.5	58	78	92	113	128	343
		0	23	40	55	78	94	343
		1	119	172	201	229	261	354
Cheyenne, WY	224	0.5	70	97	111	132	149	288
		0	16	37	52	77	100	285
		1	96	126	153	186	235	521
Chicago, IL	124	0.5	58	77	94	113	137	265
O'Hare International		0	23	38	53	75	83	150
		1	85	124	157	195	230	432
Cleveland, OH	188	0.5	52	73	92	118	147	235
		0	23	37	47	69	92	225
		1	89	135	167	202	219	327
Colorado Springs,	159	0.5	57	82	99	124	140	218
CO		0	23	45	61	87	112	165
		1	71	101	123	149	175	328
Columbus, OH	92	0.5	45	60	71	87	95	184
International Airport		0	15	30	45	60	62	135
		1	120	174	208	255	289	414
Des Moines, IA	127	0.5	74	102	120	149	180	310
		0	24	46	69	94	108	231
		1	92	130	156	192	212	360
Detriot, MI	153	0.5	57	77	94	118	134	227
Metro Airport		0	23	38	47	75	89	194
		1	123	171	201	238	250	370
Duluth, MN	238	0.5	71	97	114	131	142	213
		0	22	32	46	68	77	196
		1	67	97	116	134	162	242
Ely, NV	153	0.5	44	66	83	111	129	241
		0	23	45	67	97	112	240
		1	59	110	139	165	171	224
Eugene, OR	18	0.5	47	77	93	119	122	164
		0	30	53	70	102	120	164
		1	91	121	144	174	202	391
Fairbanks, AK	288	0.5	52	68	78	94	108	200
		0	15	23	21	40	48	87
		1	87	139	172	235	282	431
Baltimore, MD	56	0.5	69	108	147	200	237	369
BWI Airport		0	46	84	119	181	214	306
		1	123	171	193	233	276	392
Great Falls, MT	233	0.5	71	93	107	129	144	210
		0	17	31	45	60	75	143
		1	95	134	158	194	215	284
Indianapolis, IN	96	0.5	58	80	96	116	124	209
		0	23	38	52	83	99	209

Snowmelt Table Continued

Frenquencies of Snow-Melting Surface Heat Fluxes at Steady State Conditions

Location	Snowfall Hours Per Year	Snow-Free Area Ratio, Ar	Heat Fluxes Not Exceeded During Indicated Percentage of Snowfall Hours from 1982 through 1993, Btu/h*ft2: 75%	90%	95%	98%	99%	100%
		1	81	108	123	150	170	233
Lexington, KY	50	0.5	49	65	74	85	95	197
		0	16	30	39	46	55	162
		1	99	138	164	206	241	449
Madison, WI	161	0.5	61	82	98	129	163	245
		0	23	39	60	91	113	194
		1	106	141	172	200	206	213
Memphis, TN	13	0.5	75	96	115	118	130	157
		0	40	75	76	90	97	123
		1	101	135	164	196	207	431
Milwaukee, WI	161	0.5	62	83	101	128	147	246
		0	23	46	68	98	120	239
		1	119	169	193	229	254	332
Minneapolis-St. Paul, MN	199	0.5	73	99	114	138	154	287
		0	23	45	61	91	113	245
		1	91	134	164	207	222	333
New York, JFK Airport	61	0.5	63	93	118	145	164	325
		0	38	68	86	113	133	316
		1	117	168	215	248	260	280
Oklahoma City, OK	35	0.5	72	101	123	133	144	208
		0	24	46	68	78	113	190
		1	108	148	189	222	259	363
Omaha, NE	94	0.5	65	89	105	128	135	186
		0	23	38	60	90	100	136
		1	95	139	166	201	227	436
Peoria, IL	91	0.5	58	83	99	119	130	250
		0	23	38	53	76	92	228
		1	94	129	154	208	246	329
Philadelphia, PA, International Airport	56	0.5	65	90	112	162	185	267
		0	38	63	79	111	150	225
		1	83	125	159	194	219	423
Pittsburgh, PA International Airport	168	0.5	51	75	94	111	129	216
		0	16	31	46	68	77	136
		1	120	168	195	234	266	428
Portland, ME	157	0.5	76	108	132	168	199	376
		0	39	67	90	130	152	324
		1	50	78	102	177	239	296
Portland, OR		0.5	39	55	81	114	130	199
		0	23	45	60	78	102	128
		1	139	203	252	312	351	482
Rapid City, SD	177	0.5	78	111	132	164	183	245
		0	16	30	38	53	65	179
		1	50	72	89	116	137	191
Reno, NV	63	0.5	36	55	75	105	115	172
		0	23	45	68	91	113	159
		1	52	77	89	110	120	171
Salt Lake City, UT	142	0.5	39	62	76	96	104	171
		0	30	60	75	89	104	171
		1	112	153	183	216	249	439
Sault Ste. Marie, MI		0.5	66	88	104	125	142	239
		0	23	37	47	68	83	188
		1	56	107	138	171	205	210
Seattle, WA	27	0.5	45	72	97	122	133	175
		0	37	52	75	96	123	151
		1	67	98	116	141	159	227
Spokane, WA	144	0.5	45	61	73	84	95	145
		0	23	37	45	54	67	112
		1	110	155	179	215	224	292
Springfield, MO	58	0.5	70	95	117	142	171	240
		0	32	54	76	115	129	227
		1	97	147	170	193	227	344
St Louis, MO International Airport	62	0.5	66	90	105	126	144	269
		0	31	53	68	97	104	194
		1	102	153	192	234	245	291
Topeka, KS	61	0.5	64	92	110	132	139	185
		0	23	39	52	68	84	167
		1	115	163	209	248	285	326
Wichita, KS	60	0.5	71	96	116	137	153	168
		0	24	45	57	75	83	158

Heat Fluxes are at the snow-melting surface only. See Text for calculation of back and edge heat loss fluxes

Multiply values by 0.2391 to convert to W/FT2.

Annual Operating Data

The following table has been provided from the ASHRAE Applications Handbook 2014, Chapter 51 "Snow Melting and Freeze Protection." The table refers to Annual Energy Requirements per snow melting area at steady-state conditions.

Annual Operating Data at 99% Satisfaction Level of Heat Flux Requirement									
				Annual Energy Requirements per Unit Area at Steady-State Conditions, A Btu/FT2					
	Time, h/yr		2% Min. Snow	System Designed for Ar = 1		System Designed for Ar = 0.5		System Designed for Ar = 0	
Location	Melting	Idling	Temp., F	Melting	Idling	Melting	Idling	Melting	Idling
Albany, NY	156	1,883	9.3	10,132	109,230	7,252	109,004	4,731	108,240
Albuquerque, NM	44	954	16.3	2,455	38,504	1,729	38,495	984	38,332
Amarillo, TX	64	1,212	6.8	5,276	62,557	3,314	62,136	1,357	61,710
Billings, MT	225	1,800	-10.8	17,299	116,947	10,526	111,803	3,716	91,360
Bismarck, ND	158	2,887	-8.8	16,295	207,888	9,321	201,565	2,300	157,503
Boise, ID	85	1,611	5.3	3,543	74,724	2,449	73,015	1,345	68,456
Boston, MA	112	1,273	16.3	7,694	77,992	5,455	77,907	3,218	77,747
Buffalo, NY	292	1,779	3.8	23,929	105,839	14,735	105,521	5,563	101,945
Burlington, VT	204	2,215	4.3	13,182	147,122	8,485	143,824	3,783	134,634
Cheyenne, WY	224	2,152	-15.8	20,061	126,714	11,931	125,635	3,782	120,915
Chicago, IL O'Hare International	124	1,854	3.8	8,501	116,663	5,402	112,763	2,252	100,427
Cleveland, OH	188	1,570	8.8	11,419	86,539	7,359	85,470	3,208	80,851
Colorado Springs, CO	159	1,925	-8.8	11,137	97,060	7,089	96,847	3,026	96,244
Columbus, OH International Airport	92	1,429	12.8	4,581	71,037	2,972	68,002	1,367	62,038
Des Moines, IA	127	1,954	-1.8	10,884	128,140	6,796	125,931	2,654	116,545
Detriot, MI Metro Airport	153	1,781	11.3	10,199	104,404	6,467	102,289	2,704	95,777
Duluth, MN	238	3,206	0.3	20,838	251,218	12,423	236,657	3,969	187,820
Ely, NV	153	2,445	13.3	7,421	141,288	5,268	139,242	3,098	136,920
Eugene, OR	18	481	15.8	841	17,018	634	16,997	429	16,992
Fairbanks, AK	288	4,258	-15.8	19,803	343,674	11,700	318,880	3,559	194,237
Baltimore, MD BWI Airport	56	957	16.3	3,827	45,132	2,970	45,132	2,121	45,130
Great Falls, MT	233	1,907	-15.8	19,703	123,801	11,731	120,603	3,736	101,712
Indianapolis, IN	96	1,473	10.8	6,558	80,942	4,132	78,532	1,705	75,926
Lexington, KY	50	1,106	13.3	2,696	54,084	1,718	52,278	733	45,859
Madison, WI	161	2,308	5.3	11,404	149,363	7,279	147,112	3,094	140,108
Memphis, TN	13	473	12.8	1,010	21,756	691	21,518	373	21,102
Milwaukee, WI	161	1,960	7.3	11,678	127,230	7,564	123,960	3,431	119,945
Mineapolis-St. Paul, MN	199	2,513	0.3	16,532	183,980	10,325	178,495	4,097	166,921
New York, JFK Airport	61	885	18.3	4,193	50,680	2,988	50,467	1,797	50,049
Oklahoma City, OK	35	686	6.8	2,955	40,957	1,850	39,725	741	38,308
Omaha, NE	94	1,981	-2.3	7,425	124,274	4,613	119,565	1,790	112,700
Peoria, IL	91	1,748	2.3	6,544	104,380	4,078	100,581	1,606	94,045
Philadelphia, PA, International Airport	56	992	18.3	3,758	50,494	2,669	50,412	1,588	50,203
Pittsburgh, PA International Airport	168	1,514	9.3	10,029	79,312	6,350	77,750	2,626	72,361
Portland, ME	157	1,996	7.3	13,318	115,248	8,969	115,196	4,630	114,836
Portland, OR	15	329	21.8	623	13,399	464	13,194	310	12,918
Rapid City, SD	177	2,154	-4.8	16,889	137,523	9,738	135,024	2,535	106,102
Reno, NV	63	1,436	16.3	2,293	54,713	1,792	54,706	1,302	54,703
Salt Lake City, UT	142	1,578	16.3	5,263	70,254	4,271	69,927	3,286	69,927
Sault Ste. Marie, MI	425	2,731	-0.3	34,249	176,517	20,779	174,506	7,250	155,508
Seattle, WA	27	260	17.8	1,212	10,482	943	10,473	682	10,452
Spokane, WA	144	1,832	10.8	6,909	81,000	4,721	79,177	2,512	75,659
Springfield, MO	58	1,108	6.8	4,401	57,165	2,950	56,929	1,503	56,238
St Louis, MO	62	1,150	6.8	4,516	64,668	2,981	63,428	1,446	60,764
International Airport		0		31	53	68	97	104	194
Topeka, KS	61	1,409	-1.8	4,507	75,598	2,821	74,028	1,126	68,402
Wichita, KS	60	1,223	0.3	4,961	69,187	3,106	67,828	1,229	60,991
Does not include back and edge losses.									
Multiply values by 0.2391 to convert to W/FT2.									

