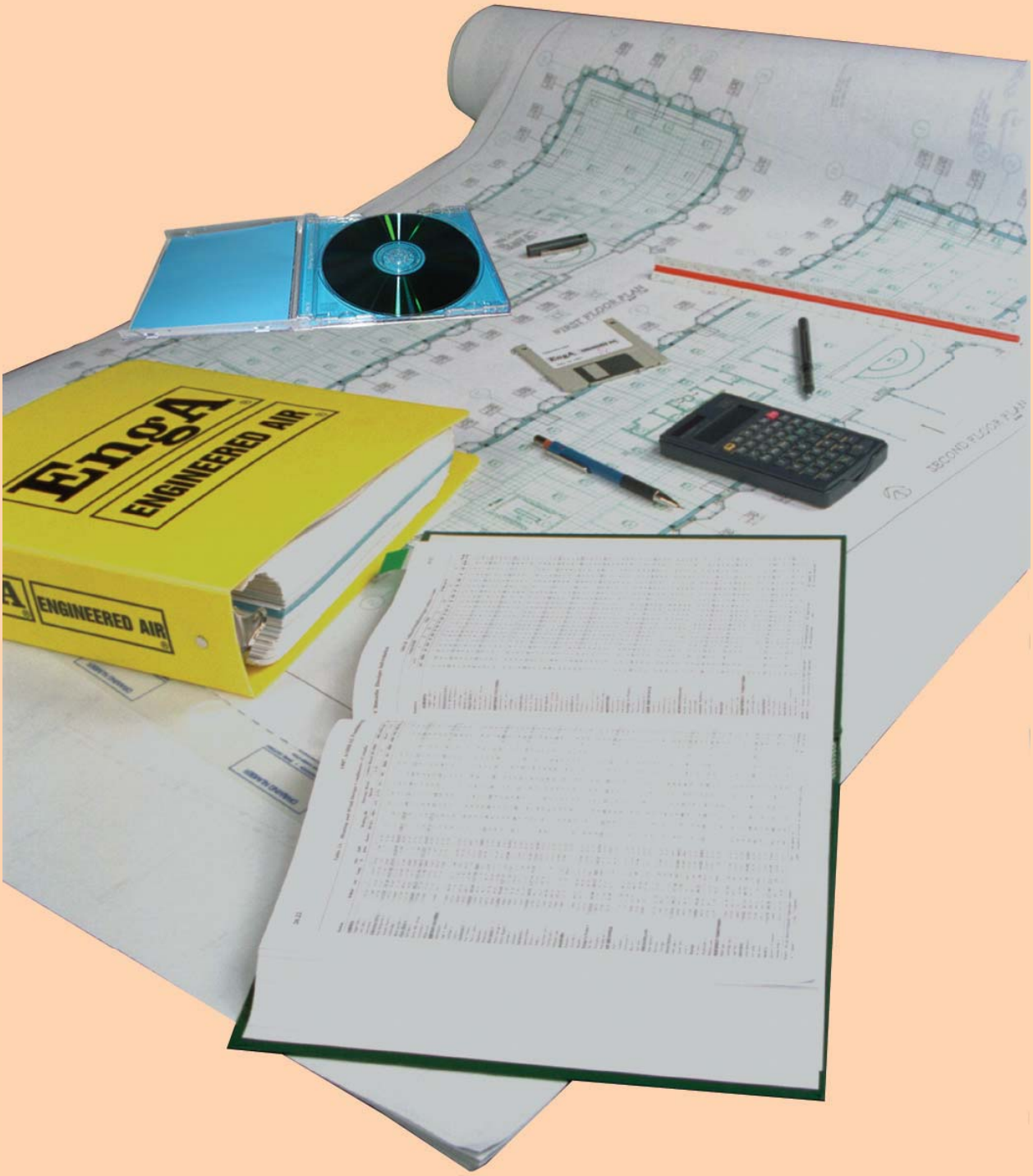
Design Data



AIRTEX™
HYDRONIC SYSTEMS

HEAT TRANSFER DIVISION

CAPACITY CORRECTION FACTORS

STEAM

Basic capacities were obtained using steam at 1 PSI (6.89 kPa) (gauge) with 65°F (18.3°C) entering air temperature in accordance with standard test procedures for finned tube radiation.

For pressures other than those of 1 PSI (6.89 kPa) (gauge) or entering air temperature other than 65°F (18.3°C), the corrected capacity may be determined by multiplying basic capacities by the factor provided in Table 6.

