



## SERVICE BULLETIN

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**Title:** Synthetic Oil Applications  
**Models Affected:** All 17, 19, 23 Series

**Number:** C9630  
**Date:** 8/26/96  
**Supersedes:**  
**Date:**

**Purpose:**

To provide the field with the correct synthetic oil application information for all centrifugal and screw chillers.

**File:** Compressor

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## **Background:**

The industry wide change in standard refrigerants and the incompatibility of the existing refrigeration oils with the new chlorine-free refrigerants created a need for new oils that could work with the new refrigerants. This bulletin provides technical background for understanding the need for these new oils and also a specific listing of oil selection by machine and refrigerant.

If a chiller was built for a CFC refrigerant (11 12 113 114 500) and is still operating with that refrigerant, this bulletin does not apply. If the machine has been reselected to use an HCFC or HFC then this bulletin will provide information on the correct oil.

There have been no changes to our oil recommendations within the last 2 years so you will not find any surprises if you have been using the oil recommendations that have been sent out via COIN from Service Engineering.

## Technical Background:

Mineral Oils are those oils produced by mixing naturally occurring hydrocarbons that are separated in the petroleum refining process. Synthetic oils are lubricants that are produced by chemical process (polymerization, catalysis, etc.) from chemical feed stocks such as benzene, esters, glycols, etc.

Mineral oils have been fairly well standardized and "or equal" substitutions can generally be made. Synthetic oils even though made for the same purpose have very different characteristics from one vendor to another. Therefore an oil cannot be assumed to be adequate unless Carrier Product Engineering has tested it in a specific product. If a vendor states that his oil is Carrier approved, it may well be but not necessarily for the compressor into which you are planning to put it.

Why do we use synthetic oils? They have characteristics that we find desirable that cannot be readily produced in mineral oils and are, in some cases, the only choice because mineral oils are not compatible with new refrigerants.

## Some types of synthetic oils:

### **PAG - poly alkylene glycols**

Widely used in the automotive industry. They are inexpensive but these are the oils that gained the synthetics the reputation for being extremely hygroscopic. They soak up moisture like a sponge then proceed to break down into acids. PAG oils also break down in the presence of chlorinated refrigerants.

We do not use them.

### **Alkylbenzenes**

Originally developed by Chevron and marketed by DuPont as "Zephron" oils. These were developed to meet specifications outlined by Carrier and were an excellent but expensive replacement for mineral oils with the traditional refrigerants and can also be used with 123.

This oil is now marketed as "Zerol" by Schreive Chemical.

Zerol 300 (PP49-8) or Zerol 150 (PP47-8) can be used in any R-11, 12, 22, 123 or 500 application requiring that viscosity.

Zerol 400 (PP49-7) is used with R-22 in the 17FA external gear compressor and with R-22 in the 19XL.

With R-22 Alkylbenzene has better miscibility than POE at low temperatures.

## **POE - Polyolester oils**

These are the oils used in R134a applications and can also be used with R-22 and the other traditional refrigerants. They should not be directly substituted for a mineral oil, however because they absorb certain refrigerants, notably R-12 and R-22, to such a degree that they lose too much of their viscosity. A higher viscosity POE may have to be used to replace a mineral oil.

The viscosity degradation just described is why we no longer recommend changing the oil before changing the refrigerant on refrigerant retrofits. You risk thrust failures, especially on industrial jobs where an upset can momentarily overload the thrust bearing.

POE oil molecules can be created two ways. One is to create branched chain esters which offer better miscibility or straight chain esters which offer better lubricity. Optimizing both lubricity and miscibility is difficult because increasing one automatically decreases the other.

Selection of the proper oil for an application depends on the needs of the particular machine. For instance, a hermetic needs miscibility because the oil circulates from the compressor to the condenser and cooler and back. If the oil is not miscible it stays in the cooler once it gets there. In a 17 series industrial application the oil does not circulate. It either stays in the compressor or it is "permanently" lost. High miscibility is not that important but high lubricity is important because of the possibility of thrust overloading.

Miscibility is important with high performance cooler tubes. If oil gets into the porous tube surface it will not be washed out if it is not miscible in the refrigerant. In other words, it's like washing grease off your hands with plain water. It won't cut it.

Properties of oils can be and are improved by additives. This is a mixed blessing because additives can separate out. This can be seen as a varnish in the transmissions of compressors where high pressure anti-wear additives have deposited. This causes problems if the high pressure additive plates out on contact seal surfaces.

In the external gear version of the 17FA we have a vendor supplied seal which utilizes all non-rotating parts except for the shaft ring. The carbon does not float as in the Carrier designed seals. This in combination with the high shaft speed produced a seal surface temperature that cause the high speed additive from Castrol SW68 (PP47-31) to plate out on the seal surface. This is why we do not use Castrol SW68 in that particular model compressor. ICI Emkarate RL68H (PP47-12) was substituted. Castrol has since qualified SW68C under PP47-26.