Annual Operating Data Explanation

Melting and idling hours are summarized in this table, along with the energy unit per area needed to operate the system during an average year based on the calculations for the years 1982 to 1993. Back and edge heat losses are not included in the energy values. Data are presented for snow-free area ratios 1.0, 0.5, and 0.

The energy per unit values are based on systems designed to satisfy the loads 99% of the time (i.e., at the levels indicated in the 99% column in the Frequencies of Snow-Melting Surface Heat Fluxes as Steady-State Conditions Table) for each AR value. The energy use for each melting hour is taken as either (1) the actual energy required to maintain the surface at 33°F or (2) the design output, whichever is less. The snow melting energy differs, of course, depending on whether the design is for AR = 1.0, 0.5, or 0; therefore, the annual melting energy differs as well.

The idling hours include all non-snowfall hours when the ambient temperature is below 32°F. The energy consumption for each idling hour is based on either (1) the actual energy required to maintain the surface at 32°F or (2) the design snow melt energy, whichever is less.

In the column labeled "2% Min. Snow Temp." is the temperature below which only 2% of the snowfall hours occur. The Annual Operating Data may only be used to predict annual operating costs. Use the Frequencies of Snow-Melting Surface Heat Fluxes as Steady-State Conditions Table for system sizing.

All the information and descriptions on the two previous tables have been taken from the 2014 ASHRAE Handbook, Chapter 51 "Snow Melting and Freeze Protection."

The ASHRAE annual operating cost formula can be found in the ASHRAE Handbook, Chapter 51 "Snow Melting and Freeze Protection," which will correspond with the table above.

The operation of idling systems can use quite a bit more energy than an on-demand system. We recommend an idling system *only* when it is imperative that the area be free of snow and ice at all times.

Pictured above is a snowmelt boiler system designed to be placed outdoors. Weather-proofing must be considered in the design application of this system. This is a great option for when indoor space is not available.

STEP 3

Tube Specifications

Select the type of tubing to be used in the system (21). PEX and BPEX are preferred in asphalt or oil applications due to their ability to withstand petrochemicals. Tube size is primarily a function of heat output required due to the flow needed to provide the necessary heat to the area. The higher the design snow load per square foot, the larger the tube. Also larger areas may require a larger diameter tube to allow longer circuit lengths.

The best heat distribution is achieved with small tubes closely spaced, but it is also the most expensive method. Also, brick pavers and asphalt have lower heat transfer rates than concrete. Therefore tubes are often placed closer together when installed with these materials, and a compromise is reached between cost and effectiveness.

Locate the closest design snowmelt load (17) at the top of the **Recommended Tube Spacing Table** and the desired tube size (22) on the left. Extend lines down and horizontally to intersect at the appropriate spacing (23). This represents the space from center line to center line of tubes laid parallel to each other.

Select the spacing factor (24) from the **Tube Spacing Factor Chart** (pg. 16). Multiply the spacing factor (24) by the snowmelt area (1) to find the total tube required (25) to cover the snowmelt area. Be sure to add any additional tube that may be required to get to and from the manifold if it is a remote location which is not a part of the snowmelt area.

To find the number of coils needed (26), divide the total tube required (25) by the maximum coil length (from the Recommended Tube Spacing Chart) and round up to the nearest whole number.

Snow Detection Slab Sensor in a hydronic snowmelt system

Recommended Tube Spacing

Tube Size	Max. Coil Length	Recommended Tube Spacing									
		Load in Btu/(hr*ft2)									
		50	100	150	200	250	300	350	400	450	500
1/2"	200 ft	12"	9"	9"	6"	4"	4"				
5/8"	250 ft	12"	9"	9"	9"	6"	6"				
3/4"	400 ft	15"	12"	12"	9"	9"	6"	6"	4"	4"	4"
1"	500 ft	15"	15"	12"	9"	9"	6"	6"	4"	4"	4"
The tube spacing factor in the table indicates the amount of tubing required per square foot for various tube spacing. Locate the tube spacing on the Table and read the spacing factor (24) directly below											

Tube Spacing Factor

Tube Spacing	Tube Spacing Factor				
Spacing	4"	6"	9"	12"	15"
Factor	3	2	1.33	1	0.8
Total Tube Required = Spacing Factor x snow melt Area					

To find the estimated coil length (27), divide the total tube required (25) by the number of coils (26). For balancing purposes, it is desirable to keep all coils as close to the same length. This is not always possible. Using Infloor's OEM LoopCAD design program, draw the snowmelt area and draw in the coils to scale using the estimated coil length found in this step. It is best to start with the area furthest from the manifold and begin to fill back towards the manifold. If it is not possible to maintain equal coil lengths, LoopCAD will record the different coil lengths as you lay them out.

In preparation for calculating the head pressure in each coil, divide the system flow rate (20) by the total tube required (25). The result is the flow per foot of tube (28). Multiply the flow per foot of tube (28) by the estimated coil length (27) to determine the flow per circuit (29).

Using the Pressure Loss Diagram with 50% Glycol (*in the Appendix*), determine the head pressure loss per foot of tube for the size selected. Enter the chart on the left at the flow rate for the circuit and move right until the pipe size is intersected. Drop down and read the pressure drop per foot of tube (30). Multiply the pressure drop by the estimated coil length (27) to determine the circuit pressure drop (31).

NOTE: TUBING PLACED IN ASPHALT OR UNDER BRICK PAVERS REQUIRES CLOSER SPACING. MOVE TUBES 1" CLOSER FOR EACH 1" THICKNESS OF ASPHALT. FOR BRICK PAVERS, MOVE TUBES 1" CLOSER FOR EACH ADDITIONAL INCH OF DEPTH BEYOND THE 2" RECOMMENDED DEPTH, I.E.: TUBING PLACED 1" DEEP IN A SAND BED UNDER 4" THICK PAVERS REQUIRES A 3" CLOSER SPACING.

INFLOOR HEATING SYSTEMS

STEP 4

Fluid Specifications

There are three factors that affect the required fluid temperature. The average fluid temperature must be hotter when the load is increased, when the depth of the tube is increased, and/or when the spacing between tubes is increased. The **Fluid Supply Temperature Table** provides the supply fluid temperature based on the design snowmelt load, tube spacing, and the design temperature drop of the fluid.

Locate the design snowmelt load (17) on the left hand side of the table. Some interpolation may be required. Extend a line horizontally to intersect the appropriate tube spacing (23) and design fluid temperature drop (6). This is the fluid supply temperature (32).

To find the fluid return temperature (33), subtract the temperature drop (6) from the supply temperature (32).

Fluid Supply Temperature

Fluid Supply Temperature at various fluid temperature drops															
Btu/ (hr*sq. ft.)	20 F Temp Drop Tube Spacing					30 F Temp Drop Tube Spacing					40 F Temp Drop Tube Spacing				
	4"	6"	9"	12"	15"	4"	6"	9"	12"	15"	4"	6"	9"	12"	15"
20	56	58	61	63	66	66	68	71	73	76	76	78	81	83	86
40	60	63	68	73	78	70	73	78	83	88	80	83	88	93	98
60	63	68	76	83	91	73	78	86	93	101	83	88	96	103	111
80	66	73	83	93	103	76	83	93	103	113	86	93	103	113	123
100	70	78	91	103	113	80	88	101	113	126	90	98	111	123	136
120	73	83	98	113	128	83	93	108	123	138	93	103	118	133	148
140	76	88	106	123	141	86	98	116	133	151	96	108	126	143	161
160	80	93	113	133	153	90	103	123	143	163	100	113	133	153	173
180	83	98	121	143	166	93	108	131	153	176	103	118	141	163	186
200	86	103	128	153	178	96	113	138	163	188	106	123	148	173	198
220	90	108	136	163	191	100	118	146	173	201	110	128	156	183	211
240	93	113	143	173	203	103	123	153	183	213	113	133	163	193	223
260	96	118	151	183	216	106	128	161	193	226	116	138	171	203	
280	100	123	158	193	228	110	133	168	203		120	143	178	213	
300	103	128	166	203		113	138	176	213		123	148	186	223	
320	106	133	173	213		116	143	183	223		126	153	193		
340	110	138	181	223		120	148	191			130	158	201		
360	113	143	188			123	153	198			133	163	208		
380	116	148	196			126	158	206			136	168	216		
400	120	153	230			130	163	213			140	173	223		
420	123	158	211			133	168	221			143	178			

As the fluid temperature difference decreases, the gpm must increase to maintain the same output.

STEP 5

Boiler Requirements

Since snowmelt systems require the addition of freeze protection fluid, it is recommended that a dedicated boiler system be used. This eliminates the need to install freeze protection in the heating system, and improves the overall efficiency of the heating system since de-rating due to the addition of freeze protection is not necessary.

However, if a snowmelt system and heating are to be serviced by the same boiler, it is not necessary to add the total snow melting load to the heating load. Since most snowfall occurs at an average temperature of 26 °F (U.S. Weather Bureau), most heating systems are not operating at their designed capacity. Heating systems are designed to overcome the heat loss during much colder temperature periods. Therefore, additional capacity exists in the boiler at snowmelt temperatures. See the **Boiler Capacity Table** for the boiler output available for snow melting.