TABLE 1

CAPACITY CORRECTION FACTORS FOR STEAM PRESSURE AND AIR TEMPERATURES OTHER THAN 1 PSI (6.89 kPa) AND 65°F (18°C) AIR

STEAM* PRESSURE GAUGE	STEAM TEMP °F (°C)	ENTERING AIR TEMPERATURE °F (°C)													
		45 (7)	55 (13)	65 (18)	70 (21)	75 (24)	80 (27)	85 (29)	90 (32)	100 (38)	110 (43)	120 (49)	130 (54)	140 (60)	150 (66)
15" HG. VAC. (381 HG. VAC)	178.9 (81.6)	0.90	0.80	0.70	0.65	0.60	0.56	0.51	0.45	0.39	0.32	0.25	0.18	0.13	0.08
10" HG. VAC. (254 HG. VAC.)	192.2 (89.0)	1.02	0.91	0.81	0.76	0.71	0.66	0.62	0.55	0.48	0.40	0.33	0.26	0.20	0.14
5" HG. VAC. (127 HG. VAC.)	202.9 (94.9)	1.11	1.00	0.90	0.85	0.79	0.75	0.70	0.63	0.56	0.48	0.40	0.33	0.27	0.20
0 PSIG (0) kPa	212.0 (100.0)	1.19	1.09	0.97	0.92	0.87	0.82	0.77	0.70	0.63	0.54	0.46	0.38	0.31	0.25
.899 PSIG (6.2) kPa	215.0 (101.7)	1.22	1.11	1.00	0.95	0.90	0.84	0.80	0.75	0.65	0.57	0.48	0.40	0.33	0.26
5 PSIG (34.5) kPa	227.1 (108.4)	1.34	1.22	1.11	1.05	1.00	0.95	0.90	0.81	0.75	0.66	0.57	0.49	0.41	0.34
10 PSIG (68.9) kPa	239.4 (115.2)	1.45	1.33	1.22	1.17	1.11	1.05	1.00	0.91	0.85	0.75	0.66	0.58	0.50	0.42
15 PSIG (103.4) kPa	249.8 (121.0)	1.55	1.43	1.31	1.26	1.20	1.14	1.09	1.00	0.94	0.84	0.75	0.66	0.57	0.49
20 PSIG (137.9) kPa	258.8 (126.0)	1.63	1.52	1.40	1.33	1.28	1.23	1.17	1.07	1.02	0.92	0.82	0.73	0.64	0.55
25 PSIG (172.4) kPa	266.8 (130.4)	1.71	1.59	1.47	1.41	1.36	1.30	1.25	1.15	1.09	0.98	0.89	0.80	0.71	0.62
30 PSIG (206.8) kPa	274.0 (134.4)	1.78	1.66	1.54	1.48	1.42	1.37	1.31	1.21	1.15	1.05	0.95	0.85	0.76	0.68
40 PSIG (275.8) kPa	286.7 (141.5)	1.91	1.79	1.66	1.61	1.54	1.49	1.43	1.32	1.27	1.16	1.06	0.97	0.87	0.78

NOTES: Gauge pressures should be adjusted for altitude.
* From Keenan & Keys linear interpolation.

HOT WATER

Hot water capacities are based on water velocities of 3 ft./sec. (0.9 m/s) or greater. If flow rate is less than 3 ft./sec. (0.9 m/s), Basic hot water capacities must be multiplied by factor shown in Table 2. Table 3 gives correction factors for non-standard entering air and/or water temperatures.

TABLE 2

CORRECTION FACTORS FOR HOT WATER CAPACITIES AT FLUID VELOCITIES IN ELEMENT LESS THAN 3 FT/SEC (0.9m/s) *(Refer to table 16)*

VELOCITY FT/SEC	5.00	4.00	3.00	2.75	2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25
VELOCITY M/SEC	1.52	1.22	0.91	0.83	0.76	0.69	0.61	0.53	0.46	0.38	0.30	0.23	0.15	0.08
CORRECTION FACTOR	1.03	1.01	1.00	0.99	0.99	0.99	0.98	0.98	0.97	0.97	0.96	0.95	0.93	0.91

TABLE 3

FACTORS FOR NON-STANDARD ENTERING AIR AND/OR WATER TEMPERATURES **

(Applies to 200°F (93°C) AWT and 65°F (18.3°C) EAT)

AWT		**ENTERING AIR TEMPERATURE**					**AWT**		**ENTERING AIR TEMPERATURE**				
		45°F	55°F	65°F	70°F	75°F			45°F	55°F	65°F	70°F	75°F
		7.2°C	12.8°C	18.3°C	21.1°C	23.9°C			7.2°C	12.8°C	18.3°C	21.1°C	23.9°C
120°F	48.9°C	0.395	0.340	0.290	0.278	0.250	180°F	82.2°C	0.980	0.890	0.805	0.764	0.725
130°F	54.4°C	0.453	0.417	0.376	0.348	0.324	190°F	87.8°C	1.110	1.010	0.910	0.864	0.820
140°F	60.0°C	0.544	0.498	0.445	0.421	0.396	**200°F**	93.3°C	1.220	1.110	**1.000**	0.950	0.900
150°F	65.6°C	0.640	0.581	0.525	0.498	0.473	210°F	98.9°C	1.350	1.228	1.107	1.050	0.995
160°F	71.1°C	0.750	0.684	0.617	0.587	0.556	220°F	104.4°C	1.490	1.357	1.222	1.160	1.100
170°F	76.7°C	0.865	0.787	0.710	0.676	0.640	230°F	110.0°C	1.620	1.473	1.328	1.260	1.144

INSTALLATION HEIGHT

Installed height for finned tube unit element is vertical distance from the floor to the top of the upper element for bare element or to the top of the enclosure. Type B Sloped Bottom and WF-5A are for mounting 36” (914mm) above floor of higher. Capacity for WF-1B and WF-5A are corrected for elevated mounting.

TABLE 4

RECOMMENDED INSTALLATION HEIGHTS FOR BARE ELEMENTS AND WF-7A ENCLOSURES

ROWS	1	2	2	3	3
INSTALLED HEIGHT	8" (203 mm)	14" (356 mm)	20" (508 mm)	20" (508 mm)	32" (813 mm)

TABLE 5

RECOMMENDED INSTALLATION HEIGHTS FOR ELEMENTS WITH WF-1, 2, 3, 4 AND 6 ENCLOSURES WITH TYPE A OPEN BOTTOM.

SIZE	12" (305 mm)	18" (457mm)	24" (610 mm)
INSTALLED HEIGHT	16" (404 mm)	22" (559 mm)	28" (711 mm)

If the unit is installed at a different height than that recommended, basic capacity tables must be adjusted. Basic capacity ratings must be multiplied by the following correction factors:

TABLE 6

INSTALLATION HEIGHT CORRECTION FACTORS

Mtg. Height	WF 12"	WF 18"	WF 24"	Mtg. Height	WF 12"	WF 18"	WF 24"
Up to 18" (457mm)	1.00			28" (711mm)	0.91	0.95	1.00
19" (483mm)	0.99			29" (737mm)	0.90	0.94	0.99
20" (508mm)	0.98			30" (762mm)	0.90	0.93	0.98
21" (533mm)	0.97			31" (787mm)	0.89	0.92	0.97
22" (559mm)	0.97	1.00		32" (813mm)	0.89	0.92	0.97
23" (584mm)	0.96	0.99		33" (838mm)	0.88	0.91	0.96
24" (610mm)	0.95	0.98		34" (864mm)	0.88	0.91	0.96
25" (635mm)	0.94	0.97		35" (889mm)	0.87	0.90	0.95
26" (660mm)	0.93	0.96		36" (914mm) & up	0.87	0.90	0.95
27" (686mm)	0.92	0.96					

NOTES: WF-2 Requires no correction factor.
Performance tables of WF-1B and WF-5A are corrected for installations above 36” (914mm).

