

SIZING INFORMATION

SIZING

To properly size a DC fan drive air-cooled oil cooler for mobile equipment, you should first determine some basic parameters associated with the system.

HEAT LOAD

In many instances the heat load must be determined by using a "total potential" method. This total potential or horse power method is the most common method, and is the simplest way to determine basic heat rejection requirements for mobile hydraulic systems. The total potential is equal to the maximum operating flow and pressure that are generated by the system under full load. To determine the total potential (HP) use the following formula.

$$HP = [\text{System Pressure (PSI)} \times \text{System flow (GPM)}] / 1714$$

Example:

$$HP = (3000 \text{ PSI} \times 40 \text{ GPM}) / 1714 = 70 \text{ HP or the total input potential}$$

To determine the system heat load in BTU / HR we must use a percentage (*v*) of the system potential HP. The factor (*v*) can be calculated by adding up the actual inefficiencies of a system; however, for most applications a (*v*) value of 25% - 30% can be used.

Example:

$$70 \text{ HP} \times .25 = 17.5 \text{ HP heat}$$

To convert the horsepower of heat into BTU/HR use the formula below:

$$HP \times 2542 = \text{BTU/HR}$$

Example:

$$17.5 \text{ HP} \times 2542 = 44,538 \text{ BTU/HR}$$

Applying into a return line

For most open loop systems with a vane or gear type fixed delivery pumps. To calculate the Fs value required when applying the air/oil cooler into a return line use the formula below.

$$Fs = \frac{\text{BTU/HR} \times Cv}{T - t_{\text{ambient}}}$$

T = Desired system oil temperature leaving the cooler °F

t_{ambient} = Ambient air temperature entering the cooler °F

Cv = Correction factor for oil viscosity. Example: ISO68 oil @ 150°F = 1.13 (see chart)

APPLYING INTO A CASE DRAIN LINE

In circumstances where the system is a closed loop or when return line flow is not

available, the case drain flow can be utilized to help cool the system. However, in many instances, the case drain flow alone will not be enough to reject all of the heat generated by the system. Case drain lines should not be treated as a normal return lines since the pressure drop allowable usually can vary from 12 - 10 PSI max. Check with your pump manufacturer for the appropriate pressure drop tolerance before applying any cooler. To size the system for case flow or case flow plus any additional flushing loops, please use the following method.

Formula

$$Tc_{\text{exit}} = \{ T - [Q / (\text{case flow gpm} \times 210)] \}$$

Example

$$Tc_{\text{exit}} = \{ 150 - [44,538 / (8 \times 210)] \} = 123.5$$

Tc_{exit} = The corrected temperature of the oil exiting the cooler.

$$Fs = \frac{Q \times Cv}{Tc_{\text{exit}} - t_{\text{ambient}}} = \frac{44,538 \times 1.13}{123.5 - 100} = 2,142$$

SELECTION

To select a model, locate the flow rate (GPM) at the bottom of the flow vs Fs graph of the series desired (AMOF, LP, EOC). Proceed upward until the GPM intersects with the calculated Fs. The curve closest above the intersection point will meet these conditions.

Examples:

Return Line	Case Line
Fs = 1,007	Fs = 2,142
GPM = 40 "return line flow"	GPM = 8
Model = EOC - 375 - 4	Model = EOC - 575 - 4 - 2P

PRESSURE DROP

Determine the oil pressure drop from the curves as indicated. For viscosities other than 50 ssu, multiply the actual indicated pressure drop (psi) for your GPM by the value in the pressure differential curve for your viscosity value.

Examples:

	<u>GPM = 40</u>	<u>GPM = 8</u>
Indicated pressure drop	21PSI	1.5 PSI
Cp correction factor for ISO 68 oil @ 150°F	1.61	1.5
Pressure drop correction	7.8x1.61 = 12.6 psi	1.5x1.61 = 2.4 psi

Average Liquid Temperature	Cv VISCOSITY CORRECTION FACTORS																
	SAE 5	SAE 10	SAE 20	SAE 30	SAE 40	ISO 22	ISO 32	ISO 46	ISO 68	ISO 100	ISO 150	ISO 220	ISO 320	MIL-L-7808	POLYGLYCOL	PHOSPHATE ESTER	50% ETHYLENE GLYCOL & WATER
100	1.11	1.15	1.25	1.38	1.45	1.08	1.14	1.18	1.26	1.37	1.43	1.56	1.84	1.19	0.92	0.83	0.85
110	1.09	1.12	1.20	1.32	1.40	1.06	1.13	1.16	1.25	1.31	1.39	1.48	1.67	1.14	0.89	0.80	0.84
120	1.06	1.10	1.17	1.27	1.35	1.04	1.11	1.14	1.20	1.27	1.35	1.40	1.53	1.09	0.88	0.79	0.84
130	1.04	1.08	1.13	1.24	1.29	1.03	1.09	1.13	1.17	1.24	1.30	1.34	1.44	1.05	0.85	0.77	0.83
140	1.03	1.05	1.11	1.19	1.25	1.02	1.08	1.10	1.16	1.20	1.26	1.30	1.39	1.03	0.84	0.76	0.82
150	1.01	1.04	1.09	1.16	1.22	1.02	1.06	1.09	1.13	1.17	1.22	1.27	1.33	1.01	0.83	0.74	0.82
200	0.98	0.99	1.01	1.04	1.07	0.98	0.99	1.00	1.01	1.02	1.08	1.09	1.14	0.98	0.79	0.71	0.80
250	0.95	0.96	0.97	0.98	0.99	0.95	0.96	0.96	0.96	0.97	0.99	1.01	1.02	0.97	0.76	0.69	0.79

Average Liquid Temperature	Cp PRESSURE DROP CORRECTION FACTORS																
	SAE 5	SAE 10	SAE 20	SAE 30	SAE 40	ISO 22	ISO 32	ISO 46	ISO 68	ISO 100	ISO 150	ISO 220	ISO 320	MIL-L-7808	POLYGLYCOL	PHOSPHATE ESTER	50% ETHYLENE GLYCOL & WATER
100	2.00	2.40	4.40	6.40	8.80	1.07	1.53	1.82	2.54	4.19	6.44	9.38	13.56	1.26	3.00	3.50	0.730
110	1.70	2.10	3.60	5.10	6.70	1.04	1.45	1.72	2.35	3.73	5.70	8.33	11.63	1.20	2.40	2.90	0.720
120	1.50	1.80	3.00	4.20	5.60	1.02	1.38	1.60	2.15	3.26	4.91	7.23	9.73	1.14	2.10	2.50	0.709
130	1.40	1.60	2.60	3.40	4.50	0.99	1.30	1.49	1.94	2.80	4.14	6.19	7.80	1.08	1.90	2.20	0.698
140	1.30	1.50	2.23	2.90	3.70	0.97	1.23	1.38	1.75	2.38	3.47	5.20	6.11	1.03	1.90	2.00	0.686
150	1.20	1.30	1.90	2.50	3.10	0.95	1.17	1.30	1.61	2.04	2.90	4.35	4.77	0.98	1.70	1.90	0.676
200	0.93	0.96	1.20	1.40	1.60	0.89	0.99	1.08	1.18	1.33	1.59	1.74	1.95	0.90	1.20	1.30	0.635
250	0.81	0.82	0.92	0.97	1.05	0.85	0.93	0.96	1.03	1.11	1.21	1.22	1.23	0.83	1.00	1.05	0.556