Protect your investment:

Five factors to consider before making the switch to aftermarket oil

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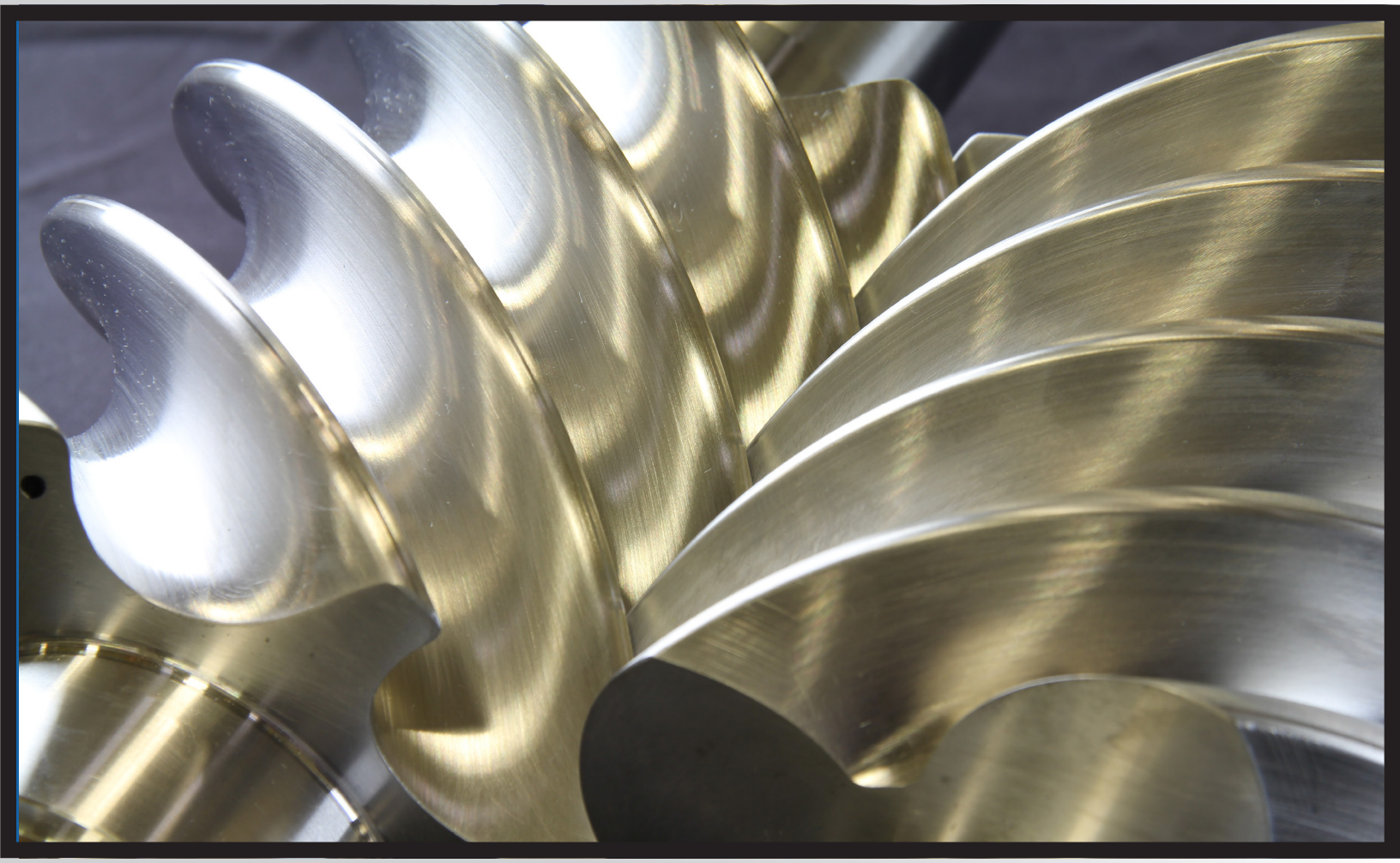
This white paper explores five factors to consider before making the switch from original equipment manufacturer oil to aftermarket oil.



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PROTECT YOUR INVESTMENT: FIVE FACTORS TO CONSIDER BEFORE MAKING THE SWITCH TO AFTERMARKET OIL

First, modern compressors have advanced well beyond those of previous generations and are today designed to achieve increasingly impressive levels of efficiency and longevity. These improvements, however, put greater demands on compressor oil to protect equipment against excessive wear and harsh operating conditions.

Second, the recent introduction of new refrigerant gasses adds a layer of complexity to the process of selecting the most compatible, reliable, high-performing compressor oil for any given piece of equipment or operating condition.

These two issues combine to create a challenge for today's contractors, and facility and operations teams who are responsible for protecting the investments they've made in chillers. Oil formulation is more critical than ever to maintaining uptime, productivity and equipment life, and aftermarket oil may not be up to the task.

This white paper explores five factors to consider before making the switch from OEM to aftermarket oil.