Example: If a snowmelt system needs 100,000 BTU/hr and a heating system needs 200,000 BTU/hr at a design condition of -10°F, the boiler has 45% of its capacity available for the snowmelt requirement. Therefore the boiler has 88,000 BTU/hr available for snowmelt and an additional 12,000 BTU/hr is all that is required. The boiler only needs to be upgraded for the additional 12,000 BTU/hr, not the whole snowmelt load. (Also add the losses through a heat exchanger, if used.)

There are energy management controls available for residential and commercial heating and snow melting that will take into account if the snow melting system is calling during heating times and limit the available BTU's to the snowmelt system.

These controls will monitor the inside heating conditions and modulate the output of the snow melt system to prevent the drop of temperature on the heating side of the system.

Boiler Capacity Table

Design Temperature of Heatin System				
20 F	10 F	0 F	-10 F	-20 F
10%	25%	35%	45%	50%
Boiler Capacity Available at 26 F for Snow Melting				

STEP 6

Tube Installation

Tubing may be installed in a serpentine or grid pattern. The serpentine pattern allows supply and return manifolds to be located together and minimizes system pipes. Whenever tube or system piping crosses an expansion joint, route the tubing under the joint in the subsoil and protect it with an insulation sleeve. (All system piping, including supply and return mains, should be insulated to prevent excessive heat loss.)

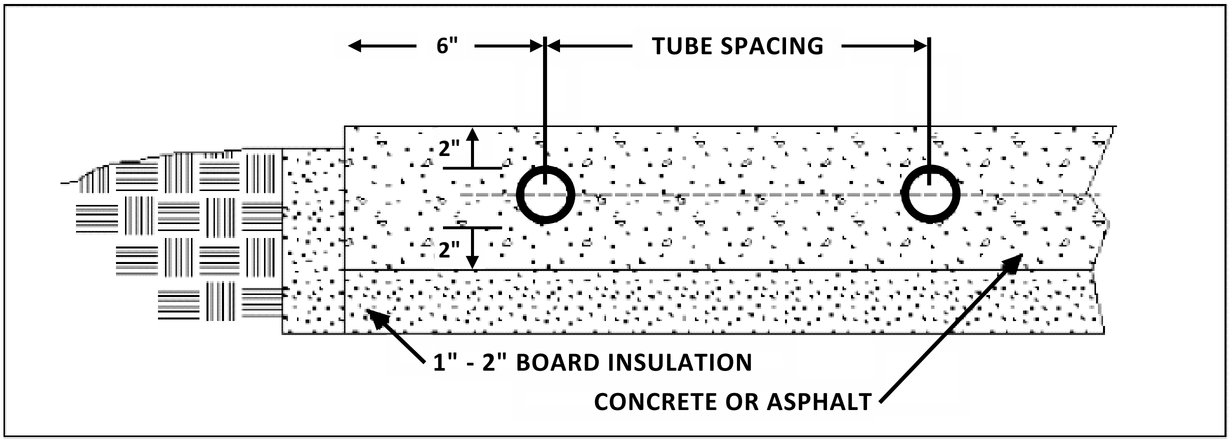
Use care to install the tube at the required depth. A change in tube depth can have a dramatic effect on system performance.

General Description of System

The hydronic system for snowmelting designed in accordance with this guide is composed of tubing buried in a concrete or asphalt walk or driveway.

Tubing size will range from 1/2" to 1" depending on system flow requirements. These coils are usually connected by means of a manifold and a supply and return main to an indirect heat exchanger attached to the boiler. The piping system is a "closed system" with an air cushion tank, pump, air eliminator, purging valves, and a pressure relief valve. It is filled with an anti-freeze solution composed of water and propylene glycol intended for this type of application. This solution is heated by the heat exchanger and circulated through the coils by means of a pump.

Slab Cross Section

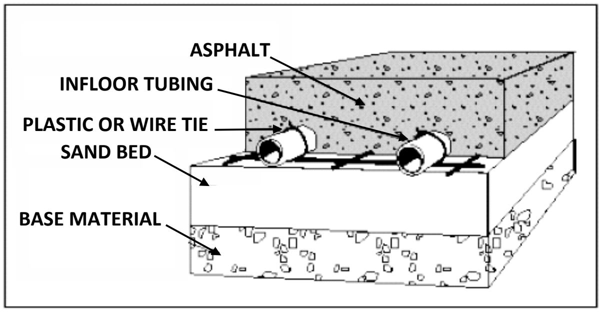


NOTE: INFLOOR TUBING MAY BE INSTALLED IN ASPHALT APPLICATIONS. SPECIFIC PROCEDURES MUST BE FOLLOWED TO PREVENT TUBE DAMAGE.

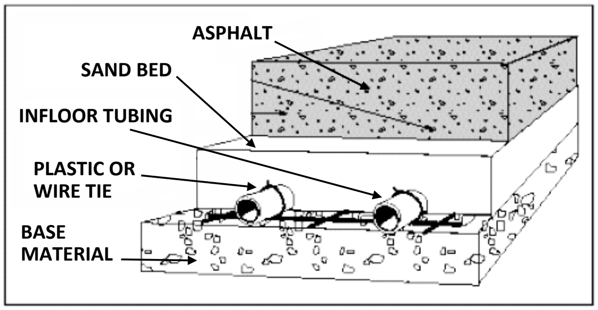
Installation in Asphalt

A maximum asphalt temperature of 270°F is required. The contractor should have workmanship, tools, and instruments required to install the asphalt successfully below this temperature. The addition of small amounts of certain petroleum products to the asphalt prior to installation is said to be common practice at comparatively low asphalt temperatures. Tubes should be pressurized prior to the asphalt pour, and cold tap water should be flushing through the tubes to a drain during the pour, maintaining a static pressure between 15-40 PSI (achieved by regulating a valve near the drain). The water flow through the tubes may need to be increased during the pour to ensure that a maximum water outlet temperature of 140°F is maintained. Continue flushing water through the tubes until the asphalt temperature is below 140°F.

PEX/BPEX in Asphalt



PEX/BPEX in Sand Bed



Summary

The line-by-line procedures provided in this guide will give the user basic information needed to design a hydronic snowmelt system. Check with code officials before installation to make sure the design meets local plumbing and mechanical requirements.

Remember, the design is only as good as the input. We highly suggest the use of Infloor's OEM LoopCAD design program for sizing snowmelt systems and loop layout. If LoopCAD is not available, utilize the best, most reliable data possible for the location and application.

Collecting weather information is not always easy, but is only required once for an area. After it is acquired, the same information is used from job to job in a given geographical location.

Acknowledgement

Special thanks to the **Hydronics Institute** and the original **Radiant Panel Association** for the information used in this snowmelt installation guide, which was based on the I-B-R "Snowmelting" guide.

The Snowmelt Tables and Annual Operating Data was provided by the 2014 **ASHRAE** Handbook, Chapter 51 "Snow Melting and Freeze Protection."

Snowmelt Design Form

STEP 1 - *DESIGN INFORMATION*

1. Snowmelt Area ________
2. Construction Method ________
3. Glycol Solution ________
4. Freeze Protection ________
5. Fluid Temperature Drop ________
6. System Type ________

STEP 2 - *SNOWMELT LOAD REQUIREMENTS*

7. Maximum Snowfall Rate ________
8. Design Temperature ________
9. Average Wind Speed ________
10. No Wind Slab Load in BTU/(h*ft^2) ________
11. Wind Speed Slab Load in BTU/(h*ft^2) ________
12. Total of 10 and 11 ________
13. Back Loss slab Load in BTU/(h*ft^2) ________
14. Adjusted Snow Load Requirement in BTU/(h*ft^2) ________
15. System Response Time ________
16. Pick-up Load in BTU/(h*ft^2) ________
17. Design Snowmelt Load in BTU/(h*ft^2) ________
18. System BTU/hr Requirement ________
19. Heat Capacity of Fluid ________
20. System Flow Rate ________

STEP 3 - *TUBE SPECIFICATIONS*

21. Type of Tubing ________
22. Tube Size ________
23. Tube Spacing ________
24. Spacing Factor ________
25. Total Tube Required ________
26. Number of Coils ________
27. Estimated Coil Length ________
28. Flow per Foot of Tube ________
29. Flow per Circuit ________
30. Pressure Drop per Foot of Tube ________
31. Circuit Pressure Drop ________

STEP 4 - *FLUID SPECIFICATIONS*

32. Fluid Supply Temperature ________
33. Fluid Return Temperature ________

Head Loss Chart 1

	Head Loss / 100 FT At 100 F									
	with 50% Propylene Glycol					with Water				
GPM	3/8" PEX/BPEX	1/2" PEX/BPEX	5/8" PEX/BPEX	3/4" PEX/BPEX	1" PEX/BPEX	3/8" PEX/BPEX	1/2" PEX/BPEX	5/8" PEX/BPEX	3/4" PEX/BPEX	1" PEX/BPEX
0.10	1.22	0.37	0.19	0.09	0.05	0.27	0.07	0.05	0.02	0.00
0.20	2.47	0.74	0.35	0.19	0.07	0.09	0.23	0.09	0.05	0.02
0.30	3.70	1.13	0.53	0.30	0.12	1.85	0.44	0.18	0.09	0.02
0.40	4.94	1.50	0.72	0.39	0.14	3.05	0.74	0.30	0.14	0.05
0.50	6.91	1.87	0.90	0.49	0.19	4.5	1.09	0.46	0.21	0.07
0.60	9.49	2.31	1.06	0.58	0.21	6.21	1.50	0.62	0.3	0.09
0.70	12.42	3.02	1.25	0.67	0.25	8.13	1.96	0.81	0.39	0.12
0.80	15.7	3.81	1.57	0.76	0.28	10.28	2.49	1.04	0.51	0.16
0.90	19.29	4.69	1.94	0.92	0.32	12.64	3.07	1.27	0.60	0.18
1.00	23.19	5.64	2.33	1.13	0.35	15.18	3.7	1.53	0.74	0.23
1.20	31.92	7.74	3.21	1.55	0.46	20.88	5.08	2.10	1.02	0.30
1.40	41.78	10.14	4.20	2.03	0.62	27.35	6.65	2.75	1.32	0.39
1.60	52.80	12.82	5.31	2.56	0.79	34.56	8.39	3.47	1.66	0.51
1.80	64.89	15.75	6.51	3.14	0.95	42.48	10.3	4.27	2.06	0.62
2.00	78.03	18.94	7.83	3.79	1.16	51.07	12.4	5.13	2.47	0.76
2.20	92.19	22.38	9.26	4.46	1.36	60.34	14.65	6.05	2.91	0.88
2.40	107.35	26.06	10.79	5.20	1.57	70.27	17.05	7.07	3.40	1.04
2.60		29.98	12.41	5.98	1.83		19.61	8.13	3.90	1.20
2.80		34.12	14.11	6.82	2.08		22.34	9.24	4.46	1.36
3.00		38.51	15.94	7.67	2.33		25.2	10.44	5.04	1.53
3.20		43.1	17.83	8.59	2.61		28.29	11.69	5.64	1.71
3.40		47.93	19.84	9.56	2.91		31.37	12.98	6.26	1.89
3.80		58.24	24.09	11.62	3.53		38.12	15.77	7.60	2.31
4.20		69.39	28.71	13.84	4.20		45.41	18.8	9.06	2.75
4.60		81.36	33.68	16.22	4.94		53.27	22.04	10.63	3.23
5.00			38.97	18.78	5.71			25.50	12.29	3.74
5.40			44.58	21.48	6.54			29.18	14.07	4.27
5.80			50.52	24.35	7.39			33.06	15.94	4.85
6.20			56.76	27.35	8.32			37.17	17.9	5.45
6.60			63.34	30.52	9.29			41.46	19.98	6.08
7.00				33.84	10.28				22.15	6.72
7.40				37.28	11.34				24.42	7.42
7.80				40.89	12.43				26.78	8.13
8.60				48.51	14.74				31.76	9.66
9.40					17.23					11.27
10.20	Velocity rate exceeds 8 feet per second				19.89	Velocity rate exceeds 8 feet per second				13.01
11.00					22.68					14.85
11.80					25.66					16.79
12.60					28.78					18.83
13.40					32.04					20.97
14.20					35.46					23.22

