To determine the heat loss that must be replaced by the heating cable, the following should be determined:

- TF Fluid temperature to be maintained
- TA Minimum ambient temperature
- Size of pipe to be heated
- Thermal insulation- type and thickness

1. Temperature Differential
Determine the temperature differential to be maintained by subtracting the ambient temperature from the fluid temperature to be maintained. (TF-TA)

2. Heat Loss
Use Table 5 to look up the heat loss for the proper pipe diameter and thickness of insulation. If a rigid insulation such as calcium silicate is used, the insulation should be oversized to the next available size. Insulation should also be oversized when using any cable besides the standard self-regulating heater, without over jackets. This will allow adequate space for the heating cable and allow the insulation joints to properly seal. As an example, you would use 2 inch pipe diameter heat losses for 1-1/2 inch pipe heating application if rigid insulation were used. Heat loss figures from Table 3 include a 10% safety factor.

3. Adjustments to Heat Loss Values
The heat losses in Table 3 are based on glass fiber insulation. If other insulations are used, multiply the heat loss value by the correction factor (shown in Table 6) for your insulation. Heat losses are based on outdoor applications with 20 m.p.h. wind. If piping is used indoors, multiply heat loss values by 0.9.

4. Adjustments for Heat Sinks
Any thermally conductive item that protrudes through the insulation will require extra heat to be applied to the pipe. The footage shown in Table 5 should be added to the required heater cable length to compensate for these extra heat losses. When multiple-tracing or spiraling cable, increase the cable adders proportionately.

5. Spiral Pitch Factor
For some applications the effective cable heat output per foot of pipe may be increased by spiraling the heater along the pipe. Use Table 6 to determine the spiral pitch factor.

Example:

- Water line to be maintained at +10°C (+50°F)
- Minimum ambient temperature is -23°C (-10°F)
- Pipe is three-inch diameter steel
- Insulation is one-inch thick mineral fiber insulation

1. Calculate Temperature Differential

∆T=TF-TA	∆T=TF-TA
∆T=10 - (-23) C	∆T=50 - (-10) F
∆T= 33°C	∆T= 60°F

2. Heat Loss
Use Table 3 to find heat loss. Where the desired temperature differential falls between two values, use interpolation:

From Table 3: @10°C Q= 14.4 w/m @ 38°C Q= 30.2 w/m

QF= 14.4 w/m + (-10/23) x (20.2w/m -14.4)

QF = 14.4 + (-2.5) = 11.9 w/m

From Table 3: @50°F Q= 4.4 w/ft @100°F Q= 9.2 w/ft

QF=4.4 w/ft + 10/50 x (9.2 – 4.4 w/ft)

QF=4.4 + 0.96=5.4 w/ft

3. Adjustments to Heat Loss
Adjust the heat loss for mineral fiber. From Table 4, the adjustment factor is 1.2.

QM = QF x 1.2	QM = QF x 1.2
QM = 11.9 w/m. x 1.2	QM = 5.4 w/ft. x 1.2
QM = 14.3 w/m	QM = 6.5 w/ft.

Since the piping is outdoors, no adjustment is necessary for the absence of wind.