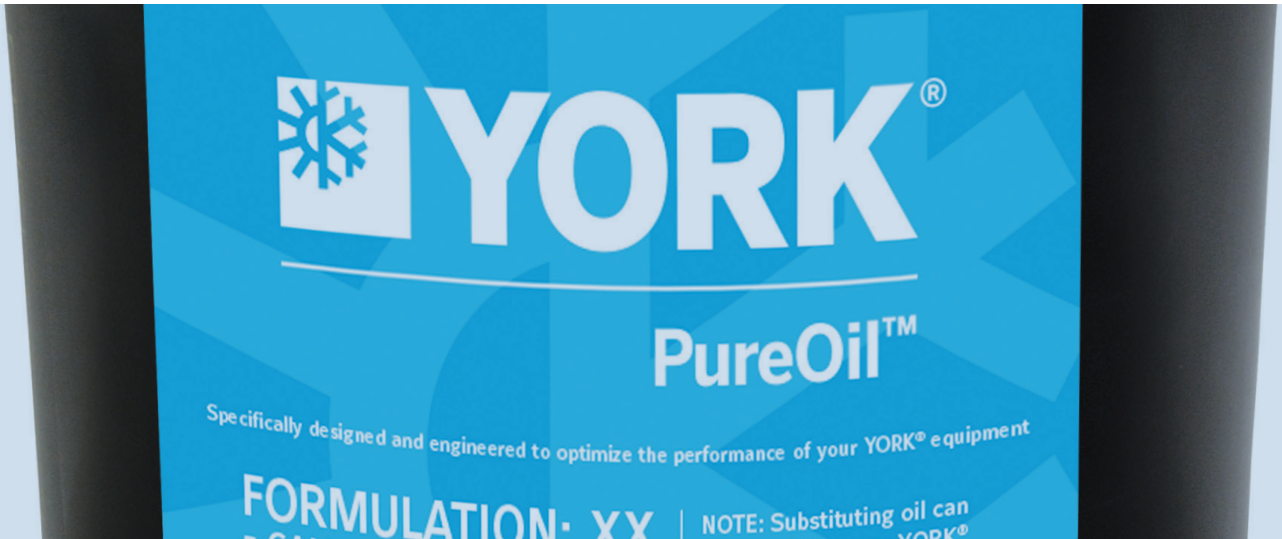
Consideration 1: It's not as simple as putting substitute oil in your car.

Some car and truck owners wouldn't think twice about switching from a manufacturer's 'genuine' motor oil to a comparable, often less expensive, aftermarket oil – especially after the warranty period has ended. But there's a big difference between substituting motor oil in an automobile engine and substituting compressor oil in a chiller.

Automobile manufacturers routinely test their engines with a number of different third-party oils and, based on those tests (and a rating system established by the Society of Automotive Engineers), may approve a handful of brands for recommended use. In those cases, the vehicle owner can choose from a number of options and feel confident that the oil will perform as expected.

There are no standardized formulations, industry-approved rating systems or established best practices for third-party testing of oils used in refrigeration compressors. In fact, the development and testing of compressor oil is today more specialized and complex than it has ever been. As compressors become increasingly sophisticated and refrigerant chemistries continue to evolve, oil formulations are being engineered for each type of individual equipment to ensure the best compatibility and performance.

One size does not fit all.



Consideration 2: The industry landscape has changed.

In recent years, three trends have combined to create increased risk when using aftermarket oil.

NEW REGULATIONS

As Chlorofluorocarbons (CFCs) were phased out, the old rules of thumb about the interactions between refrigerants and oil ceased to apply. Today, lubricant suppliers are taking the lead on researching oil/gas interactions for many of the newer refrigerants, and equipment manufacturers are shouldering the responsibility for validating that research within working chiller systems.

Understandably, OEMs are focused on identifying combinations they know will be compatible with the specific products they build, sell and stand behind. By contrast, not all aftermarket oil manufacturers make their own oil; many buy and resell oil, making recommendations based on cross-reference information that may not necessarily be current or accurate. In addition, aftermarket oil manufacturers typically concentrate on 'wear testing' such as FALEX testing, which does not consider how well the lubricants or additives behave within a specific chiller system.

EQUIPMENT ADVANCES

Over the past two decades, compressor manufacturers have made significant improvements to compressor systems and software in an effort to enhance performance and efficiency. As the technology and design continues to evolve, the role of oil becomes increasingly critical.

For example, modern centrifugal and screw compressors also have much tighter clearances compared to the reciprocating compressors of the past, which means the oil must reliably deliver proper lubrication of compressor components to maintain high efficiency. And while the use of naphthenic mineral oils are, in some cases, still the best choice for some newer refrigerants, the industry has seen an increased use of more complex, engineered synthetic lubricants such as Polyolester (POE), Polyalkylene glycol (PAG) and Poly-alpha-olefin (PAO) oils.

TIGHTER BUDGETS

Because many operations and facilities teams continue to feel capital budget pressure, it's understandable that some would consider substituting aftermarket compressor oil, which can be less expensive. But lower first-costs often come with a higher long-term risk of unplanned system downtime.

The issue is this: Aftermarket manufacturers develop oil for the masses; they can't possibly consider the many characteristics that are specific to any given compressor, application or environment. So while aftermarket oil manufacturers may stand by their oil, they are not likely to stand by a compressor that fails because the oil does not perform correctly with certain system or compressor components.

