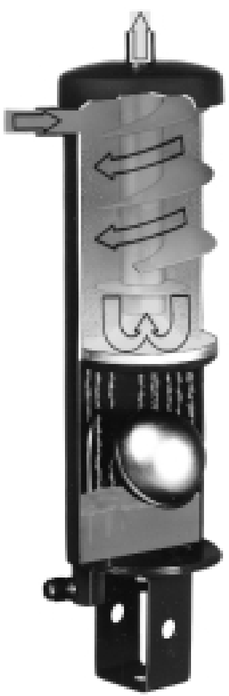
Oil Separators

Figure 1
HELICAL OIL
SEPARATOR



In any refrigeration system, refrigerant and oil are always present. Refrigerant is required for cooling. Oil is required for lubrication of the compressor. Refrigerant and oil are miscible in different percent depending on type of refrigerant, temperature and pressure. Certain amounts of oil will always leave the compressor crankcase with the refrigerant.

The prime function of an oil separator is to separate the oil from the refrigerant and return it to the compressor crankcase before it can enter other components of the system. Remember, oil is not a refrigerant, it belongs in the crankcase to lubricate.

Originally, the purpose of an oil separator was to maintain the correct level of oil in the compressor crankcase, but this has long been overshadowed by the benefits found in preventing free circulation of even small amounts of the oil in the refrigeration or air conditioning system.

An added advantage to installing an oil separator in a system is the muffling effect on the discharge gas pulsations from the compressor, thus reducing the noise level.

Effects of Oil in Circulation

Oil in circulation being subjected to heat at the compressor and cold in the evaporator on repeating passages of circulation with contaminates forms carbon sludge which is detrimental to all parts of the system. The overall effect of oil in circulation is to lower the efficiency of the unit and thereby require additional running time and thus added operating costs.

Effects on Condenser

When oil leaves the compressor with the discharge gas some of it will coat the wall of the parts thru which it passes and reduces the rate of heat transfer lowering the condenser capacity. Oil also reduces the volumetric capacity of the condenser in that it reduces the amount of refrigerant by the amount of its own volume; that is, if 10 percent of the liquid and oil solution is oil, then only 90 percent can be refrigerant and so the unit must operate that much longer in order to pass the required amount of refrigerant through the condenser.

Effect on Evaporators

Probably the greatest lowering of efficiency occurs in the evaporator. First, the volumetric effect is felt here too. Second, and of far worse effect, the inner surfaces of the evaporator become coated with a film of oil bubbles. This film acts as a very efficient insulator and greatly reduces the rate of heat transfer of the evaporator and results in higher temperatures in the low side and the medium to be cooled as well as longer running cycles.

Discharge Oil Separators

How the Helical Oil Separator functions:

The helical oil separator features a centrifugal flow path achieving approximately 99% efficiency of oil separation with low pressure drop. Testing by an independent laboratory found that only .006% oil by volume was being discharged into the system after leaving a helical oil separator.

Upon separator entry (see Fig. 1), refrigerant gas containing oil in aerosol form, encounters the leading edge of the helical flighting. The gas/oil mixture is centrifugally forced along the spiral path of the helix, causing heavier oil particles to spin to the perimeter, where impingement with a screen layer occurs. The screen layer serves dual functions as an oil stripping and draining medium. Separated oil flows downward along the boundary of the shell through a baffle and into the oil collection area at the bottom of the separator. The specially engineered baffle isolates the oil collection area and eliminates oil reentrantment by preventing turbulence. Virtually oil-free refrigerant gas exits through a fitting just below the lower edge of the helical flighting. A float activated oil return valve allows the captured oil to return to the crankcase or oil reservoir, thereby completing the oil circuit. Our Patented Mechanical Design offers high oil separation efficiency, plus the following advantages:

- Low pressure drop throughout the entire range of velocities found in a refrigeration system.
- No clogging elements because of too much oil in the system.
- No oil blow-out at start-up from oil left in a coalescing element.

Oil can be drained from the separator when necessary through a ⅛" NPT fitting at the bottom of the separator.

