Refrigeration Oil

Zerol® Alkylbenzene Refrigeration Oil

- **Excellent miscibility & compatibility with all CFC & HCFC refrigerants**
- **Recommended by OEM's for use with HCFC-based service blends**
- **Copeland approved (Zerol 200TD)**
- **Oil of choice for retrofitting with R401a, R401b, R402a, R402b and R123.**
- **Excellent "clean-up" and replacement oil in burn-outs.**



Description

Zerol Refrigeration Oil is a high-quality, premium synthetic alkylbenzene refrigeration oil. It is similar in many ways to natural mineral oils but has superior properties that make it particularly valuable in refrigeration, air-conditioning applications. It is available in three grades: Zerol 150 (150 SUS), Zerol 200TD (200 SUS) and Zerol 300 (300 SUS).

Zerol 200TD is a unique formulation of the alkylbenzene in that it contains a special additive package. This package includes an extreme pressure or EP lubricity additive as well as an additive that provides controlled foaming in specific operating conditions. It is preferred by Copeland for field service applications with the HCFC-based service blends.

Features

Zerol Refrigeration Oil is recommended for use with all CFC and HCFC refrigerants as well as with hydrocarbons and ammonia in all refrigeration and air conditioning applications. It has the following distinct features:

- Solvency
- High Miscibility
- Low foaming
- Excellent Thermal Stability
- Low Floc Point Quality
- Excellent Compatibility

Solvency. As a synthetic alkylbenzene, Zerol has excellent solvency. and because of this solvency, it has the ability to emulsify and clean up mineral oil deposits as well as carbonized oil stemming from a moderate burn-out. As a result, Zerol is an excellent lubricant to use as the first or initial flush oil in HFC-retrofits (see Zerol flush) as well as the flush and replacement oil in burn-outs where naphthenic mineral oils were used. Such burn-outs result in a considerable amount of acid by-products and carbonized or burnt oil, and Zerol emulsifies this matter, enhancing the clean-up.

High Miscibility. The primary reason for improved CFC and HCFC system performance with Zerol is its excellent miscibility with fluorinated refrigerants like R-22 and R-502. Miscibility can be described as the ability of the refrigerant and lubricant to stay together as one homogeneous solution. Zerol has excellent miscibility with these refrigerants; the result is that the oil and the refrigerant will remain as one mixture at wide ranges in temperature and pressure. This is particularly true between Zerol and R-22, explaining why Zerol is the recommended lubricant for retrofitting with the HCFC service blends as they contain a significant amount of R-22.

Low Foaming. The low-foam quality of Zerol, due to its high purity, helps eliminate explosive carry over at start-up, a potentially damaging situation caused by foaming and the subsequent oil loss from the crankcase. In the laboratory, Zerol has given outstanding performance vs. competitive oils in compressor foam-out tests. Practical application demonstrates this same low foaming tendency.

In certain specific applications or where it is recommended by the equipment manufacturer, enhanced or controlled foaming can be achieved through the use of Zerol 200TD.

Excellent Thermal Stability. Zerol enhances the life of refrigeration systems by providing better thermal stability in the presence of refrigerants. Laboratory tests and field experience show that Zerol resists change under high temperatures, thus eliminating problems with sludge, acids, and copper plating. A good indicator of a lubricant's stability is the sealed tube or Elsey test.

Low Floc Quality. Because it is synthetic and is highly pure, it contains no paraffin or wax, a substance in mineral oil that normally causes flocking or the formation of waxy deposits that can plug up a system. Strict quality controls from manufacturing through shipping ensure that Zerol maintains its high purity, allowing better efficiency at low temperatures, well below -100°F.

Excellent Compatibility. Converting refrigeration and air conditioning systems to Zerol is easily achieved due to its excellent compatibility. Zerol can be blended with conventional oils, is inert toward motor insulation, has UL approval for use in hermetic systems, and is compatible with most elastomers and additives often used to improve lubricity such as tricresyl phosphate (TCP).

Packaging

All Zerol formulations are packaged in 1 gallon bottles (6 per case) and 55 gallon drums. Note that 5 gallon pails are available upon special request.

Handling

Contamination problems are extremely critical in refining and handling refrigeration oils. Great care is used to insure that Zerol Refrigeration Oil is free of moisture and non-condensables such as air. The same degree of care must be used by the service professional to make certain that the oil remains clean and dry.

