VILTER®

Since 1867

Oil Program for Refrigeration Service

Compressor Types	Application Model No.
Single Screw Compressors	VSS., VSR &VSM
Reciprocating Compressors	450XL,440,350ES & 320
Twin Scew Compressors	VRS

Authorized Distributor Manual

Table of Contents

Glossary of Terms
for Oil Lubrication Systems

Dew Point Temperature- The temperature at which the gas will start to condense. Typically it is desired to have the gas temperature at least 15-20 ° F higher than the dew point temperature of the refrigerant, at the given operating pressure to prevent vapor condensation.

Dilution- The amount of refrigerant mixed with the oil expressed as a percentage, to that of the same volume of oil at a given temperature /pressure condition.

Flash Point Temperature- The flash point of the oil is the temperature to which the oil must be heated for sufficient vapor formation above the surface, of the oil, which will momentarily flash or burn when brought into contact with a very small flame or ignition source.

Floc Point Temperature- A measure of the temperature point where wax in a refrigerant / oil mixture will begin to form wax crystals. At or below the crystal formation temperature the wax agglomerates into larger plastic solids, that can restrict refrigerant flows through strainers and orifices.–

Miscibility- The ability of the liquid refrigerant to mix with the lubricant. If the lubricant will form a single phase with the refrigerant, it is miscible. If the lubricant will not form a single homogenous mixture with the refrigerant, then it is immiscible and two phase.

Miscibility Temperature- Above this temperature the oil will be completely miscible with the refrigerant. Below this temperature the oil will separate into two liquid phases, depending upon the mixture composition.

Pour Point Temperature- The lowest temperature at which oil will flow of its own accord without being disturbed. The pour point of the oil should be less than the lowest expected operating temperature to provide sufficient oil fluidity and viscosity. Oil pour points higher than the refrigerant evaporating temperature will tend to coat the evaporator heat transfer surface and reduce the overall heat transfer coefficient.

Solubility- The ability of refrigerant vapor to dissolve in the lubricant. An oil with a high solubility potential will have the effect of reducing the oil viscosity due to the refrigerant dilution.

SSU (Seconds Saybolt Universal)- The time in seconds for a specified quantity of oil to flow through a calibrated orifice. The oil quantity is fixed, however the time interval increases or decreases based on the oil viscosity.

Viscosity- The amount of fluid friction exhibited by the oil in motion, or in other terms, viscosity may be regarded as the resistance an oil offers to motion (flow). Viscosity is usually expressed in centipoise, SSU (see above), or kinematic viscosity (see viscosity kinematic).

Viscosity Index- A method of indicating the rate of change in oil viscosity with changes in the oil temperature. An oil which is assigned low viscosity index numbers will display large viscosity changes with a change in temperature. Conversely, a high viscosity index will represent low viscosity changes with a change in temperature. The viscosity index applies only to the oil viscosity and does not reflect other changes in the oil properties.

Viscosity, Kinematic- Derived by (viscosity in centipoise) divided by (the oil density at the same tempertature) = centistokes.

Storage Guidelines for Vilter B & FL Type Lubricants

Background

Vilter Type B and FL lubricants are an ester-based fluid and are hygroscopic by nature. This means that they absorb water moisture from the surrounding environment. Compared to mineral based lubricants which are typically saturated with water at less than 100 PPM, ester based lubricants become saturated with water at approximately 2,500 PPM.

High water moisture levels cannot be tolerated in the refrigeration systems where ester based lubricants are utilized and require specific handling and storage guidelines, in addition to the normal precautions for system dehydration prior to system start-up.

All Vilter lubricants are manufactured to meet strict requirements to ensure minimal water moisture content as shipped. The following guidelines are provided for the end-user of the equipment as a means to minimize the water moisture content of lubricants in storage.

Guidelines

• Use a suitable dehydration process for the complete refrigeration system to ensure that the system as a whole is completely dry and water free. This can be accomplished by the use of vacuum pumps and checked by a vacuum gauge to ensure that a suitable micron value has been reached, and maintained.

• Store all lubricant containers in a dry environment. Do not expose the lubricant to the atmosphere by opening the container until the compressor sump or separator is ready to be charged.

• Keep the lubricant in its original container. Some plastic containers allow water moisture to pass through the container itself.

• If possible, use container sizes appropriate to the compressor charge to avoid leaving partially filled containers for long period of times. Vilter B Type lubricant is available in 5 and 55 gallon containers.

• Refrigeration systems using ester based lubricants will require suitable high capacity moisture filter/driers to maintain low total moisture content in the refrigerant and lubricant.

Compatibility & Misc.

• Vilter Type B lubricant has been extensively tested with many of the components in a refrigeration system. Elastomers, driers, etc. for use with HFCs have demonstrated no adverse effects when tested for hardness, swelling and brittleness.

• Vilter Type B lubricant cannot be used in conjunction with a mineral based oil. CFC and HCFC refrigerants typically have used mineral oil; however, mineral oils are not miscible with HFCs. The performance of a refrigeration system is optimized when the lubricant is allowed to be miscible with the refrigerant to aid in the oil return to the compressor. If the oil used in an HFC refrigeration system does not provide oil return capability, the oil will tend to accumulate in the evaporator reducing the overall system capacity.

• CFC and HCFC refrigerants should not be used with Vilter Type B lubricant since these types of refrigerants greatly reduce the viscosity of ester based lubricants, resulting in inadequate compressor lubrication.

Miscible Regions for Oil & Refrigerant Mixtures

Vilter Lubricant	**Ammonia R-717**	**R-22**	**R-134a**	**R-410a**	**R-404a**	**R-407c**	**Propylene R-1270**	**Propane R-290**
717	Immis.	-	-	-	-	-	-	-
F-68	-	60 to -30°C[1]	-	-	-	-	-	-
FL-100	-	60 to <-60°C[1]	-	-	-	-	-	-
FL-150	-	60 to <-60°C[1]	-	-	-	-	-	-
B-120	-	-	60 to -20°C[1]	60 to 35°C[2]	60 to -45°C[2]	40 to -60°C[3]	-	-
B-68	-	-	60 to -10°C[1]	60 to -60°C[3]	60 to -60°C[3]	60 to -60°C[3]	-	-
HCL-68	Immis.	-	-	-	-	60 to <-60°C[1]		-
HCL-100	-	-	-	-	-	-	60 to <-60°C[1]	-
HC-68	-	-	-	-	-	-	-	60 to <-40°C[1]
HC-100	-	-	-	-	-	-	-	60 to <-40°C[1]
D	Immis.	60 to+30°C[1]	-	-	-	-	-	-
Oil Location When Immiscbile[5]	Bottom	Top	Top	> 45°C Bottom < 44°C Top[4]	> 40°C Bottom < 39°C Top[4]	> 40°C Bottom < 39°C Top[4]	Bottom	Bottom

[1] 10% oil by weight in refrigerant
[2] 8% oil by weight in refrigerant
[3] 5% oil by weight in refrigerant
[4] Concentration dependent –contact Vilter
[5] **Bottom** notation means oil phase will fall below refrigerant liquid phase. **Top** notation means oil phase will rise above the refrigerant liquid phase. Temperature ranges given in table for specific refrigerant and oil selections are the miscible regions where the two fluids (liquid refrigerant & oil) are mixed as one homogenous fluid. This issue is particularly important for oil recovery requirements for flooded shell & tube chillers as the operating pressure can change the relative location of the "immiscible phase" for refrigerants R410a, R-404a, & R-407c. See note 4 above.

Direct expansion shell & tube chillers will also be dependent on the solubility of the oil and refrigerant vapor for oil return to the compressor. Traditional schemes of controlling the return vapor velocity vs. allowable pressure loss will apply, i.e.. last pass velocity and suction line velocity to return the liquid oil phase where it exists.

Immi. = Immiscible

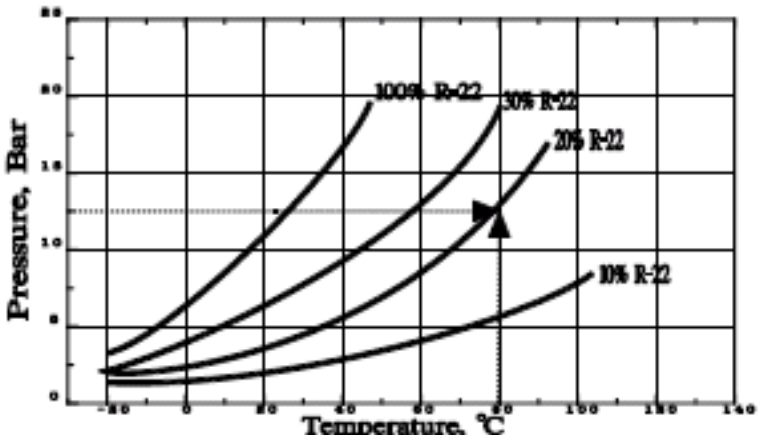
The Effect of Dilution on Lube Oil Viscosity

The following example illustrates how to determine dilution and diluted viscosity using a Pressure –Viscosity Temperature (PVT) chart. The example given below is for R-22 using Vilter oil type FL-150.

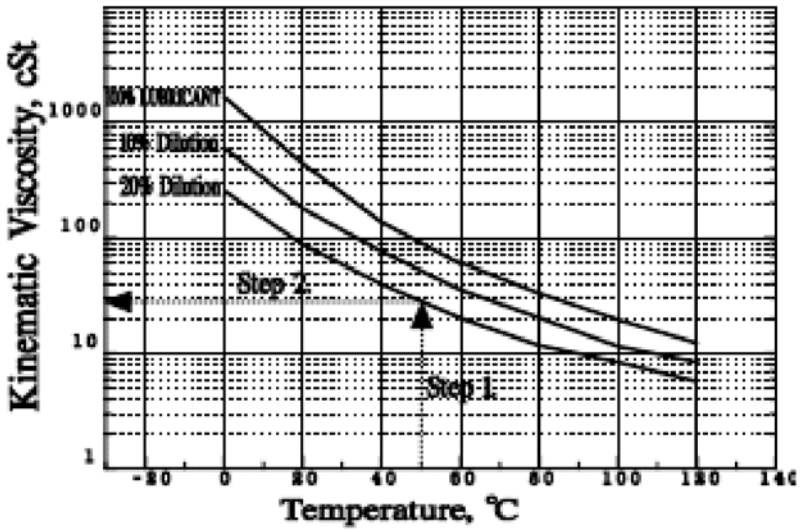
Charts are given for each specific refrigerant and lube oil combination.

Please review the specific application operating conditions carefully. For operating conditions outside of the chart values, please consult Vilter.

1. Lubricant must be soluble with the refrigerant – Unlike mineral oil or Polyalphaolefins with ammonia.
2. Dilution is determined at compressor operating conditions to determine if the mixture going to the bearings is adequate for lubrication and does not contain excessive amounts of refrigerant. ***For screw compressors***, dilution is measured from the discharge temperature and pressure. The resulting viscosity, that supplies the bearings, is then found by using the oil supply temperature at the given dilution level. Acceptable viscosities for bearings are produced by compressor OEMs and can vary by designs. For example, FL-150 is utilized with R-22. A screw compressor has a discharge temperature and pressure of 176°F (80°C) and 12.5 bar absolute, the amount (dilution) of R-22 in the lubricant will be about 20%.



3. In order to determine the viscosity of the mixture, the 20% dilution is paired with the oil supply temperature to obtain the mixture viscosity. For example, if the oil supply temperature was 122°F (50°C), the dilution is 20% from above, the resulting mixture viscosity would be approximately 28-29 cSt. The chart on the following page outlines the process:



4. In order to determine if the mixture viscosity will adequately lubricate, consult Vilter Manufacturing Corporation. In general, screw compressors require at least 10 cSt at discharge conditions to adequately lubricate the bearings.

5. ***For reciprocating compressors***, the crankcase temperature and pressure are used to determine dilution instead of discharge temperature and pressure. The procedure, however, is the similar to the above.

VSS, VSM and VSR SINGLE SCREW COMPRESSORS
SERVICE INTERVAL REQUIREMENTS

FOR VILTER EXTENDED WARRANTY

The following service intervals are based on the usage of Vilter Manufacturing Corporation Premium Grade refrigeration oil in VSS, VSM and VSR Single Screw Compressor units.

GROUP	INSPECTION OR MAINTENANCE ITEM	SERVICE INTERVAL (HOURS)													
		200	5,000	10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000	100,000	110,000	120,000
OIL CIRCUIT															
	Oil Change (1)		R		R		R		R		R		R		R
	Oil Analysis (2)		S	S	S	S	S	S	S	S	S	S	S	S	S
	Oil Filters (3)	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	Oil Strainer	I	I	I	I	I	I	I	I	I	I	I	I	I	I
PACKAGE															
	Coalescing Elements					R			R			R			R
	Suction Screen	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Liquid Line Strainers	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Coupling Alignment and Integrity	I	I	I	I	I	I	I	I	I	I	I	I	I	I
CONTROL CALIBRATION															
	Transducers	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	RTD's	I	I	I	I	I	I	I	I	I	I	I	I	I	I
COMPRESSOR															
	Inspect Compressor		I		I		I		I		I		I		I
	Bearings														I

Key: I Inspect.
R Replace.
S Sample.

Notes: (1) The oil should be changed at these intervals, unless oil analysis results exceed the allowable limits. The frequency of changes will depend on the system cleanliness.

(2) Oil analysis should be done at these intervals as a minimum; the frequency of analysis will depend on system cleanliness.

(3) The oil filter(s) on a minimum must be changed at these intervals or annually if not run continuously. However, the oil filter(s) must be changed if the oil filter differential exceeds 12 psi or oil analysis requires it.

300 AND 400 SERIES VMC
RECIPROCATING COMPRESSORS
SERVICE INTERVAL REQUIREMENTS

The following service intervals are based on the usage of Vilter Manufacturing Corporation Premium Grade refrigeration oil in 300 and 400 Series VMC Compressor units.

