(214) 361-6611 OR (817) 926-4623 ASHCRAFT COMPANY SALES@ASHCRAFTCOMPANY.COM

CONVERSION FACTORS AND ENGINEERING TOOLBOX

WATER DATA		
One Gallon of Potable Water	8.33 lbs.	
One Cubic foot of Water	7.48 Gallons	
One Cubic foot of Water	62.43 lbs.	(at 39.2°F – max. density)
One Cubic foot of Water	59.83 lbs.	(at 212°F – boiling point)
One U.S. Gallon	231 cubic inches	

- ✦ The capacity of a cylinder in Gallons = (length in inches) (diameter squared in inches squared) (0.0034)
- ✦ A water column one foot high exerts a pressure of 0.4333 pounds per square inch.
- ✦ Doubling the diameter of a pipe increases the capacity four times.
- ✦ Water expands 4.34% when heated from 40°F to 212°F.
- ✦ Water is nearly incompressible, a pressure of 7000 PSI will reduce the volume of water about 2%.
- ✦ Water expands 8% when it freezes to a solid.
- ✦ Water changes to steam at sea level when heated to 212°F.
- ✦ As altitude increases the boiling point of water decreases, at one mile of altitude water boils at 202°F, at an altitude of two miles it boils at 192°F.
- ✦ Gases such as oxygen, chlorine, carbon dioxide, hydrogen sulfide and others are soluble in water.
- ✦ Dissolved gases in water are expelled when it is heated. Commonly observed as milky water. The dissolved minerals and solids in water precipitate out as water is heated forming limescale. Limescale formation greatly increases at water temperatures greater than 140°F.
- ✦ The formation of limescale from minerals dissolved in water increases with water temperature and decreases with velocity. The decrease in limescale on a heating surface is caused by lowering of the heating surface temperature and the scrubbing/shearing action of the water flow.
- ✦ The pH scale is used to determine the relative acidity, neutrality or alkalinity of water.
- ✦ A pH of less than 7 is acid, a pH of 7 is neutral and a pH greater than 7 is alkaline
- ✦ One British thermal unit (Btu) is the amount of heat required to raise one pound of water one degree Fahrenheit.

GAS DATA	
Pressure	
1 – Pound of Gas =	28" Water Column (w.c.)
1 – Pound of Gas =	16 Ounces
Natural Gas	
Specific Gravity =	0.62
Flammability Limits =	4% – 14% Gas/Air Mixture
Maximum Flame Propagation =	10% Gas/Air Mixture
Ignition Temperature =	1200°F
Propane Gas (LP)	
Specific Gravity =	1.52
Flammability Limits =	2.4% – 9.6% Gas/Air Mixture
Maximum Flame Propagation =	5% Gas/Air Mixture
Ignition Temperature =	950°F

Btu/hr Input
$$= \frac{\text{GPM x 60 min/hr x 8.33 lb/gal x Temp. Rise}}{\text{\% Efficiency}}$$

Efficiency of Heat Transfer
% Efficiency
$$= \frac{\text{GPH x 8.33 lb/gal x Temp. Rise}}{\text{Btu/hr Input}}$$

Recovery - Gas
GPH
$$= \frac{\text{Btu/hr Input x \% Efficiency}}{\text{Temp. Rise x 8.33 lb./gal}}$$

Recovery - Electric
GPH
$$= \frac{\text{kW Input x 3412 Btu/kW x \% Efficiency}}{\text{Temp. Rise x 8.33 lb./gal}}$$

Temperature Rise
Temp. Rise
$$= \frac{\text{Btu/hr Input x \% Efficiency}}{\text{GPM x 60min/hr x 8.33 lb./gal}}$$

Heat-Up Time
Time in Hours
$$= \frac{\text{(GPH) x 8.33 lb./gal x Temp. Rise}}{\text{Btu/hr Input x \% Efficiency}}$$

Water Content

Pipe Size Inches (nominal)	Volume (in3/ft)	Volume (gal/ft)	Weight (lb/ft)	Volume/Weight (liter/m, kg/m)
1/4	0.59	0.003	0.02	0.030
3/8	1.33	0.006	0.05	0.074
1/2	2.36	0.010	0.09	0.130
3/4	5.30	0.023	0.19	0.280
1	9.43	0.041	0.34	0.510
1 1/4	14.7	0.064	0.53	0.790
1 1/2	21.2	0.092	0.77	1.100
2	37.7	0.163	1.36	2.000
2 1/2	58.9	0.255	2.13	3.200
3	84.8	0.367	2.31	3.400
4	150.8	0.653	5.44	8.100
5	235.6	1.020	8.50	13
6	339.3	1.470	12.20	18
8	603.2	2.610	21.80	32
10	942.5	4.080	34.00	51
12	1357.2	5.880	49.00	73
15	2120.6	9.180	76.50	114

BTU CONTENT OF FUELS

GAS	Btu	ELECTRICITY	Btu
1 Cubic Foot Natural	1,075	1 Kilowatt (kW)	3412
1 Cubic Foot Propane	2,570	**OIL**	**Btu**
1 Pound Propane	21,600	1 Gallon # 1 Fuel	136000
1 Gallon Propane	91,000	1 Gallon # 2 Fuel	138500
1 Cubic Foot Butane	3,260	1 Gallon # 3 Fuel	141000
1 Pound Butane	21,300	1 Gallon # 5 Fuel	148500
1 Gallon Butane	102,600	1 Gallon # 6 Fuel	152000
1 Cubic Foot Manufacture	530	**COAL**	**Btu**
1 Cubic Foot Mixed	850	1 Pound	10,000 – 15,000
		1 Ton	Approx. 25 Million

% Hot Water Required to Provide Mixed Water at a Lower Temperature

$$\frac{\text{Temp. Mixed Water °F – Temp. Cold Water °F}}{\text{Temp. Hot Water °F – Temp. Cold Water °F}} = \text{\% of Hot Water Required in Mixture}$$

ELECTRICAL DATA

Amps (3 Phase) = $\frac{\text{kW x 1000}}{\text{Volts x 1.732}}$

Amps (1 Phase) = kW x 1000