Here are some rules for handling refrigeration oil:

1. Use clean tools – Pumps, funnels, tubing, etc. – while working with the oil.
2. Recap the bottle immediately after use. Refrigeration oil in an open bottle will absorb moisture.
3. Keep refrigeration oil in its original container. If you must pour oil into another container, be sure that the container is clean and dry.
4. Properly dispose of oil that you think dirt or moisture has contaminated. Don't risk using it. It is much less expensive to replace a bottle or refrigeration oil than to repair or replace a compressor.

Read and understand the product's label and Safety Data Sheet ("SDS") for precautionary and first aid information.

The SDS is available on the Nu-Calgon website at www.nucalgon.com.

PRODUCT SPECIFICATIONS

Properties	Test Method	ZEROL 150 Specifications	ZEROL 300 Specifications	ZEROL 200TD* Specifications
Viscosity, SUS, 100˚F	ASTM D445, D2161	140-160	290-310	200-210
Color Gardner	ASTM D1544, D1500	2.0 Max.	4.0 Max.	1.0 Max.
Pour Point, ˚F	ASTM D97	-35 Max.	-30 Max.	-30 Max.
Floc Point, ˚F	ASHRAE 86	< - 100	< -80	-60 Max.
Gravity, API	ASTM D287	29.5-31.5	29.5-31.5	29.5-31.5
Acid No. mg KOH / gram	ASTM D664, D974	Nil	Nil	Nil
Dielectric Strength, KV	ASTM D877	>25	>25	30 Min.
Flash Point, ˚F	ASTM D92	310 Min.	310 Min.	310 Min.
Stability, % R22 in 14 days	Elsey Test, 14 Days at 175˚C	0.2 Max.	0.2 Max.	0.2 Max.
Specific Gravity, @ 60˚F	ASTM D1298			
Refractive Index		1.4865	1.4841	1.4857

PRODUCT CODE NUMBERS

Package	ZEROL 150	ZEROL 300	ZEROL 200TD*
6 x 1 gallon case	4310-07 (43101)	4311-07 (43111)	4308-07 (43080)
55-gallon drum	4310-01 (43108)	4311-01 (43118)	4308-01 (43088)

***USDA Approved**

Applications

Because of its unique solvency and miscibility properties, Zerol is particularly useful in several specific applications. In burnouts, the solvency of Zerol enables it to be used to clean up the by-products and burnt oil while its exceptional miscibility with R-22 and R-502 makes it the oil of choice with these two refrigerants, especially R-22 low temp applications. And this exceptional miscibility with R-22 is also why Zerol is recommended for use in retrofitting with the HCFC service blends as they are based on R-22.

Recommended for Burn-outs

In systems utilizing mineral oils where a moderate burn-out has occurred, Zerol can be used to flush and clean up the system. Zerol will emulsify the acid by-products, burnt oil and wax that result from such burn-outs, and allow the system to be flushed clean.

Use the following general procedure:

1. Remove burned-out compressor and disconnect electrical leads.
2. Remove expansion valve (or cap tube) and install by-passes.
3. Replace suction and liquid line filter driers.
4. Use connections where burned compressor was located, and push Zerol 150 through the system with a positive displacement pump. Use a volume of Zerol 150 equal to three times the amount (weight) of refrigerant typically charged into the system. Although the system may possibly operate on Zerol 150, Zerol 300 or Zerol 200TD, we recommend the use of 150 for the flushing as it is a lighter cut oil and will therefore perform the task more effectively.
5. Circulate for 2-4 hours, change filters often. Then remove Zerol cleaning solution from system.
6. Blow nitrogen through system.
7. Install new compressor as well as other removed components and triple evacuate the system; conduct leak check.
8. Operate the system with fresh refrigerant and Zerol of the proper viscosity (150, 200TD or 300).
9. Check system. If oil discolors, replace oil and filter-driers.