(For pressure drop, divide head loss by 2.31)

Head Loss Chart 2

	Head Loss / 100 FT At 120 F									
	with 50% Propylene Glycol					with Water				
GPM	3/8" PEX/BPEX	1/2" PEX/BPEX	5/8" PEX/BPEX	3/4" PEX/BPEX	1" PEX/BPEX	3/8" PEX/BPEX	1/2" PEX/BPEX	5/8" PEX/BPEX	3/4" PEX/BPEX	1" PEX/BPEX
0.10	0.88	0.28	0.12	0.07	0.02	0.25	0.07	0.02	0.02	0.00
0.20	1.76	0.53	0.25	0.14	0.05	0.85	0.21	0.09	0.05	0.02
0.30	2.63	0.81	0.37	0.21	0.07	1.76	0.42	0.18	0.09	0.03
0.40	4.27	1.06	0.51	0.28	0.09	2.89	0.69	0.30	0.14	0.05
0.50	6.31	1.52	0.62	0.35	0.12	4.27	1.04	0.44	0.21	0.07
0.60	8.66	2.10	0.88	0.42	0.16	5.89	1.43	0.60	0.28	0.09
0.70	11.34	2.75	1.13	0.55	0.18	7.69	1.87	0.76	0.37	0.12
0.80	14.35	3.49	1.43	0.69	0.21	9.73	2.36	0.97	0.46	0.14
0.90	17.63	4.27	1.78	0.85	0.25	11.97	2.91	1.20	0.58	0.18
1.00	21.18	5.15	2.13	1.02	0.32	14.37	3.49	1.46	0.69	0.21
1.20	29.15	7.07	2.93	1.41	0.44	19.77	4.80	1.99	0.95	0.30
1.40	38.18	9.26	3.83	1.85	0.55	25.92	6.28	2.61	1.25	0.39
1.60	48.23	11.71	4.85	2.33	0.72	32.73	7.95	3.28	1.59	0.49
1.80	59.27	14.39	5.96	2.86	0.88	40.22	9.77	4.04	1.94	0.60
2.00	71.26	17.30	7.16	3.44	1.04	48.37	11.73	4.85	2.33	0.72
2.20	84.22	20.44	8.45	4.09	1.25	57.15	13.88	5.75	2.77	0.83
2.40	98.06	23.82	9.84	4.76	1.43	66.55	16.15	6.68	3.21	0.97
2.60		27.37	11.34	5.45	1.66		18.57	7.69	3.70	1.13
2.80		31.18	12.89	6.21	1.89		21.16	8.76	4.23	1.29
3.00		35.18	14.55	7.02	2.13		23.86	9.89	4.76	1.46
3.20		39.39	16.31	7.85	2.38		26.73	11.06	5.34	1.62
3.40		43.80	18.11	8.73	2.66		29.71	12.29	5.94	1.80
3.80		53.20	22.01	10.60	3.23		36.11	14.95	7.21	2.19
4.20		63.39	26.22	12.64	3.83		43.01	17.81	8.57	2.61
4.60		74.31	30.75	14.83	4.50		50.43	20.86	10.05	3.05
5.00			35.6	17.16	5.22			24.14	11.64	3.53
5.40			40.73	19.64	5.96			27.63	13.31	4.04
5.80			46.15	22.25	6.77			31.30	15.08	4.60
6.20			51.86	24.99	7.6			35.18	16.96	5.15
6.60			57.84	27.88	8.48			39.25	18.92	5.75
7.00				30.91	9.4				20.97	6.38
7.40				34.07	10.35				23.12	7.02
7.80				37.35	11.37				25.34	7.72
8.60				44.31	13.47				30.08	9.15
9.40					15.73					10.67
10.20	Velocity rate exceeds 8 feet per second				18.16	Velocity rate exceeds 8 feet per second				12.31
11.00					20.72					14.07
11.80					23.42					15.89
12.60					26.29					17.83
13.40					29.27					19.89
14.20					32.41					21.99

(For pressure drop, divide head loss by 2.31)

INFLOOR HEATING SYSTEMS

Head Loss Chart 3

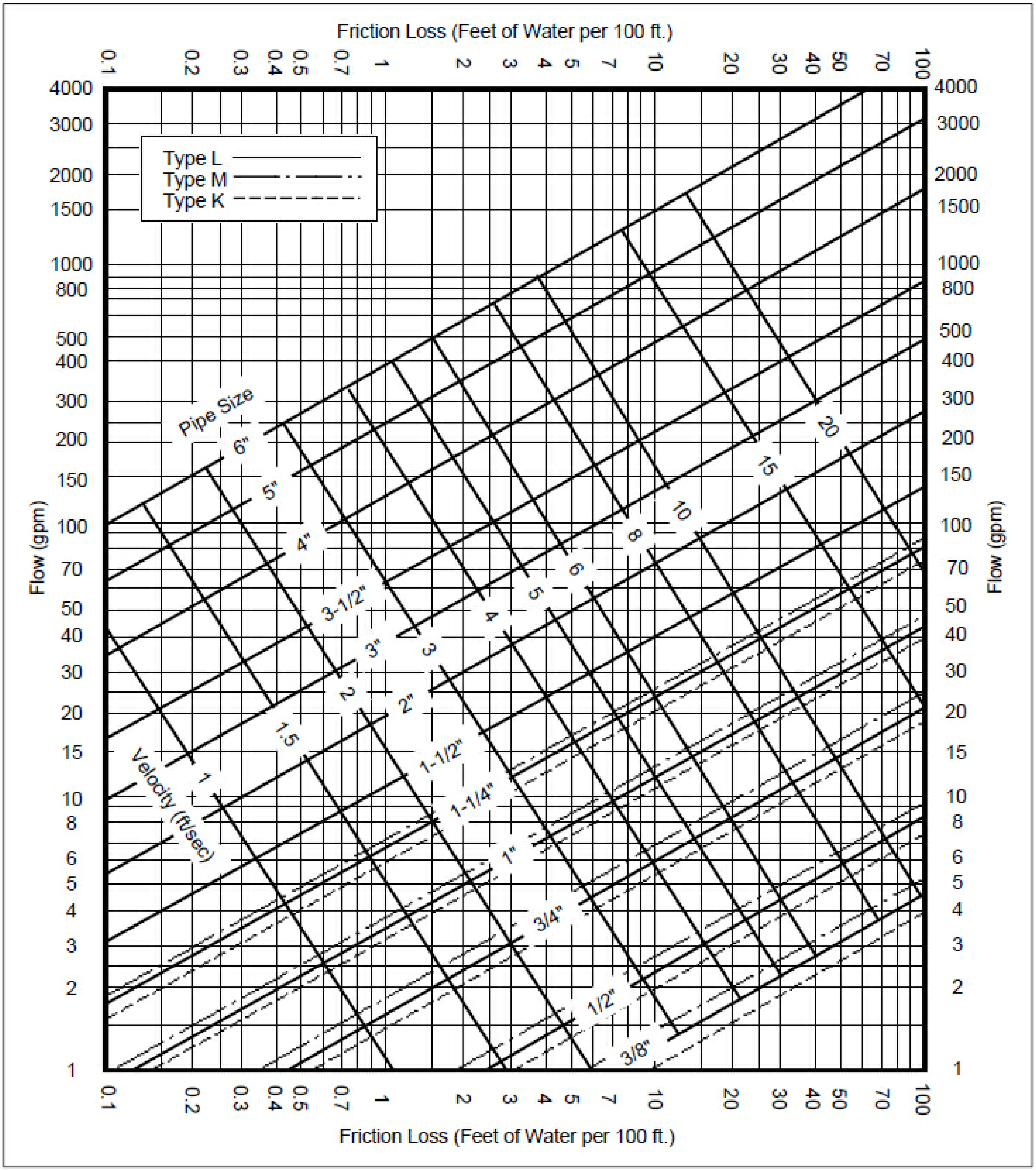
	Head Loss / 100 FT At 140 F									
	with 50% Propylene Glycol					with Water				
	3/8"	1/2"	5/8"	3/4"	1"	3/8"	1/2"	5/8"	3/4"	1"
GPM	PEX/BPEX	PEX/BPEX	PEX/BPEX	PEX/BPEX	PEX/BPEX	PEX/BPEX	PEX/BPEX	PEX/BPEX	PEX/BPEX	PEX/BPEX
0.10	0.67	0.21	0.09	0.05	0.02	0.25	0.07	0.02	0.02	0.00
0.20	1.34	0.42	0.18	0.12	0.05	0.83	0.21	0.09	0.05	0.02
0.30	2.40	0.62	0.30	0.16	0.07	1.66	0.42	0.16	0.07	0.02
0.40	3.97	0.97	0.39	0.21	0.07	2.75	0.67	0.28	0.14	0.05
0.50	5.87	1.43	0.58	0.28	0.09	4.07	0.99	0.42	0.21	0.07
0.60	8.06	1.96	0.81	0.39	0.12	5.61	1.36	0.55	0.28	0.09
0.70	10.56	2.56	1.06	0.51	0.16	7.35	1.78	0.74	0.35	0.12
0.80	13.33	3.23	1.34	0.65	0.19	9.29	2.26	0.92	0.44	0.14
0.90	16.40	3.97	1.64	0.79	0.23	11.41	2.77	1.12	0.55	0.16
1.00	19.70	4.78	1.99	0.95	0.30	13.72	3.33	1.39	0.67	0.21
1.20	27.12	6.58	2.73	1.32	0.39	18.87	4.57	1.89	0.92	0.28
1.40	35.5	8.62	3.56	1.71	0.53	24.72	6.01	2.47	1.20	0.37
1.60	44.86	10.88	4.50	2.17	0.67	31.21	7.58	3.14	1.50	0.46
1.80	55.12	13.38	5.54	2.68	0.81	38.37	9.31	3.86	1.85	0.55
2.00	66.30	16.10	6.65	3.21	0.97	46.13	11.20	4.64	2.24	0.67
2.20	78.33	19.01	7.88	3.79	1.16	54.49	13.24	5.47	2.63	0.81
2.40	91.2	22.13	9.17	4.41	1.34	63.46	15.41	6.38	3.07	0.92
2.60		25.48	10.53	5.08	1.55		17.72	7.32	3.53	1.09
2.80		28.99	11.99	5.78	1.76		20.17	8.34	4.02	1.22
3.00		32.71	13.54	6.51	1.99		22.75	9.42	4.55	1.39
3.20		36.64	15.15	7.30	2.22		25.48	10.56	5.08	1.55
3.40		40.73	16.86	8.13	2.47		28.34	11.73	5.66	1.71
3.80		49.48	20.47	9.86	3.00		34.42	14.25	6.86	2.08
4.20		58.95	24.39	11.76	3.58		41.03	16.98	8.18	2.49
4.60		69.12	28.60	13.79	4.18		48.09	19.91	9.59	2.91
5.00			33.10	15.96	4.85			23.03	11.11	3.37
5.40			37.86	18.25	5.54			26.36	12.71	3.86
5.80			42.92	20.67	6.28			29.87	14.39	4.37
6.20			48.23	23.24	7.07			33.56	16.17	4.92
6.60			53.80	25.94	7.88			37.45	18.04	5.47
7.00				28.74	8.73				20.01	6.08
7.40				31.67	9.63				22.04	6.70
7.80				34.74	10.56				24.16	7.35
8.60				41.21	12.52				28.67	8.71
9.40					14.65					10.19
10.20	Velocity rate exceeds 8 feet per second				16.89	Velocity rate exceeds 8 feet per second				11.76
11.00					19.27					13.42
11.80					21.78					15.15
12.60					24.44					17.00
13.40					27.23					18.94
14.20					30.12					20.97