Table 3: Pipe Heat Loss

Insulation Thickness Millimeters (Inches)	ΔT °C (°F)	Pipe Diameter (IPS) in Inches: 1/2	3/4	1	1–1/4	1–1/2	2	2–1/2	3	4	6
		Tubing Size (Inches): 3/4	1	1–1/4	1–1/2	2					
25.0 (1.0)	-12 (10)	1.0 (0.3)	1.3 (0.4)	1.3 (0.4)	1.6 (0.5)	2.0 (0.6)	2.3 (0.7)	2.6 (0.8)	3.0 (0.9)	3.6 (1.1)	5.0 (1.5)
	10 (50)	5.6 (1.7)	6.2 (1.9)	7.2 (2.2)	8.2 (2.5)	9.2 (2.8)	10.8 (3.3)	12.5 (3.8)	14.4 (4.4)	17.7 (5.4)	24.6 (7.5)
	38 (100)	11.5 (3.5)	12.8 (3.9)	14.8 (4.5)	17.4 (5.3)	19.0 (5.8)	22.3 (6.8)	25.9 (7.9)	30.2 (9.2)	37.1 (11.3)	51.5 (15.7)
	65 (150)	17.7 (5.4)	20.3 (6.2)	23.3 (7.1)	27.2 (8.3)	29.8 (9.1)	35.1 (10.7)	40.7 (12.4)	47.2 (14.4)	57.7 (17.6)	80.7 (24.6)
	93 (200)	24.6 (7.5)	28.2 (8.6)	32.5 (9.9)	37.7 (11.5)	41.3 (12.6)	48.9 (14.9)	56.4 (17.2)	65.6 (20.0)	80.4 (24.5)	112.2 (34.2)
	121 (250)	1.0 (0.3)	36.7 (11.2)	42.0 (12.8)	49.2 (15)	54.1 (16.5)	63.6 (19.4)	73.5 (22.4)	85.3 (26.0)	104.6 (31.9)	146.3 (44.6)
38.0 (1.5)	-12 (10)	1.0 (0.3)	1.0 (0.3)	1.3 (0.4)	1.3 (0.4)	1.3 (0.4)	1.6 (0.5)	2.0 (0.6)	2.3 (0.7)	2.6 (0.8)	3.6 (1.1)
	10 (50)	4.3 (1.3)	4.9 (1.5)	5.6 (1.7)	6.2 (1.9)	6.9 (2.1)	8.2 (2.5)	9.2 (2.8)	10.5 (3.2)	12.8 (3.9)	17.4 (5.3)
	38 (100)	9.2 (2.8)	10.2 (3.1)	11.5 (3.5)	13.4 (4.1)	14.4 (4.4)	16.7 (5.1)	19.4 (5.9)	22.3 (6.8)	26.9 (8.2)	36.7 (11.2)
	65 (150)	14.4 (4.4)	16.1 (4.9)	18.0 (5.5)	21.0 (6.4)	22.6 (6.9)	26.6 (8.1)	30.2 (9.2)	34.8 (10.6)	42.0 (12.8)	57.7 (17.6)
	93 (200)	20.0 (6.1)	22.3 (6.8)	25.3 (7.7)	29.2 (8.9)	31.8 (9.7)	36.7 (11.2)	42.0 (12.8)	48.2 (14.7)	58.4 (17.8)	80.0 (24.4)
	121 (250)	25.9 (7.9)	29.2 (8.9)	32.8 (10)	38.0 (11.6)	41.3 (12.6)	47.9 (14.6)	54.8 (16.7)	63.0 (19.2)	76.1 (23.2)	104.3 (31.8)
50.0 (2.0)	-12 (10)	0.7 (0.2)	1.0 (0.3)	1.0 (0.3)	1.3 (0.4)	1.3 (0.4)	1.3 (0.4)	1.6 (0.5)	1.64 (0.5)	2.0 (0.6)	3.0 (0.9)
	10 (50)	3.4 (1.2)	4.3 (1.3)	4.6 (1.4)	5.2 (1.6)	5.9 (1.8)	6.6 (2.0)	7.5 (2.3)	8.5 (2.6)	10.2 (3.1)	13.8 (4.2)
