

## POE oil

A new filter drier will pull the moisture out of the POE very quickly (usually less than an hour of operation).

Vacuum will pull the moisture out of the POE, but it will take days if not weeks of constant vacuum and breaking with dry nitrogen cycles. It's much quicker and easier to remove the moisture with a new filter drier.

Rob Yost  
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**RobY: In reference to your statement that a dryer will pull the moisture out of POE oil very quickly. Do you have any reference literature to explain this. And to what quantities. And how do you size a drier so you know it is all removed? This is very interesting. I was taught by Lennox reps that once POE gets saturated with moisture that the best thing is for it to come out, then replace it with new. Where can I read about this? Thank you.**

The statement was based on work I had done at a previous employer where we dosed a R-134a / POE system with water until it was at over 1000 ppm of moisture. We then valved in a fresh liquid line filter drier and took samples every few minutes until the moisture concentration stabilized. It took an hour for most of the moisture to be removed (over 90% of the dose), and within four hours the moisture concentration had stopped changing. I know at one point this was presented to the OEM engineers, but I don't know if it was ever put into a technical bulletin for the aftermarket.

A rough rule of thumb you may want to use is as follows:

If the HFC refrigerant and POE oil are almost saturated with moisture they will contain about 1000 ppm of moisture. That means for every ounce of wet refrigerant or oil, it will contain about 1/2 drop of water. You want to choose a dryer with 1/2 the capacity in water drops at 125 degrees F as the number of ounces of wet refrigerant and oil in the system.

For example, if the system has 48 ounces of wet POE and 5 pounds (80 ounces) of wet refrigerant, then you have 128 ounces of total wet refrigerant and oil. You would need a drier with at least 64 drops of water capacity at 125 degrees F to bring the moisture in the system down to 50 ppm or less, where the POE will be very stable.

At the end of the drying process, the filter drier would be used up and would not be able to handle any more moisture that enters the system. If you want to have a reserve in the drier to safeguard the system, go bigger than the 1/2 factor, or change the first drier after a couple of days.

Rob Yost  
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**I think Dupont needs to work on an moisture resistant oil a good POE replacment if the stuff is that bad.**

First, DuPont is not an oil company, don't look to them for new refrigeration lubricants.

Second, POE is not as bad as some are saying. You have to make sure you don't do something stupid when working with POE, but if you do things right it works very well. Don't let the system get wet and then run it with high condensing temperatures is a good rule of thumb. That combination is not too wonderful with R-22 and mineral oil either, and a dead compressor will be the likely result.

There are lubricants that aren't POE that are stable around moisture that can be used with the HFC refrigerants. They are not used for some vwry good reasons. PAG lubricant is used in automotive systems with R-134a, is very stable around moisture, but is a real bad idea in stationary systems. The PAG holds even more moisture than the POE, and the moisture it holds can then react with the slot lining insulation in the hermetic electric motor - causing all the slot lining insulation to end up as powder in the bottom of the compressor shell. Not a good thing for the life of the motor.

PVE (polyvinylether) has been looked at as well, is stable around moisture, but has not been as good of a lubricant as POE. The Japanese are fond of it in rotary compressors where POE does have problems with lubrication at the vane tip.

You can make a more moisture stable POE by choosing different raw materials to make the POE from, but it isn't as good at lubrication and is not as thermally stable as the ones used today. Trading better moisture stability for shorter compressor life is not a popular choice with compressor manufacturers that have 10 year warranties.

If there was a better overall lubricant than POE for use in R-410A systems, every single compressor manufacturer and system OEM would be using it. POE bashing is easy, it's just not so easy to find something better.

Rob Yost  
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This is Turtle.

Your filter may pull it out but POE / Ester / anti-freeze is designed to not boil at very high or very low temps. and vacuuming the system is useless. To get the water to boil out of the anti-freeze it will be equal to 250 degree to get the water to try to boil out of the mix of anti-freeze and water. A lot of race cars will run the cooling system water at 220 degree and never boil out or over. The last time i checked water boils at 212 degree F and it don't let go of the water or moisture at even 220 degree f cooling system Mix of water and Anti-freeze.

You better have a Damn good drier to pull this moisture out of the ester for it knows how to hold on to moisture or water.

Turtle, the POE isn't a magical moisture holding material. It gives the water back if something else wants it more. Filter driers have a **LOT** more affinity for the moisture than the POE. POE can be dried if it gets wet - it just can't be easily dehydrated by using a vacuum pump.

The antifreeze comparison is not a good one. The boiling point of water under pressure mixed with glycol in a radiator is not the same thing as the boiling point of water dissolved in oil in a HVAC system under vacuum. Apples and oranges.

The only decision you need to think about if it is easier / quicker / less expensive to change the POE to carry the water out of the system, or to instead change the drier after it has been loaded up with moisture. With a small hermetic compressor where an oil change is almost impossible, then changing the drier is easier and quicker. In a compressor with an oil drain, changing the POE may be easier and quicker.

I know this is impractical in a system, but I used to dry POE at room temperature by bubbling dry nitrogen through it. I could take the water from 500 ppm to 20 ppm in about 6 hours. The POE gave the water up to the nitrogen, and the nitrogen carried the water out of the container into the air. Speaking as a former rocket scientist, this ain't rocket science.

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once the oil is contaminated with moisture it is acidic. mean while you are damaging your compressor during your clean up process. in order for your oil to go through the filter drier it has to leave the compressor. on system with oil separator most of the oil will not go through the filters any time soon. on small systems it is not as bad. the damage is you may get a few years less on the machine. which you will not be able to measure. but then again it is back to how much is one willing to spend to save a 300.00 pot compressor or a 30,000.00 compressor.