GROUP	INSPECTION OR MAINTENANCE ITEM	SERVICE INTERVAL (HOURS)													
		200	5,000	10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000	100,000	110,000	120,000
UNIT															
	Suction Screen	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Coupling Alignment and Integrity	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	V-Belt Drive Alignment and Integrity	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Water Line Strainers	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Liquid Line Strainers	I	I	I	I	I	I	I	I	I	I	I	I	I	I
CONTROL CALIBRATION															
	Electro-Mechanical Pressure Controls	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Transducers	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	RTD's	I	I	I	I	I	I	I	I	I	I	I	I	I	I
COMPRESSOR															
	Oil Change (1)		R	R	R	R	R	R	R	R	R	R	R	R	R
	Flush Oil Circuit				R		R		R		R		R		R
	Oil Analysis (2)		S	S	S	S	S	S	S	S	S	S	S	S	S
	Oil Filter (3)	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	Inspect Compressor (4)		I	I	I	I	I	I	I	I	I	I	I	I	I

Key: I Inspect.
R Replace or Service.
S Sample.

Notes: (1) The oil should be changed at these intervals, unless oil analysis results exceed the allowable limits. The frequency of changes will depend on the system cleanliness.

(2) Oil analysis should be done at these intervals as a minimum; the frequency of analysis will depend on system cleanliness.

(3) The oil filter on a minimum must be changed at these intervals or annually if not run continuously. However, the oil filter must be changed if the oil filter differential exceeds 25 psi or oil analysis requires it.

(4) To prevent possible breakdowns, the compressor should be opened and the condition of the valves, valve seats, liners and connecting rod bearings should be checked and excessively worn parts be re placed. At the same time the crankshaft bearing float should also be checked.

VRS TWIN SCREW COMPRESSORS
SERVICE INTERVAL REQUIREMENTS

The following service intervals are based on the usage

GROUP	INSPECTION OR MAINTENANCE ITEM	SERVICE INTERVAL (HOURS)													
		200	5,000	10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000	100,000	110,000	120,000
OIL CIRCUIT															
	Oil Change (1)		R		R		R		R		R		R		R
	Oil Analysis (2)		S	S	S	S	S	S	S	S	S	S	S	S	S
	Oil Filters (3)	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	Oil Strainer	I	I	I	I	I	I	I	I	I	I	I	I	I	I
PACKAGE															
	Coalescing Elements					R			R			R			R
	Suction Screen	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Liquid Line Strainers	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Coupling Alignment and Integrity	I	I	I	I	I	I	I	I	I	I	I	I	I	I
CONTROL CALIBRATION															
	Transducers	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	RTD's	I	I	I	I	I	I	I	I	I	I	I	I	I	I
COMPRESSOR															
	Inspect Compressor		I	I	I	I	I	I	I	I	I	I	I	I	I
	Bearings		I	I	I	I	I	I	I	I	I	I	I	I	I

Key
- I Inspect.
- R Replace.
- S Sample.

Notes:
(1) The oil should be changed at these intervals, unless oil analysis results exceed the allowable limits. The frequency of changes will depend on the system cleanliness.

(2) Oil analysis should be done at these intervals as a minimum; the frequency of analysis will depend on system cleanliness.

(3) The oil filter(s) on a minimum must be changed at these intervals or annually if not run continuously. However, the oil filter(s) must be changed if the oil filter differential exceeds 12 psi or oil analysis requires it.

COOL COMPRESSION
SERVICE INTERVAL REQUIREMENTS

The following service intervals are based on the usage of Vilter Manufacturing Corporation Premium Grade refrigeration oil in VSM Single Screw Cool Compression Compressor units.

Group	**Inspection/ Maintenance Item**	*SERVICE INTERVAL (HOURS)*															
		25 (4)	50	200	5,000	10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000	100,000	110,000	120,000
		OIL CIRCUIT															
	Oil Change (1) Oil Analysis (2) Oil Filters (3) Oil Strainer	R C C	 C C	R S C C	R S C C	S C C	R S C C	S C C	R S C C	S C C	R S C C	S C C	R S C C	S C C	R S C C	S C C	R S C C
	Suction Screen Liquid Line Strainers Coupling Alignment and Integrity	C C	C C	C C C	C C C	C C C	C C C	C C C	C C C	C C C	C C C	C C C	C C C	C C C	C C C	C C C	C C C
CONTROL CALIBRATION	Transducers RTD's Inspect Compressor Bearings			I I	I I I	I I	I I I	I I	I I I	I I	I I I	I I	I I I	I I	I I I	I I	I I I

Key
- I Inspect.
- C Clean
- R Replace.
- S Sample.

Notes:

(1) The oil should be changed at these intervals, unless oil analysis results exceed the allowable limits. The frequency of changes will depend on the system cleanliness.

(2) Oil analysis should be done at these intervals as a minimum; the frequency of analysis will depend on system cleanliness.

(3) The oil filter(s) on a minimum must be changed at these intervals or annually if not run continuously. However, the oil filter(s) must be changed if the oil filter differential exceeds 20 psi or oil analysis requires it.

(4) Initially the oil charge on existing system may need to be changed after 25 hours dependent on the amount of contaminates in the system.

VSS, VSM and VSR SINGLE SCREW COMPRESSORS
SERVICE INTERVAL REQUIREMENTS
Based on WF-68 Refrigeration Oil Usage

The following service intervals are based on the usage of WF-68 refrigeration oil in VSS, VSM and VSR Single Screw Compressor units that meets specifications in the Vilter Manufacturing LLC. Single Screw Operation Manual.

GROUP	INSPECTION OR MAINTENANCE ITEM	SERVICE INTERVAL (HOURS)													
		200	5,000	10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000	100,000	110,000	120,000
OIL CIRCUIT															
	Oil Change (1)		R	R	R	R	R	R	R	R	R	R	R	R	R
	Oil Analysis (2)		S	S	S	S	S	S	S	S	S	S	S	S	S
	Oil Filters (3)	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	Oil Strainer	I	I	I	I	I	I	I	I	I	I	I	I	I	I
PACKAGE															
	Coalescing Elements			I	R	I	R	I	R	I	R	I	R	I	R
	Suction Screen	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Liquid Line Strainers	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Coupling Alignment and Integrity	I	I	I	I	I	I	I	I	I	I	I	I	I	I
CONTROL CALIBRATION															
	Transducers	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	RTD's	I	I	I	I	I	I	I	I	I	I	I	I	I	I
COMPRESSOR															
	Inspect Compressor		I	I	I	I	I	I	I	I	I	I	I	I	I
	Bearings		I		I		I		I		I		I		I

Key I Inspect.
R Replace.
S Sample.

Notes: (1) The oil should be changed at these intervals, unless oil analysis results exceed the allowable limits. The frequency of changes will depend on the system cleanliness.

(2) Oil analysis should be done at 6-month intervals if using WF-68 refrigeration oil.

(3) The oil filter(s) on a minimum must be changed at these intervals or annually if not run continuously. However, the oil filter(s) must be changed if the oil filter differential exceeds 12 psi or oil analysis requires it.

300 AND 400 SERIES VMC RECIPROCATING COMPRESSORS
SERVICE INTERVAL REQUIREMENTS
Based on WF-68 Refrigeration Oil Usage

The following service intervals are based on the usage of Vilter Manufacturing Corporation Premium Grad refrigeration oil in 300 and 400 Series VMC Compressor units.

GROUP	INSPECTION OR MAINTENANCE ITEM	SERVICE INTERVAL (HOURS)													
		200	5,000	10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000	100,000	110,000	120,000
UNIT															
	Suction Screen	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Coupling Alignment and Integrity	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	V-Belt Drive Alignment and Integrity	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Water Line Strainers	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Liquid Line Strainers	I	I	I	I	I	I	I	I	I	I	I	I	I	I
CONTROL CALIBRATION															
	Electro-Mechanical Pressure Controls	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Transducers	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	RTD's	I	I	I	I	I	I	I	I	I	I	I	I	I	I
COMPRESSOR															
	Oil Change (1)		R	R	R	R	R	R	R	R	R	R	R	R	R
	Flush Oil Circuit				R		R		R		R		R		R
	Oil Analysis (2)		S	S	S	S	S	S	S	S	S	S	S	S	S
	Oil Filter (3)	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	Inspect Compressor (4)		I	I	I	I	I	I	I	I	I	I	I	I	I

Key
- I — Inspect.
- R — Replace or Service.
- S — Sample.

Notes:

(1) The oil should be changed at these intervals, unless oil analysis results exceed the allowable limits. The frequency of changes will depend on the system cleanliness.

(2) Oil analysis should be done at these intervals as a minimum; the frequency of analysis will depend on system cleanliness.

(3) The oil filter on a minimum must be changed at these intervals or annually if not run continuously. However, the oil filter must be changed if the oil filter differential exceeds 25 psi or oil analysis requires it.

(4) To prevent possible breakdowns, the compressor should be opened and the condition of the valves, valve seats, liners and connecting rod bearings should be checked and excessively worn parts be replaced. At the same time the crankshaft bearing float should also be checked.

VRS TWIN SCREW COMPRESSORS
SERVICE INTERVAL REQUIREMENTS
Based on WF-68 Refrigeration Oil Usage

The following service intervals are based on the usage of Vilter Manufacturing Corporation Premium Grade refrigeration oil in VRS Twin Screw Compressor units.

GROUP	INSPECTION OR MAINTENANCE ITEM	SERVICE INTERVAL (HOURS)													
		200	5,000	10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000	100,000	110,000	120,000
OIL CIRCUIT															
	Oil Change (1)		R		R		R		R		R		R		R
	Oil Analysis (2)		S	S	S	S	S	S	S	S	S	S	S	S	S
	Oil Filters (3)	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	Oil Strainer	I	I	I	I	I	I	I	I	I	I	I	I	I	I
PACKAGE															
	Coalescing Elements					R			R			R			R
	Suction Screen	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Liquid Line Strainers	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Coupling Alignment and Integrity	I	I	I	I	I	I	I	I	I	I	I	I	I	I
CONTROL CALIBRATION															
	Transducers	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	RTD's	I	I	I	I	I	I	I	I	I	I	I	I	I	I
COMPRESSOR															
	Inspect Compressor		I	I	I	I	I	I	I	I	I	I	I	I	I
	Bearings		I	I	I	I	I	I	I	I	I	I	I	I	I

Key
- I Inspect.
- R Replace.
- S Sample.

Notes:
(1) The oil should be changed at these intervals, unless oil analysis results exceed the allowable limits. The frequency of changes will depend on the system cleanliness.

(2) Oil analysis should be done at these intervals as a minimum; the frequency of analysis will depend on system cleanliness.

(3) The oil filter(s) on a minimum must be changed at these intervals or annually if not run continuously. However, the oil filter(s) must be changed if the oil filter differential exceeds 12 psi or oil analysis requires it

Oil Sampling Procedure

1) Fill sample bottle as full as possible. It takes a minimum of 4 ounces to perform all the analytical tests.
2) Fill out the information label (see example below) as completely as possible. We request that customers provide all information as to hazards related to sample. If a hazard exists, this information should clearly be marked in the comments area on the label.
3) Attach information portion of sample label to the sample bottle and put bottle in mailer.
4) Place address label on the outside of the mailer and send. U.P.S. is preferred, or the U.S. Postal Service.

Sample bottle label

FROM

Machine and Serial No. _____
Lubricant _____
Lot No. _____ **Sample Date** _____
Hours on Lubricant _____ **Hours on Machine** _____
Refrigerant _____ **Vilter Order No.** _____
Comments _____
Sold by

Vilter Manufacturing Corporation • 2300 James Savage Rd. • Midland, MI 48642

FROM

TO

Vilter Manufacturing Corporation
Oil Analysis Lab
2300 James Savage Road
Midland, MI 48642

Sample Anaylis Report

PRODUCT ANALYSIS REPORT

VILTER Since 1867

5555 S. Packard Avenue
Cudahy, WI 53110-8904
Phone: (414) 744-0111
Fax: (414) 744-3483

REPORT DATE:

REPORT NUMBER:

Customer Address

Customer
Comp. Mfr.
Oil Type
Serial #
Model #
Hrs. on Fluid
Hrs. on Machine
Sample Date
I.D. #

Evaluation:

Physical Properties* Results

Water By Karl Fisher	Viscosity 40°C (cSt)	TAN Total Acid #	Particle Count/ml								ISO Code	Antioxidant Level
			5 µm	10 µm	15 µm	20 µm	25 µm	30 µm	35 µm	40 µm		

* Property values, not to be construed as specifications.

Spectrochemical Analysis (ppm)

Sample Date (Lube Hours)	Wear Metals										Contaminate / Additive Metals							
	Silver (Ag)	Alum (Al)	Chrom (Cr)	Copper (Cu)	Iron (Fe)	Nickel (Ni)	Lead (Pb)	Tin (Sn)	Titan (Ti)	Vanad (V)	Bari (Ba)	Calc (Ca)	Mag (Mg)	Mol (Mo)	Sodi (Na)	Phos (P)	Sili (Si)	Zinc (Zn)

Thank you for this opportunity to provide technical assistance to your company. If you have any questions about this report please contact Technical Service at 1-800-637-8628.

