CALCULATING PROCESS HEAT LOADS

This section contains some basic methods for calculating the heat load of various industrial processes. In order to use the heat load calculations some general definitions need to be addressed. The calculations will reference the following basic definitions and formulas:

One Ton of Refrigeration = 12,000 Btu per Hour

One Refrigeration Ton = 3,025 kg calories per hour

One Ton of Tower Water = 15,000 Btu per Hour

One Tower Ton = 3,782 kg calories per hour

Btuh for Water = GPM x 500 x Delta-T

Btuh for other fluids = Lbs. per Hr. x Spec. Heat x Spec. Grav. x Delta-T

Btuh for solids = Lbs. per hour x Spec Heat x Delta-T

Btuh = kW x 3,413

Btuh = HP x 2,544

PSIA = PSIG + 14.7

Btuh = kW x 1000 / .293

kW = Btuh / 1000 x .293

Lbs/Hr = GPM x Density x 8.022

Lbs/Hr = GPM x 501.375 x Specific Gravity

Specific Gravity = Density / 62.4

GPM of Water = Btuh / Specific Heat / Specific Gravity / Delta-T / 500

Heat rejection for common industrial machinery:

Air Compressors:	1,500 Btuh per HP
Air Compressor Aftercooler	1,500 Btuh per HP
Vacuum Pump Cooling	1,500 Btuh per HP
Hydraulic Cooling	2,544 Btuh per HP x .6
Unloaded Hydraulic Cooling	2,544 Btuh per HP x .3
Extrusion Barrel Cooling	12,000 Btuh per screw inch
Hot Runners	3,420 Btuh per Kw

If component heat loads cannot be learned from customer supplied data, multiply the total input Hp or kW times the appropriate conversion factor. This represents the maximum possible heat load. See Application Bulletins regarding hydraulics cooling in bypass relief equipped and modern pressure compensated machinery.

PLASTIC MOLD COOLING

The chilled water heat load for cooling resins is based on the resin used and the shot size and cycle rate of the machine. Some manufacturers refer to this as the machines plasticizing rate. In molding, it is important to consider that even cooling from a molten to solid state is critical so that a small differential temperature will exist across a given mold. This indicates that a reservior is required to provide a thermal flywheel effect to reduce inconsistency of the chilled water temperature.

The formula for calculating the heat load from common injected resins is as follows:

Q = Lbs per hour x Specific Heat x Delta-T

The physical properties of common resins for use in heat load calculations are as follows:

Material	Processing Range	Specific Heat	Density	Thermal Conductivity
ABS	470-125	0.43	68.8	0.1
Nylon	470-160	0.85	68.8	0.17
HD Polyethylene	450-115	1.0	59.7	0.2
LD Polyethylene	430-110	0.75	57.5	0.16
Polypropylene	450-115	0.75	56.9	0.12
Polystyrene	400-110	0.45	65.6	0.1
PVC	340-105	0.45	86.9	0.1

Example: A trash bin manufacturer has four large injection molding machines each processing 2,100 Lbs per hour of High Density Polyethylene:

Btuh = (2,100 Lbs/Hr x 4 machines) x 1.0 Spec Heat x (450°-115°)

Btuh = 8,400 x 1 x 335

Btuh = 2,814,000 Btuh or 234.5 refrigeration tons

A central water cooled chiller will reject 187.6 tower tons to the water system for the chiller condenser *plus* the hydraulic heat load if cooled by the chiller. Otherwise the tower will be selected to serve both the hydraulics cooling and condenser loads.

It is prudent to oversize a chiller for an injection molding machine by a minimum of 15% due to heat added by a recirculation pump, uninsulated pipes and hoses and mold scale. If the machine is equipped with a hot runner and if this heat load is to be cooled by chilled water, then the input Kw x 3,420 Btu per Kw must be added to the chiller heat load.