	38 (100)	7.9 (2.4)	8.9 (2.7)	9.8 (3.0)	11.2 (3.4)	12.1 (3.7)	14.1 (4.3)	15.7 (4.8)	18.0 (5.5)	21.6 (6.6)	29.2 (8.9)
	65 (150)	12.5 (3.8)	13.8 (4.2)	15.4 (4.7)	17.7 (5.4)	19.0 (5.8)	22.0 (6.7)	24.9 (7.6)	28.2 (8.6)	33.8 (10.3)	45.6 (13.9)
	93 (200)	17.4 (5.3)	19.4 (5.9)	21.6 (6.6)	24.6 (7.5)	26.6 (8.1)	30.5 (9.3)	34.4 (10.5)	39.4 (12.0)	47.2 (14.4)	63.6 (19.4)
	121 (250)	22.6 (6.9)	25.3 (7.7)	28.3 (8.6)	32.1 (9.8)	34.8 (10.6)	39.7 (12.1)	44.9 (13.7)	51.2 (15.6)	61.3 (18.7)	83.0 (25.3)
63.0 (2.5)	-12 (10)	0.7 (0.2)	0.7 (0.2)	1.0 (0.3)	1.0 (0.3)	1.0 (0.3)	1.3 (0.4)	1.3 (0.4)	1.6 (0.5)	1.6 (0.5)	2.3 (0.7)
	10 (50)	3.3 (1.0)	3.9 (1.2)	4.3 (1.3)	4.6 (1.4)	5.2 (1.6)	5.9 (1.8)	6.6 (2.0)	7.5 (2.3)	8.9 (2.7)	11.8 (3.6)
	38 (100)	7.2 (2.2)	7.9 (2.4)	8.9 (2.7)	9.8 (3.0)	10.8 (3.3)	12.1 (3.7)	13.8 (4.2)	15.4 (4.7)	18.4 (5.6)	24.6 (7.5)
	65 (150)	11.2 (3.4)	12.5 (3.8)	13.8 (4.2)	15.7 (4.8)	16.7 (5.1)	19.0 (5.8)	21.6 (6.6)	24.3 (7.4)	28.9 (8.8)	38.4 (11.7)
	93 (200)	15.7 (4.8)	17.4 (5.3)	19.4 (5.9)	21.6 (6.6)	23.3 (7.1)	26.6 (8.1)	29.8 (9.1)	33.8 (10.3)	40.3 (12.3)	53.5 (16.3)
	121 (250)	20.3 (6.2)	22.6 (6.9)	24.9 (7.6)	28.2 (8.6)	30.5 (9.3)	34.8 (10.6)	39.0 (11.9)	44.3 (13.5)	52.5 (16)	69.9 (21.3)
75.0 (3.0)	-12 (10)	0.7 (0.2)	0.7 (0.2)	1.0 (0.3)	1.0 (0.3)	1.0 (0.3)	1.0 (0.3)	1.3 (0.4)	1.3 (0.4)	1.6 (0.5)	2.0 (0.6)
	10 (50)	3.28 (1.0)	3.6 (1.1)	3.4 (1.2)	4.3 (1.3)	4.6 (1.4)	5.2 (1.6)	5.9 (1.8)	6.6 (2.0)	7.9 (2.4)	10.2 (3.1)
	38 (100)	6.6 (2.0)	7.2 (2.2)	8.2 (2.5)	9.2 (2.8)	9.8 (3.0)	11.2 (3.4)	12.1 (3.7)	13.8 (4.2)	16.4 (5.0)	21.3 (6.5)
	65 (150)	10.5 (3.2)	11.5 (3.5)	12.8 (3.9)	14.1 (4.3)	15.1 (4.6)	17.4 (5.3)	19.4 (5.9)	21.6 (6.6)	25.6 (7.8)	33.8 (10.3)
	93 (200)	14.4 (4.4)	16.1 (4.9)	17.7 (5.4)	19.7 (6.0)	21.3 (6.5)	22.0 (6.7)	26.9 (8.2)	30.2 (9.2)	35.4 (10.8)	46.9 (14.3)
	121 (250)	19.0 (5.8)	20.7 (6.3)	23.0 (7.0)	25.6 (7.8)	27.6 (8.4)	31.2 (9.5)	34.8 (10.6)	39.4 (12.0)	46.2 (14.1)	61.0 (18.6)