Vilter Manufacturing LLC.
Oil Recommendations for Standard Warranty Coverage

Single Screw and Reciprocating Compressors Only

Vilter Oil Type	**717**	**HCL-68**	**D** ***Recip Only***	**F-68**	**FL-100**	**B-68** ***Single Screw Only***	**B-68(AW)** ***Recip Only***	**HC-68**
ISO Grade	68	68	68	68	100	68	68	68
@ 100°F (cSt)	77	75.7	68.5	65.67	76.4	71	71	67.2
Viscosity Index	100	132	65	79	115	108	114	168
Spec. Gravity	0.867	0.835	0.905	0.876	0.96	0.957	0.957	0.989
Density lbm/gal, 60°F	7.4	6.95	7.52	7.30	8.26	7.96	8.02	8.25
Flash Point - °F	440	525	345	295	558	505	266	425
Fire Point - °F	475	570	360	315	633	560	296	465
Pour Point - °F	-38.2	-67	-40	-31	-35	-45	-45	-55
Floc Point - °F	-25	NA	-35	-75	NA	NA	NA	NA
Refrigerant Type	**R-717**	**R-717** **R-1270**	**R-717** **R-22**	**R-22**	**R-22**	**R-134a** **R-507** **R-404A** **R-407C** **R-410A**	**R-134a** **R-507** **R-404A** **R-407C** **R-410A**	**R-290**

Cross Reference Index

Vilter Part No.	Vilter Lube Type	Oil Type	Lube Oil Base Stock	Container Size	Used w/Refrig. Type
2939A	717	HMO	Semi-synthetic	5 gallon pail	R-717
2939B	717	HMO	Semi-synthetic	55 gallon drum	R-717
3100A	Vilter D	Naphthenic	Mineral	5 gallon pail	R-717 & R-22
3100B	Vilter D	Naphthenic	Mineral	55 gallon drum	R-717 & R-22
3103A	HCL-68	PAO	Synthetic	5 gallon pail	R717 & R-1270
3103B	HCL-68	PAO	Synthetic	55 gallon drum	R717 & R-1270
3105A	F-68	AB	Semi-synthetic	5 gallon pail	R-22
3105B	F-68	AB	Semi-synthetic	55 gallon drum	R-22
3101A	FL-100	POE	Ester	5 gallon pail	R-22
3101B	FL-100	POE	Ester	55 gallon drum	R-22
3106A	B-68	POE	Ester	5 gallon pail	Blends
3106B	B-68	POE	Ester	55 gallon pail	Blends
3106C	B-68 AW	POE	Ester	5 gallon pail	Blends
3106D	B-68 AW	POE	Ester	55 gallon drum	Blends
3098A	HC-68	PAG	Synthetic	5 gallon pail	R-290
3098B	HC-68	PAG	Synthetic	55 gallon drum	R-290

Key: POE= Polyol Ester
PAO= Polyalfaolefin
AB= Alkylbenzene
HMO= Hydro Treated Mineral Oil
PAG= Poly Alkylglycols

Vilter Manufacturing LLC
Oil Recommendations for Standard Warranty Coverage
All Twin Screw Compressors

Vilter Code	717	HCL-68	D	F-68	FL-150	B-120	HCL-100	HC-100
ISO Grade	68	68	68	68	150	120	100	100
@ 100°F (cSt)	77	75.7	68.5	65.67	875.1	40.6	111.4	100.3
Viscosity Index	100	132	65	79	150	106	138	223
Spec. Gravity	0.867	0.835	0.905	0.876	1.01	0.940	0.839	0.992
Density lbm/gal, 60°F	7.4	6.95	7.52	7.30	8.41	7.83	6.99	8.27
Flash Point - °F	440	525	345	295	555	505	510	500
Fire Point - °F	475	570	360	315	630	555	560	530
Pour Point - °F	-38.2	-67	-40	-31	-45	-27	-55	-40
Floc Point - °F	-25	NA	-35	-75	NA	NA	NA	NA
Refrigerant Type	**R-717**	**R-717**	**R-717** **R-22**	**R-22**	**R-22**	**R-134a** **R-507** **R-404A** **R-407C** **R-410A**	**R-1270**	**R-290**

Cross Reference Index

Vilter Part No.	Vilter Lube Type	Oil Type	Lube Oil Base Stock	Container Size	Used w/Refrig. Type
2939A	717	HMO	Semi-synthetic	5 gallon pail	R-717
2939B	717	HMO	Semi-synthetic	55 gallon drum	R-717
3100A	Vilter D	Naphthenic	Mineral	5 gallon pail	R-717 & R-22
3100B	Vilter D	Naphthenic	Mineral	55 gallon drum	R-717 & R-22
3103A	HCL-68	PAO	Synthetic	5 gallon pail	R-717
3103B	HCL-68	PAO	Synthetic	55 gallon drum	R-717
3105A	F-68	AB	Semi-synthetic	5 gallon pail	R-22
3105B	F-68	AB	Semi-synthetic	55 gallon drum	R-22
3102A	FL-150	POE	Ester	5 gallon pail	R-22
3102B	FL-150	POE	Ester	55 gallon drum	R-22
3107A	B-120	POE	Ester	5 gallon pail	Blends
3107B	B-120	POE	Ester	55 gallon drum	Blends
3099A	HC-100	PAG	Synthetic	5 gallon pail	R-290
3099B	HC-100	PAG	Synthetic	55 gallon drum	R-290
3104A	HCL-100	PAO	Synthetic	5 gallon pail	R-1270
3104B	HCL-100	PAO	Synthetic	55 gallon drum	R-1270

Key: POE= Polyol Ester
PAO= Polyalfaolefin
AB= Alkylbenzene
HMO= Hydro Treated Mineral Oil
PAG= Poly Alkylglycols

Oil Recommendation for Warranty Coverage

Vilter Single Screw Compressors

Vilter 5/15 warranty is valid for the above lube oil selections only, WITH THE EXCEPTION OF THE “D” TYPE OIL (WARRANTY EXCLUSION). The standard Vilter 2-year warranty is applicable if the “D” type oil is utilized.

Vilter Reciprocating Compressors

The standard Vilter 2-year warranty is applicable to all lube oil selections above.

Vilter Twin Screw Compressors

The standard Vilter 2-year warranty is applicable to all lube oil selections above.

General: Oil analysis per service schedule interval is required to maintain warranty coverage.

These recommendations are based on a minimum oil supply temperature of 100 °F for start-up conditions. For applications installed outdoors or in a climate where the oil sump and supply temperature can fall below this minimum temperature requirement additional precautions will be necessary. Installations intended for outdoor duty or any ambient temperature less than 85 °F can experience start-up problems due to low oil injection temperature, oil dilution, foaming, high filter pressure drop, etc.. To prevent these situations from occurring the use of external heat tracing and insulation on all lube oil lines and oil coolers will be required to provide a sufficient injection supply temperature. Additionally, with screw compressor packages the oil separator provides a large amount of surface area for heat loss to the ambient air. To maintain the oil separator temperature in these environments a supplemental heat source (additional sump heaters) and separator insulation may be required. As a minimum requirement the oil sump and injection temperature should be maintained at 100 °F, or 15 °F greater than the surrounding ambient, whichever is greater to prevent potential start-up conflicts related to cold, thick lube oil. Operating conditions should be verified to ensure that the discharge gas superheat is greater than 25 °F. Discharge gas superheat is defined as the actual discharge gas temperature minus the refrigerant saturated temperature at discharge pressure.

The following fluid properties , pages 4 to 7, are based on pure lube oil only. Some lube oils will experience dilution with certain refrigerants, please see the miscibility and solubility curves in Section 2 for property correction to a specific operating condition.

Oil Analysis Limits
Vilter 717

PROPERTY	UNITS	TEST METHOD	NEW OIL	MARGINAL	UNACCEPTABLE
Viscosity @ 40C	cSt	ASTM D-445	61-75	55-61 & 80-82	<55 & >82
Antioxidant Level	% Remaining	Liquid Chromatography	Normal	Below Normal	Depleted
Acid Number	mg KOH/g	ASTM D-974	<0.2	0.8-1.0	>1.0
Pour Point		ASTM D-97	-36°C	-36°C	>-36°C
Phosphorus	PPM	Plasma Emission	0	6-20	>20
Zinc	PPM	Plasma Emission	0	6-20	>20
Calcium	PPM	Plasma Emission	0	6-20	>20
Barium	PPM	Plasma Emission	0	6-20	>20
Iron	PPM	Plasma Emission	0	6-10	>10
Copper	PPM	Plasma Emission	0	6-10	>10
Lead	PPM	Plasma Emission	0	6-10	>10
Tin	PPM	Plasma Emission	0	6-10	>10
Aluminum	PPM	Plasma Emission	0	6-10	>10
Silicon	PPM	Plasma Emission	0	6-10	>10
Molybdenum	PPM	Plasma Emission	0	6-20	>20
Silver	PPM	Plasma Emission	0	6-10	>10
Chromium	PPM	Plasma Emission	0	6-10	>10
Nickel	PPM	Plasma Emission	0	6-10	>10
Vanadium	PPM	Plasma Emission	0	6-10	>10
Titanium	PPM	Plasma Emission	0	5-10	>10
Magnesium	PPM	Plasma Emission	0	6-20	>20
Sodium	PPM	Plasma Emission	0	6-20	>20
Water Content	PPM	Karl Fischer	<75	150-200	>200
Particle Count	Micron	Hiac Royco	ISO CODE 14/10	ISO CODE XX/19	ISO CODE XX/>19

XX Any Number

HCL-68

PROPERTY	UNITS	TEST METHOD	NEW OIL	MARGINAL	UNACCEPTABLE
Viscosity @ 40C	cSt	ASTM D-445	60-69	54-55 & 75-76	<54 & >76
Antioxidant Level	% Remaining	Liquid Chromatography	N/A	N/A	N/A
Acid Number	mg KOH/g	ASTM D-974	<0.2	0.8-0.9	>1.0
Phosphorus	PPM	Plasma Emission	0	6-20	>20
Zinc	PPM	Plasma Emission	0	6-20	>20
Calcium	PPM	Plasma Emission	0	6-20	>20
Barium	PPM	Plasma Emission	0	6-20	>20
Iron	PPM	Plasma Emission	0	6-10	>10
Copper	PPM	Plasma Emission	0	6-10	>10
Lead	PPM	Plasma Emission	0	6-10	>10
Tin	PPM	Plasma Emission	0	6-10	>10
Aluminum	PPM	Plasma Emission	0	6-10	>10
Silicon	PPM	Plasma Emission	0	6-10	>10
Molybdenum	PPM	Plasma Emission	0	6-20	>20
Silver	PPM	Plasma Emission	0	6-10	>10
Chromium	PPM	Plasma Emission	0	6-10	>10
Nickel	PPM	Plasma Emission	0	6-10	>10
Vanadium	PPM	Plasma Emission	0	6-10	>10
Titanium	PPM	Plasma Emission	0	6-10	>10
Magnesium	PPM	Plasma Emission	0	6-20	>20
Sodium	PPM	Plasma Emission	0	6-20	>20
Water Content	PPM	Karl Fischer	<100	150-200	>200
Particle Count	Micron	Hiac Royco	ISO CODE 15/13	ISO CODE XX/19	ISO CODE XX/>19

*This Parameter is not relevant to the Condition of the oil.

XX Any Number

F-68

PROPERTY	UNITS	TEST METHOD	NEW OIL	MARGINAL	UNACCEPTABLE
Viscosity @ 40C	cSt	ASTM D-445	52-60	47-48 & 65-66	<47 & >66
Antioxidant Level	% Remaining	Liquid Chromatography	N/A	N/A	N/A
Acid Number	mg KOH/g	ASTM D-974	<0.1	0.4-0.5	>0.5
Phosphorus	PPM	Plasma Emission	0	6-20	>20
Zinc	PPM	Plasma Emission	0	6-20	>20
Calcium	PPM	Plasma Emission	0	6-20	>20
Barium	PPM	Plasma Emission	0	6-20	>20
Iron	PPM	Plasma Emission	0	6-10	>10
Copper	PPM	Plasma Emission	0	6-10	>10
Lead	PPM	Plasma Emission	0	6-10	>10
Tin	PPM	Plasma Emission	0	6-10	>10
Aluminum	PPM	Plasma Emission	0	6-10	>10
Silicon	PPM	Plasma Emission	<50	N/A	>55
Molybdenum	PPM	Plasma Emission	0	6-20	>20
Silver	PPM	Plasma Emission	0	6-10	>10
Chromium	PPM	Plasma Emission	0	6-10	>10
Nickel	PPM	Plasma Emission	0	6-10	>10
Vanadium	PPM	Plasma Emission	0	6-10	>10
Titanium	PPM	Plasma Emission	0	6-10	>10
Magnesium	PPM	Plasma Emission	0	6-20	>20
Sodium	PPM	Plasma Emission	0	6-20	>20
Water Content	PPM	Karl Fischer	<75	150-200	>200
Particle Count	Micron	Hiac Royco	ISO CODE 15/13	ISO CODE XX/19	ISO CODE XX/>19

XX Any Number

FL-100

PROPERTY	UNITS	TEST METHOD	NEW OIL	MARGINAL	UNACCEPTABLE
Viscosity @ 40C	cSt	ASTM D-445	90-110	80-82 & 120-122	<80 & >122
Antioxidant Level	% Remaining	Liquid Chromatography	N/A	N/A	N/A
Acid Number	mg KOH/g	ASTM D-974	<0.2	0.4-0.5	>0.5
Phosphorus	PPM	Plasma Emission	0	6-20	>20
Zinc	PPM	Plasma Emission	0	6-20	>20
Calcium	PPM	Plasma Emission	0	6-20	>20
Barium	PPM	Plasma Emission	0	6-20	>20
Iron	PPM	Plasma Emission	0	6-10	>10
Copper	PPM	Plasma Emission	0	6-10	>10
Lead	PPM	Plasma Emission	0	6-10	>10
Tin	PPM	Plasma Emission	0	6-10	>10
Aluminum	PPM	Plasma Emission	0	6-10	>10
Silicon	PPM	Plasma Emission	0	6-10	>10
Molybdenum	PPM	Plasma Emission	0	6-20	>20
Silver	PPM	Plasma Emission	0	6-10	>10
Chromium	PPM	Plasma Emission	0	6-10	>10
Nickel	PPM	Plasma Emission	0	6-10	>10
Vanadium	PPM	Plasma Emission	0	6-10	>10
Titanium	PPM	Plasma Emission	0	6-10	>10
Magnesium	PPM	Plasma Emission	0	6-20	>20
Sodium	PPM	Plasma Emission	0	6-20	>20
Water Content	PPM	Karl Fischer	<100	150-200	>200
Particle Count	Micron	Hiac Royco	ISO CODE 15/13	ISO CODE XX/19	ISO CODE XX/>19

*This Parameter is not relevant to the condition of the oil.