(For pressure drop, divide head loss by 2.31)

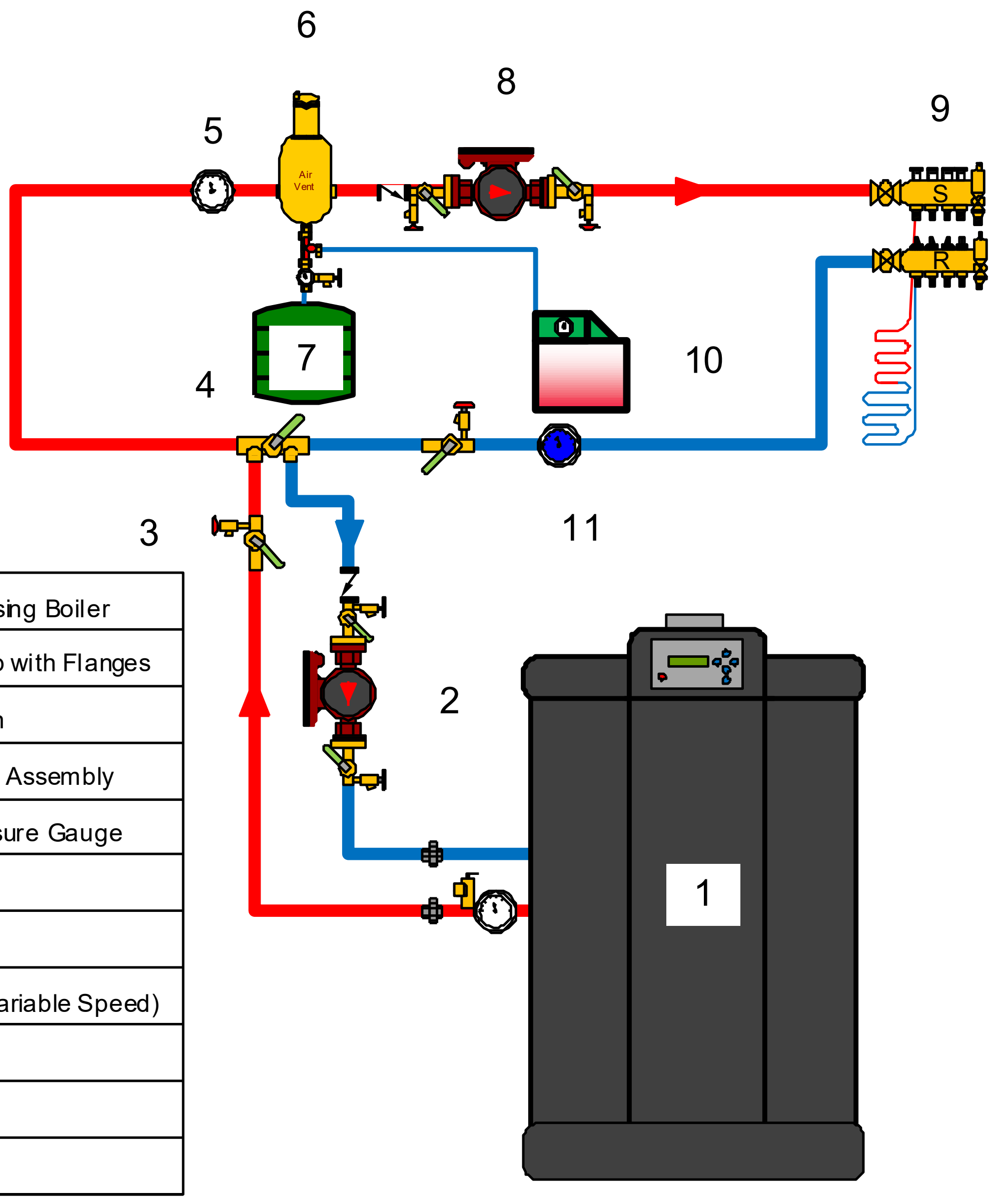
Friction Loss Chart

(Feet of Water Per 100 ft.)

For Copper Pipe

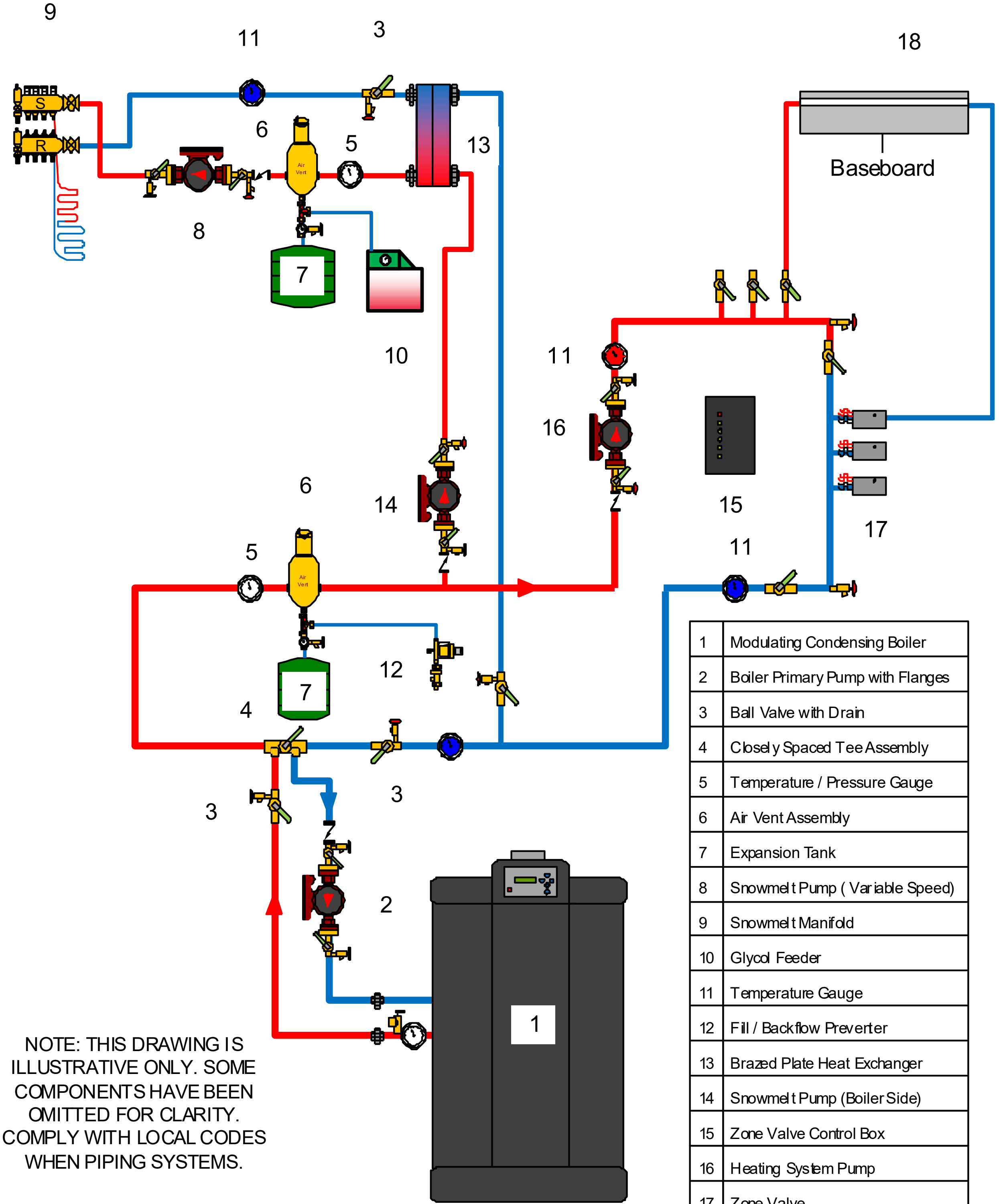


Dedicated Snowmelt Boiler System



1	Modulating Condensing Boiler
2	Boiler Primary Pump with Flanges
3	Ball Valve with Drain
4	Closely Spaced Tee Assembly
5	Temperature / Pressure Gauge
6	Air Vent Assembly
7	Expansion Tank
8	Snowmelt Pump (Variable Speed)
9	Snowmelt Manifold
10	Glycol Feeder
11	Temperature Gauge