TABLE 7

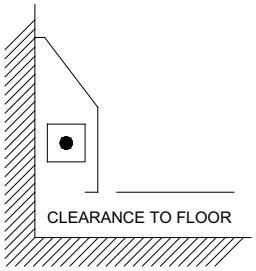
EFFECT OF BOTTOM CLEARANCE ON WF SERIES FINNED TUBE RADIATION CAPACITY (A Bottom)

Clearance to Floor	3 1/2" & up (89mm)	3" (76mm)	2 1/2" (63mm)	2" (52mm)	1 1/2" (32mm)	1" (25mm)
Correction Factor	1.000	0.985	0.962	0.925	0.875	0.800

TABLE 8

EFFECT OF BOTTOM CLEARANCE ON PROFILE SERIES FINNED TUBE RADIATION CAPACITY

Clearance to Floor	2 1/4" & up (57mm)	2" (52mm)	1 1/2" (32mm)	1" (25mm)
Correction Factor	1.000	0.980	0.950	0.880



MAXIMUM INSTALLED LENGTH

1. STEAM SYSTEMS

The maximum length of element depends on the condensate carrying capacity of the element tube. Maximum installed length can be determined as follows:

$$\text{MAXIMUM LENGTH} = \frac{\text{Maximum Capacity (}\textit{Table 9}\text{)}}{\text{Hot Water Lineal Capacity (}\textit{Basic Capacity Table}\text{)}}$$

TABLE 9

MAXIMUM INSTALLED RADIATION - STEAM SYSTEMS

TUBE SIZE	1 1/4" COPPER (32mm)
MAX. CAPACITY	50,000 BTU/HR (14.6 Kw)

Capacities above are based on 1/4 PSI pressure drop per 100 feet. For high pressure systems and other pressure drops see ASHRAE guide.

Where elements are connected in parallel (each row piped separately) maximum length is obtained by calculating for one element.

2. HOT WATER SYSTEMS

Maximum installed lengths of elements in hot water system are influenced by velocity and pressure drop. Velocity in any given pipe size is dependent upon the capacity of the element and temperature drop of the water through the element. Maximum recommended installed capacity for an element is based on a 4 ft./sec. (1.2 m/s) velocity through the tube (maximum recommended for quiet operation) and a 20°F (11°C) water temperature drop between water entering and leaving.

The maximum installed length can be determined as follows:

$$\text{MAXIMUM LENGTH} = \frac{\text{Maximum Capacity (}\textit{Table 10}\text{)}}{\text{Hot Water Lineal Capacity (}\textit{Basic Capacity Table}\text{)}}$$

For a Water temperature drop other than 20°F (11°C) the maximum capacity can be determined as follows:

Maximum Capacity = Max. Capacity (Table 10) x Correction Factor (Table 11)

TABLE 10

MAXIMUM RADIATION HOT WATER SYSTEMS

TUBE SIZE	1 1/4" COPPER (32mm) COPPER	3/4" COPPER (19mm)
MAX. CAPACITY	150,000 BTU/HR (43.9 kW)	58,000 BTU/HR (17.0 Kw)

TABLE 11

CORRECTION FACTORS FOR DIFFERENT TEMPERATURE DROPS

TEMP DROP °F (°C)	5°F (3°C)	10°F (5°C)	15°F (8°C)	20°F (11°C)
FACTORS	0.25	0.50	0.75	1.00

EXPANSION

EngA element supports allow for 1 1/4" (32mm) maximum free expansion. Provisions must be made for expansion at piping connections.

TABLE 12

EXPANSION OF NON FERROUS ELEMENTS AND COPPER TUBE

IMPERIAL			
INSTALLED LEGTH FT.	TEMPERATURE		
	200°F	250°F	300°
	EXPANSION in.	EXPANSION in.	EXPANSION in.
20	0.40	0.51	0.62
25	0.50	0.64	0.77
30	0.60	0.77	0.92
35	0.70	0.90	1.07
40	0.80	1.03	1.22
45	0.90	1.16	1.37
50	1.00	1.23	1.52
60	1.20	1.18	1.82

TABLE 13

EXPANSION OF NON FERROUS ELEMENTS AND COPPER TUBE

METRIC			
INSTALLED LENGTH m	TEMPERATURE		
	93°C	121°C	149°C
	EXPANSION mm	EXPANSION mm	EXPANSION mm
6.1	10.2	13.0	15.7
7.6	12.7	16.3	19.6
9.1	15.2	19.6	23.4
10.7	17.8	22.9	27.2
12.2	20.3	26.2	31.0
13.7	22.9	29.5	34.8
15.2	25.4	31.2	38.6
18.3	30.5	37.6	46.2

Table 14 and 15 give heat loss from, or capacity of uninsulated pipe and tubing. The capacities are for pipe and tubing in an open space. If located within an enclosure, capacity will increase.