XX Any Number

FL-150

PROPERTY	UNITS	TEST METHOD	NEW OIL	MARGINAL	UNACCEPTABLE
Viscosity @ 40C	cSt	ASTM D-445	135-165	120-122 & 180-182	<120 & >182
Antioxidant Level	% Remaining	Liquid Chromatography	N/A	N/A	N/A
Acid Number	mg KOH/g	ASTM D-974	<0.15	0.4-0.5	>0.5
Phosphorus	PPM	Plasma Emission	0	6-20	>20
Zinc	PPM	Plasma Emission	0	6-20	>20
Calcium	PPM	Plasma Emission	0	6-20	>20
Barium	PPM	Plasma Emission	0	6-20	>20
Iron	PPM	Plasma Emission	0	6-10	>10
Copper	PPM	Plasma Emission	0	6-10	>10
Lead	PPM	Plasma Emission	0	6-10	>10
Tin	PPM	Plasma Emission	0	6-10	>10
Aluminum	PPM	Plasma Emission	0	6-10	>10
Silicon	PPM	Plasma Emission	0	6-10	>10
Molybdenum	PPM	Plasma Emission	0	6-20	>20
Silver	PPM	Plasma Emission	0	6-10	>10
Chromium	PPM	Plasma Emission	0	6-10	>10
Nickel	PPM	Plasma Emission	0	6-10	>10
Vanadium	PPM	Plasma Emission	0	6-10	>10
Titanium	PPM	Plasma Emission	0	6-10	>10
Magnesium	PPM	Plasma Emission	0	6-20	>20
Sodium	PPM	Plasma Emission	0	6-20	>20
Water Content	PPM	Karl Fischer	<50	150-200	>200
Particle Count	Micron	Hiac Royco	ISO CODE 15/13	ISO CODE XX/19	ISO CODE XX/>19

*This Parameter is not relevant to the condition of the oil.

B-68

PROPERTY	UNITS	TEST METHOD	NEW OIL	MARGINAL	UNACCEPTABLE
Viscosity @ 40C	cSt	ASTM D-445	58-70	52-53 & 76-77	<52 & >77
Antioxidant Level	% Remaining	Liquid Chromatography	N/A	N/A	N/A
Acid Number	mg KOH/g	ASTM D-974	<0.1	0.4-0.5	>0.5
Phosphorus	PPM	Plasma Emission	0	6-20	>20
Zinc	PPM	Plasma Emission	0	6-20	>20
Calcium	PPM	Plasma Emission	0	6-20	>20
Barium	PPM	Plasma Emission	0	6-20	>20
Iron	PPM	Plasma Emission	0	6-10	>10
Copper	PPM	Plasma Emission	0	6-10	>10
Lead	PPM	Plasma Emission	0	6-10	>10
Tin	PPM	Plasma Emission	0	6-10	>10
Aluminum	PPM	Plasma Emission	0	6-10	>10
Silicon	PPM	Plasma Emission	0	6-10	>10
Molybdenum	PPM	Plasma Emission	0	6-20	>20
Silver	PPM	Plasma Emission	0	6-10	>10
Chromium	PPM	Plasma Emission	0	6-10	>10
Nickel	PPM	Plasma Emission	0	6-10	>10
Vanadium	PPM	Plasma Emission	0	6-10	>10
Titanium	PPM	Plasma Emission	0	6-10	>10
Magnesium	PPM	Plasma Emission	0	6-20	>20
Sodium	PPM	Plasma Emission	0	6-20	>20
Water Content	PPM	Karl Fischer	<50	150-200	>200
Particle Count	Micron	Hiac Royco	ISO CODE 17/14	ISO CODE XX/19	ISO CODE XX/>19

*This Parameter is not relevant to the Condition of the oil.

XX Any Number

B-120

PROPERTY	UNITS	TEST METHOD	NEW OIL	MARGINAL	UNACCEPTABLE
Viscosity @ 40C	cSt	ASTM D-445	108-132	97-98 & 144-145	<97 & >145
Antioxidant Level	% Remaining	Liquid Chromatography	N/A	N/A	N/A
Acid Number	mg KOH/g	ASTM D-974	<0.1	0.3-0.5	>0.5
Phosphorus	PPM	Plasma Emission	0	6-20	>20
Zinc	PPM	Plasma Emission	0	6-20	>20
Calcium	PPM	Plasma Emission	0	6-20	>20
Barium	PPM	Plasma Emission	0	6-20	>20
Iron	PPM	Plasma Emission	0	6-10	>10
Copper	PPM	Plasma Emission	0	6-10	>10
Lead	PPM	Plasma Emission	0	6-10	>10
Tin	PPM	Plasma Emission	0	6-10	>10
Aluminum	PPM	Plasma Emission	0	6-10	>10
Silicon	PPM	Plasma Emission	0	6-10	>10
Molybdenum	PPM	Plasma Emission	0	6-20	>20
Silver	PPM	Plasma Emission	0	6-10	>10
Chromium	PPM	Plasma Emission	0	6-10	>10
Nickel	PPM	Plasma Emission	0	6-10	>10
Vanadium	PPM	Plasma Emission	0	6-10	>10
Titanium	PPM	Plasma Emission	0	6-10	>10
Magnesium	PPM	Plasma Emission	0	6-20	>20
Sodium	PPM	Plasma Emission	0	6-20	>20
Water Content	PPM	Karl Fischer	<50	150-200	>200
Particle Count	Micron	Hiac Royco	ISO CODE 17/14	ISO CODE XX/19	ISO CODE XX/>19

*This Parameter is not relevant to the Condition of the oil.

XX Any Number

HC-68

HC-100

PROPERTY	UNITS	TEST METHOD	NEW OIL	MARGINAL	UNACCEPTABLE
Viscosity @ 40C	cSt	ASTM D-445	90-110	48-60 & 118-120	<48 & >120
Antioxidant Level	% Remaining	Liquid Chromatography	Normal	Below Normal	Depleted
Acid Number	mg KOH/g	ASTM D-974	N/A	N/A	N/A
Phosphorus	PPM	Plasma Emission	5-50	1-5	0
Zinc	PPM	Plasma Emission	0	6-20	>20
Calcium	PPM	Plasma Emission	0	6-20	>20
Barium	PPM	Plasma Emission	0	6-20	>20
Iron	PPM	Plasma Emission	0	6-10	>10
Copper	PPM	Plasma Emission	0	6-10	>10
Lead	PPM	Plasma Emission	0	6-10	>10
Tin	PPM	Plasma Emission	0	6-10	>10
Aluminum	PPM	Plasma Emission	0	6-10	>10
Silicon	PPM	Plasma Emission	<50	N/A	>55
Molybdenum	PPM	Plasma Emission	0	6-20	>20
Silver	PPM	Plasma Emission	0	6-10	>10
Chromium	PPM	Plasma Emission	0	6-10	>10
Nickel	PPM	Plasma Emission	0	6-10	>10
Vanadium	PPM	Plasma Emission	0	6-10	>10
Titanium	PPM	Plasma Emission	0	6-10	>10
Magnesium	PPM	Plasma Emission	0	6-20	>20
Sodium	PPM	Plasma Emission	0	6-20	>20
Water Content	PPM	Karl Fischer	<2000	N/A	N/A
Particle Count	Micron	Hiac Royco	N/A	N/A	N/A

*This Parameter is not relevant to the Condition of the oil in this application; however, it may show acidity of the gas stream.

XX Any Number

VILTER D

PROPERTY	UNITS	TEST METHOD	NEW OIL	MARGINAL	UNACCEPTABLE
Viscosity @ 40C	cSt	ASTM D-445	57-63	52-53 & 68-69	<52 & >69
Antioxidant Level	% Remaining	Liquid Chromatography	N/A	N/A	N/A
Acid Number	mg KOH/g	ASTM D-974	<0.1	0.8-1.0	>1.0
Phosphorus	PPM	Plasma Emission	0	6-20	>20
Zinc	PPM	Plasma Emission	0	6-20	>20
Calcium	PPM	Plasma Emission	0	6-20	>20
Barium	PPM	Plasma Emission	0	6-20	>20
Iron	PPM	Plasma Emission	0	6-10	>10
Copper	PPM	Plasma Emission	0	6-10	>10
Lead	PPM	Plasma Emission	0	6-10	>10
Tin	PPM	Plasma Emission	0	6-10	>10
Aluminum	PPM	Plasma Emission	0	6-10	>10
Silicon	PPM	Plasma Emission	0	6-10	>10
Molybdenum	PPM	Plasma Emission	0	6-20	>20
Silver	PPM	Plasma Emission	0	6-10	>10
Chromium	PPM	Plasma Emission	0	6-10	>10
Nickel	PPM	Plasma Emission	0	6-10	>10
Vanadium	PPM	Plasma Emission	0	6-10	>10
Titanium	PPM	Plasma Emission	0	6-10	>10
Magnesium	PPM	Plasma Emission	0	6-20	>20
Sodium	PPM	Plasma Emission	0	6-20	>20
Water Content	PPM	Karl Fischer	<75	150-200	>200
Particle Count	Micron	Hiac Royco	ISO CODE 15-13	ISO CODE XX/19	ISO CODE XX>19

XX Any Number

B-68AW

PROPERTY	UNITS	TEST METHOD	NEW OIL	MARGINAL	UNACCEPTABLE
Viscosity @ 40C	cSt	ASTM D-445	58-70	52-53 & 76-77	<52 & >77
Antioxidant Level	% Remaining	Liquid Chromatography	N/A	N/A	N/A
Acid Number	mg KOH/g	ASTM D-974	<0.1	0.4-0.5	>0.5
Phosphorus	PPM	Plasma Emission	730-1350	1-100	0
Zinc	PPM	Plasma Emission	0	6-20	>20
Calcium	PPM	Plasma Emission	0	6-20	>20
Barium	PPM	Plasma Emission	0	6-20	>20
Iron	PPM	Plasma Emission	0	6-10	>10
Copper	PPM	Plasma Emission	0	6-10	>10
Lead	PPM	Plasma Emission	0	6-10	>10
Tin	PPM	Plasma Emission	0	6-10	>10
Aluminum	PPM	Plasma Emission	0	6-10	>10
Silicon	PPM	Plasma Emission	0	6-10	>10
Molybdenum	PPM	Plasma Emission	0	6-20	>20
Silver	PPM	Plasma Emission	0	6-10	>10
Chromium	PPM	Plasma Emission	0	6-10	>10
Nickel	PPM	Plasma Emission	0	6-10	>10
Vanadium	PPM	Plasma Emission	0	6-10	>10
Titanium	PPM	Plasma Emission	0	6-10	>10
Magnesium	PPM	Plasma Emission	0	6-20	>20
Sodium	PPM	Plasma Emission	0	6-20	>20
Water Content	PPM	Karl Fischer	<50	150-200	>200
Particle Count	Micron	Hiac Royco	ISO CODE 17/14	ISO CODE XX/19	ISO CODE XX/>19

*This Parameter is not relevant to the Condition of the oil.

MSDS Sheets

MSDS
Vilter R717
6/2006

Emergency Number: (517) 496-3780

Section 1 ***Product Name and Information***

Product (Trade Name and Synonyms): Vilter R717
Chemical Name: Semi-synthetic Hydrocarbon
Chemical Family: Mineral Oil
Formula: Proprietary
CAS#: Proprietary

Section 2 ***Components and Hazard Statement***

This product is non-hazardous. The product contains no known carcinogens. No special warning labels are required under OSHA 29 CFR 191 0.1200.

Section 3 ***Safe Handling and Storage***

Handling. Do not take internally. Avoid contact with skin, eyes, and clothing. Upon contact with skin, wash with soap and water. Flush eyes with water for 15 minutes and consult physician. Wash contaminated clothing before reuse.

Storage. Keep container tightly sealed when not in use.

Section 4 ***Physical Data***

Appearance: Colorless liquid
Boiling Point: >500°F
Vapor Pressure: <0.1 mmHg ~20°C
Specific Gravity (water=1): 0.86-0.87
Volatiles, Percent by Volume: 0%
Odor: slight
Solubility in Water: insoluble
Evaporation Rate (butyl acetate~1): nil

Section 5 ***Fire and Explosion Hazards***

Flash Point (by Cleveland Open Cup): 216-232°C (420-450°F)
Flammable Limits: not established
Autoignition Temperature: no data
HMIS Ratings:
Health: 0
Flammability: 1
Reactivity: 0
NFPA Ratings: not established

Extinguishing Media: Dry chemical; CO_2 foam

Unusual Fire and Explosion Hazards: **None**

Special Fire Fighting Techniques: Burning fluid may evolve irritating/noxious fumes. Firefighters should use NIOSH/MNSA-approved self-contained breathing apparatus. Use water carefully to cool fire-exposed containers. Spraying water directly on hot or burning liquid may cause frothing or splashing.

Section 6 ***Reactivity Data***

Stability: Stable
Hazardous Polymerization: Will not occur
Incompatible Materials: Strong Oxidizers
Conditions to Avoid: Excessive heat
Hazardous Decomposition Products: Analogous compounds evolve carbon monoxide, carbon dioxide and other unidentified fragments when burned. See Section 5.

Section 7 ***Health Hazard Data***

Threshold Limit Value: 5mg/m^3 for oil mist

Situations to Avoid: Avoid breathing oil mists

First Air Procedures:

Ingestion:	**DO NOT INDUCE VOMITING**. Consult a physician at once. DO NOT give anything by mouth if the person is unconscious or having convulsions.
Inhalation:	Product is not toxic by inhalation. If oil mist is inhaled, remove to fresh air and consult physician.
Contact:	Prolonged exposure may irritate the skin. Wash exposed skin with soap and water.

To the best of our knowledge, the toxicological properties of these compounds have not been fully investigated. Analogous compounds are considered essentially non-toxic.

Section 8 ***Personal Protection Information***

Respiratory Protection: Use in well-ventilated area
Ventilation: Local exhaust
Protective Gloves: Not required, but recommended, especially for long term exposure
Eye/Face Protection: Goggles

Section 9 ***Spill or Leak Procedures***

In Case of Spill: Wear suitable protective equipment, especially goggles. Stop source of spill. Dike spill area. Use absorbent materials to soak up fluid (i.e. sand, sawdust, or commercially available materials). Wash spill area with large amounts of water. Properly dispose of all materials.

