

TABLE 4. HEAT OUTPUT AND FLUID TEMPERATURE FOR SNOW MELTING SYSTEMS

RATE OF SNOWFALL s	ϕ		$t_a = 0^\circ\text{F}$			$t_a = 10^\circ\text{F}$			$t_a = 20^\circ\text{F}$			$t_a = 30^\circ\text{F}$		
			Velocity v			Velocity v			Velocity v			Velocity v		
			5	10	15	5	10	15	5	10	15	5	10	15
0.08	1.0	q_o	151	205	260	127	168	209	102	128	154	75	84	94
		t_m	108	135	162	97	117	138	85	97	110	70	75	79
	0.0	q_o	66	66	66	64	64	64	62	62	62	60	60	60
		t_m	66	66	66	65	65	65	64	64	64	63	63	63
0.16	1.0	q_o	218	273	327	193	233	274	165	191	217	135	144	154
		t_m	142	169	198	129	149	170	117	129	142	100	105	109
	0.0	q_o	133	133	133	129	129	129	125	125	125	121	121	121
		t_m	99	99	99	97	97	97	95	95	95	93	93	93
0.25	1.0	q_o	292	347	401	265	305	346	235	261	287	203	212	221
		t_m	179	206	234	165	186	206	151	163	176	134	139	144
	0.0	q_o	208	208	208	202	202	202	195	195	195	188	188	188
		t_m	137	137	137	134	134	134	131	131	131	127	127	127

Note: This table is based on a relative humidity of 80 percent for all air temperatures.

s = Rate of snowfall, inches of water equivalent per hour (See Table 3).

ϕ = Free area ratio.

q_o = Slab output, Btu per (hour) (square foot).

t_a = Air temperature, Fahrenheit.

t_m = Fluid temperature, Fahrenheit. Based on construction as shown in Fig. 16.

v = Wind velocity, miles per hour.

approximate data for ethylene glycol without an inhibitor and for a light oil, see Table 5.

For small installations requiring less than 1 hp pump capacity, it may be satisfactory to compute the pump head required from friction loss tables for hot water heating systems, as given in Chapter 22, and to correct for the effect of the anti-freeze solution.

Generally, hydraulic tables are prepared for water at 60 F and, 10 to 15 year old pipe. Since the circuit will be closed and the pipe will not scale or deteriorate, the age allowance on the pipe will probably be a sufficient allowance for the anti-freeze. If there is no age allowance, but the table is for 60 F water, then the following allowances for heated anti-freeze solutions will be adequate:

1. For fluid temperatures less than 100 F, add 15 percent.
2. For fluid temperatures between 100 and 130 F, add 10 percent.
3. For fluid temperatures above 130 F, no allowance.

If friction data for higher temperature water are used as a basis, the allowances needed will be much greater.

If the system is operated intermittently, fluid temperatures may drop to the freezing protection point. At that temperature, the fluid may be so viscous as to prevent the pump from discharging. If such conditions are expected the pump manufacturer should be consulted for advice in selecting the pump.

Another allowance must be made in sizing the pump for anti-freeze; the volume of fluid to be pumped must be increased because of its low specific heat. Table 5 lists typical specific heat values, but here again,

on large jobs the manufacturer should be consulted for accurate data on his product.

INSTALLATION

There are certain precautions that must be taken during installation. They concern internal corrosion, flammability, toxicity, cleaning, joints, and hookup. A comprehensive discussion of these precautions may be found in Reference 8.

Safety

Since ethylene glycol is slightly toxic, the system should be installed and maintained independently. There should be no permanent connection between the snow melting system and the drinking water supply.

TABLE 5. PHYSICAL PROPERTIES OF ANTI-FREEZE SOLUTIONS

SOLUTION	FREEZING PROTECTION TEMP., F.	% BY VOLUME	ITEM	FLUID TEMPERATURE, F.			
				80	120	160	200
Ethylene Glycol ^a	0	31.4	$\mu \times 10^6$	1.92	1.14	0.77	0.56
			c	0.839	0.854	0.874	0.899
			w	65.1	64.4	63.6	62.7
	-20	42.7	$\mu \times 10^6$	2.55	1.46	0.95	0.68
			c	0.813	0.832	0.856	0.883
			w	66.0	65.3	64.4	63.4
Light Oil ^b	-40	51.2	$\mu \times 10^6$	3.16	1.77	1.14	0.80
			c	0.788	0.809	0.835	0.866
			w	66.8	65.9	65.0	64.0
	-40	100	$\mu \times 10^6$	5.60	3.13	2.06	1.50
			c	0.426	0.444	0.462	0.479
			w	60.7	59.8	59.0	58.1

^a Interpolated from Reference 9.

^b From Socony-Vacuum Oil Co.

μ = kinematic viscosity, (feet squared per second) (e.g. for oil at 80 F, $\mu = 0.000056 \text{ ft}^2 \text{ per sec.}$)

c = specific heat, Btu per (pound) (Fahrenheit degree).

w = specific weight, pounds per cubic foot.

Ethylene glycol is not considered flammable. In fact, aqueous solutions of less than 60 percent glycol are used for fire sprinkler systems. These solutions do not freeze, and they are effective fire extinguishing agents.

Petroleum distillates suitable for fluids in snow melting systems are classified as non-flammable, but have a flash point between 260 and 280 F. When using fluids of this type, care should be taken to collect any oil dripping from the packing seal on the pump.

Internal Corrosion

Ethylene glycol solutions tend to become corrosive in service; therefore, rust inhibitors are generally included. Even with an inhibitor, the solution should be tested annually to determine any change in acidity. If the test indicates that the inhibitor has been exhausted, the entire system should be drained and a fresh solution installed.

To increase the life of the inhibitor, the heat exchanger surfaces should