Combined Snowmelt/Space Heating System with Heat Exchanger

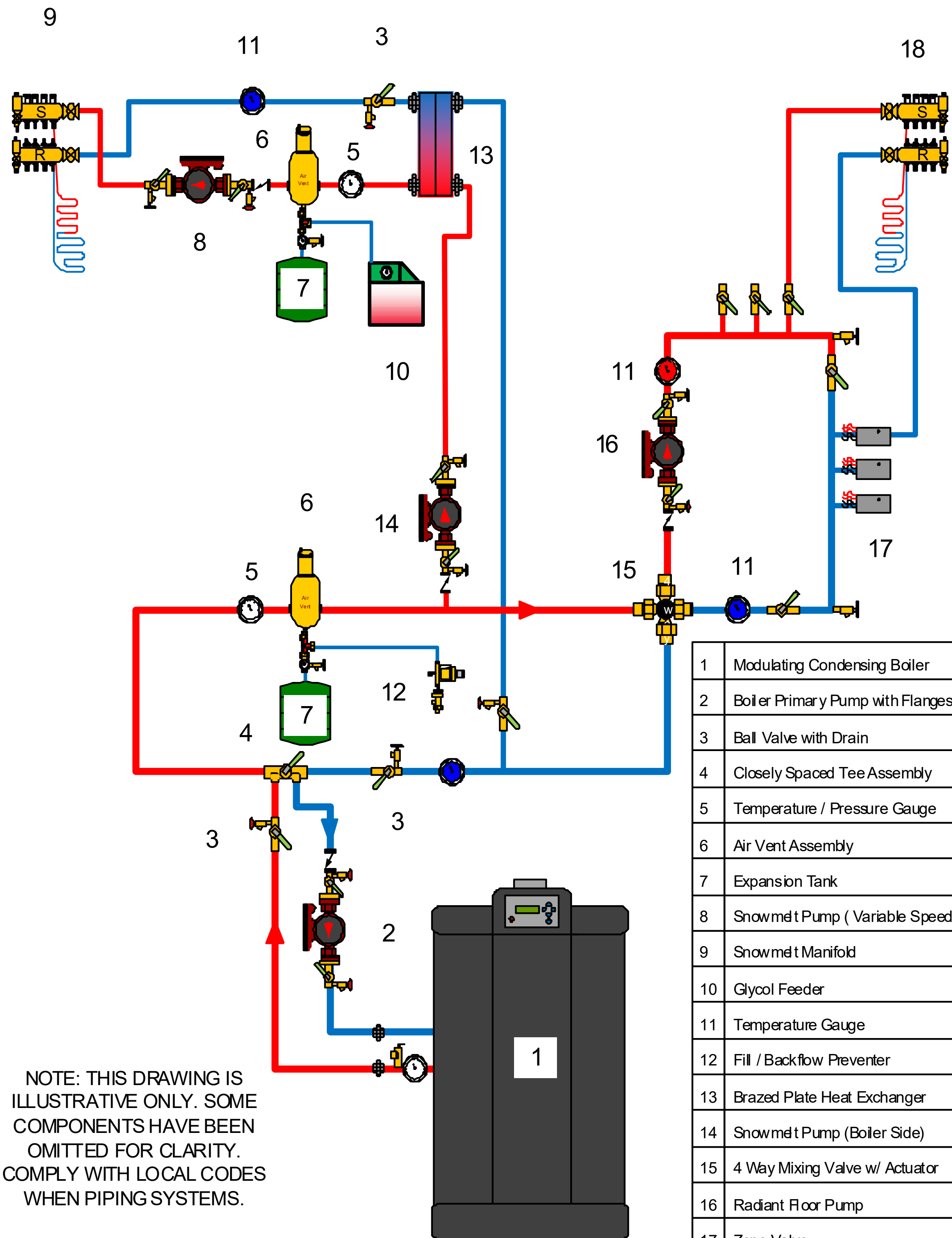


1	Modulating Condensing Boiler
2	Boiler Primary Pump with Flanges
3	Ball Valve with Drain
4	Closely Spaced Tee Assembly
5	Temperature / Pressure Gauge
6	Air Vent Assembly
7	Expansion Tank
8	Snowmelt Pump (Variable Speed)
9	Snowmelt Manifold
10	Glycol Feeder
11	Temperature Gauge
12	Fill / Backflow Preverter
13	Brazed Plate Heat Exchanger
14	Snowmelt Pump (Boiler Side)
15	Zone Valve Control Box
16	Heating System Pump
17	Zone Valve
18	Baseboard Typical

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

INFLOOR HEATING SYSTEMS

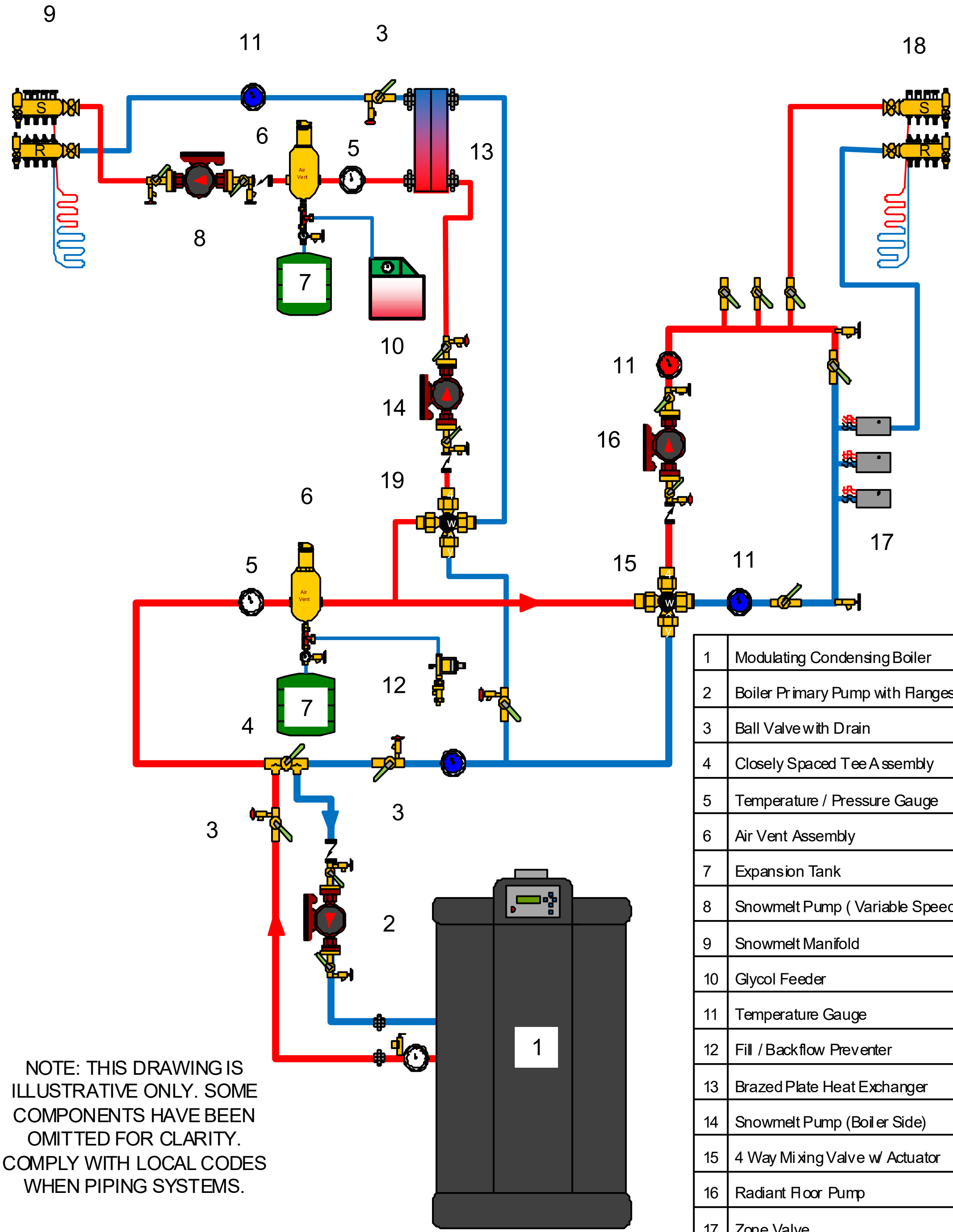
Combined Snowmelt/Space Heating System with **4**-Way Mixing Valve



1	Modulating Condensing Boiler
2	Boiler Primary Pump with Flanges
3	Ball Valve with Drain
4	Closely Spaced Tee Assembly
5	Temperature / Pressure Gauge
6	Air Vent Assembly
7	Expansion Tank
8	Snowmelt Pump (Variable Speed)
9	Snowmelt Manifold
10	Glycol Feeder
11	Temperature Gauge
12	Fill / Backflow Preventer
13	Brazed Plate Heat Exchanger
14	Snowmelt Pump (Boiler Side)
15	4 Way Mixing Valve w/ Actuator
16	Radiant Floor Pump
17	Zone Valve
18	Radiant Manifold