Insulation Thickness Millimeters (Inches)	ΔT °C (°F)	8	10	12	14	16	18	20	24
25.0 (1.0)	-12 (10)	6.2 (1.9)	7.9 (2.4)	8.9 (2.7)	9.84 (3.0)	11.2 (3.4)	12.5 (3.8)	13.8 (4.2)	16.4 (5.0)
	10 (50)	31.16 (9.5)	37.7 (11.5)	44.3 (13.5)	48.2 (14.7)	54.8 (16.7)	61.0 (18.6)	67.2 (20.5)	80.0 (24.4)
	38 (100)	64.9 (19.8)	79.4 (24.2)	92.5 (28.2)	101.0 (30.8)	114.5 (34.9)	127.6 (38.9)	141.0 (43.0)	167.6 (51.1)
	65 (150)	101.7 (31.0)	124.0 (37.8)	145.0 (44.2)	158.4 (48.3)	179.1 (54.6)	200.1 (61.0)	220.7 (67.3)	262.4 (80.0)
	93 (200)	141.7 (43.2)	172.5 (52.6)	201.7 (61.5)	220.1 (67.1)	249.0 (75.9)	277.8 (84.7)	307.0 (93.6)	364.7 (111.2)
	121 (250)	184.0 (56.1)	224.4 (68.4)	262.4 (80)	286.3 (87.3)	323.7 (98.7)	361.5 (110.2)	399.2 (121.7)	474.3 (144.6)
38.0 (1.5)	-12 (10)	4.592 (1.4)	5.248 (1.6)	6.232 (1.9)	6.9 (2.1)	7.9 (2.4)	8.5 (2.6)	9.5 (2.9)	11.2 (3.4)
	10 (50)	22.0 (6.7)	26.6 (8.1)	30.8 (9.4)	33.5 (10.2)	37.7 (11.5)	42.0 (12.8)	46.6 (14.2)	55.1 (16.8)
	38 (100)	46.0 (14.0)	55.4 (16.9)	64.6 (19.7)	70.2 (21.4)	79.4 (24.2)	88.2 (26.9)	97.1 (29.6)	115.1 (35.1)
	65 (150)	71.8 (21.9)	86.9 (26.5)	101.0 (30.8)	110.2 (33.6)	124.3 (37.9)	138.4 (42.2)	152.5 (46.5)	180.4 (55.0)
	93 (200)	100.0 (30.5)	121.0 (36.9)	140.7 (42.9)	153.2 (46.7)	172.9 (52.7)	192.2 (58.6)	211.9 (64.6)	250.9 (76.5)
	121 (250)	129.9 (39.6)	157.4 (48.0)	183.0 (55.8)	199.1 (60.7)	224.7 (68.5)	250.3 (76.3)	275.8 (84.1)	326.7 (99.6)
50.0 (2.0)	-12 (10)	3.6 (1.1)	4.3 (1.3)	4.9 (1.5)	5.2 (1.6)	5.9 (1.8)	6.6 (2.0)	7.2 (2.2)	8.528 (2.6)
	10 (50)	17.1 (5.2)	20.7 (6.3)	23.9 (7.3)	25.9 (7.9)	29.52 (9.0)	32.5 (9.9)	35.8 (10.9)	42.3 (12.9)