Consideration 3: Formulating the right oil for the right equipment and application is a complex task.

Original equipment manufacturers put a great deal of effort into making sure oil is formulated to meet the specifications of each type of equipment, and is tested under real-world conditions - both in the lab and in the field. This includes consideration of characteristics such as:

- **Miscibility:** Does the oil mix well with refrigerant? Proper miscibility assures a relatively uniform mixture of refrigerant and oil within the heat exchangers, which allows the oil-return system to function properly.
- **Viscosity:** Viscosity is always affected by two things: the amount of refrigerant that's dissolved in the oil, and the temperature of the oil. Compressor oil that is too viscous may cause compressor bearings to overheat and reduce system efficiency. Compressor oil that is too thin cannot provide enough of an oil film to support the bearing load, and thereby lead to bearing failure. That's why it's beneficial to align oil viscosity (including the effects of temperature and refrigerant dilution) to a specific application.
- **Dilution:** The conditions under which the compressor operates dictate the percentage of refrigerant dissolved in the oil. If a system is designed to handle 10 percent refrigerant in the oil, it may be overwhelmed by oil that is diluted to 20 percent, causing damage to bearings and, potentially, compressor failure.

Based on those characteristics, OEM oil is formulated and then put through extensive, targeted reliability testing. Are the instrumented bearings running at the right temperature? Does the friction horsepower or bearing loss align with what was expected for this compressor at these conditions and for this application? This level of testing gives OEM manufacturers the confidence to stand behind their oil because they fully understand how the oil will behave in the application for which it is being developed.

By contrast, aftermarket oil is developed for a mass market. So while it may be marketed an 'equivalent' to an OEM product, there is no way to guarantee that aftermarket oil will be compatible with any given piece of equipment and under any given set of operating conditions. Bottom line: You won't know what you're getting.

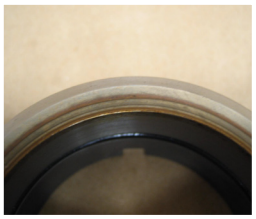
Consideration 4: The risks are significant.

One of the greatest risks of using oil that hasn't been tested in a particular type of equipment or environment is that it can result in unintended, but costly, chemical reactions that shorten compressor life or cause unplanned outages.

CASE IN POINT: The following images illustrate the impact on seal faces tested using OEM oil and aftermarket oil. The OEM oil test (on top) showed virtually no wear after 400 hours. The aftermarket oil (on bottom) resulted in compressor failure.

LAB TEST: OEM Oil

RESULT: No significant wear on the seal face



LAB TEST: Aftermarket Oil

RESULT: Abrasive, dark deposits that led to shaft seal failure and unplanned equipment outage.

Additives were found to be present in the aftermarket oil. Often, these additives are marketed to provide benefits such as preventing oil from oxidizing, reducing friction, preventing wear under high-pressure metal-to-metal contact or improving the efficiency of the compressor. Across the industry, many of these claims go unsubstantiated. But one thing is certain: Unproven additives have the potential to cause catastrophic equipment damage.

Consideration 5: Calculate the true cost.

Because it is specially formulated, OEM compressor oil may cost 50 to 100 percent more than aftermarket oil. But when measured against the potential long-term cost of equipment failure, the up-front cost pales in comparison. If equipment breakdown or failure is linked to the use of aftermarket oil, the compressor manufacturer will likely void the warranty, leaving the end user to absorb the full cost to repair or replace the unit – which can range from thousands to tens of thousands of dollars.

As a hypothetical example, here are the cost considerations in a scenario where Polyolester oils (POE) are used to run a compressor over a 10-year period and where the oil is changed every 2.5 years.

Cost of Oil Changes over 10 years		Potential Cost of a Single incident Caused by Use of incorrect Oil
Oil Change	**Aftermarket Oil**	**Compressor Repair**
Four oil changes at $3,300 per change	**Four oil changes at $1,700 per change**	**The use of incorrect oil can lead to premature failure of critical components such as shaft seals, bearing, gears and other compressor components. Major repairs can run between $20,000 to $75,000, when considering parts and labor.**
$13,200	**$6,800**	

**When using OEM oil, it may not be necessary to change the oil at fixed intervals. The OEM typically works with you to conduct periodic analysis of the compressor oil, and will change it only on an as-needed basis.*

Downtime is also part of the true cost calculation. When an overhaul or new compressor is needed, the chiller may also be offline for weeks or months, which can have a significant impact on production or operations – even if the chiller is one of many units on site.

CONCLUSION

Choosing the right compressor oil for any given piece of equipment and application is a decision that deserves careful consideration. Creating the perfect match between equipment, application and oil composition is both complex and essential. Aftermarket oil, developed for a mass market, may not be up to the task.

Still, some contractors, operations and facility managers continue to be enticed by first-time cost savings offered by the manufacturers of aftermarket oil. And as this paper has shown, it can be a risky decision. Industry professionals must ask themselves, "How much would I be willing to pay for the peace of mind in knowing the investments I've made in refrigeration equipment are protected against damage or catastrophic loss?"

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