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

Combined Snowmelt/Radiant Heating System with **4**-Way Valves

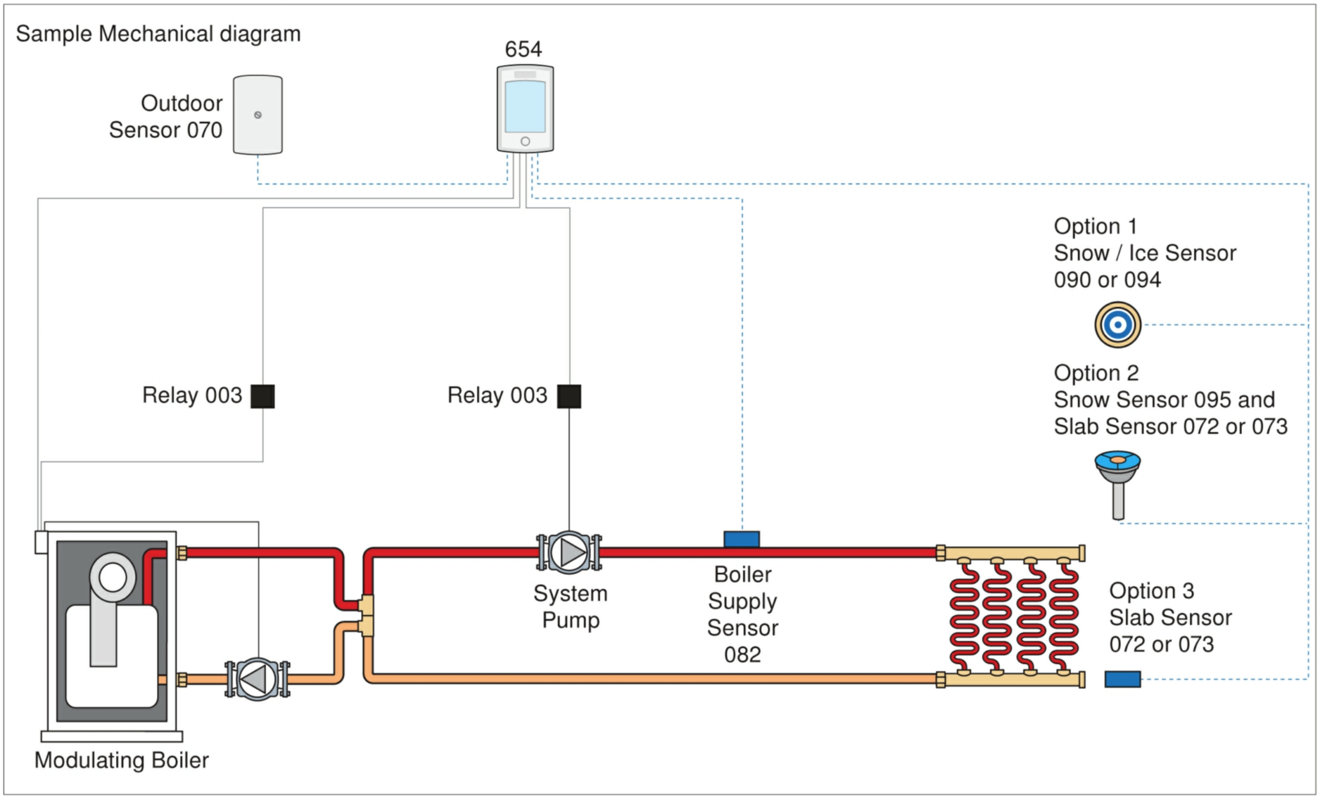


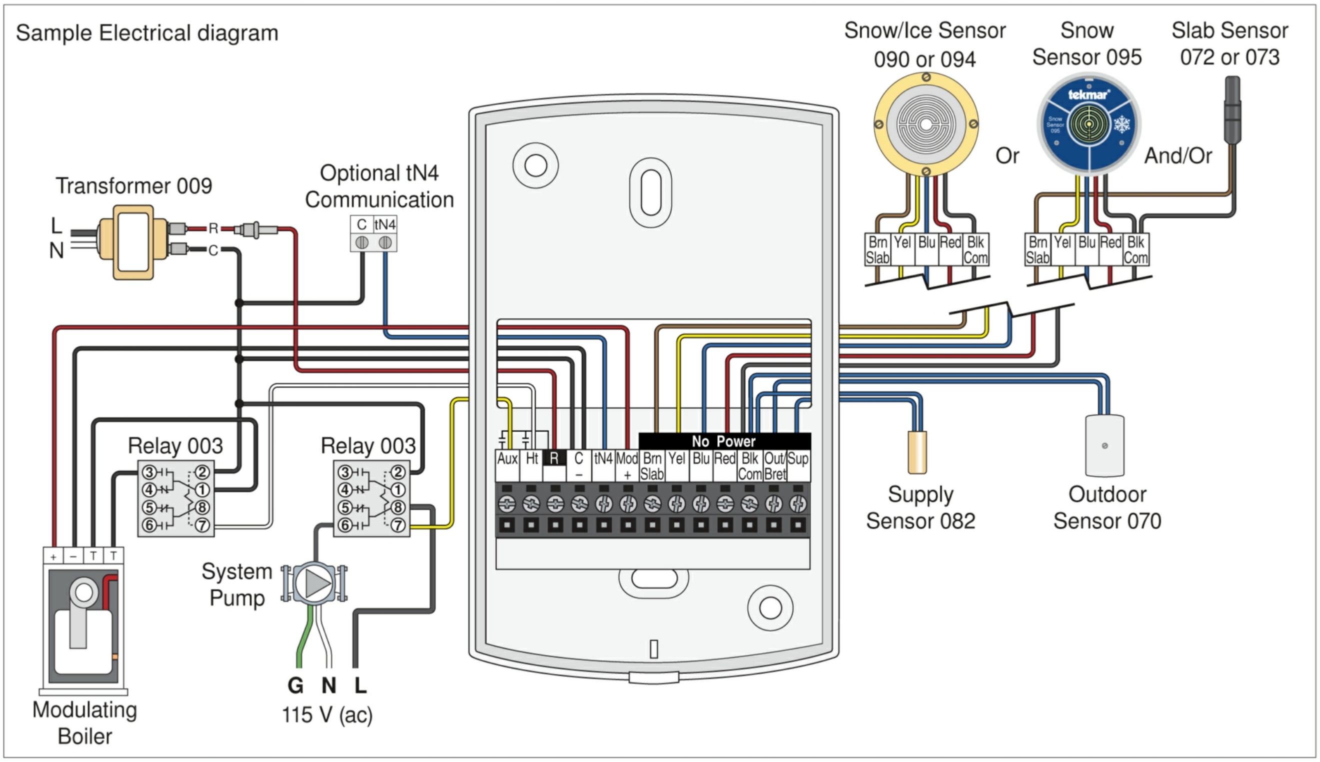
1	Modulating Condensing Boiler
2	Boiler Primary Pump with Flanges
3	Ball Valve with Drain
4	Closely Spaced Tee Assembly
5	Temperature / Pressure Gauge
6	Air Vent Assembly
7	Expansion Tank
8	Snowmelt Pump (Variable Speed)
9	Snowmelt Manifold
10	Glycol Feeder
11	Temperature Gauge
12	Fill / Backflow Preventer
13	Brazed Plate Heat Exchanger
14	Snowmelt Pump (Boiler Side)
15	4 Way Mixing Valve w/ Actuator
16	Radiant Floor Pump
17	Zone Valve
18	Radiant Manifold
19	4 Way Mixing Valve w/ Actuator

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

Automatic Snowmelt Controls

Below is a diagram for automatic snowmelt controls, which includes Snow Detection and Idling Controls.





CSI
Snowmelt Specifications

Section 1: General

CODES, LISTINGS, STANDARDS

ASTM
Infloor BPEX is manufactured to ASTM F-876 and F-877 standards, and to SDR-9 dimensions.

NSF-pw
Infloor BPEX is tested and listed by the National Sanitation Foundation to Standards 14 and 61.

UPC/UMC
Infloor BPEX carries both the UPC and UMC certification mark, as approved by the International Association of Plumbing and Mechanical Officials.

ES
Infloor BPEX is listed by the International Code Council Evaluation Service (ICC-ES) Report #ESR-1155.

NSF
All Infloor BPEX labeled with "cNSF-CAN/B.137.5" is certified to CSA Standard B137.5 by NSF.

RELATED DOCUMENTS
Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

Refer to Division-15 Basic Mechanical Materials & Methods sections apply to work of this section.

Refer to Division-3 Concrete for structural requirements of concrete slabs.

DESCRIPTION OF WORK
To the Extent of snowmelting work is indicated by drawings and schedules, and by requirements of this section. Types of snowmelting applications for this project may include the following:

Slab Snowmelting: Four inches (4") or greater in thickness.

Brick Paver Snowmelt: Install in two inches (2") or greater sand or gravel below pavers.

Refer to other Division sections for boilers, water heaters, and water source heat pumps; other heat sources, pumps, piping, and other hydronic appurtenances not work of this section.

Refer to Division Section Automatic Temperature Controls for the following work: Interlock wiring between electrically-operated pumps, valves, and their respective field-installed indicating and control devices.

Refer to other Division sections for the following work: Power supply wiring from power source to power connection for heat sources and pumps. Includes starters, disconnects, and required electrical devices; except where specified as furnished or factory installed by manufacturer.

QUALITY ASSURANCE
Manufacturer's Qualifications: Firms regularly engaged in the manufacturing and distribution of hydronic radiant floor heating and snowmelting products, of types and size required, whose products have been in satisfactory use in similar service for not less than five (5) years. Tubing shall have a minimum of a twenty-five (25) year, non-prorated warranty including tubing installed at temperatures above freezing and/or is exposed to sunlight for up to thirty (30) days. Tubing shall be Oxygen Barrier of a saline construction, high-grade cross-linked polyethylene tubing.

SUBMITTALS
Product Data: Submit manufacturer's specifications for radiant floor heating and snowmelting products showing dimensions, temperature capacities (both constant and intermittent), pressure ratings (both operating and burst), flow rates, material composition, and bend radius.

Shop Drawings: Submit shop drawings within thirty (30) days of bid date showing representative radiant floor tube spacing's and manifold locations on a per-zone basis, appropriate construction details, and field connection details. Include information on all parts of the system being provided by the manufacturer. Submit three (3) copies of each shop drawing.

CSI
Snowmelt Specifications

Control Sequence: Submit control manufacturer's sequence of operation for the radiant floor heating and snowmelting portions of this project, if not previously described by the architect/engineer in Division Automatic Temperature Controls. Provide a written sequence describing operation and logic, along with a schematic wiring diagram.

Samples: Submit three (3) twelve-inch (12") samples of each type and size of radiant floor tubing being furnished.

Maintenance Data: Submit maintenance instructions, including repair of damaged components and a spare parts list. Include product data and drawings in accordance with requirements in Division.

DELIVERY, STORAGE, AND HANDLING

Comply with manufacturer's instructions for unloading radiant floor heating and snowmelting materials and components, and moving them to their final locations.

Handle system components carefully to prevent damage, breaking, or scoring. Do not install damaged system components; refer to manufacturer's guidelines. Project architect/engineer to determine whether to repair or replace. Store radiant floor tubing and components to protect from physical damage, weather related damage, and construction debris.