	38 (100)	36.1 (11)	43.3 (13.2)	50.2 (15.3)	54.4 (16.6)	61.3 (18.7)	68.2 (20.8)	74.8 (22.8)	88.6 (27)
	65 (150)	56.4 (17.2)	67.9 (20.7)	78.7 (24)	85.6 (26.1)	96.1 (29.3)	106.9 (32.6)	117.4 (35.8)	138.7 (42.3)
	93 (200)	78.7 (24.0)	94.5 (28.8)	109.6 (33.4)	119.1 (36.3)	133.8 (40.8)	148.6 (45.3)	163.3 (49.8)	192.9 (58.8)
	121 (250)	102.3 (31.2)	123.0 (37.5)	142.7 (43.5)	154.8 (47.2)	174.2 (53.1)	193.5 (59.0)	212.9 (64.9)	251.2 (76.6)
63.0 (2.5)	-12 (10)	3.0 (0.9)	3.6 (1.1)	3.9 (1.2)	4.3 (1.3)	4.9 (1.5)	5.6 (1.7)	5.9 (1.8)	6.7 (2.1)
	10 (50)	14.4 (4.4)	17.1 (5.2)	19.7 (6.0)	21.6 (6.6)	23.9 (7.3)	26.6 (8.1)	29.2 (8.9)	34.4 (10.5)
	38 (100)	30.2 (9.2)	36.1 (11.0)	41.7 (12.7)	44.9 (13.7)	50.5 (15.4)	56.1 (17.1)	61.3 (18.7)	72.5 (22.1)
	65 (150)	47.2 (14.4)	56.4 (17.2)	65.3 (19.9)	70.5 (21.5)	79.0 (24.1)	87.9 (26.8)	96.4 (29.4)	113.5 (34.6)
	93 (200)	65.6 (20)	78.72 (24.0)	90.5 (27.6)	98.1 (29.9)	110.2 (33.6)	122.0 (37.2)	134.2 (40.9)	157.8 (48.1)
	121 (250)	85.6 (26.1)	102.3 (31.2)	118.1 (36.0)	127.9 (39.0)	143.3 (43.7)	159.1 (48.5)	174.5 (53.2)	205.3 (62.6)
75.0 (3.0)	-12 (10)	2.6 (0.8)	3.0 (0.9)	3.6 (1.1)	3.6 (1.1)	4.3 (1.3)	4.6 (1.4)	5.2 (1.6)	5.9 (1.8)
	10 (50)	12.5 (3.8)	14.8 (4.5)	17.1 (5.2)	18.4 (5.6)	20.6 (6.3)	23.0 (7.0)	24.9 (7.6)	29.2 (8.9)
	38 (100)	26.2 (8.0)	31.2 (9.5)	35.8 (10.9)	38.7 (11.8)	43.3 (13.2)	47.9 (14.6)	52.5 (16.0)	61.7 (18.8)
	65 (150)	41 (12.5)	48.9 (14.9)	56.1 (17.1)	60.7 (18.5)	67.9 (20.7)	75.1 (22.9)	82.0 (25.0)	96.4 (29.4)
	93 (200)	57.1 (17.4)	67.9 (20.7)	78.1 (23.8)	84.3 (25.7)	94.1 (28.7)	104.3 (31.8)	114.1 (34.8)	134.2 (40.9)
	121 (250)	74.1 (22.6)	88.2 (26.9)	101.4 (30.9)	109.9 (33.5)	122.7 (37.4)	135.8 (41.4)	148.9 (45.4)	174.8 (53.3)