HEAT LOSS FROM HORIZONTAL BARE PIPE AND TUBING IN STILL AIR AT 80°F (26°C)

TABLE 14

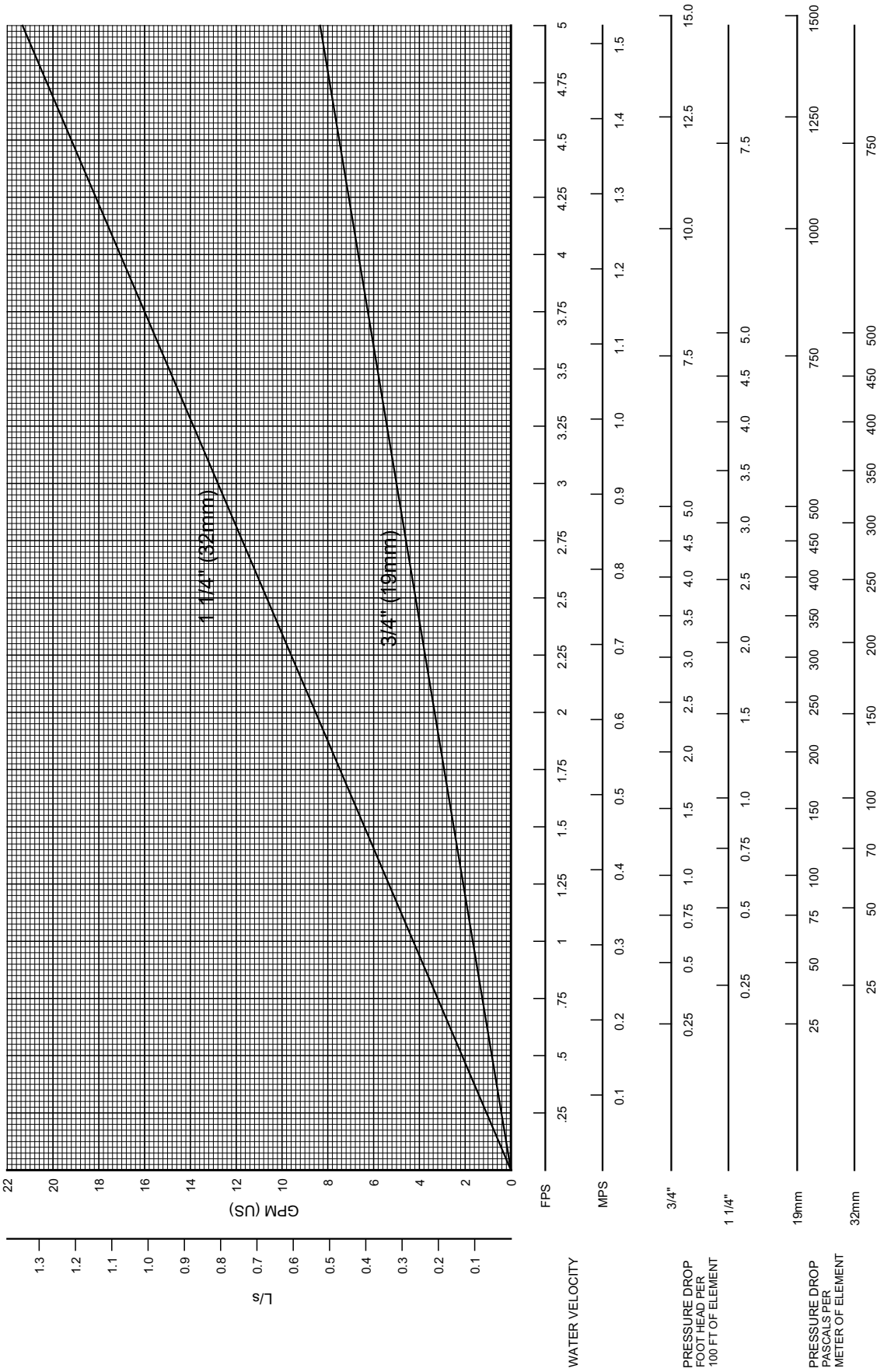
in.	BTU/HR/FT	
	Steel 180°F	Dull Copper 180°F
1/2"	59.3	34.0
3/4"	72.5	45.4
1"	88.8	56.4
1 1/4"	109.7	67.2
1 1/2"	123.9	77.6
2"	151.8	98.0
2 1/2"	180.5	117.9

TABLE 15

mm	kW/m	
	Steel 82.2°C	Dull Copper 82.2°C
12	57.0	32.7
19	69.7	43.7
25	85.4	54.2
32	105.5	64.6
40	119.1	74.6
52	146.0	94.2
63	173.6	113.4

FLOW VS. VELOCITY AND PRESSURE DROP

TABLE 16



The heat output of all heating products from finned tube radiation to convectors and unit heaters is affected by the operating conditions including the fluid type. The use of ethylene or propylene glycol solution is to protect the equipment from freezing. The use of these glycols restricts the rate of heat transfer thereby requiring a deration of the equipment performance.

To correct for the effect of using ethylene or propylene glycol solution in a system simply apply the appropriate correction factor from Table 17 to the rate of heat transfer found in the capacity tables for the corresponding product found in this catalogue.

$$q_2 = q_1 \times \text{Correction Factor (Table 17)}$$

where:

q_1 = catalog performance rate of heat transfer for appropriate product, Btuh (kW)
q_2 = derated rate of heat transfer, Btuh (kW)

TABLE 17

CAPACITY CORRECTION FACTORS FOR FLUIDS OTHER THAN WATER AT 180°F (82.2°C)

(CONCENTRATION BY VOLUME)