Section 10 ***Waste Disposal Methods***

Incinerate this product and all associated wastes in a licensed facility in accordance with Federal, state and local regulations.

The information in this material safety data sheet should be provided to all that use, handle, store, transport, or are otherwise exposed to this product. We believe the information in this document to be reliable and current as of the date of publication, but makes no guarantee.

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MSDS
Vilter HCL-68
6/06

Emergency Number: (517) 496-3780

Section 1 ***Product Name and Information***

Product (Trade Name and Synonyms): Vilter HCL-68

Chemical Name: Polyalphaolefin
Chemical Family: Synthetic Hydrocarbon
Formula: $C_{1n}H_{20n}+_{2}$

CAS#: Proprietary

Section 2 ***Components and Hazard Statement***

This product is non-hazardous. The product contains no known carcinogens. No special warning labels are required under OSHA 29 CFR 1910.1200.

Section 3 ***Safe Handling and Storage***

Handling. Do not take internally. Avoid contact with skin, eyes, and clothing. Upon contact with skin, wash with soap and water. Flush eyes with water for 15 minutes and consult physician. Wash contaminated clothing before reuse.

Storage. Keep container tightly sealed when not in use.

Section 4 ***Physical Data***

Appearance: Clear liquid, yellow to light brown tint
Boiling Point: >300°F
Vapor Pressure: <0.01mmHg @ 20°C
Specific Gravity (water=1): 0.79-0.85
Volatiles, Percent by Volume: 0%
Odor: None
Solubility in Water: Insoluble
Evaporation Rate (butyl acetate=1): Nil

Section 5 ***Fire and Explosion Hazards***

Flash Point (by Cleveland Open Cup): 425°F
Flammable Limits: not established
Autoignition Temperature: no data
HMIS Ratings:
Health: 0
Flammability: 1
Reactivity: 0
NFPA Ratings: not established

Extinguishing Media: Dry chemical; CO2 foam; water spray (fog)

Unusual Fire and Explosion Hazards: None

Special Fire Fighting Techniques: Burning fluid may evolve irritating/noxious fumes. Firefighters should use NIOSH/MNSA-approved self-contained breathing apparatus. Use water to cool fire-exposed containers. Use water carefully near exposed liquid to avoid frothing and splashing of hot liquid.

HCL-68

Section 6 ***Reactivity Data***

Stability: **Stable**
Hazardous Polymerization: Will not occur
Incompatible Materials: Strong oxidizers
Conditions to Avoid: Excessive heat
Hazardous Decomposition Products: Analogous compounds evolve carbon monoxide carbon dioxide and other unidentified fragments when burned. See Section 5.

Section 7 ***Health Hazard Data***

Threshold Limit Value: 5mg/m3 ACGIH
Situations to Avoid: Avoid breathing oil mists
First Aid Procedures:

Ingestion: Consult physician at once. **DO NOT INDUCE VOMITING.** May cause nausea and diarrhea.

Inhalation: Product is not toxic by inhalation. If oil mist is inhaled, remove to fresh air and consult physician.

To the best of our knowledge, the toxicity of this product has not been fully investigated. Analogous compounds are considered essentially non-toxic.

Section 8 ***Personal Protection Information***

Respiratory Protection: Use in well-ventilated area
Ventilation: Local exhaust
Protective Gloves: Not required, but recommended, especially for prolonged exposure
Eye/Face Protection: Goggles

Section 9 ***Spill or Leak Procedures***

In Case of Spill: Wear suitable protective equipment, especially goggles. Stop source of spill. Dike spill area. Use absorbent materials to soak up fluid (i.e. sand, sawdust, and commercially available materials). Wash spill area with large amounts of water. Properly dispose of all materials.

Section 10 ***Waste Disposal Methods***

Incinerate this product and all associated wastes in a licensed facility in accordance with Federal, state, and local regulations.

The information in this material safety data sheet should be provided to all that use, handle, store, transport, or are otherwise exposed to this product. We believe the information in this document to be reliable and current as of the date of publication, but makes no guarantee.

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MSDS
Vilter F-68
6/06

Emergency Number: (517) 496-3780

Section 1 ***Product Name and Information***

Product (Trade Name and Synonyms): Vilter F-68

Chemical Name: Semi-synthetic hydrocarbon blend
Chemical Family: Petroleum hydrocarbon/alkylate
Formula: Proprietary
CAS#: Proprietary

Section 2 ***Components and Hazard Statement***

This product is non-hazardous. The product contains no known carcinogens. No special warning labels are required under OSHA 29 CFR 1910.1200.

Section 3 ***Safe Handling and Storage***

Handling. Do not take internally. Avoid contact with skin, eyes, and clothing. Upon contact with skin, wash with soap and water. Flush eyes with water for 15 minutes and consult physician. Wash contaminated clothing before reuse.

Storage. Keep container tightly sealed when not in use.

Vilter F-68

Section 4 ***Physical Data***

Appearance: colorless to light amber

Boiling Point: >315°F
Vapor Pressure: <0.5 mmHg @ 20°C
Specific Gravity (water=1): 0.815 – 0.876
Volatiles, Percent by Volume: 0%
Odor: slight
Solubility in Water: insoluble
Evaporation Rate (butyl acetate+1): nil

Section 5 ***Fire and Explosion Hazards***

Flash Point (by Cleveland Open Cup): 275 – 295°F
Flammable Limits: not established
Autoignition Temperature: no data
HMIS Ratings:

Health	0
Flammability:	1
Reactivity:	0
Personal Protection:	B

NFPA Ratings in Air: not established

Extinguishing Media: Dry chemical; CO_2 foam, water fog

Special Fire Fighting Techniques: Burning fluid may evolve irritating/noxious fumes. Firefighters should use NIOSH/MNSA-approved self-contained breathing apparatus. Use water carefully to cool fire-exposed containers. Spraying water directly on hot or burning liquid may cause frothing or splashing.

Vilter F-68

Section 6 ***Reactivity Data***

Stability: **Stable**
Hazardous Polymerization: Will not occur
Incompatible Materials: Strong Oxidizers
Conditions to Avoid: Excessive heat
Hazardous Decomposition Products: Analogous compounds evolve carbon monoxide, carbon dioxide, and other unidentified fragments when burned. See Section 5.

Section 7 ***Health Hazard Data***

Threshold Limit Value: 5mg/m^3 for oil mist
Situations to Avoid: Avoid breathing oil mists
First Aid Procedures:

Ingestion:	**DO NOT INDUCE VOMITING.** Consult physician at once. DO NOT give anything by mouth if the person is unconscious or having convulsions.
Inhalation:	Product is not toxic by inhalation. If oil mist is inhaled, remove to fresh air and consult physician.
Contact:	Prolonged exposure may irritate the skin. Wash exposed skin with soap and water.

To the best of our knowledge, the toxicological properties of these compounds have not been fully investigated. Analogous compounds are considered essentially non-toxic.

Section 8 ***Personal Protection Information***

Respiratory Protection: Use in well-ventilated area
Ventilation: Local exhaust
Protective Gloves: Not required, but recommended, especially for long term exposure.
Eye/Face Protection: Goggles

Section 9 ***Spill or Leak Procedures***

In Case of Spill: Wear suitable protective equipment, especially goggles. Stop source of spill. Dike spill area. Use absorbent materials to soak up fluid (i.e. sand, sawdust, or commercially available materials). Wash spill area with large amounts of water. Properly dispose of all materials.

Section 10 ***Waste Disposal Methods***

Incinerate this product and all associated wastes in a licensed facility in accordance with Federal, state, and local regulations.

The information in this material safety data sheet should be provided to all that use, handle, store, transport, or are otherwise exposed to this product. We believe the information in this document to be reliable and current as of the date of publication, but makes no guarantee.

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MSDS
ViltерFL-100
6/06

Emergency Number: (517) 496-3780

Section 1 ***Product Name and Information***

Product (Trade Name and Synonyms): Vilter FL-100

Chemical Name: Ester

Chemical Family: Polyol Ester
Formula: Proprietary
CAS#: Proprietary

Section 2 ***Components and Hazard Statement***

This product is non-hazardous. The product contains no known carcinogens. No special warning labels are required under OSHA 29 CFR 1910.1200.

Section 3 ***Safe Handling and Storage***

Handling. Do not take internally. Avoid contact with skin, eyes, and clothing. Upon contact with skin, wash with soap and water. Flush eyes with water for 15 minutes and consult physician. Wash contaminated clothing before reuse.

Storage. Keep container tightly sealed when not in use. Product will absorb moisture from the air. Storage under nitrogen highly recommended.

ViterFL-100

Section 4 ***Physical Data***

Appearance: Clear liquid, yellow to light brown tint
Boiling Point: 650°F
Vapor Pressure: <0.01mmHg @ 20°C
Specific Gravity (water=1): 0.99 – 1.03
Volatiles, Percent by Volume: 0%
Odor: Mild, distinct
Solubility in Water: Insoluble
Evaporation Rate (Butyl Acetate=1): Nil

Section 5 ***Fire and Explosion Hazards***

Flash Point (by Cleveland Open Cup): >530°F
Flammable Limits: not established
Autoignition Temperature: no data
HMIS Ratings:
Health: 0
Flammability: 1
Reactivity: 0
NFPA Ratings: not established

Extinguishing Media: Dry chemical: CO_2 foam

Unusual Fire and Explosion Hazards: None

Special Fire Fighting Techniques: Burning fluid may evolve irritating/noxious fumes. Firefighters should use NIOSH/MNSA-approved self-contained breathing apparatus. Use water carefully to cool fire-exposed containers. Water spray may cause frothing or splashing of hot material.

Section 6 ***Reactivity Data***

Stability: **Stable**
Hazardous Polymerization: Will not occur
Incompatible Materials: Strong oxidizers, caustic or acidic solutions
Conditions to Avoid: Excessive heat
Hazardous Decomposition Products: Analogous compounds evolve carbon monoxide, carbon dioxide, and other unidentified fragments when burned. See Section 5.

Section 7 ***Health Hazard Data***

Threshold Limit Value: not established
Situations to Avoid: Avoid breathing oil mists
First Aid Procedures:

Ingestion:	Consult physician at once. May cause nausea and diarrhea.
Inhalation:	Product is not toxic by inhalation. If oil mist is inhaled, remove to fresh air and consult physician.

To the best of our knowledge, the toxicity of this product has not been fully investigated. Analogous compounds are considered essentially non-toxic.

Section 8 ***Personal Protection Information***

Respiratory Protection: Use in well-ventilated area
Ventilation: Local exhaust
Protective: Gloves not required, but recommended, especially for prolonged exposure
Eye/Face Protection: Goggles

ViterFL-100

Section 9 ***Spill or Leak Procedures***

In Case of Spill: Wear suitable protective equipment, especially goggles. Stop source of spill. Dike spill area. Use absorbent materials to soak up fluid (i.e. sand, sawdust, and commercially available materials). Wash spill area with large amounts of water. Properly dispose of all materials.

Section 10 ***Waste Disposal Methods***

Incinerate this product and all associated wastes in a licensed facility in accordance with Federal, state, and local regulations.

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MSDS
Vilter FL-150
6/06

Emergency Number: (517) 496-3780

Section 1 ***Product Name and Information***

Product (Trade Name and Synonyms): Vilter FL-150

Chemical Name: Ester
Chemical Family: Polyol Ester
Formula: Proprietary
CAS#: Proprietary

Section 2 ***Components and Hazard Statement***

This product is non-hazardous. The product contains no known carcinogens. No special warning labels are required under OSHA 29 CFR 1910.1200.

Section 3 ***Safe Handling and Storage***

Handling. Do not take internally. Avoid contact with skin, eyes, and clothing. Upon contact with skin, wash with soap and water. Flush eyes with water for 15 minutes and consult physician. Wash contaminated clothing before reuse.

Storage. Keep container tightly sealed when not in use. Product will absorb moisture from the air. Storage under nitrogen highly recommended.

Section 4 ***Physical Data***

Appearance: Clear liquid, yellow to light brown tint
Boiling Point: 650°F
Vapor Pressure: <0.01mmHg @ 20°C
Specific Gravity (water=1): 0.99 – 1.03
Volatiles, Percent by Volume: 0%
Odor: Mild, distinct
Solubility in Water: Insoluble
Evaporation Rate (butyl acetate=1): Nil

Section 5 ***Fire and Explosion Hazards***

Flash Point (by Cleveland Open Cup): >530°F
Flammable Limits: not established
Autoignition Temperature: no data
HMIS Ratings:
Health: 0
Flammability: 1
Reactivity: 0
NFPA Ratings: not established

Extinguishing Media: Dry chemical; CO2 foam

Unusual Fire and Explosion Hazards: None

Special Fire Fighting Techniques: Burning fluid may evolve irritating/noxious fumes. Firefighters should use NIOSH/MNSA-approved self-contained breathing apparatus. Use water carefully to cool fire-exposed containers. Water spray may cause frothing or splashing of hot material.

Vilter FL-150

Section 6 ***Reactivity Data***

Stability: **Stable**
Hazardous Polymerization: Will not occur
Incompatible Materials: Strong oxidizers, caustic or acidic solutions
Conditions to Avoid: Excessive heat
Hazardous Decomposition Products: Analogous compounds evolve carbon monoxide, carbon dioxide, and other unidentified fragments when burned. See Section 5.

Section 7 ***Health Hazard Data***

Threshold Limit Value: not established
Situations to Avoid: Avoid breathing oil mists
First Aid Procedures:

Ingestion: Consult physician at once. May cause nausea and diarrhea.
Inhalation: Product is not toxic by inhalation. If oil mist is inhaled, remove to fresh air and consult physician.

To the best of our knowledge, the toxicity of this product has not been fully investigated. Analogous compounds are considered essentially non-toxic.

Section 8 ***Personal Protection Information***

Respiratory Protection: Use in well-ventilated area
Ventilation: Local exhaust
Protective Gloves: Not required, but recommended, especially for prolonged exposure
Eye/Face Protection: Goggles

Section 9 ***Spill or Leak Procedures***

In Case of Spill: Wear suitable protective equipment, especially goggles. Stop source of spill. Dike spill area. Use absorbent materials to soak up fluid (i.e. sand, sawdust, and commercially available materials). Wash spill area with large amounts of water. Properly dispose of all materials.

