$$C = \frac{A_p q_t}{c_m \Delta t} \qquad (24)$$

where

C = pump capacity, pounds per hour.
A_p = area of slab, square feet.
q_t = total heat requirement (slab output, q_o, plus back and edge losses) Btu per (hour) (square foot).
c_m = specific heat at temperature t_m, Btu per (pound) (Fahrenheit degree).
Δ_t = temperature drop through circuit, Fahrenheit degrees.

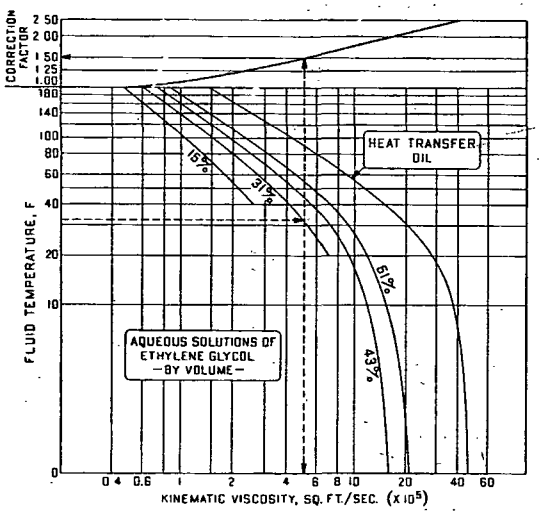


FIG. 21. FRICTION CORRECTION FACTOR FOR VISCOSITY (For $N_{Re} > 3000$)

For a temperature drop of $\Delta t = 20$ F, Equation 24 becomes

$$G = \frac{A_p q_t}{160 w_m c_m} \qquad (25)$$

where

G = gallons per minute.
w_m = mean specific weight at temperature t_m, pounds per cubic foot.

An approximate solution for systems using pipe sizes other than 1-in. IPS can be obtained by using Table 10 or Fig. 21. Table 10 is for use when the flow is in the laminar zone. Fig. 21 is for flow in the turbulent zone. For flows where Reynolds number falls between 2000 and 3000, no reliable prediction for pressure loss can be made. It is generally safe to assume the flow to be increased to a Reynolds number of 3000 with the pressure loss estimated at that flow rate.

Figure 20 is based on a pipe size of 1 in. IPS. If another pipe size is used and the flow is *laminar*, the correction factor K from Table 10 can be used.

TABLE 6. HEAT OUTPUT AND FLUID TEMPERATURE FOR SNOW MELTING SYSTEMS

s RATE OF SNOWFALL	R_A		t_a = 0 F			t_a = 10 F			t_a = 20 F			t_a = 30 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	255	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 5).
R_A = 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. 19.
v = Wind velocity, miles per hour.

For example, assume a viscosity of 300 SSU, a flow of 5 gpm and a ¾-in. IPS pipe. Fig. 20 shows that for 1-in. IPS, friction loss would be 15.50 ft/100 ft. Table 10 gives $K = 2.62$ for ¾-in. pipe; therefore, friction loss would be $15.5 \times 2.62 = 40.6$ ft/100 ft.

If the flow is in the *transition* zone or is *turbulent*, then Fig. 5 of Chapter 21 can be used in conjunction with Fig. 21. For example, assume a viscosity of 0.0001 sq ft/sec. (56.5 SSU), a flow rate of 14 gpm and a 1½-in. IPS pipe size. Fig. 5, Chapter 21, shows a head loss for water to be 190 milinches per foot or 1.58 ft/100 ft. Figure 21 gives a correction factor K of 1.75 for a viscosity of 0.0001 sq ft/sec; hence, the pressure loss is $1.58 \times 1.75 = 2.77$ ft/100 ft.

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 17.

Safety

Since ethylene glycol and petroleum distillates are 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.

Ethylene glycol is not considered flammable. In fact, aqueous solutions of less than 60 percent glycol are used for fire sprinkler systems.