BASIC FORMULA FOR CALCULATING HEAT REQUIREMENTS

$Q = W \times S.H. \times T.R.$ or $Q = MC_P\Delta T$

Q = Heat required to heat up any material (B.T.U./Hr.)
W = Weight of Material (Pounds) = m = MASS
W = V x D (Volume x Density)
S.H. = Specific Heat = C_P
T.R. = Temperature Rise (°F) ^{t} final - ^{t} initial = ΔT

Note: If the material being heated changes state, the latent heat or heat of vaporization must be added. All items such as metal containers must also be considered.

Total Q = Q (all materials)
+ Q (latent or vaporization)
+ Q (loses)

Heat Loss normally figured from 15-30% of Q. More accurate valves can be assigned depending on particulars of job.

$$H.P. = \frac{\text{Total Q}}{33{,}500}$$ (Based on 212°F feedwater into steam at 212°F - see above examples)

STEAM AND HOT WATER RADIATION

Equivalent Direct Radiation (E.D.R.) or Square Feet Equivalent Direct Radiation for steam is defined as heat delivery at a rate of 240 BTU/hr. In the case of E.D.R. for hot water heating it is taken as delivery at a rate of 150 BTU/Hr.

THE OVERALL COEFFICIENT OF HEAT TRANSFER (THE U FACTOR)

Heat flows from one body to another by conduction, convection, or radiation, the sum total of the heat flow is represented by the Overall Coefficient of Heat Transfer (The U Factor). It is expressed in BTU per hour for each square foot of surface area at a temperature difference of one °F.

The Coefficient of Thermal Conductivity (The K Factor) is a factor expressing the flow of heat due to conduction alone. It is expressed in BTU ft. (or in.) per hour for each square foot of surface area at a temperature difference of one °F.

BASIC FORMULA FOR HEAT FLOW

$Q = U \times A \times T_{LMTD}$

Q = Heat flow (BTU/Hr)
U = Overall Coefficeint of Heat Transfer (Btu/Hr x Sq.Ft.x °F)
A = Surface Area (Sq. Ft.)
$\mathbf{T_{LMTD}}$ = Logarithmic Mean Temperature Difference (LMTD) (°F)

Logarithmic Mean Temperature Difference (LMTD): Defined by the following equation:

$$(lmtd) = \frac{\text{(greatest temperature difference) - (least temperature difference)}}{LN\ \left(\frac{\text{greatest temperature difference}}{\text{least temperature difference}}\right)}$$