Please also realize that there are applications in which we desire and require that same anti-wear additive, such as in compressors with internal gears.

Note that some mineral oils such as PP49-5 (Mobil DTE26, Texaco Rando HD-68 & others) also contain anti-wear additives for the same reasons.

## **What is an OIL Specification?**

An oil specification is a listing of characteristics that an oil must have to meet the requirements of a specific duty. Oils are then selected for use that meet the specification.

The following is a list of Carrier chillers and the oil specifications that meet the requirements of those chillers with specific refrigerants. This list is followed by a listing of the synthetic oil specifications and the oils that meet them.

## Synthetic Oil Applications

- \* indicates that this is an application where a mineral oil may also be used.
- \* R-11, 12, 22, 113, 114 & 500 hermetic & open drive chillers (not 17DA PP49-8)
  - 17FA with external gear & HCFC-22 . . . . .PP49-7
  - 17FA with external gear & HFC-134a. . . . .PP47-12, PP47-26
  - 17FA with internal gear & HFC-134a . . . . .PP47-31
  - 19EA, EB, FA with HFC-134a . . . . .PP47-31
  - 19XL with HFC-134a. . . . .PP47-31
  - 19XL with HCFC-22 . . . . .PP49-7
  - 19XR/XRT with HFC-134a . . . . .PP47-31
  - 19XT with HFC-134a. . . . .PP47-31
- \* 17MPS with HCFC-22. . . . .PP49-8
  - 17MPS with HFC-134a . . . . .PP47-12, PP47-26
- \* 17DA & 17EA with CFC-12, CFC-500. . . . .PP47-8
- \* 17DA & 17EA with HCFC-22 . . . . .PP47-8
  - 17DA & 17EA with HFC-134a. . . . .PP47-11, PP47-25
  - 17/19EX with HFC-134a. . . . .PP47-31
  - 23XL with HCFC-22 or HFC-134a . . . . .PP47-32

## Oil Specifications

Spec #. Description

RCD P/N (if available)

Oils tested that meet spec.

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PP47-8 Alkylbenzene ISO32, 150SSU  
Zerol 150A

PP47-11 POE ISO32, 150SSU High Stability  
PP23BZ106-001 1 gal.  
PP23BZ106-005 5 gal.  
PP23BZ106-055 55 gal.  
ICI Emkarate RL32H

PP47-12 POE ISO68, 300SSU High Stability  
PP23BZ107-001 1 gal.  
PP23BZ107-005 5 gal.  
PP23BZ107-055 55 gal.  
Totaline P903-1301 10 ounces (for Totalclaim/Save w/HFC-134a)  
ICI Emkarate RL68H

PP47-25 POE ISO32, 150SSU No anti-wear additive  
Castrol Icematic SW32C  
ICI Emkarate RL32H  
Mobil EAL Arctic 32

PP47-26 POE ISO68, 300SSU No anti-wear additive  
PP23BZ108-001 1 gal.  
PP23BZ108-005 5 gal.  
PP23BZ108-055 55 gal.  
Castrol Icematic SW68Csw  
Mobil EAL Artic 68

PP47-30 POE ISO32, 150SSU Contains anti-wear additive  
PP23BZ102-001 1 gal.  
PP23BZ102-005 5 gal.  
PP23BZ102-055 55 gal.  
Totaline P903-1101 1 gallon  
P903-1105 5 gallons  
P903-1125 1 quart  
Castrol Icematic SW32

PP47-31 POE ISO68, 300SSU Contains anti-wear additive

PP23BZ103-001 (1 gal.)

PP23BZ103-005 (5 gal.)

PP23BZ103-055 (55 gal.)

Totaline P903-1001 1 gallon

P903-1005 5 gallons

P903-1025 1 quart

Castrol Icematic SW68

ICI Emkarate RL68HP

PP47-32 POE ISO220,1000SSU

PP23BZ104-001 (1 gal)

PP23BZ104-005 (5 gal)

PP23BZ104-055 (55 gal)

Totaline PP903-1201 1 gallon

PP903-1205 5 gallons

PP903-1225 1 quart

Castrol Icematic SW220

PP49-7 Alkylbenzene ISO86, 400SSU

PP23BZ101-001 (1 gal.)

PP23BZ101-005 (5 gal.)

PP23BZ101-055 (55 gal.)

Schriever Zerol 400CA

PP49-8 Alkylbenzene ISO68, 300SSU

PP23BZ105-001 (1 gal.)

PP23BZ105-005 (5 gal.)

PP23BZ105-055 (55 gal.)

Schriever Zerol 300A