

# COOLERS

## FORMULAS AND EXAMPLES

### Expected heat load in a system at the conceptual stage

- Gear box

Estimate an average of 1% of the input power per train of gears.

i.e.: A 450kW gear box with 3 reduction trains will generate a heat load of approx. 14kW

- Hydraulic power unit

Take into consideration volumetric efficiency and friction losses.

Typical efficiencies:

⊗ Geared pumps and motors: 85%

⊗ Vane pumps: 88 to 90%

⊗ Piston pumps and motors: 92 to 95%

Caution : Systems using fixed displacement pumps in conjunction with a pressure relief/unloading valve may incur losses equivalent to 100% of installed power at certain stages in their cycle.

### Calculation of the heat load in an overheating system

The heat load can be easily calculated by measuring the increase in temperature in the tank over a specific period of time. The total oil volume needs to be known:

Assuming:

T1: Initial temperature at start up (°C)  
T2: Final temperature (°C)  
H: Running time to reach T2 (minute)  
V: Total oil volume (Litre)  
SG: Specific gravity of oil (kg/Litre)  
SH: Specific heat of the oil (kJ/kg°C)  
P: Heat load generated in the system (kW)

$$P = \frac{V \times SG \times SH \times (T2-T1)}{H \times 60}$$

### Variation of temperatures through a cooler

The temperature variation in any fluid being cooled or heated may be calculated as follow:

Assuming:

P: Heat transfer (kW)  
Q: Flow rate (kg/sec)  $Q = \frac{\text{Flow (L/min)} \times \text{SG}}{60}$   
SG: Specific gravity (kg/Litre)  
SH: Specific heat (kJ/kg°C)  
 $\Delta T$ : Temperature decrease or increase

$$\Delta T = \frac{P}{Q \times SH}$$

Typical Properties		
Media Fluid	SG (kg/Litre)	SH (kJ/kg°C)
Oil	0.89	2.08
Water	1	4.15

Cooler sizing software available on request.