	60%	50%	40%	30%	25%	20%	10%
ETHYLENE GLYCOL	**0.84**	**0.87**	**0.90**	**0.93**	**0.94**	**0.96**	**0.98**
FREEZE POINT	below -60°F	-34.6°F	-12.6°F	3.7°F	10.2°F	16.0°F	25.3°F
	below(-51.1°C)	(-37.0°C)	(-24.7°C)	(-15.7°C)	(-12.1°C)	(-8.9°C)	(-3.7°C)
BURST POINT	-	-	below -60°F	-16.6°F	-4.5°F	5.8°F	22.1°F
	-	-	below (-51.1°C)	(-27.0°C)	(-20.3°C)	(-14.5°C)	(-5.5°C)
PROPYLENE GLYCOL	**0.79**	**0.84**	**0.88**	**0.92**	**0.93**	**0.95**	**0.97**
FREEZE POINT	-60°F	-28.6°F	-6.7°F	8.4°F	14.0°F	18.7°F	25.8°F
	(-51.1°C)	(-33.7°C)	(-21.5°C)	(-13.1°C)	(-10.0°C)	(-7.4°C)	(3.4°C)
BURST POINT	-	-	below -60°F	-20.0°F	-2.5°F	10.0°F	22.5°F
	-	-	below (-51.1°C)	(-28.9°C)	(-16.4°C)	(-12.2°C)	(-5.3°C)

The rate of heat transfer when using water is determined using the formula:

$$q = 500 \times M \times (t_1 - t_2) = 500 \times M \times \Delta T$$

q = rate of heat transfer (Btu/h)
M = mass flow rate of water (usgpm)
500 = constant based on the mass flow rate (usgpm) and the specific heat of water
ΔT = the temperature drop of the water °F
t_1 = entering water temperature °F
t_2 = leaving water temperature °F

STEAM APPLICATIONS

When steam is used in finned tube radiation the element should be sloped to aid condensate drainage. For all steam applications drain traps are essential. Consult a steam trap specialist for selection and orientation of the traps.

The condensate flow is dependent on the heat output and the steam pressure. The condensate flow is calculated using the following formula:

$$m = \frac{q}{h_L}$$

m = mass flow in lb/hr
q = rate of heat transfer in Btuh
h_L = latent heat of steam in Btu/lb

Latent heat of steam is found in Table 18.

TABLE 18

PROPERTIES OF SATURATED STEAM

Steam Pressure		Steam Temperature		Latent Heat	
PSIG	kPa	°F	°C	BTU/lb	kW/kg
0.0899	6.2	212	100.0	970.4	0.627
1	6.9	215.3	101.8	968.2	0.626
2	13.8	218.5	103.6	966.2	0.624
4	27.6	224.4	106.9	962.4	0.622
6	41.4	229.8	109.9	958.8	0.620
8	55.2	234.8	112.7	955.5	0.617
10	69.0	239.4	115.2	952.5	0.616
15	103.4	249.8	121.0	945.5	0.611
25	172.4	266.8	130.4	933.6	0.603
50	344.8	297.7	147.6	911.2	0.589
75	517.2	320.1	160.1	894.2	0.578
100	689.6	337.9	169.9	880.0	0.569
125	862.0	352.9	178.3	867.8	0.561
150	1034.4	365.4	185.2	857.2	0.554
175	1206.8	376.9	191.6	847.1	0.547
200	1379.2	387.4	197.4	838.6	0.542

Forced convection heating equipment follow basic thermodynamic laws and the fluid flow laws. The rate of heat transfer is determined using the following formula:

$$q = Q \times 1.085 \times (T2 - T1) = Q \times 1.085 \times \Delta T$$

- q = rate of heat transfer in Btu/hr
- Q = mass flow rate of standard air in CFM
- T_1 = entering air temperature °F
- T_2 = leaving air temperature °F
- ΔT = air temperature rise °F

From this formula the leaving air temperature can be calculated

$$T2 = T1 + \frac{q}{Q \times 1.085}$$

Changing fan RPM changes the mass flow of air as shown in the following formula:

$$\frac{Q_1}{Q_2} = \frac{N_1}{N_2}$$

- Q_1 = initial mass flow rate of air
- Q_2 = final mass flow rate of air
- N_1 = initial rotational speed
- N_2 = final rotational speed

The fan power for such a change increases by the cube of the rotational speed rate change as shown in the following formula:

$$\frac{W_1}{W_2} = \left(\frac{N_1}{N_2}\right)^3$$

- W_1 = initial fan power
- W_2 = final fan power

The rate of heat transfer also changes as shown in the following formula:

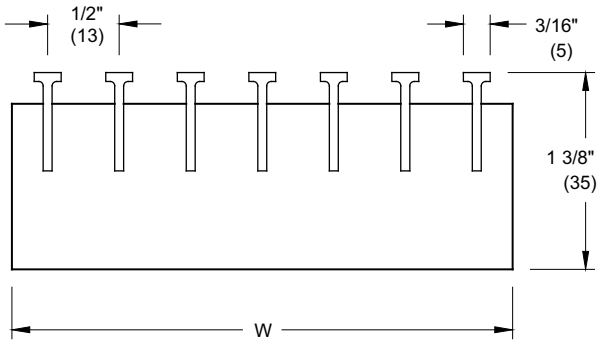
$$\frac{q_1}{q_2} = \left(\frac{N_1}{N_2}\right)^{0.6}$$

- q_1 = initial rate of heat transfer
- q_2 = final rate of heat transfer

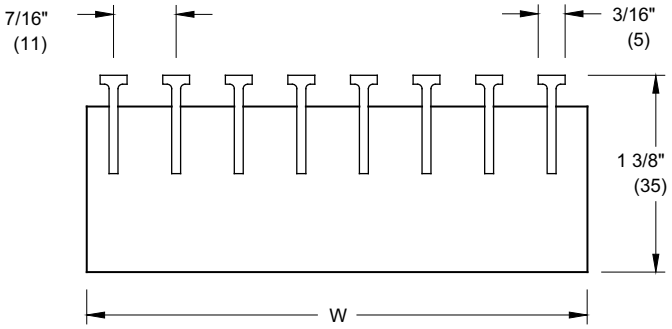
This is a general formula to give a quick comparison of performance. Consult your Engineered Air representative for actual performance change.

