

# CHAPTER 3

## *Design Data*

<b>WATER BASICS</b>
1 ft. <sup>3</sup> of water contains 7.48 gal., 1,728 in. <sup>3</sup> , and weighs 62.48 lb.
1 ft. <sup>3</sup> of ice weighs 57.2 lb.
1 gal. of water weighs 8.33 lb. and contains 231 in. <sup>3</sup> or 0.1337 ft. <sup>3</sup>
1 lb. of water equals 27.72 in. <sup>3</sup>
One BTU is the heat needed to raise one pound of water one degree F.
1 ft. of water equals 0.434 psi
2.31 ft. of water equals 1.0 psi
The height of a column of water, equal to a pressure of 1.0 psi, is 2.31 ft.
To find the pressure in psi of a column of water, multiply the height of the column in feet by 0.434.
The average pressure of the atmosphere is estimated at 14.7 psi so that with a perfect vacuum it will sustain a column of water 34 ft. high.
Water expands $\frac{1}{23}$ of its volume when heated from 40° to 212°F.
Water is at its greatest density at 39.2°F
The friction of water in pipes varies as the square of the velocity.
To evaporate 1 ft. <sup>3</sup> of water requires the consumption of 7½ lb. of ordinary coal or about 1 lb. of coal to 1 gal. of water.
1 in. <sup>3</sup> of water evaporated at atmospheric pressure is converted into approximately 1 ft. <sup>3</sup> of steam.

## WATER FORMULAS

Gallons per minute through a pipe:

$$\text{GPM} = 0.0408 \times [\text{Pipe I.D. (in.)}]^2 \times \text{Feet/Water Velocity(min.)}$$

Horsepower to raise water:

$$\text{HP} = \frac{\text{Total Head (ft.)} \times \text{GPM}}{3960}$$

Note: For non-water liquids, multiply GPM by the liquid's specific gravity.

Round Tank capacity in gallons:

$$\text{Round Tank (gal.)} =$$

$$[\text{Tank Dia. (ft.)}]^2 \times 0.7854 \times \text{Tank Length (ft.)} \times 7.48 \text{ (gal. per ft.}^3\text{)}$$

Weight of water in a pipe:

$$\text{Water (lb.)} = 0.34 \times [\text{Pipe I.D. (in.)}]^2 \times \text{Pipe Length (ft.)}$$

## BOILING POINTS OF WATER AT SEA LEVEL

Gauge (psi)	Boiling Point (F)
0	212°
2	218.5°
4	224.4°
6	229.8°
8	234.8°
10	239.4°
15	249.8°
25	266.8°
50	297.1°
100	337.9°
125	352.9°
200	387.9°

Note: A 0 gauge pressure equals 14.7 psi actual air pressure at sea level.

**WEIGHT OF WATER IN POUNDS**

<b>Temp. (F)</b>	<b>Wt. Per Cu. Ft.</b>	<b>Wt. Per Gallon</b>	<b>Temp. (F)</b>	<b>Wt. Per Cu. Ft.</b>	<b>Wt. Per Gallon</b>
32°	62.418	8.344	130°	61.563	8.230
35°	62.422	8.345	135°	61.472	8.218
39.2°	62.425	8.346	140°	61.381	8.206
40°	62.425	8.346	145°	61.291	8.193
45°	62.422	8.345	150°	61.201	8.181
50°	62.409	8.343	155°	61.096	8.167
55°	62.394	8.341	160°	60.991	8.153
60°	62.372	8.338	165°	60.843	8.134
65°	62.344	8.334	170°	60.783	8.126
70°	62.313	8.331	175°	60.665	8.110
75°	62.275	8.325	180°	60.548	8.094
80°	62.232	8.321	185°	60.430	8.078
85°	62.182	8.313	190°	60.314	8.063
90°	62.133	8.306	195°	60.198	8.047
95°	62.074	8.297	200°	60.081	8.032
100°	62.022	8.291	205°	59.980	8.018
105°	61.960	8.283	210°	59.820	7.997
110°	61.868	8.271	212°	59.760	7.989
115°	61.807	8.261	250°	58.750	7.854
120°	61.715	8.250	300°	56.970	7.616
125°	61.654	8.242	400°	54.250	7.252