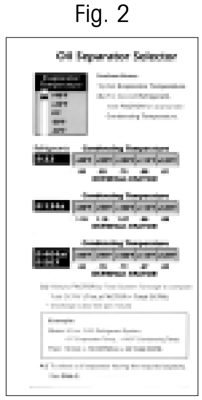
How the Conventional Oil Separator functions:

Refrigerant gas from the compressor containing oil in aerosol form enters the separator and passes through the inlet baffling. As it passes through the inlet screen, the fine particles collide with one another and form heavier particles that impinge on the surface of the shell wall. The gas then passes through the outlet screen where there is a final separation. The oil free gas escapes through the outlet fitting and goes to the condenser. The separated oil drips to the bottom of the separator where a float operated needle valve returns the oil to the crankcase or oil reservoir in the same way as the Helical Oil Separator.

Selecting the size of an Oil Separator:

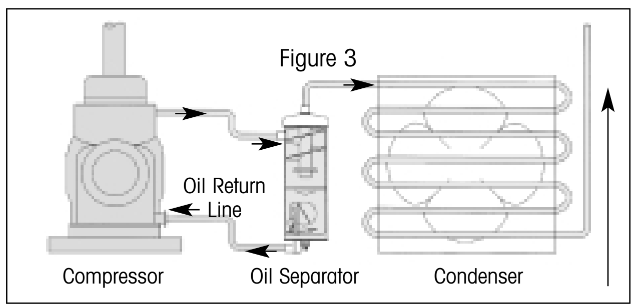
Although Oil Separator catalogs show capacity in tons or horsepower, the actual tonnage or B.T.U. capacity of a system may vary widely from the horsepower size of the compressor. The selecting of an oil separator should be first done by comparing the system tonnage or load to the rated capacities of the oil separator using the charts provided on page 4. After the selection has been made, DCFM factors can fine tune the selection. Use the DCFM charts on page 4 or our Oil Separator Selector Slide Chart (see Fig. 2). The ultimate deciding factor should be the maximum DCFM with care taken to not select below 50% of the maximum rating. Understanding the total system capacity and percentage of full load run time can also be helpful in selecting the oil separator. In cases where the max. DCFM has been exceeded by only a minimal amount and the system has unloading characteristics, select the smaller oil separator.

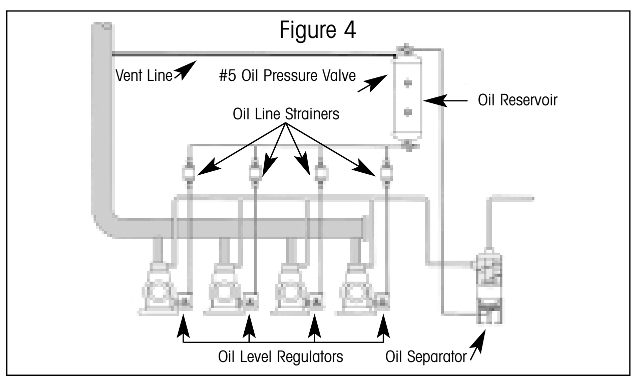
Fig. 2



Where and how to install an Oil Separator

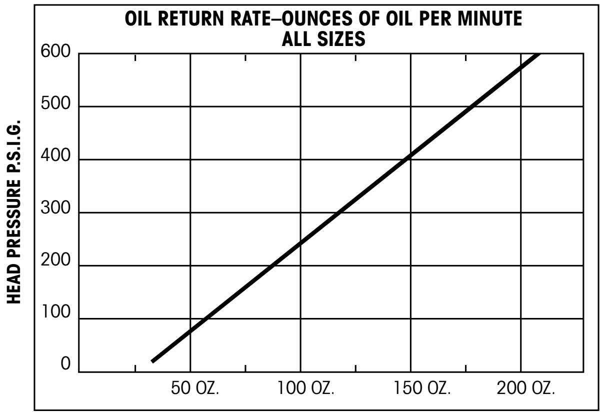
Before the oil separator is installed an initial charge of oil should be added to it. This amount is held over the sump of the oil separator. Refer to the Oil Separator Instruction Sheet for the proper amount of oil. CAUTION: Oil Precharge is important. Failure to precharge separator sump may result in damage to the oil return float mechanism. Use the same type of oil that is in the compressor crankcase. The oil separator should be installed reasonably close to the compressor in the discharge line between the compressor and the condenser. To prevent refrigerant from condensing in the oil separator during the off cycle of the system, we recommend a check valve be installed between the condenser and oil separator outlet connection. Proper piping practices must also be followed. The oil separator must be mounted securely in a vertical position. A line must be run from the oil return fitting (⅜" flare) to the compressor crankcase (Fig. 3) or oil reservoir if an oil control system is being used (Fig. 4). See Fig. 5 for oil return rate.