BAR GRILLE DIFFUSER

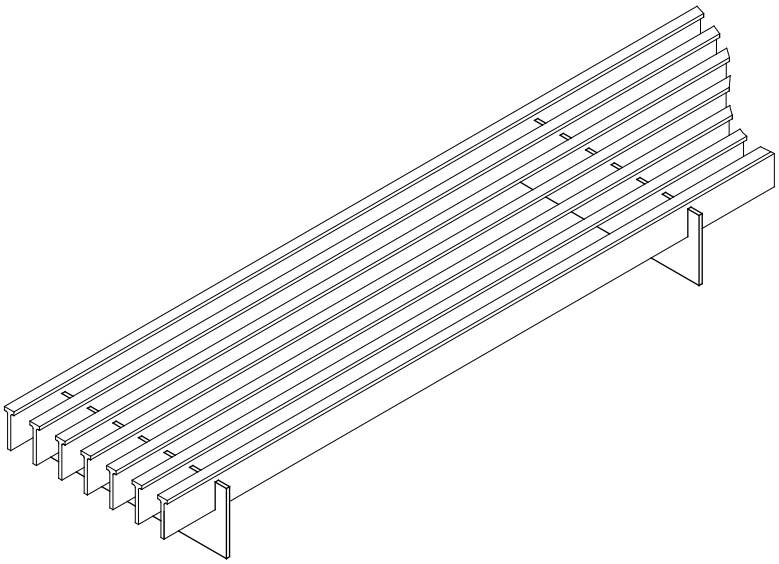
Airtex offers an extruded aluminum bar grille in the WF-6 enclosure and in a variety of our other fine products. The bar grille has attractive clean crisp lines and is streamlined for high efficiency. The bars are uniformly spaced and rigidly mounted in retaining brackets. Airtex offers two popular spacings, the standard 1/2” (13mm) or the 7/16” (11mm) pencil proof style. Individual core widths up to 5” (127mm) and lengths up to 96” (2438mm) are available and can be provided with custom finishes. Enclosures can be provided with continuous or sectional bar grilles. The extruded bar grille is also offered in our C Series convectors and in selected arrangements of our CUH Series cabinet unit heaters. Contact your Sales Representative for further information.



STANDARD SPACING



PENCIL PROOF SPACING



WATER HEAD

Feet	Metres	PSI	kPa	Feet	Metres	PSI	kPa	Feet	Metres	PSI	kPa
1	0.305	0.43	2.99	25	7.620	10.83	74.73	140	42.672	60.62	418.46
2	0.610	0.87	5.98	30	9.144	12.99	89.67	150	45.720	64.95	448.35
3	0.914	1.30	8.97	40	12.192	17.32	119.56	160	48.768	69.28	478.24
4	1.219	1.73	11.96	50	15.240	21.65	149.45	170	51.816	73.61	508.13
5	1.524	2.17	14.95	60	18.288	25.98	179.34	180	54.864	77.94	538.02
6	1.829	2.60	18.18	70	21.336	30.31	209.23	190	57.912	82.27	567.91
7	2.134	3.03	20.92	80	24.384	34.64	239.12	200	60.960	86.60	597.80
8	2.438	3.46	23.91	90	27.432	38.97	269.01	250	76.200	108.25	747.25
9	2.743	3.90	26.90	100	30.480	43.30	298.90	300	91.440	129.90	896.70
10	3.048	4.33	29.89	110	33.528	47.63	328.79	400	121.920	173.20	1195.60
15	4.572	6.50	44.84	120	36.576	51.96	358.68	500	152.400	216.50	1494.5
20	6.096	8.66	59.78	130	39.624	56.29	388.57	750	228.600	324.75	2241.75

kPa	PSI	Metres	Feet	kPa	PSI	Metres	Feet	kPa	PSI	Metres	Feet
1	0.15	0.102	0.33	40	5.80	4.080	13.38	180	26.10	18.360	60.21
2	0.29	0.204	0.67	50	7.25	5.100	16.73	190	27.55	19.380	63.56
3	0.44	0.306	1.00	60	8.70	6.120	20.07	200	29.00	20.400	66.90
4	0.58	0.408	1.34	70	10.15	7.140	23.42	250	36.25	25.500	83.63
5	0.73	0.510	1.67	80	11.60	8.160	26.76	300	43.50	30.600	100.35
6	0.87	0.612	2.01	90	13.05	9.180	30.11	400	58.00	40.800	133.80
7	1.02	0.714	2.34	100	14.50	10.200	33.45	500	72.50	51.000	167.25
8	1.16	0.846	2.68	110	15.95	11.220	36.80	600	87.00	61.200	200.70
9	1.31	0.918	3.01	120	17.40	12.240	40.14	700	101.50	71.400	234.15
10	1.45	1.020	3.25	130	18.85	13.260	43.49	800	116.00	81.600	267.60
15	2.18	1.530	5.02	140	20.30	14.280	46.83	900	130.50	91.800	301.05
20	2.90	2.040	6.69	150	21.75	15.300	50.18	1000	145.00	102.000	334.50
25	3.63	2.550	8.36	160	23.20	16.320	53.52	1250	181.25	127.500	418.13
30	4.35	3.060	10.04	170	24.65	17.340	56.87	1500	217.50	153.000	501.75

WATER HEAD

PSI	kPa	Feet	Metres	PSI	kPa	Feet	Metres
1	6.90	2.31	0.703	60	413.79	138.54	42.180
2	13.79	4.62	1.406	70	482.76	161.63	49.210
3	20.69	6.93	2.109	80	551.72	184.72	56.240
4	27.59	9.24	2.812	90	620.69	207.81	63.270
5	34.48	11.55	3.515	100	689.66	230.90	70.300
6	41.38	13.85	4.218	110	758.62	253.99	77.330
7	48.28	16.16	4.921	120	827.59	277.08	84.360
8	55.17	18.47	5.624	130	896.55	300.17	91.390
9	62.07	20.78	6.327	140	956.52	323.26	98.420
10	68.97	23.09	7.030	150	1034.48	346.35	105.450
15	103.45	34.64	10.545	160	1103.45	369.44	112.480
20	137.93	46.18	14.060	170	1172.41	392.53	119.510
25	172.41	57.73	17.575	180	1241.38	415.62	126.540
30	206.90	69.27	21.090	190	1310.34	438.71	133.570
40	275.86	92.36	28.120	200	1379.31	461.80	140.600
50	344.83	115.45	35.150	250	1724.14	577.25	175.750