Tubing shall be capable of withstanding exposure to direct sunlight without degradation for a period of at least thirty (30) days prior to installation. Tubing shall be capable of being installed directly on conventional base rock or sand fill material. The tubing can be pulled through holes drilled in construction framing and can be stapled directly to the top of the subfloor, or attached to the underside of the subfloor with the use of aluminum plates. Tubing shall be capable of bending at minimum bend radius (see Section 3), at temperatures above 50°F, without detrimental effect. Additionally, the tubing can be kinked without detrimental effect and shall be capable being restored to its original condition after kinking with the use of applied heat gun or a physical repair.

PART 2: PRODUCTS

RADIANT FLOOR TUBING (Infloor BPEX)

Provide radiant tubing in lengths and locations as indicated, with capacities, sizes, spacings, and depths as indicated by drawings, schedules, and/or Infloor OEM LoopCAD computer printout. Radiant tubing shall be a single layer, cross-linked polyethylene extrusion with an outer layer composed of an EVOH oxygen barrier. Tubing dimensions and capacities shall be as shown on the Infloor BPEX submittal. Tubing shall conform to the Standard Thermoplastic Pipe Dimension Ration (SDR-9). Tubing shall contain a minimum cross-linking value of 65% and no greater than 89%, inclusive. The radiant tubing shall be warranted to 180°F in hydronic heating applications without detrimental effect. *Tubing shall conform to the following operational conditions:*

Rated Temperature (F)	Hydrostatic Design (psi)	Operational Pressure (psi)
73.4	630	160
180	400	100
200	315	80

Burst Pressure Requirements			
	Temperature (F)		
ID Tube Size	73.4	180	200
3/8”	620	275	235
1/2”	480	215	185
5/8” and larger	475	210	180

Heat transfer fluids shall only be water or water/ propylene glycol mixtures. Use of corrosion-proofing chemicals are permitted and recommended. Use of other heat transfer fluids such as oil, alcohol, or automotive glycol, are not permitted.

MANIFOLDS

Copper Manifolds: Materials shall be of type L copper trunks and copper base branches, with (sweat) branches. Connections shall be soldered with a lead-free, high-strength solder. Standard diameter is one inch (1") with other diameters available or as specified up to two inches (2"). Manifolds shall be

CSI
Snowmelt Specifications

fitted with ball valves (mini or standard size) with crimp fitting or without ball valve with crimp fitting as specified by drawings and/or schedules. Manifolds are optionally fitted with vent/purge assemblies for bleeding air, and pressure test kits are available. Infloor BPEX shall be attached to the manifold branches by one of the following methods: Crimp Ring, Oterick Cinch Clamp, or compression. Each to be applied in accordance to manufacturer's specifications.

Brass Manifolds: Standard diameter is one inch (1") or one and one quarter inch (1-1/4"). Manifolds shall be fitted with ball valves on supply and return manifolds with micrometric balancing valves per loop on the supply manifold and isolation valves per loop on the return manifold. Manifolds come completely assembled with air vents and purge valves on the end pieces and are mounted to manifold mounting brackets. Return manifold has ability to accept thermal actuators per loop as well as optional flow meter per loop. Pressure test kits are available for both 1" and 1-1/4" manifolds.

Infloor BPEX shall be attached to the manifold branches by the following method: using the self-adjusting fitting for simple and multi-layer plastic pipes is a mechanical device that allows the pipes, the radiant panel system circuit and the manifolds to be connected easily and securely. This versatile fitting has been designed to adapt to the varying pipe diameters of these type systems. Each to be applied in accordance to manufacturer's specifications.

Materials shall be of brass Supply Manifold body: made of Brass EN 1982 CB753S with micrometric balancing valves consisting of Body: PA, control device upper part: brass EN 12164 CW614N, obturator: POM, obturator seal: EDPM, knob: ABS Return Manifold body: made of Brass EN 1982 CB753S with Shut-off valve consisting of, control device upper part: brass EN 12164 CW614N, obturator stem: stainless steel, obturator: EDPM, springs: stainless steel, seals: EDPM, knob: ABS Ball Valves, Body: made of Brass EN 121165 CW641N, Ball: Brass EN 121165 CW641N chrome plated, Handle (red for supply blue for return): Aluminum EN AB 46100, End fittings: Brass EN 12165 SW641N, Automatic Air Vents obturator stem: Brass EN 12165 SW641N, springs: stainless steel, seals: EDPM, float PP.

ACCESSORIES (*Contractor to provide the following*)**:**
Repair Kit: One (1) for each size of radiant floor tubing used in the project.

Plastic Tie: One (1) every twelve (12") to eighteen inches (18") of tubing and place 5 ties at each turn, two at the beginning and end and one in the middle.

Wire Tie: One (1) every twelve (12") to eighteen inches (18") of tubing and place 5 ties at each turn, two at the beginning and end and one in the middle.

Plastic Staples: One (1) every twelve (12") to eighteen inches (18") of tubing and place 5 staples at each turn, two at the beginning and end and one in the middle.

Screw Clips: One (1) every twelve (12") to eighteen inches (18") of tubing and place 3 clips at each turn, one at the beginning and end and one in the middle.

Octa Rail: One (1) every ten (10') square feet of tubing for framed floor or on top of concrete applications.

Universal Copper Manifold Bracket: One (1) pair per manifold set.

Tubing Uncoiler: Minimum of one (1) per project. Contractor to determine if more are needed.

Pressure Test Kit: Minimum of one (1) per manifold location. Contractor to determine if more are necessary.

Primary/Secondary Pumps: Contractor to determine quantities needed based on system design.

Tempering Valve: Sizes, quantities, and temperature ranges shown by drawings and/or specifications.

Variable Speed Injection Pump Control (VIP): Quantity as shown in drawings/specifications.

Micro-bubble Air Remover: Size/quantities shown in drawings or specifications.

CSI
Snowmelt Specifications

RECOMMENDED APPLICATIONS

Concrete Slab: Secure tubing to wire mesh or rebar by mechanical attachments every twelve (12") to eighteen inches (18") of tubing and place 5 ties at each turn, two at the beginning and end and one in the middle with a minimum of two inches (2") of concrete coverage above the top of the tubing. More coverage may be required depending on load requirements.

Concrete Cap: Secure tubing to existing concrete or insulation by mechanical attachments every twelve (12") to eighteen inches (18") of tubing and place 5 ties at each turn, two at the beginning and end and one in the middle with a minimum of three-fourths of an inch (3/4") concrete coverage above the top of the tubing for interior light duty applications, and a minimum of two inches (2") of concrete coverage above the top of the tubing for exterior applications. More coverage may be required depending on load requirements.

Slab Snowmelt: Secure tubing to wire mesh or rebar by mechanical attachments every twelve (12") to eighteen inches (18") of tubing and place 5 ties at each turn, two at the beginning and end and one in the middle with a minimum of two inches (2") of concrete coverage above the top of the tubing. More coverage may be required depending on load requirements.

Brick Paver Snowmelt: Secure tubing to wire mesh or rebar by mechanical attachments every twelve (12") to eighteen inches (18") of tubing and place 5 ties at each turn, two at the beginning and end and one in the middle with a minimum of one inch (1") of concrete or sand coverage above the top of the tubing. More coverage may be required depending on load requirements.

PART 3: EXECUTION

INSPECTION

Examine areas and conditions in which the radiant floor tubing is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the installer, the architect/engineer, and/or the owner.

INSTALLATION OF RADIANT FLOOR TUBING

General: Install tubing as indicated by architect/engineer on drawings, schedules, and specifications, in accordance with the manufacturer's installation instructions. Locate tubing in the floors, walls, or ceilings as indicated; cover areas continuously wall to wall at specified tubing spacing unless otherwise indicated. Provide insulation as indicated by architect/engineer drawings, or in accordance with the manufacturer's instructions or local code.

Provide pressure testing of a minimum of 60 psi or to local code for a minimum of twenty-four (24) hours prior to, and during the pour for concrete, and paver; and for twenty-four (24) hours after all other applications. Install access panels centered in front of each manifold set.

3/8" I.D. = Four inch (4") radius	3/4" I.D. = Seven inch (7") radius
1/2" I.D. = Five inch (5") radius	1" I.D. = Ten inch (10") radius
5/8" I.D. = Six inch (6") radius	

ADJUSTING AND CLEANING

General: After construction is completed (including painting), clean exposed surfaces and components inside cabinets and in mechanical rooms, where accessible according to manufacturer's instructions. Repair any damaged materials prior to system start-up.

System Start-Up and Balancing: Provide system start-up, air purging, and balancing to ensure proper operation. Check pumps for flows, valves for proper setting and operation, and water temperature and pressure levels in accordance with design specification and manufacturer's recommendations. System will operate properly for two (2) days before the owner and/or the architect/engineer shall be required to certify system compliance.

***Questions?* We're here to help! Email or call us at info@infloor.com • (800) 608-0562.**

INFLOOR HEATING SYSTEMS

Snowmelt System Pictures

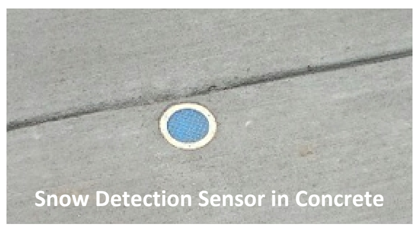
Installation Applications


Under Pavers - Walkway


Concrete - Entranceway


Decorative Concrete - Driveway


Concrete - Stairs


Snow Detection Sensor in Concrete


Under Pavers - Driveway

Snowmelt Boiler Systems

Dedicated HTP High Efficiency Snowmelt Boiler


Dedicated Lochinvar High Efficiency Snowmelt Boiler


Combined Snowmelt, Radiant Heating, & Domestic Hotwater Boiler System

Bringing You The Very Best In Radiant Heating

Infloor Heating Systems is a pioneer in the radiant heating industry, designing and providing systems since 1984. Infloor specializes in electric and hydronic radiant heating, snowmelt systems, and energy-saving solutions such as solar and geo thermal additions. The benefits of radiant heating are superior to conventional forced-air and baseboard systems. Radiant heating is energy-efficient, reducing gas and electric bills, eliminates duct work and duct losses, creates a quieter home, and is a healthier way of living for those with allergies. Infloor Heating Systems is proud to offer premium, innovative radiant heating systems and products designed to improve your everyday living and comfort.

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