Section 10 ***Waste Disposal Methods***

Incinerate this product and all associated wastes in a licensed facility in accordance with Federal, state, and local regulations.

The information in this material safety data sheet should be provided to all that use, handle, store, transport, or are otherwise exposed to this product. We believe the information in this document to be reliable and current as of the date of publication, but makes no guarantee.

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MSDS
Vilter B-68
6/06

Emergency Number: (517) 496-3780

Section 1 ***Product Name and Information***

Product (Trade Name and Synonyms): Vilter B-68
Chemical Name: Ester
Chemical Family: Polyol Ester
Formula: Proprietary
CAS#: Proprietary

Section 2 ***Components and Hazard Statement***

This product is non-hazardous. The product contains no known carcinogens. No special warning labels are required under OSHA 29 CFR 1910.1200.

Section 3 ***Safe Handling and Storage***

Handling. Do not take internally. Avoid contact with skin, eyes, and clothing. Upon contact with skin, wash with soap and water. Flush eyes with water for 15 minutes and consult physician. Wash contaminated clothing before reuse.

Storage. Keep container tightly sealed when not in use. Product is Hygroscopic. Storage under nitrogen highly recommended.

Vilter B-68

Section 4 ***Physical Data***

Appearance: Clear liquid, gray to yellow or light brown tint
Boiling Point: >650°F
Vapor Pressure: <0.01 mmHg @ 20°F°C
Specific Gravity (water=1): 0.94 – 0.97
Volatiles, Percent by Volume: 0%
Odor: Mild, distinct
Solubility in Water: Negligible
Evaporation Rate (butyl acetate=1): Nil

Section 5 ***Fire and Explosion Hazards***

Flash Point (by Cleveland Open Cup): 230 – 300°C
Flammable Limits: not established
Autoignition Temperature: no data
HMIS Ratings:
Health: 0
Flammability: 1
Reactivity: 0

Extinguishing Media: Dry chemical; CO2 foam; water fog (see below)

Unusual Fire and Explosion Hazards: None

Special Fire Fighting Techniques: Burning fluid may evolve irritating/noxious fumes. Firefighters should use NIOSH/MNSA-approved self-contained breathing apparatus. Use water fog to cool fire-exposed containers. USE WATER CAREFULLY NEAR EXPOSED/BURNING LIQUIDS. May cause frothing and splashing of hot material.

Vilter B-68

Section 6 ***Reactivity Data***

Stability: **Stable**
Hazardous Polymerization: Will not occur
Incompatible Materials: Strong oxidizers, caustic or acidic solutions
Conditions to Avoid: Excessive heat
Hazardous Decomposition Products: Analogous compounds evolve carbon monoxide, carbon dioxide and other unidentified fragments when burned. See Section 5.

This product may degrade some paints and rubber materials.

Section 7 ***Health Hazard Data***

Threshold Limit Value: not established
Situations to Avoid: Avoid breathing oil mists
First Aid Procedures:

Ingestion:	Consult physician at once. May cause nausea and diarrhea.
Inhalation:	Product is not toxic by inhalation. If oil mist is inhaled, remove to fresh air and consult physician.

To the best of our knowledge, the toxicological properties of these compounds have not been fully investigated. Analogous compounds are considered essentially non-toxic.

Section 8 ***Personal Protection Information***

Respiratory Protection: Use in well-ventilated area
Ventilation: Local exhaust
Protective Gloves: Strongly recommended, especially for prolonged exposure
Eye/Face Protection: Goggles

Vilter B-68

Section 9 ***Spill or Leak Procedures***

In Case of Spill: Wear suitable protective equipment, especially goggles. Stop source of spill. Dike spill area. Use absorbent materials to soak up fluid (i.e. sand, sawdust, and commercially available materials). Wash spill area with large amounts of water. Properly dispose of all materials.

Section 10 ***Waste Disposal Methods***

Incinerate this product and all associated wastes in a licensed facility in accordance with Federal, state, and local regulations.

The information in this material safety data sheet should be provided to all that use, handle, store, transport, or are otherwise exposed to this product. We believe the information in this document to be reliable and current as of the date of publication, but makes no guarantee.

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MSDS
Vilter B-120
6/06

Emergency Number: (517) 496-3780

Section 1 ***Product Name and Information***

Product (Trade Name and Synonyms): Vilter B-120

Chemical Name: Ester
Chemical Family: Polyol Ester
Formula: Proprietary
CAS#: Proprietary

Section 2 ***Components and Hazard Statement***

This product is non-hazardous. The product contains no known carcinogens. No special warning labels are required under OSHA 29 CFR 191 0.1200.

Section 3 ***Safe Handling and Storage***

Handling. Do not take internally. Avoid contact with skin, eyes, and clothing. Upon contact with skin, wash with soap and water. Flush eyes with water for 15 minutes and consult physician. Wash contaminated clothing before reuse.

Storage. Keep container tightly sealed when not in use. Product is Hygroscopic. Storage under nitrogen highly recommended.

Vilter B-120

Section 4 ***Physical Data***

Appearance: Clear liquid, gray to yellow or light brown tint
Boiling Point: >650°F
Vapor Pressure: <0.01 mmHg @ 20°C
Specific Gravity (water=1): 0.94 – 0.97
Volatiles, Percent by Volume: 0%
Odor: Mild, distinct
Solubility in Water: Negligible
Evaporation Rate (butyl acetate=1): Nil

Section 5 ***Fire and Explosion Hazards***

Flash Point (by Cleveland Open Cup): 230 – 300°C
Flammable Limits: not established
Autoignition Temperature: no data
HMIS Ratings:

Health:	0
Flammability:	1
Reactivity:	0

Extinguishing Media: Dry chemical; CO_2 foam; water fog (see below)

Unusual Fire and Explosion Hazards: **None**

Special Fire Fighting Techniques: Burning fluid may evolve irritating/noxious fumes. Firefighters should use NIOSH/MNSA-approved self-contained breathing apparatus. Use water fog to cool fire-exposed containers. USE WATER CAREFULLY NEAR EXPOSED/BURNING LIQUIDS. May cause frothing and splashing of hot material.

Section 6 ***Reactivity Data***

Stability: **Stable**
Hazardous Polymerization: Will not occur
Incompatible Materials: Strong oxidizers, caustic or acidic solutions
Conditions to Avoid: Excessive heat
Hazardous Decomposition Products: Analogous compounds evolve carbon monoxide, carbon dioxide, and other unidentified fragments when burned. See Section 5.

This product may degrade some paints and rubber materials.

Section 7 ***Health Hazard Data***

Threshold Limit Value: not established
Situations to Avoid: Avoid breathing oil mists
First Aid Procedures:

Ingestion:	Consult physician at once. May cause nausea and diarrhea.
Inhalation:	Product is not toxic by inhalation. If oil mist is inhaled, remove to fresh air and consult physician.

To the best of our knowledge, the toxicological properties of these compounds have not been fully investigated. Analogous compounds are considered essentially non-toxic.

Section 8 ***Personal Protection Information***

Respiratory Protection: Use in well-ventilated area
Ventilation: Local exhaust
Protective Gloves: Strongly recommended, especially for prolonged exposure
Eye/Face Protection: Goggles

Section 9 ***Spill or Leak Procedures***

In Case of Spill: Wear suitable protective equipment, especially goggles. Stop source of spill. Dike spill area. Use absorbent materials to soak up fluid (i.e. sand, sawdust, and commercially available materials). Wash spill area with large amounts of water. Properly dispose of all materials.

Section 10 ***Waste Disposal Methods***

Incinerate this product and all associated wastes in a licensed facility in accordance with Federal, state, and local regulations.

The information in this material safety data sheet should be provided to all that use, handle, store, transport, or are otherwise exposed to this product. We believe the information in this document to be reliable and current as of the date of publication, but makes no guarantee.

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MSDS
Vilter HCL-100
6/06

Emergency Number: (517) 496-3780

Section 1 ***Product Name and Information***

Product (Trade Name and Synonyms): Vilter HCL-100

Chemical Name: Polyalphaolefin
Chemical Family: Synthetic Hydrocarbon
Formula: $C_{10n}H_{20n}+_2$

CAS#: Proprietary

Section 2 ***Components and Hazard Statement***

This product is non-hazardous. The product contains no known carcinogens. No special warning labels are required under OSHA 29 CFR 191 0.1200.

Section 3 ***Safe Handling and Storage***

Handling. Do not take internally. Avoid contact with skin, eyes, and clothing. Upon contact with skin, wash with soap and water. Flush eyes with water for 15 minutes and consult physician. Wash contaminated clothing before reuse.

Storage. Keep container tightly sealed when not in use.

Section 4 ***Physical Data***

Solubility in Water: Insoluble
Evaporation Rate (butyl acetate=1): Nil

Section 5 ***Fire and Explosion Hazards***

Flash Point (by Cleveland Open Cup): 425°F
Flammable Limits: not established
Autoignition Temperature: no data
HMIS Ratings:
Health: 0
Flammability: 1
Reactivity: 0
NFPA Ratings: not established

Extinguishing Media: Dry Chemical; CO_2 foam; water spray (fog)

Unusual Fire and Explosion Hazards: None

Special Fire Fighting Techniques: Burning fluid may evolve irritating/noxious fumes. Firefighters should use NIOSH/MNSA-approved self-contained breathing apparatus. Use water to cool fire-exposed containers. Use water carefully near exposed liquid to avoid frothing and splashing of hot liquid.

Vilter HCL-100

Section 6 ***Reactivity Data***

Stability: **Stable**
Hazardous Polymerization: Will not occur
Incompatible Materials: Strong oxidizers
Conditions to Avoid: Excessive heat
Hazardous Decomposition Products: Analogous compounds evolve carbon monoxide, carbon dioxide and other unidentified fragments when burned. See Section 5.

Section 7 ***Health Hazard Data***

Threshold Limit Value: 5mg/m3 ACGIH
Situations to Avoid: Avoid breathing oil mists
First Aid Procedures:

Ingestion:	Consult physician at once. **DO NOT INDUCE VOMITING**. May cause nausea and diarrhea.
Inhalation:	Product is not toxic by inhalation. If oil mist is inhaled, remove to fresh air and consult physician.

To the best of our knowledge, the toxicity of this product has not been fully investigated. Analogous compounds are considered essentially non-toxic.

Section 8 ***Personal Protection Information***

Respiratory Protection: Use in well-ventilated area
Ventilation: Local exhaust
Protective Gloves: Not required, but recommended, especially for prolonged exposure
Eye/Face Protection: Goggles

Section 9 ***Spill or Leak Procedures***

In Case of Spill: Wear suitable protective equipment, especially goggles. Stop source of spill. Dike spill area. Use absorbent materials to soak up fluid (i.e. sand, sawdust, and commercially available materials). Wash spill area with large amounts of water. Properly dispose of all materials.

Section 10 ***Waste Disposal Methods***

Incinerate this product and all associated wastes in a licensed facility in accordance with Federal, state, and local regulations.

The information in this material safety data sheet should be provided to all that use, handle, store, transport, or are otherwise exposed to this product. We believe the information in this document to be reliable and current as of the date of publication, but makes no guarantee.

Vilter Manufacturing LLC
5555 South Packard Avenue * P.O. Box 8904 * Cudahy, Wisconsin 53110-8904
(414) 744-0111 *FAX (414) 744-3483

MSDS
Vilter HC-68
6/06

Emergency Number: (517) 496-3780

Section 1 ***Product Name and Information***

Product (Trade Name and Synonyms): Vilter HC-68

Chemical Name: Polyalkylene Glycol
Chemical Family: Polyglycol
Formula: Proprietary
CAS#: Proprietary

Section 2 ***Components and Hazard Statement***

This product is non-hazardous. The product contains no known carcinogens. No special warning labels are required under OSHA 29 CFR 191 0.1200.

Section 3 ***Safe Handling and Storage***

Handling. Do not take internally. Avoid contact with skin, eyes, and clothing. Upon contact with skin, wash with soap and water. Flush eyes with water for 15 minutes and consult physician. Wash contaminated clothing before reuse.

Storage. Keep container tightly sealed when not in use.

Section 4 ***Physical Data***

Appearance: Clear liquid; gray to brown tint
Boiling Point: >400°F
Vapor Pressure: <0.01 mmHg ~ 20°C
Specific Gravity (water=1): 0.99 – 1.01
Volatiles, Percent by Volume: 0%
Odor: slight
Solubility in Water: <1%
Evaporation Rate (butyl acetate=1): nil

Section 5 ***Fire and Explosion Hazards***

Flash Point (by Cleveland Open Cup): >218°C
Flammable Limits: not established
Autoignition Temperature: no data
HMIS Ratings:
Health: 0
Flammability: 1
Reactivity: 0
NFPA Ratings: not established

Extinguishing Media: Water spray; Dry chemical; CO_2 foam

Unusual Fire and Explosion Hazards: none

Special Fire Fighting Techniques: Burning fluid may evolve irritating/noxious fumes. Firefighters should use NIOSH/MNSA-approved self-contained breathing apparatus. Do not spray water directly on fire. This may cause splashing and frothing of hot liquid.

Section 6 ***Reactivity Data***

Stability: **Stable**
Hazardous Polymerization: Will not occur
Incompatible Materials: Strong oxidizers and materials incompatible with alcohols
Conditions to Avoid: Excessive heat
Hazardous Decomposition Products: Analogous compounds evolve carbon monoxide, carbon dioxide, and other unidentified fragments when burned. See Section 5.

Section 7 ***Health Hazard Data***

Threshold Limit Value: not established
Situations to Avoid: Avoid breathing oil mists
First Aid Procedures:

Ingestion:	**DO NOT INDUCE VOMITING.** Consult physician at once. DO NOT give anything by mouth if the person is unconscious or having convulsions.
Inhalation:	Product is not toxic by inhalation. If oil mist is inhaled, remove to fresh air and consult physician.
Contact:	Wash exposed skin with soap and water. Flush eyes with large quantities of water and consult physician immediately.