Metres	Feet	kPa	PSI	Metres	Feet	kPa	PSI
1	3.28	9.80	1.42	30	98.42	294.12	42.60
2	6.56	19.61	2.84	40	131.23	392.16	56.80
3	9.84	29.41	4.26	50	164.04	490.20	71.00
4	13.12	39.22	5.68	60	196.85	588.23	85.20
5	16.40	49.02	7.10	70	229.66	686.27	99.40
6	19.68	58.82	8.52	80	262.46	784.31	113.60
7	22.97	68.63	9.94	90	295.27	882.35	127.80
8	26.25	78.43	11.36	100	328.08	980.39	142.00
9	29.53	88.24	12.78	110	360.89	1078.43	156.20
10	32.81	98.04	14.20	120	393.70	1176.47	170.40
15	49.21	147.06	21.30	130	426.50	1274.51	184.60
20	65.62	196.08	28.40	140	459.31	1372.55	198.80
25	82.02	245.10	35.50	150	492.12	1470.59	213.00

PIPE AND WATER WEIGHT AND VOLUME PER UNIT LENGTH

Type L Copper

Size		lbs/ft pipe	lbs/ft water	total lbs/ft	kg/m pipe	kg/ft water	total kg/ft	US gal/ft	ft/US gal	imp gal/ft	ft/imp gal	litre/m	m/litre
in.	mm												
1/4	6	0.126	0.034	0.160	0.188	0.050	0.238	0.004	246.79	0.003	296.39	0.050	19.872
3/8	9	0.198	0.063	0.261	0.295	0.093	0.388	0.008	132.76	0.006	159.43	0.094	10.690
1/2	12	0.285	0.101	0.386	0.424	0.150	0.574	0.012	82.62	0.010	99.22	0.150	6.652
3/4	19	0.455	0.209	0.664	0.677	0.312	0.989	0.025	39.77	0.021	47.76	0.312	3.202
1	25	0.655	0.357	1.012	0.975	0.531	1.506	0.043	23.33	0.036	28.02	0.532	1.879
1 1/4	32	0.884	0.545	1.429	1.316	0.811	2.127	0.065	15.28	0.055	18.35	0.813	1.230
1 1/2	40	1.140	0.770	1.910	1.697	1.146	2.843	0.092	10.81	0.077	12.99	1.148	0.871
2	52	1.750	1.337	3.087	2.604	1.990	4.594	0.161	6.23	0.134	7.48	1.994	0.502
2 1/2	63	2.480	2.064	4.544	3.691	3.072	6.763	0.248	4.04	0.206	4.85	3.077	0.325
3	75	3.330	2.947	6.277	4.956	4.386	9.342	0.354	2.83	0.295	3.39	4.394	0.228
4	100	5.380	5.193	10.573	8.006	7.729	15.735	0.623	1.60	0.519	1.93	7.742	0.129
6	150	10.200	11.598	21.798	15.179	17.260	32.440	1.392	0.72	1.159	0.86	17.290	0.058
8	200	19.300	20.297	39.597	28.722	30.206	58.927	2.436	0.41	2.029	0.49	30.258	0.033

Schedule 40 Steel Pipe

Size		lbs/ft pipe	lbs/ft water	total lbs/ft	kg/m pipe	kg/ft water	total kg/ft	US gal/ft	ft/US gal	imp gal/ft	ft/imp gal	litre/m	m/litre
in.	mm												
1/2	12	0.851	0.132	0.983	1.266	0.196	1.463	0.016	63.35	0.013	76.08	0.196	5.101
3/4	19	1.131	0.231	1.362	1.683	0.344	2.027	0.028	36.20	0.023	43.47	0.343	2.915
1	25	1.679	0.374	2.053	2.499	0.557	3.055	0.045	22.36	0.037	26.85	0.555	1.800
1 1/4	32	2.273	0.648	2.921	3.383	0.964	4.347	0.077	12.90	0.065	15.50	0.962	1.039
1 1/2	40	2.718	0.882	3.600	4.045	1.313	5.357	0.105	9.48	0.088	11.39	1.310	0.763
2	52	3.653	1.453	5.106	5.436	2.162	7.599	0.174	5.76	0.145	6.91	2.158	0.463
2 1/2	63	5.794	2.073	7.867	8.622	3.085	11.707	0.248	4.03	0.206	4.84	3.079	0.325
3	75	7.580	3.200	10.780	11.280	4.762	16.042	0.383	2.61	0.319	3.14	4.753	0.210
4	100	10.790	5.510	16.300	16.057	8.200	24.257	0.659	1.52	0.549	1.82	8.183	0.122
6	150	18.980	12.510	31.490	28.245	18.617	46.862	1.496	0.67	1.246	0.80	18.580	0.054
8	200	28.560	21.680	50.240	42.502	32.263	74.765	2.593	0.39	2.159	0.46	32.199	0.031