In locating the oil separator it is advisable to choose a position where it will not be in the slip stream from the compressor flywheel or a condenser fan. The reason for this is to avoid chilling of the shell of the separator which may result in condensing of

Figure 5



liquid within the separator. Oil separators perform best when operating at or near the compressor discharge temperature.

If oil separator has to be installed where the ambient temperature is lower than the condensing temperature of the refrigerant system, a strap heater may be installed to the bottom of the separator. The strap heater should be electronically connected to either operate all the time, or be on only when the compressor is off. The strap heater will help prevent the refrigerant in the system from condensing in the oil separator.

When installing an oil separator in a location where it is lower than the condenser it is recommended that the line from the separator to the condenser be carried about two inches higher than the condenser and then pitched with a downward slope into the condenser inlet connection. In this way if any condensation occurs in this line at the condenser connection it will then drain forward into the condenser rather than drain back into the separator. A check valve on the discharge line of the oil separator is also recommended.

Do not install a shut-off valve in the oil return line. The reason for this is that the valve could be shut off and stop oil from going to the compressor crankcase, causing damage to the compressor. A sight glass may be installed in the oil line, install the sight glass in a position that the oil is flowing thru the tube, and not in a trapped position.

When installing an oil separator in an existing (old) system in which oil may be out in the low side, it is essential that the oil level in the crankcase be checked after the oil has had a chance to return to the compressor and excess oil which as returned should be removed.

When experiencing a compressor burnout, the oil separator should be taken apart and inspected. If it is of the flanged design and if the unit has been damaged as most often occurs, it should be replaced. When the oil separator is of the welded design, it should be replaced after a compressor burnout. If an oil separator was not being used when the compressor burnout occurred, and one is installed after the burnout, the system should be cleaned out before installing the oil separator.

How to Service Oil Separators

Oil separators are ruggedly build units and usually present little service problems, if manufacturer’s sizing and installation directions are followed. Also consideration should be given to ambient temperatures likely to be encountered by the oil separator.

In normal operation the oil return line to the compressor crankcase will be alternately hot and cool. This is caused by the oil float valve opening and returning oil to the crankcase and then closing as the level of oil in the separator is lowered. If the oil return line is at ambient temperature all the time, the oil return valve in the oil separator may be blocked by some foreign matter.

If the oil return line is continually hot, the oil float valve may be leaking or being held open by sludge or foreign matter. The oil separator should be cleaned. If the float mechanism is damaged, replace it. If the separator is of all welded design, the entire unit will have to be replaced. A compressor that is pumping excessive oil or an oil logged system (excessive amount of oil in the system) will also cause the return line to be continually hot.

If the oil return line is continually cold, there may be condensation of liquid refrigerant in the separator.

When condensing occurs the cure is very simple. First apply heat to the bottom of the separator to heat it up until any liquid entrained in the oil in the sump is driven off. Then wrap a 2" thick batt of fiberglass or rock wool around the separator shell. This will then keep the separator above condensing temperature and no further trouble should be experienced.

It should be pointed out that if the heating of the bottom of the shell of the separator to drive off the condensed refrigerant is not done, there could be considerable liquid refrigerant in with the oil, it will leave the oil separator as the float opens to return the oil to the crankcase. This will chill down the crank-case and reduce the lubricating ability of the oil.