The POE will not turn acidic or form metallic salts unless it is overheated in the presence of moisture. A system left open while not running won't overheat.

The moisture will rapidly leave the compressor shell even if the compressor doesn't pump much oil. The refrigerant is the vehicle that carries the moisture from the POE in the compressor to the filter drier where it will be removed. I dry POE all the time by bubbling dry nitrogen through it - you can't remove it very quickly by vacuum, but if you have a dry carrier gas to take the water away, POE will readily give up the moisture it has absorbed.

In one hour of operation with a fresh drier, I would expect more than half of the moisture to be removed. Within 24 hours, over 90 percent of the moisture should be caught in the drier (assuming the drier has enough capacity to hold the amount of moisture in the system). This is based on work where water was added to a small hermetic compressor and circulated until it reached equilibrium, then a liquid line drier was switched into the loop to catch the moisture.

Dash, I don't think you have a major problem as long as you changed the drier. Your drier won't have any reserve capacity to handle another moisture spike, so it would be a good idea to change the drier after you get the system dried out.

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You are another example of how the overblown fears of POE may not always be real. Yes, POE will absorb moisture from the atmosphere, but in real systems it may not be as rapid as some think (even in Florida). It takes a long time for moisture to migrate through the very small openings in a typical open system into the POE to load it up with a lot of water.

It's always good practice to keep any system sealed up, but POEs are not a disaster waiting to happen if the system is left open for an hour. Of course, if some people think an hour is OK, then two hours is probably OK, then 2 days may still be OK, so why not leave it open for 2 months and who needs to worry about putting in a new drier anyway.

The ten days you were planning before coming back is more than enough time to get the water out. The least amount of time I would give it is 48 hours, that makes sure the clean-up drier has had time to do its thing so the next drier going into the system will have as much of its available capacity as possible.

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Can you tell us how much moisture POE oil can absorb per ounce/quart ??

The POE will saturate with moisture at about 1000-1500 ppm by weight when exposed to high humidity air. The final moisture level in the POE depends on the dew point of the air.

This means that every pound of POE can hold a maximum of 1,500 / 1,000,000 pounds of moisture, or 0.0015 pounds of moisture. In grams that is 0.68 grams of water per pound of refrigerant. Each drop of moisture weighs 0.05 grams, so a pound of POE can hold about 14 drops of moisture. POE weighs about 8 pounds per gallon, so each gallon of POE can hold about 110 drops of moisture. Each ounce of POE can hold 110/128 drops, or just under one drop per ounce.

That should let you size the drier appropriately. Even a small drier has the capacity to dry a reasonable amount of POE.

I have used commercial filter driers to dry pure POE during charging of systems, and a single pass through the driers knocked down the moisture concentration in half. A four core molecular sieve drier (Z48 at the time) would dry over 1000 gallons of POE from 50 ppm down to 25 ppm moisture as it went from the oil tank to the charging board. The customer loved the bastardized compressed air driven diaphragm pump oil drying rig we built them.

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Related question Rob--I have a system with a new POE condensing unit attached to a used R22 (i.e. mineral oil) evaporator. Before hooking up to the old evaporator, I blew it out as best I could with dry nitrogen. I still suspect there is some mineral oil left in the system. What happens when POE & mineral oil mix (assuming the mineral oil content is much less than the POE content)?

Thanks for your above posts by the way!!

The POE will carry a lot of mineral oil around the system. You won't get a pure mineral oil phase ever when POE is around. You can get a mineral oil rich liquid phase in the evaporator that is higher viscosity than the POE rich phase (because the HFC refrigerant isn't as soluble in the mineral oil rich phase), and won't return as well as pure POE.

The ability of mineral oil to return in a DX system depends on the temperature (how thick the mineral oil rich phase gets) and the velocity of the vapor in the back end of the evaporator and the suction line. Air conditioning is the best case, and refrigeration is the worst case for returning residual mineral oil.

Even in the worst case refrigeration system, 5% mineral oil is certain to circulate well. In A/C, you may be able to get over 50% mineral oil to circulate well, but I haven't seen a whole lot of testing at that level of mineral oil to confirm exactly what happens. With the R-422 series refrigerants, you can circulate 100% mineral oil OK because of the viscosity thinning of the oil with the hydrocarbon component of the refrigerant. If you want to avoid the creation of a mineral oil rich liquid phase in a receiver or condenser, then adding 15% POE to the oil will keep the refrigerant and oil mixed together in the high side liquid.

It is still a very good idea to get the mineral oil level as low as possible when retrofitting to HFC refrigerants just in case something bad happens with the suction gas velocity.

One more word of warning before someone gets in trouble:

Mineral refrigeration oil is highly refined and has very low wax content. If someone were to put some other mineral oil material into an HFC based system that had normal levels of wax, the system would plug up very quickly (within 24 hours). This is why some trainers emphasize removal of all mineral oil from the system, just in case there are some wax containing materials in the system. Removing the mineral oil removes the waxes as well. Flushing also helps remove any wax like materials.

The hydrocarbon components of R-422 etc. also do a good job of preventing any wax in the system from turning solid and forming plugs.

If you have only clean refrigeration grade mineral oil in the system, there can't be much wax to worry about. Most times you have clean systems when doing retrofits, but once in a while a system is a mess. If the system plugs from wax, then changing the oil another time will normally remove enough wax to prevent future plugs.

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