To the best of our knowledge, the toxicological properties of these compounds have not been fully investigated. Analogous compounds are considered essentially non-toxic.

Section 8 ***Personal Protection Information***

Respiratory Protection: Use in well-ventilated area
Ventilation: Mechanical exhaust needed at elevated temperatures
Protection Gloves: Not required, but recommended, especially for long term exposure
Eye/Face Protection: Goggles

Section 9 ***Spill or Leak Procedures***

In Case of Spill: Wear suitable protective equipment, especially goggles. Stop source of spill. Dike spill area. Use absorbent materials to soak up fluid (i.e. sand, sawdust, and commercially available materials). Wash spill area with large amounts of water. Properly dispose of all materials.

Section 10 ***Waste Disposal Methods***

Incinerate this product and all associated wastes in a licensed facility in accordance with Federal, state, and local regulations.

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Vilter Manufacturing LLC
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MSDS
Vilter HC-100
6/06

Emergency Number: (517) 496-3780

Section 1 ***Product Name and Information***

Product (Trade Name and Synonyms): Vilter HC-100

Chemical Name: Polyalkylene Glycol
Chemical Family: Polyglycol
Formula: Proprietary
CAS#: Proprietary

Section 2 ***Components and Hazard Statement***

This product is **non-hazardous**. The product contains no known carcinogens. No special warning labels are required under OSHA 29CFR 1910.1200.

Section 3 ***Safe Handling and Storage***

Handling. Do not take internally. Avoid contact with skin, eyes, and clothing. Upon contact with skin. Wash with soap and water. Flush eyes with water for 15 minutes and consult physician. Wash contaminated clothing before reuse.

Storage. Keep container tightly sealed when not in use.

Section 4 ***Physical Data***

Appearance: Clear liquid; gray to brown tint
Boiling Point: >400°F
Vapor Pressure: <0.01 mmHg @ 20°C
Specific Gravity (water=1): 0.99 – 1.01
Volatiles, Percent by Volume: 0%
Odor: slight
Solubility in Water: <1%
Evaporation Rate (butyl acetate=1): nil

Section 5 ***Fire and Explosion Hazards***

Flash Point (by Cleveland Open Cup): >218°C
Flammable Limits: not established
Autoignition Temperature: no data
HMIS Ratings:
Health: 0
Flammability: 1
Reactivity: 0
NFPA Ratings: not established

Extinguishing Media: Water spray; Dry chemical; CO2 foam

Unusual Fire and Explosion Hazards: None

Special Fire Fighting Techniques: Burning fluid may evolve irritating/noxious fumes. Firefighters should use NIOSH/MNSA-approved self-contained breathing apparatus. Do not spray water directly on fire. This may cause splashing and frothing of hot liquid.

Vilter HC-100

Section 6 ***Reactivity Data***

Stability: **Stable**
Hazardous Polymerization: Will not occur
Incompatible Materials: Strong oxidizers and materials incompatible with alcohols
Conditions to Avoid: Excessive heat
Hazardous Decomposition Products: Analogous compounds evolve carbon monoxide, carbon dioxide, and other unidentified fragments when burned. See Section 5.

Section 7 ***Health Hazard Data***

Threshold Limit Value: not established
Situations to Avoid: Avoid breathing oil mists
First Aid Procedures:

Ingestion:	**DO NOT INDUCE VOMITING**. Consult physician at once. DO NOT give anything by mouth if the person is unconscious or having convulsions.
Inhalation:	Product is not toxic by inhalation. If oil mist is inhaled, remove to fresh air and consult physician.
Contact:	Wash exposed skin with soap and water. Flush eyes with large quantities of water and consult physician immediately.

To the best of our knowledge, the toxicological properties of these compounds have not been fully investigated. Analogous compounds are considered essentially non-toxic.

Section 8 ***Personal Protection Information***

Respiratory Protection: Use in well-ventilated area
Ventilation: Mechanical exhaust needed at elevated temperatures
Protective Gloves: Not required, but recommended, especially for long term exposure
Eye/Face Protection: Goggles

Section 9 ***Spill or Leak Procedures***

In Case of Spill: Wear suitable protective equipment, especially goggles. Stop source of spill. Dike spill area. Use absorbent materials to soak up fluid (i.e. sand, sawdust, and commercially available materials). Wash spill area with large amounts of water. Properly dispose of all materials.

Section 10 ***Waste Disposal Methods***

Incinerate this product and all associated wastes in a licensed facility in accordance with Federal, state, and local regulations.

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Vilter Manufacturing LLC
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(414) 744-0111 *FAX (414) 744-3483

MSDS
Vilter D
6/06

Emergency Number: (517) 496-3780

Section 1 ***Product Name and Information***

Product (Trade Name and Synonyms): Vilter D

Chemical Name: Semi-synthetic Hydrocarbon
Chemical Family: Petroleum Hydrocarbon
Formula: Proprietary
CAS#: Proprietary

Section 2 ***Components and Hazard Statement***

This product is non-hazardous. The product contains no known carcinogens. No special warning labels are required under OSHA 29 CFR 1910.1200.

Section 3 ***Safe Handling and Storage***

Handling. Do not take internally. Avoid contact with skin, eyes, and clothing. Upon contact with skin, wash with soap and water. Flush eyes with water for 15 minutes and consult physician. Wash contaminated clothing before reuse.

Storage. Keep container tightly sealed when not in use.

Vilter D

Section 4 ***Physical Data***

Appearance: Colorless liquid
Boiling Point: >350°F
Vapor Pressure: <0.5 mmHg @ 20°C
Specific Gravity (water+1): 0.89-0.905
Volatiles, Percent by Volume: 0%
Odor: slight
Solubility in Water: insoluble
Evaporation Rate (butyl acetate=1): nil

Section 5 ***Fire and Explosion Hazards***

Flash Point (by Cleveland Open Cup): 330 – 345°F
Flammable Limits: not established
Autoignition Temperature: no data
HMIS Ratings:

Health:	0
Flammability:	1
Reactivity:	0
Person Protection:	B NFPA Ratings in air: not established

Extinguishing Media: Dry chemical, CO_2 foam, water fog

Unusual Fire and Explosion Hazards: **None**

Special Fire Fighting Techniques: Burning fluid may evolve irritating/noxious fumes. Firefighters should use NIOSH/MNSA-approved self-contained breathing apparatus. Use water carefully to cool fire-exposed containers. Spraying water directly on hot or burning liquid may cause frothing or splashing.

Vilter D

Section 6 ***Reactivity Data***

Stability: **Stable**
Hazardous Polymerization: Will not occur
Incompatible Materials: Strong Oxidizers
Conditions to Avoid: Excessive heat
Hazardous Decomposition Products: Analogous compounds evolve carbon monoxide, carbon dioxide and other unidentified fragments when burned. See Section 5.

Section 7 ***Health Hazard Data***

Threshold Limit Value: 5mg/m3 for oil mist
Situations to Avoid: Avoid breathing oil mists
First Aid Procedures:

Ingestion:	**DO NOT INDUCE VOMITING.** Consult physician at once. DO NOT give anything by mouth if the person is unconscious or having convulsions.
Inhalation:	Product is not toxic by inhalation. If oil mist is inhaled, remove to fresh air and consult physician.
Contact:	Prolonged exposure may irritate the skin. Wash exposed skin with soap and water.

To the best of our knowledge, the toxicological properties of these compounds have not been fully investigated. Analogous compounds are considered essentially non-toxic.

Section 8 ***Personal Protection Information***

Respiratory Protection: Use in well-ventilated area
Ventilation: Local exhaust
Protective Gloves: Not required, but recommended, especially for long term exposure
Eye/Face Protection: Goggles

Section 9 ***Spill or Leak Procedures***

In Case of Spill: Wear suitable protective equipment, especially goggles. Stop source of spill. Dike spill area. Use absorbent materials to soak up fluid (i.e. sand, sawdust, or commercially available materials). Wash spill area with large amounts of water. Properly dispose of all materials.

Section 10 ***Waste Disposal Methods***

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Lubrication Terminology

Lubrication Terminology

A

Additive – a chemical added in small quantities to a petroleum product to improve certain properties. Such is the complexity of their action, that additives should not be incorporated indiscriminately, but should constitute well-defined components of the product's original formulation, a formulation determined by research to yield best performance. Among the more common petroleum-product additives are:

Oxidation Inhibitors For increasing the product's resistance to oxidation and for lengthening its service life, rust inhibitors.

Corrosion Inhibitors To protect lubricated surfaces against rusting and corrosion, demulsifiers to promote oil-water separation.

Viscosity Index Improvers To make and oil's viscosity less sensitive to changes in temperature, pour point depressants to lower the pour point of petroleum products.

Oiliness Agents, Anti-Wear
Agents EP Additives, etc. To prevent high friction wear, or scoring under various conditions of boundary lubrication.

Detergents and Dispersants To maintain cleanliness of lubricated parts.

Anti-Foam Agents To reduce foaming tendencies.

Tackiness Agents To increase the adhesive properties of a lubricant, improve retention, and prevent dripping and spattering.

Anti-wear Agent – an additive that minimizes wear caused by metal-to-metal contact during conditions of mild boundary lubrication (e.g. stops and starts, oscillating motion). The additive reacts chemically with, and forms a film on metal surfaces under normal operating conditions.

Auto-Ignition Temperature – minimum temperature at which a combustible fluid will burst into flame without an extraneous ignition source. The auto-ignition temperature assumes only enough "fuel" to form and explosive mixture in the presence of air at atmospheric pressures. The auto-ignition temperature may vary considerably depending upon the conditions of the test. For petroleum products, the conditions are outlined in ASTM D 2155. Auto-ignition temperature is not to be confused with flash or fire points, which are generally a few hundred degrees lower. As a generality for gasoline, the higher the octane number, the higher the auto-ignition temperature. For a diesel fuel, the lower the cetane number, the higher the auto-ignition temperature. Such correlation's are very general and assume the same boiling points or ranges in each case. In general industrial practice, auto-ignition temperature has its greatest importance with process oils such as heat transfer oils, transformer oils and with solvents such as are used in cooking resins.

B

Bearing Corrosion – chemical attack on bearing metals caused by acids evolved during chemical deterioration of the oil. The acids may be mild organic acids from the oil itself or, more likely, the strong acids that result from breakdown of nitrogen or sulfur compounds, which can enter the oil from several sources.

Blow-by – seepage of gas from a high pressure zone into an adjacent lower pressure zone as the result of pressure differential, warped values, loose rings, groove to groove leakage in screw compressors, etc.

C

Crude Oil – naturally occurring hydrocarbon fluid that contains small amounts of nitrogen, oxygen, and sulfur derivatives and other impurities. It is refined to yield finished petroleum products and petrochemical feedstocks. The hydrocarbon composition of crude oils varies widely. Two broad classifications are naphenic and paraffinic. The nature of crude oil is related to its geographical location and it is usually named accordingly.

cSt – abbreviation of **centistoke**.

D

Demulsibility – test time required for a specified oil-water emulsion to separate, ASTM D 1401. Demulsibility is thus a measure of a lubricating oil's ability to separate from water, an important consideration in the lubricant maintenance of many circulating systems.

Detergent – an additive in crankcase oils generally combined with (and confused with) dispersant additives. A detergent chemically neutralizes acidic contaminants in the oil before they become insoluble and fall out of the oil forming sludge. Neutral or basic compounds are created which can remain in suspension in the oil. Dispersants operate to break up insoluble contaminant particles already formed. Particles are kept finely divided so they can remain "dispersed" or colloidally suspended in the oil.

Dew Point Temperature – the temperature at which a gas will condense. Typically, it is desired to have the gas temperature at least 15-20°F higher than the dew point temperature of the refrigerant, at a given operating pressure to prevent vapor condensation.

Dielectric Strength – minimum voltage required to produce an electric arc through an oil sample under standard conditions. ASTM D 877 or D 1816. Hence, the measurement of the insulating (arc-preventive) properties of an oil, normally associated with transformer oils. A low dielectric-strength value may indicate contamination, especially water. Also called the **breakdown voltage**.

Dilution – the amount of refrigerant mixed with the oil expressed as a percentage, to that of the same volume of oil at a given temperature/pressure condition.

E

Emulsion – a mechanical mixture of two mutually insoluble liquids (such as oil and water). Emulsification may or may not be desirable, depending on circumstances. Highly refined straight mineral oils are inherently resistant to emulsification. Even after violent shaking, the oil separates and rises rapidly to the top of the water. This is true also of other oils formulated for good demulsibility, and it is a desirable characteristic of oils, such as circulating lubricating oils, that must separate from water readily. Demulsibility may be reduced, however, by the presence of oxidation products or other contamination that promotes emulsification

and makes separation difficult. In other cases, emulsification is desirable. It can be effected by the addition of emulsifiers, polar compounds that are oil-soluble at one extreme, water-soluble at the other. Emulsifiers are used in products formulated to mix readily with water. The resulting emulsions may be of two types – water-in-oil or oil-in-water (in which case, the oil is in the inner phase). Water-in-oil emulsions are used where the oil, not the water, should contact the solid surfaces, as in rust preventives, fire-resistant hydraulic fluids, compounded steam cylinder oils, etc. such emulsions are sometimes referred to as invert emulsions. Oil-in-water emulsions are used in cutting-oil mixtures, because of the need for the cooling effect of the water.

EP Agent – an additive to improve the extreme pressure properties of a lubricant.

Ester – a compound generally formed by the reaction of an alcohol with an organic acid. For example, ethyl alcohol and acetic acid produce ethyl acetate (an ester) and water. Esters were among the earliest types of synthetic lubricating oils; they are still widely used in this application. Esters also find applications as solvents.

Extreme Pressure – see boundary lubrication, EP agent.

F

Falex Test – a method for determining the **extreme pressure** or anti-wear properties of oils and greases. A rotating pin, ¼" in diameter is clamped between 2 vee blocks in such a manner that load can be applied to the blocks. Initially, 4 line contacts are made between the pin and blocks but, with increasing load, area contacts are made. Wear can be measured by determining the width of the contact areas or the weight loss of pins and blocks.