Schedule 80 Steel Pipe

Size		lbs/ft pipe	lbs/ft water	total lbs/ft	kg/m pipe	kg/ft water	total kg/ft	US gal/ft	ft/US gal	imp gal/ft	ft/imp gal	litre/m	m/litre
in.	mm												
1/2	12	1.088	0.101	1.189	1.619	0.150	1.769	0.012	82.79	0.010	99.43	0.150	6.666
3/4	19	1.474	0.187	1.661	2.194	0.278	2.472	0.022	44.72	0.019	53.70	0.278	3.601
1	25	2.172	0.331	2.503	3.232	0.493	3.725	0.040	25.26	0.033	30.34	0.492	2.034
1 1/4	32	2.997	0.555	3.552	4.460	0.826	5.286	0.066	15.07	0.055	18.09	0.824	1.213
1 1/2	40	3.632	0.765	4.397	5.405	1.138	6.543	0.091	10.93	0.076	13.13	1.136	0.880
2	52	5.022	1.278	6.300	7.474	1.902	9.375	0.153	6.54	0.127	7.86	1.898	0.527
2 1/2	63	7.662	1.835	9.497	11.402	2.731	14.133	0.219	4.56	0.183	5.47	2.725	0.367
3	75	10.250	2.860	13.110	15.254	4.256	19.510	0.342	2.92	0.285	3.51	4.248	0.235
4	100	14.990	4.980	19.970	22.308	7.411	29.719	0.596	1.68	0.496	2.02	7.396	0.135
6	150	28.580	11.290	39.870	42.532	16.801	59.333	1.350	0.74	1.124	0.89	16.768	0.060
8	200	43.400	19.800	63.200	64.586	29.466	94.052	2.368	0.42	1.972	0.51	29.407	0.034

UNIT CONVERSION

Length								
1 metre (m)	=	3.28 ft	=	39.7 inches	=	1000 mm		
1 foot (ft)	=	1 ft	=	12 inches	=	304.8 mm	=	0.3048 metre
1 inch (in)	=	0.08333 ft	=	1 inch	=	25.4 mm		
Area								
1 m^2	=	10.76 ft^2	=	1550 $inch^2$				
1 cm^2			=	0.155 $inch^2$				
1 ft^2			=	144 $inch^2$	=	929 cm^2	=	9.29 dm^2
1 $inch^2$					=	6.45 cm^2		
Volume								
1 m^3	=	264.2 US gal	=	219.9 IMP gal	=	35.315 ft^3	=	1000 litres
1 US gal			=	0.003785 m^3	=	0.134 ft^3	=	3.785 litres
1 litre	=	0.264 US gal	=	0.2199 IMP gal	=	0.035 ft^3		
1 IMP gal			=	0.004546 m^3	=	0.1605 ft^3	=	4.546 litres
Velocity								
1 metre/sec	=	1 m/s	=	196.8 FPM	=	3.2808 ft/s		
1 FPM (ft/min)	=	0.00508 m/s			=	0.0167 ft/s		
500 FPM	=	2.54 m/s			=	8.3333 ft/s		
1 FPS (ft/s)	=	0.3048 m/s	=	60 FPM				
Pressure								
1 bar	=	100 kPa	=	10200 mm WG	=	14.504 PSI	=	33.45 ft WG
1 kPa			=	102 mm WG	=	0.145 PSI	=	0.33 ft WG
1 PSI	=	6.9 kPa	=	703 mm WG			=	2.31 ft WG
1 ft WG	=	2.989 kPa	=	305 mm WG	=	0.433 PSI		
1 m WG	=	9.8 kPa	=	1000 mm WG	=	1.42 PSI	=	3.28 ft WG
1 in WG	=	0.249 kPa	=	25.4 mm WG	=	0.036 PSI	=	0.083 ft WG
Flow								
1 m^3/h	=	1000 l/h	=	0.278 l/s	=	4.4 GPM	=	0.588 CFM
1 GPM (US)	=	227 l/h	=	0.063 l/s			=	0.134 CFM
1 CFM	=	1700 l/h	=	0.472 l/s	=	7.48 GPM		
1 l/s	=	3600 l/h			=	15.86 GPM	=	2.117 CFM
1 lb/hr			=	0.0001260 l/s	=	0.001997 US GPM (water)		
1 kg/hr			=	0.0002778 l/s	=	0.004403 US GPM (water)		
Power								
1 Watt (W)	=	3.4 BTUH			=	1 J/s		
1 kW	=	3412.1 BTUH	=	1.341 HP	=	1000 W	=	860 kcal/h = 0.28 TON
1 BTUH					=	0.29307 W		
1 MBTUH	=	1000 BTUH	=	0.393 HP	=	293.07 W	=	252 kcal/h
1 HP	=	2544 BTUH			=	745.7 W	=	641 kcal/h
1 kcal/h	=	3.97 BTUH			=	1.16 W		
1 ton (cooling)	=	12000 BTUH			=	3517 W	=	3025 kcal/h
Energy								
1 kJ	=	0.948 BTU					=	0.023885 kcal
1 BTU			=	1.0522 kJ			=	0.0252 kcal
1 MBTU	=	1000 BTU	=	1.0522 kJ	=	0.293 kWh	=	252 kcal
1 kcal	=	3.968 BTU	=	4.1868 kJ				
1000 kcal	=	3968.3 BTU	=	4186.8 kJ	=	1.163 kWh		
1 kWh	=	3412.1 BTU	=	3600 kJ			=	859.85 kcal
1 BTUH/ft					=	0.961 watt/m		
1 W/m					=	1.040 BTUH/ft		
1 $BTUH/ft^2$					=	3.155 $watts/m^2$		
1 W/m^2					=	0.3169 $BTUH/ft^2$		
Mass								
1 lb	=	0.454 kg	=	7000 grains				
1 kg	=	2.205 lbs						
Water Volume & Mass								
1 US gal	=	8.345 lbs	=	3.785 kg				
1 IMP gal	=	10.022 lbs	=	4.546 kg				
1 ft^3	=	62.428 lbs	=	29.317 kg				
1 l	=	1.000 kg	=	2.205 lbs				
1 m^3	=	1000 kg	=	2205 lbs				
Temperature								
Relative	=	$\frac{(°F - 32)}{1.8} = °C$			=	(°C x 1.8) + 32 = °F		
Difference	=	°F x 0.55 = °C			=	°C x 1.8 = °F		