FORMULAS AND CONVERSION FACTORS

WATER VAPOR
7,000 grains = 1 lb. of water
1 gallon water = 8.3 lbs.

FUEL-ENERGY CONVERSION
1 kW electricity = 3,412 BTU/hr
1 Ft³ natural gas = 1,000 BTU
1 gallon #2 fuel oil = 140,000 BTU
1 gallon propane = 91,600 BTU
1 gallon propane = 35.97 ft³ propane
1 ther = 100,000 BTU/hr
1 kCal/hr = 3,968 BTU/hr
Hp (air) = SCFM * ΔP (in. H₂O) / (6,350 * Eff.)
Hp (water) = GPM * ΔP (ft. H₂O) / (3,960 * Eff.)

SENSIBLE HEATING/COOLING
BTU/hr = lb/hr * Cp * ΔT
BTU/hr = SCFM * 1.08 * ΔT
(Assumes Cp = .24 and density = .075 lb/ft³)
BTU/hr = 500 * GPM * ΔT
BTU/hr = 4.5 * SCFM * Δh (Total Energy)
BTU/hr = 4,840 * SCFM * ΔHR
(Latent Energy)
12,000 BTUs = 1 ton
Tons = 24 * GPM * ΔT (water)

FLOW CONVERSION
SCFM = lb/hr / 4.5
SCFM = ACFM * [(460 + T)]
ACFM = SCFM * [(530/(460 + T))] (sea level)
Altitude Correction Factor:
[(1 - (0.003566*Alt) / 518.69)*5.26]
(Alt = altitude in feet)
ACFM = SCFM*[(460 + T) / 530] / [(1 -
(0.003566*Alt) / 518.69)*5.26]
Nm3/hr = Normal m3/hr = m3/hr measured
at 0°C
SCFM = Nm3/hr * 0.634

PRESSURES
27.7 inches W.C. = 1 psi
1 bar = 14.5 psi
1 inch W.C. = 25.4 mm W.C.

THERMAL MATERIAL PROPERTIES
<table>
<thead>
<tr>
<th>Material</th>
<th>Density (lb / in³)</th>
<th>Coef of Thermal Expansion (in / in·°F)</th>
<th>Thermal Conductivity (BTU / hr - in · °F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1100 Aluminum</td>
<td>0.1</td>
<td>13 x 10⁻⁶</td>
<td>1536</td>
</tr>
<tr>
<td>Carbon Steel</td>
<td>0.29</td>
<td>7.7 x 10⁻⁶</td>
<td>456</td>
</tr>
<tr>
<td>304 Stainless Steel</td>
<td>0.29</td>
<td>10 x 10⁻⁶</td>
<td>105.6</td>
</tr>
</tbody>
</table>

AMBIENT PRESSURE AT ALTITUDE
P (psia) = 14.696* [1 - (6.8754* 10⁻⁶ * Alt)]¹⁵.⁵⁵⁹

PAYBACK
Yearly savings = MMBTU/hr saved* Yearly
hours of operation* Cost of Fuel ($/MMBTU)
Simple payback = equipment cost /
yearly savings

HEAT EXCHANGER EFFECTIVENESS
% η = \[\frac{T₄ - T₁}{T₃ - T₁}\]
T1 = cold gas inlet
T2 = cold gas outlet
T3 = hot gas inlet
T4 = hot gas outlet
Valid with equal flows or when cold flow is
the smallest

STACK FRICTION LOSS
Friction Loss (in W.C./100 ft. of stack =
[(0.109136* q¹.⁹)] / [D¹.⁰²]
D = stack diameter in inches
q = Air flow rate in CFM (cubic feet
per minute)

Note: These formulæ are for reference and estimation
purposes only. Assumptions have been made to
simplify formulæ and conversions.