Table 4: Insulation Factors

Preformed Pipe Insulation	Insulation (f)	Based on K factor @ 10°C (50° F) mean temp BTU/hr–°F–ft²/in
Glass Fiber	1.00	0.250
Calcium Silicate	1.72	0.375
Cellular Glass	1.84	0.400
Rigid Urethane	0.76	0.165
Foamed Elastomer	1.16	0.290
Mineral Fiber	1.20	0.300
Expanded Perlite	1.42	0.375
Mineral Wool	1.04	0.260
Polystyrene	1.04	0.260
Flexible Elastomer	1.16	0.290
Polyisocyanarate	0.68	0.170

Table 5: Heat Loss Adder

	Additional Heater Feet For Various Heat Sinks in Meters (Feet)					
Pipe Size	Standard Flange	Blind Flange	Pipe Support ①	Screwed or Welded Valve	Flanged Valve	Butterfly Valve
0.5	0.09 (0.3)	0.15 (0.5)	0.30 (1.0)	0.30 (1.0)	0.31 (1.0)	0.30 (1.0)
0.75	0.09 (0.3)	0.15 (0.5)	0.46 (1.5)	0.30 (1.0)	0.45 (1.5)	0.30 (1.0)
1.0	0.09 (0.3)	0.15 (0.5)	0.46 (1.5)	0.30 (1.0)	0.61 (2.0)	0.30 (1.0)
1.5	0.09 (0.3)	0.15 (0.5)	0.46 (1.5)	0.46 (1.5)	0.76 (2.5)	0.46 (1.5)
2.0	0.09 (0.3)	0.15 (0.5)	0.61 (2.0)	0.61 (2.0)	0.76 (2.5)	0.61 (2.0)
3.0	0.15 (0.5)	0.23 (0.75)	0.61 (2.0)	0.762 (2.5)	0.91 (3.0)	0.76 (2.5)
4.0	0.15 (0.5)	0.23 (0.75)	0.76 (2.5)	0.91 (3.0)	1.22 (4.0)	0.91 (3.0)
6.0	0.23 (0.75)	0.30 (1.0)	0.76 (2.5)	1.07 (3.5)	1.52 (5.0)	1.07 (3.5)
8.0	0.23 (0.75)	0.30 (1.0)	0.76 (2.5)	1.22 (4.0)	2.13 (7.0)	1.22 (4.0)
10.0	0.23 (0.75)	0.30 (1.0)	0.91 (3.0)	1.52 (5.0)	2.44 (8.0)	1.37 (4.5)
12.0	0.23 (0.75)	0.30 (1.0)	0.91 (3.0)	1.83 (6.0)	2.74 (9.0)	1.52 (5.0)
14.0	0.30 (1.0)	0.46 (1.5)	0.91 (3.0)	2.13 (7.0)	3.05 (10.0)	1.68 (5.5)
16.0	0.30 (1.0)	0.46 (1.5)	1.07 (3.5)	2.44 (8.0)	3.35 (11.0)	1.83 (6.0)
18.0	0.30 (1.0)	0.46 (1.5)	1.07 (3.5)	2.74 (9.0)	3.66 (12.0)	2.13 (7.0)
20.0	0.30 (1.0)	0.46 (1.5)	1.07 (3.5)	3.05 (10.0)	3.96 (13.0)	2.29 (7.5)
24.0	0.30 (1.0)	0.53 (1.75)	1.22 (4.0)	3.66 (12.0)	4.57 (15.0)	2.44 (8.0)

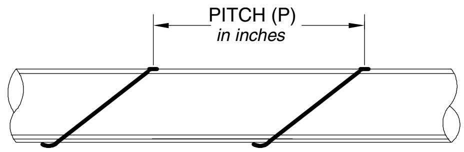
Nominal pipe length in meters (feet). Adders are for various in-line pipe fittings to compensate for greater areas of heat loss.
① NOTE: Values above are based on area average of various fittings available, and the assumption that fitting insulation will be equivalent to pipe insulation.
The nominal length of tracer to be applied to a fitting would be the values shown in this chart plus the flange-to-flange length of the fitting.