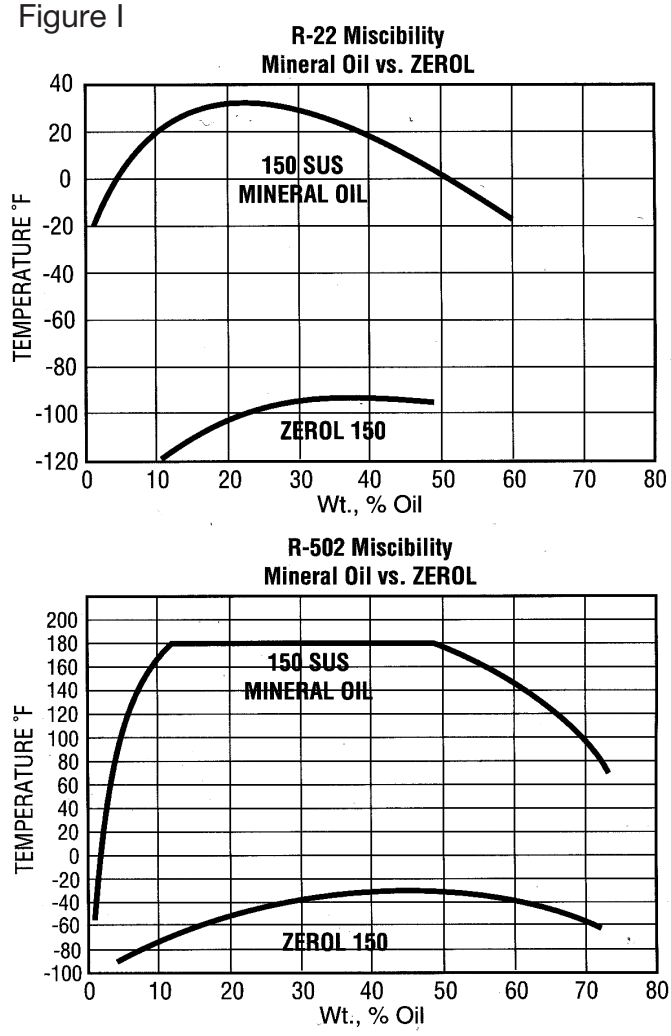
Recommended for Existing R-22 & R-502 Systems

If refrigerants and their oils are not fully miscible at all operating temperatures and pressures, as is the case with mineral oil and R-22 & R-502, they can separate into liquid layers. This results in poor oil return as well as poor heat transfer as the oil logs in the evaporator, an area with the system's lowest temperature. In turn, the poor oil return can result in subsequent lubricity problems.

In addition, refrigerant migration to the compressor during shut down can result in the formation of two layers, with the lighter mineral oil layer on top; this is particularly true with R-502 and mineral oil. At start-up, the heavier refrigerant-rich layer will be lubricating some moving parts, and that is not a good idea. In flooded evaporators, where an oil-rich layer forms on top of the refrigerant, all these problems are magnified.

Of particular concern is the use of mineral oil and R-22 in low temperature applications. At the lower operating temperatures in the evaporator, the immiscibility between the R-22 and the mineral oil can become a significant problem. As you can see in Figure I, even the best naphthenic mineral oil will separate out at about 30°F, where the oil/refrigerant ratio is approximately 20%/80%. Zerol 150, however, will not form two phases until -105°F at the same 20%/80% oil/refrigerant ratio. Similar disparities between these oils when used with R-502 can be seen in the second chart.

Figure I



Recommended for Retrofitting with HCFC Service Blends

Because of its exceptional history in working with R-22, due primarily to its excellent miscibility with this refrigerant, Zerol has been identified by compressor and equipment manufacturers as the oil of choice in retrofitting to the interim HCFC-based service blends such as:

R-401a	R-402a	R-408a
R-401b	R-402b	R-409a

The reason for this is simple: these interim refrigerants are blends, and R-22 is a significant component in each of them. It is understood that good refrigerant/lubricant miscibility is one of the performance characteristics that must be maintained as a system is retrofitted from R-12 or R-502 to one of these blends, and the use of Zerol accomplishes this performance level.

Use with HCFC blends… Continued

Within the last several years, thousands of systems have been retrofitted with Zerol and the HCFC interim blends. Here is a simplified version of the procedure:

1. Establish and obtain all data pertinent to the systems operation.
2. Evacuate the CFC refrigerant, and recover it appropriately.
3. Remove the mineral oil. In systems with small hermetic compressors, use the Nu-Calgon CanVerter® or similar pump, or drain from the suction line. Utmost care must be exercised to insure that all or nearly all of the mineral oil is removed, particularly in larger systems where components like separators are in use.
4. If compressor was removed in the oil draining process, reinstall it.
5. Measure the volume of mineral oil removed and compare with the systems specification fill to judge how much has been removed. Replace it with a like volume of Zerol of the proper viscosity (ie. Copeland recommends Zerol 200TD).
6. Replace filter drier. Typically for loose filled driers, the XH-9 molecular sieve desiccant or equivalent is recommended. Compacted bead driers may use the XH-9 or XH-6 desiccant or equivalent.
7. Reconnect system and evacuate. Check for leaks.
8. Charge system with appropriate amount of the HCFC service blend refrigerant.
9. Mark system as to refrigerant and lubricant in use. Make appropriate system adjustments.
10. Observe operation. Zerol will tend to clean up old mineral oil deposits, and this matter will be trapped by the drier. Change driers as needed. If the oil loads up with carbon deposits and other matter, this indicates that the system had experienced rather severe depositing of mineral oil over time, and the Zerol should be replaced.

Zerol Flush. As the sir conditioning, refrigeration industry continues to move to the increased use of long-term HFC refrigerants, it will be necessary to utilize polyol ester or POE lubricants. These lubricants have been found to provide long term performance advantages with HFC refrigerants. And as existing equipment or systems in the field are retrofitted to these new HFC refrigerants, it will actually be necessary to drain (flush) the system 3-5 times with polyol ester in order to reduce the residual level of the previously used mineral oil to 5% or less. The concern here is once again miscibility as the HFC and mineral oil are not miscible together.

This POE flushing procedure has been successfully accomplished thousands of times in the field. The results are predictable, and the mineral oil residual is effectively reduced to the desired level. Perhaps the only drawback to the procedure is that 2-4 flushes of comparatively more expensive POE oil must be used and discarded.

An attractive and proven alternative is the Zerol Flush, a procedure that involves the use of Zerol alkylbenzene lubricant in place of the polyol ester lubricant for the first 1 or 2 oil flushes, followed by 1 or 2 POE flushes. Because Zerol's solvency is similar to the POE, it does an equally effective job of emulsifying mineral oil and cleaning up existing mineral oil deposits. More importantly, it provides for two distinct cost savings:

First, because Zerol is generally one-third the cost of the POE, using it in the first 1 or 2 flushes will result in immediate savings. It also provides the added benefit of being easier to handle since it is not susceptible to moisture contamination like POE's are. This, too, will save money by saving time.

Secondly, because it has been shown that HFC/POE systems can tolerate twice as much residual alkylbenzene as residual mineral oil (see Figure II), it may be possible to eliminate one of the subsequent POE flushes if the system is initially flushed with Zerol.

Figure II: The effect on HFC/POE miscibility of residual mineral oil (5%) vs. residual Zerol (10%)

Temperature	5% MO/ 95% POE	5% Zerol/ 95% POE
35ºF	Homogeneous Mixture	Homogeneous Mixture
4ºF	Cloudy, with Oil-Rich Layer	Cloudy, Homog. Mixture
-40ºF	More Cloudy, Oil Layer Near Solid	More Cloudy, Oil Rich Layer

Tests were conducted with HFC-404a at a ratio of 20% Lubricant and 80% Refrigerant

As you can see in Figure II, we have mixed two equal samples of R-404a with lubricant mixtures, one being 5%/95% Mineral/POE and the other 10%/90% Zerol/POE. At 35ºF, both lubricant mixture/refrigerant samples exhibit good miscibility by remaining as homogeneous mixtures. However, at 4ºF the sample with 5% mineral oil has turned cloudy and formed an oil-rich layer while the sample with 10% Zerol has only turned cloudy but exhibited no miscibility problems. At -40ºF, the oil layer in the 5% mineral oil sample has turned solid while the 10% Zerol sample is only beginning to form an oil rich layer. Simply stated, this shows that twice the residual of Zerol exhibits even less miscibility problems than residual mineral oil.

Here is how to use the Zerol Flush in converting from a CFC to the long term HFC refrigerant:

1. Obtain pertinent system operational data.
2. Drain existing oil and replace with an equal volume of Zerol of the proper viscosity.
3. Operate system for at least 48 hours with CFC in it.
4. Drain lubricant and either repeat steps 2 and 3 one more time, or replace with an equal volume of POE.
5. Repeat steps 3 and 4 using POE until mineral oil residual is below 5% when tested. Use the Number 4815-0 Refractometer for testing.
6. Charge with new HFC refrigerant and label the system.
7. Be sure to change filter driers at appropriate times during the process.