Flash Point – minimum temperature (°F) of a petroleum product or other combustible fluid at which vapor is produced at a rate sufficient to yield a combustible mixture. Specifically, it is the lowest sample temperature at which the air vapor mixture will "flash" in the presence of an ignition source (small flame). Flash point may be determined by the following ASTM Methods;

Closed cup (covered sample container); D 93 "Hash Point by Pensky-Martens Closed Tester" for fuel oils, also for cutback asphalt's and other viscous materials and suspensions of solids.

Open cup (uncovered sample container); D 92 "Flash and Fire Points by Cleveland Open Cup" for lubricating oils.

As indicated, this last method provides also for the determination of a **fire point**. Fire point is the minimum sample temperature at which vapor is produced at a sufficient rate to sustain combustion. Specifically, it is the lowest temperature at which the ignited vapor of a sample persists in burning for at least 5 seconds. Since the fire points of commercial petroleum oils ordinarily run about 50°F above the corresponding flash point, they are often omitted from petroleum-oil data. Flash and fire points have obvious safety connotations – the higher the test temperature, the less the hazard of fire or explosion. Of comparable significance, however, is their value in providing a simple indication of volatility, where a lower flash point denotes a more volatile material. The dilution of a crankcase oil with fuel, for example, lowers the flash point. With hydrocarbon solvents, flash point can be roughly related to initial boiling point (IBP) by the formula; Flash Point = (0.79

X IBP) – 136, where all units are degrees Fahrenheit. Flash and fire points should not be confused with **auto-ignition temperature**, the temperature at which combustion occurs spontaneously (without an external source of ignition).

Floc Point (of refrigeration lubricant) – highest temperature at which waxy particles solidify to give a cloudy appearance to a mixture of 10% oil in Refrigerant 12. Hence flocculation. A low floc point is desirable for refrigeration lubrication, in which waxy or plastic solid particles might otherwise settle out and restrict refrigerant flow. Not to be confused with cloud point, a similar test value determined for the oil, or fuel, without mixture with refrigerant.

Foaming – may occur when a liquid is intimately mixed with air or gas. Foaming may result in reduced film strength of a lubricant because of the entrained vapor. Test methods provide an indication of foaming tendency and are reported on empirical ratings.

Foam Inhibitor – an additive that causes foam to dissipate more rapidly. It promotes the combination of small bubbles into large bubbles, which burst more easily.

Friction – resistance to motion offered by a surface or substance because of its contact with another surface or substance. **Sliding (kinetic) friction** is that which occurs between two solid bodies, while fluid friction is that which occurs between the molecules of a fluid in motion. Sliding friction is measured in units of the resistive force, while fluid friction is measured in terms of shear stress. Both types of friction can be wasteful of power and energy, and sliding friction causes wear. In other respects, however, their characteristics are diametrically opposite. Whereas sliding friction is independent of speed and area, fluid friction varies with speed and area. Whereas sliding friction is directly proportional to the load (force normal to the sliding plane), fluid friction is independent of load (fluid pressure). Fluid friction also decreases with lower fluid viscosity. In general, lubrication is the substitution of low fluid friction in place of high sliding friction and the resulting wear.

G

Gravity – Weight-per-unit volume relationship. With petroleum products, this relationship may be expressed as specific gravity, the ratio of the weight of a volume of the product at a designated temperature to the weight of an equal volume of water – also at a designated temperature. The designated temperature is often 60°F in both cases. The higher the specific gravity, the "heavier" the material. Petroleum products may also be defined in terms of **API gravity** (ASTM D287) in accordance with the formula:

$$\text{API Gravity (degrees)} = \frac{141.5}{\text{Specific Gravity } 60/60°\text{F}} - 131.5$$

Hence, the higher the API value, the "lighter" the material. Kerosene has an API gravity of about 41.4 and a specific gravity of about 0.82. A measurement related to specific gravity is density, the weight of a given volume at a specified temperature, as pounds per gallon at 60°F.

H

Hydrodynamic Lubrication – that which is effected solely by the "pumping" action developed by the

sliding of one surface over another in contact with a lubricating oil. Adhesion to the moving surface draws the oil into the high-pressure area between the surfaces, and viscosity retards the tendency to squeeze the oil out. If the pressure developed by this action is sufficient to completely separate the two surfaces – as it ordinarily is – full-fluid-film lubrication is said to prevail.

I

ISO – International Standards Organization.

K

Kerosene – a colorless hydrocarbon distillate with distillation range higher than gasoline but lower than furnace oil or diesel. Largest use is jet fuel. Other applications are as a solvent, and for heating and lighting.

Kinematic Viscosity – see viscosity. Derived by (viscosity in centipoise) divided by (the oil density at the same temperature) = centistockes.

L

Lubricity (of and oil) – a moderate load-carrying ability over and above that indicated by its viscosity. The property can be enhanced by additive treatment.

M

Miscible – mutually soluble. The ability of the liquid refrigerant to mix with the liquid lubricant. If the lubricant will form a single phase with the refrigerant, it is miscible. If the lubricant will not form a homogenous mixture with the refrigerant, then it is immiscible and two phase. Water and alcohol are miscible; whereas water and petroleum oil, are immiscible.

Miscibility Temperature – Above this temperature the lubricant will be completely miscible with the refrigerant. Below this temperature, the lubricant will separate into two distinct phases, depending upon the mixture composition.

N

Neut Number – short for neutralization number: the specific quantity of reagent required to "neutralize" the acidity or alkalinity of a lube oil sample. Either of these characteristics – acidity or alkaliity – may be exhibited by an unused oil, depending on its composition. In addition, certain additives impart acidity, while alkalinity may be derived from the presence of detergents or of basic material added to control oxidation. In service, the oil will, in time, show increasing acidity as the result of oxidation and, in some cases, additive depletion. Though acidity is not, of itself, necessarily harmful, an increase in acidity may be indicative of oil deterioration, and neut number is widely used to evaluate the condition of an oil in service. The most common measurement is acid number. The specific quantity of KOH (potassium hydroxide) required to counterbalance the acid characteristics. How high an acid number can be tolerated depends on the oil and the service conditions and only broad experience with the individual situations can determine such a value. Neut number is determined in accordance with the ASTM Method D 664 or D 974. The former is a potentiometric method, the latter, calorimetric. Values for **total acid, strong acid, total base, and strong base** can, where

they exist, be obtained. Strong acid numbers are considered to be related to inorganic acids, such as those derived from sulfur, while the difference between the total and strong acid numbers is attributed to weak (organic) acids – possibly the products of oxidation. A total acid number (TAN) and total base number (TBN) can exist simultaneously, both representing components too weak to completely neutralize the other. When results are reported simply as "neut number" or "acid number", a **total acid number (TAN)** is implied.

O

Organic Compound – compound of carbon. So called because of its association with living organisms. Inorganic compounds include those substances that contain no carbon.

OSHA – Occupational Safety and Health Administration. A United States Federal agency that conducts studies leading to occupational safety and health standards in all facets of plant facilities, operation, and procedure. One of their responsibilities is to publish a list showing the safety threshold level for every contaminant in a plant working atmosphere, usually stated in parts per million. These threshold levels in turn lead to a level of contaminant allowable in every raw material used in a plant. These composition limits take into account type of contact between raw material and worker, exposure time, ventilation, and working conditions.

Oxidation – a form of chemical deterioration to which petroleum products – like most other organic materials - is subject. The resistance of many petroleum products to oxidation, however, is very high. Oxidation usually involves the addition of oxygen atoms, and the result is nearly always one of degradation. It is accelerated by higher temperatures, the reaction becoming significant at temperatures above 160°F. For every 18°F rise, the rate of oxidation doubles. Oxidation is also promoted by the presence of catalytic metals, copper being particularly active in this latter respect. What is more, the peroxides that are the initial products of oxidation are themselves oxidizing agents. So the oxidation of petroleum products is a chain reaction, the farther is progresses the more rapid it becomes. With fuels and lube oils, oxidation produces sludge, varnishes, gums, and acids, all of which are undesirable. Nevertheless, many oils, such as turbine oils, give years of service without need for replacement. Petroleum products that require a long service or storage life can be formulated to meet requirements by:

1) Proper selection of crude type. Paraffinic oils are noted for natural resistance to oxidation.
2) Thorough refining, which removes oxidation-susceptible materials and allows greater response to inhibitors.
3) Addition of oxidation inhibitors.
4) Long service is also promoted by good maintenance practices;
   a) filtration, centrifuging, or other means of controlling contamination
   b) limiting duration or intensity of high temperatures
   c) eliminating the presence of air and of catalytic metals

For information on the prediction of an oil's oxidation stability, consult this heading. For information on determining the degree of deterioration sustained by used oil and hence, its suitability for further service, see neut number XFT.

Oxidation Inhibitor – chemical added in small quantities to a petroleum product to increase its oxidation resistance and, hence, to lengthen its service or storage life. An oxidation inhibitor may combine with the peroxides formed initially by oxidation, thereby modifying them in such a way as to arrest their oxidizing influence. On the other hand, the inhibitor (a passivator) may react with a catalyst to either "poison" it or

coat it with a inert film.

P

Petroleum – term applicable to crude oil and the hydrocarbon products and materials that are derived from it.

Pour Point – is a widely used low-temperature flow indicator and is 5°F above the temperature to which a normally liquid petroleum product maintains fluidity. It is a significant factor in cold-weather start-up, but must be considered along with pumpability, the ease with which oil pumps at low temperatures. The pour point of the lubricant should be less than the lowest expected operating temperature to provide sufficient oil fluidity and viscosity. The use of pour points higher than the refrigerant evaporating temperature will tend to coat the evaporator heat transfer surface and reduce the overall heat transfer coefficient. Paraffinic oils contain wax, which forms a honeycomb of crystals at low temperatures near the pour point. However, agitation by a pump breaks down this wax structure and allows paraffinic oils to be pumped at temperatures well below their pour point. Napthenic oils, on the other hand, contain little or no wax and reach their pour point through increase in viscosity: they cannot be pumped readily near the pour point. ASTM D 97 is used to determine pour point. See also pour depressant under additives. ASTM D 97 also provides for the determination of **cloud point**, the lowest temperature (°F) at which the sample becomes clouded by the formation of wax crystals. Clouding is a characteristic only of paraffinic oils. It is a consideration in the evaluation of refrigerants whose filtration might be impaired by the plugging effect of wax crystals.

R

R&O – rust- and oxidation-inhibited. Term applied to highly-refined industrial lubricating oils formulated for long service in circulating systems, compressors, hydraulic systems, bearing housings, gear cases, etc. The finest R&O oils are often referred to as turbine oils.

Rust Inhibitor – a lubricant additive for protecting ferrous (iron & steel) components from rusting caused by water contamination or other harmful materials from oil degradation. Some rust inhibitors operate similarly to corrosion inhibitors by reacting chemically to form an inert film on metal surfaces. Other rust inhibitors absorb water by incorporating it into water-in-oil emulsion so that only the oil touches the metal surfaces.

S

Solubility – the ability of the refrigerant vapor to dissolve in the lubricant. An oil with a high solubility potential will have the effect of reducing the oil viscosity due to dilution.

SSU (Saybolt Seconds Universal) – the time in seconds for a specified quantity of oil to flow through a calibrated orifice. The oil quantity is fixed, however the time interval increases or decreases based on the oil viscosity.

Surfactant – additive that reduces surface tension of a liquid. With a petroleum oil, a surfactant may increase its affinity for metals and other materials.

V

Vapor Pressure – a measure of liquid's volatility (the vapor pressure of water at 212°F is one atmosphere). Under the ASTM Method D 323 (Reid vapor pressure), it is the absolute vapor pressure exerted by a liquid at 100°F. The higher this value, the more volatile the sample and the more readily it will evaporate. Unlike distillation data, vapor pressure provides a single value that reflects the combined effect of the individual vapor pressure of the different petroleum fractions in accordance with their mole ratios. It is thus possible for two wholly different products to exhibit the same vapor pressure at the same temperature – provided the cumulative pressures exerted by the fractions are the same. A narrow-cut distillate, for example, may exhibit the same vapor pressure as that of a dumbbell blend where that of the lighter ones counterbalances the effect of heavy fractions.

Viscosity – measure of a fluid's resistance to flow. It is ordinarily expressed in terms of the time required for a standard quantity of the fluid at a certain temperature to flow through a standard orifice. The higher the value, the more viscous the fluid. Since viscosity varies inversely with temperature, its value is meaningless unless accompanied by the temperature at which it is determined. With petroleum oils, viscosity is commonly reported in Saybolt seconds, Universal-SSU or SUS-or, for very viscous oils, in Saybolt seconds, Furol-SSF. For a given oil, the Saybolt Universal viscosity will run 10 times that of the Saybolt Furol viscosity measured at the same temperature. Both values are determined in accordance with the ASTM Method D88. **Kinematic viscosity** is now widely used concerning petroleum oils, and the unit is the stoke, or, more generally, the **centistoke** (cSt). Less common are the Engler and Redwood viscosity scales, whose principal applications are outside of North America.

Viscosity Index (V.I.) – the measure of the rate of change of viscosity with temperature. This change is common to all fluids – some more, some less. Heating tends to make them thinner – cooling, thicker. The higher the Viscosity Index, the less the tendency for the viscosity to change. Viscosity Index is determined by formula from the viscosities at 100°F and 210°F in accordance with the ASTM Test Method D 567 or D 2270. The latter test is required for Viscosity Indexes above 100. High Viscosity Index oils are often preferred for service which a relatively constant viscosity is desired under conditions of varying temperature. Some hydraulic systems require this property. Paraffinic oils are inherently high in Viscosity Index. Naphthenic oils are inherently low in Viscosity Index and aromatics are still lower – often having negative numbers. The Viscosity Index of any petroleum oil can be increased by the addition of a Viscosity Index improver.

Volumetric Efficiency – mass of refrigerant drawn into the cylinder of a reciprocating compressor cylinder in relation to the mass that the cylinder could hold under static equilibrium conditions. In basic terms, volumetric efficiency is the difference in volume flow between actual volume flow and the theoretical compressor displacement. The difference is a result of blow-by or the losses associated with compressing a vapor.

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