Table 6: Spiral Pitch Factor

IPS (Inches)	Feet of Cable per Foot of Pipe in Millimeters (Inches) 1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8
1	229 (9)	152 (6)	127 (5)	102 (4)	102 (4)	76.2 (3)	76 (3)	76 (3)
1-1/4	279 (11)	203 (8)	152 (6)	127 (5)	127 (5)	101.6 (4)	102 (4)	76 (3)
1-1/2	330 (13)	229 (9)	178 (7)	152 (6)	127 (5)	127 (5)	102 (4)	102 (4)
2	406 (16)	279 (11)	229 (9)	178 (7)	152 (6)	152 (6)	127 (5)	127 (5)
2-1/2	508 (20)	356 (14)	279 (11)	229 (9)	203 (8)	178 (7)	152 (6)	152 (6)
3	610 (24)	432 (17)	330 (13)	279 (11)	254 (10)	229 (9)	203 (8)	178 (7)
4	787 (31)	533 (21)	432 (17)	356 (14)	330 (13)	279 (11)	254 (10)	229 (9)
6	1143 (45)	787 (31)	635 (25)	533 (21)	457 (18)	432 (17)	381 (15)	356 (14)
8	1499 (59)	1041 (41)	813 (32)	686 (27)	610 (24)	559 (22)	508 (20)	457 (18)
10	1880 (74)	1295 (51)	1041 (41)	864 (34)	762 (30)	686 (27)	635 (25)	584 (23)
12	2210 (87)	1524 (60)	1219 (48)	1041 (41)	914 (36)	813 (32)	762 (30)	686 (27)
14	2438 (96)	1676 (66)	1346 (53)	1143 (45)	991 (39)	889 (35)	813 (32)	737 (29)
16	2794 (110)	1930 (76)	1549 (61)	1295 (51)	1143 (45)	1016 (40)	940 (37)	864 (34)
18	3124 (123)	2261 (89)	1727 (68)	1473 (58)	1295 (51)	1143 (45)	1041 (41)	965 (38)
20	3480 (137)	2413 (95)	1930 (76)	1626 (64)	1422 (56)	1270 (50)	1168 (46)	1067 (42)
24	4166 (164)	2896 (114)	2311 (91)	1956 (77)	1702 (67)	1524 (60)	1397 (55)	1270 (50)

Example

For 3" pipe, with 1.3 feet of Self-Regulating heater cable per foot of pipe. P = 330.2 mm (13.0 in)



INDUSTRIAL HEATING SYSTEMS

NELSON™

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To calculate the heat loss that must be replaced by the heater, the following should be determined:

- TF Fluid temperature to be maintained
- TA Minimum ambient temperature
- Vessel surface area
- Thermal insulation type and thickness

1. Temperature Differential
Determine the temperature differential to be maintained by subtracting the ambient temperature from the fluid temperature to be maintained. (TF – TA).

2. Vessel Surface Area
Determine the total surface area A of the vessel using the appropriate formula (see below).

3. Surface Heat Loss
Use Table 7 to determine the surface heat loss from the vessel in watts/ft². Multiply this value by the total surface area calculated in step 2 to determine the total vessel heat loss.

4. Adjustments To Heat Loss Values
The heat losses in Table 7 are based on glass fiber insulation.
If other insulations are used, multiply the heat loss value by the correction factor (shown in Table 4) for your insulation.
Heat losses are based on outdoor applications with 20 m.p.h. wind.
If vessel is located indoors, multiply heat loss values by 0.9.
Heat losses are based on a 10% safety factor.

5. Adders For Heat Sinks
Any non-insulated thermally conductive item that protrudes through the insulation will require extra heat to be applied. Use Table 6 to determine the additional amount of heat to apply for various heat sinks. Add these totals to the heat loss calculated in Section 4.

Example

- Tank fluid is to be maintained at 71°C (160°F)
- Minimum ambient temperature is -12°C (10°F)
- Tank is round with flat heads, resting on concrete pad
- Height = 3.0m (10ft)
- Diameter = 2.4m (8ft)
- Insulation is 2” calcium silicate

1. Calculate temperature differential.

$(T_F - T_A) = 71 - (-12) = 83°C$ $(T_F - T_A) = 160 – 10 = 150°F$

2. Determine surface heat loss from Table 7.
The base heat loss is 66.7 w/m² (6.2 w/ft²) with glass fiber Insulation. To adjust for calcium silicate, multiply by 1.72 (from Table 4). This gives 115.2 w/m² (10.7 w/ft²). This applies to the top and sides.