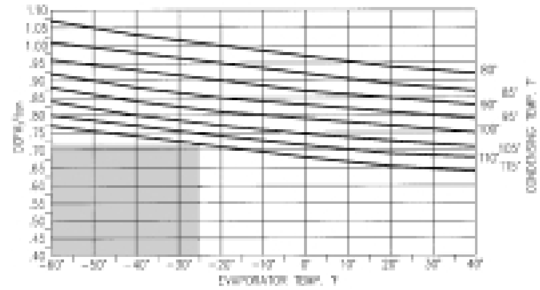
One important thing to remember is that foaming of oil in the crankcase is normal when the unit starts up after a protracted off cycle due to the fact that the oil will absorb refrigerant. When the compressor starts up the crankcase pressure is reduced and the refrigerant will boil out. This absorption will take place even if the ambient temperature is high

How to Calculate Discharge CFM (DCFM)

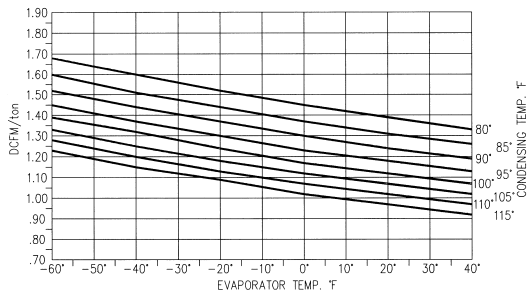
Example:
50 ton R-22 system: -25°F Evaporator Temp.
115°F Condensing Temp.

From the R-22 DCFM Chart, follow the -25°F evaporator temperature line to the intersection of the 115°F condensing temperature line. Extend a line horizontally from this point to the DCFM/ton factor. Multiply the DCFM/ton factor by the total tonnage to calculate the total DCFM.

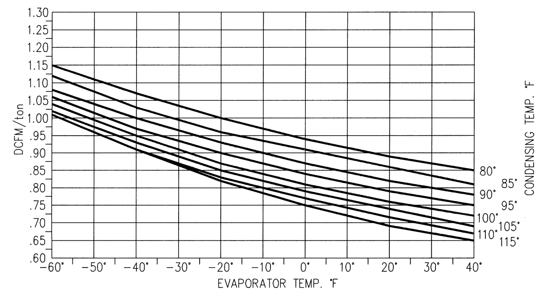
DCFM Chart - R22



DCFM Chart - R134a



DCFM Chart - R-404a/R-507



Catalog Number	Size Conn.	Maximum Capacity in tons of Refrigeration at Evaporator Temperature (nominal)						Discharge CFM
		R-134a		R-22		R-404a/R507		
		-40°F	+40°F	-40°F	+40°F	-40°F	+40°F	
Helical Oil Separator								
S-5180	¼ ODS	.50	.75	.75	1.00	.75	1.00	.75
S-5181	⅜ ODS	.75	1.00	1.00	1.50	1.00	1.50	1.00
S-5182	½ ODS	1.00	1.50	1.50	2.00	1.50	2.00	1.50
S-5185	⅝ ODS	3.00	4.00	4.50	5.50	4.00	5.50	4.00
S-5187	⅞ ODS	4.50	5.50	7.00	8.00	6.50	8.50	6.00
S-5188	1⅛ ODS	6.00	7.50	9.00	10.50	8.50	11.00	8.00
S-5190	1⅜ ODS	8.00	10.00	13.00	14.00	12.00	15.00	11.00
S-5192	1⅝ ODS	11.00	13.00	16.00	18.00	15.00	19.00	14.00
S-5194	2⅛ ODS	18.00	21.00	25.00	30.00	24.00	31.00	22.00
S-5290	1⅜ ODS	8.00	10.00	13.00	14.00	12.00	15.00	11.00
S-5292	1⅝ ODS	11.00	13.00	16.00	18.00	15.00	19.00	14.00
S-5294	2⅛ ODS	18.00	21.00	25.00	30.00	24.00	31.00	22.00
S-5202	2⅛ ODS	22.00	27.00	35.00	39.00	31.00	41.00	29.00
S-5203	2⅝ ODS	46.00	56.00	71.00	80.00	64.00	83.00	60.00
S-5204	3⅛ ODS	72.00	88.00	112.00	127.00	100.00	131.00	94.00
Conventional Oil Separator								
S-5582	½ ODS	1.00	1.50	1.50	2.00	1.50	2.00	1.50
S-5585	⅝ ODS	3.00	4.00	4.50	5.50	4.00	5.50	4.00
S-5587	⅞ ODS	4.50	5.50	7.00	8.00	6.50	8.50	6.50
S-5588	1⅛ ODS	6.00	7.50	9.00	10.50	8.50	11.00	8.00
S-5590	1⅜ ODS	8.00	9.50	11.50	13.50	10.50	14.00	10.00