3. Determine tank surface area.

Sides: $\pi DL = (\pi)(2.4)(3.0) = 22.6\ m^2$

Top: $\pi D^2/4 = (\pi)(2.4^2)(3.0)/4 = 4.5\ m^2$

Bottom: $\pi D^2/4 = (\pi)(2.4^2)(3.0)/4 = 4.5\ m^2$

Surface Area = 22.6 + 4.5 + 4.5 = 31.6

Sides: $\pi DL = (\pi)(8)(10) = 251.3\ ft^2$

Top: $\pi D^2/4 = (\pi)(8^2)/4 = 50.3\ ft^2$

Bottom: $\pi D^2/4 = (\pi)(8^2)/4 = 50.3\ ft^2$

Surface Area = 251.3 + 50.3 + 50.3 = 351.9 ft²

4. Determine heat loss from bottom.
Because the tank is resting on a concrete pad without insulation, the heat loss from the tank bottom must be determined from table 8.

$(T_F – 55°C) = (83-13) = 70°C$

From table 10, 0.377 x 70 = 26.4 w/m²

$(T_F – 55°F) =$

From table 10, 0.035 x 105 = 3.7 w/ft²

5. Calculate total tank heat loss.

Sides: 22.6 m² x 115.2 w/m² = 2604 watts

Top: 4.5 m² x 115.2 w/m² = 518 watts

Bottom: 4.5 m² x 26.4 w/m² =119 watts

Total Tank Loss: 2604 + 518 + 119 = 3241 watts

Sides: 251.3 ft² x 10.7 w/ft² = 2689 watts

Top: 50.3 ft² x 10.7 w/ft² = 538 watts

Bottom: 50.3 ft² x 3.7 w/ft² =188 watts

Total Tank Loss: 2689 + 538 + 188 = 3345 watts

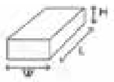
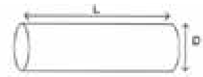
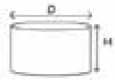
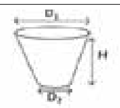
	Vessel Type	Equation For Surface Area
	Rectangle	2 (WxL + WxH + LxH)
	Sphere	πD^2
	Round Horizontal	$\pi DL + \pi D^2/2$ (Sides) (Ends)
	Round Vertical	$\pi DH + \pi D^2/4 + \pi D^2/4$ (Sides) (Top) (Bottom)
	Cone	$H \times (D_1+D_2)/2 + \pi D_1^2/4 + \pi D_2^2/4$ (Sides) (Top) (Bottom)

Table 7: Vessel Heat Loss

Delta T °C (°F)	Insulation Thickness in Millimeters (Inches)			
	25 (1.0)	38 (1.5)	50 (2.0)	75 (3.0)
28 (50)	96.5 (3.8)	63.5 (2.5)	48.3 (1.9)	33.0 (1.3)
56 (100)	200.7 (7.9)	134.6 (5.3)	101.6 (4.0)	68.6 (2.7)
83 (150)	312.4 (12.3)	210.8 (8.3)	157.5 (6.2)	106.7 (4.2)
111 (200)	434.3 (17.1)	292.1 (11.5)	221.0 (8.7)	147.3 (5.8)
139 (250)	566.4 (22.3)	381.0 (15.0)	287.0 (11.3)	193.0 (7.6)
167 (300)	708.7 (27.9)	475.0 (18.7)	358.1 (14.1)	238.8 (9.4)

Table 8: Adders For Non Insulated Vessel Heat Sinks

Heat Sink Type	Watt Loss Adder
Support Leg	Add 1.51 (0.84) watts per degree temperature differential (°C/ °F) for each leg
Saddle Support	Add 13.7 (7.6) watts per degree temperature differential (°C/ °F) for each support
Concrete Pad	Calculate the heat loss from the tank bottom separate from the insulated tank. Use 0.377 w/m² (0.035 w/ft²) per degree temperature difference (°C/ °F) between fluid temperature (TF) and13°C (55°F) ground temperature
24" Manway	Add 5.6 (3.1) watts per degree temperature differential (°C/ °F) for each opening
36" Manway	Add 12.8 (7.1) watts per degree temperature differential (°C/ °F) for each opening