Controlling Rust

ExxonMobil
Aviation Lubricants

Tests prove one multi-grade engine oil offers the best protection.

Can one brand of oil really work more effectively than another to combat rust in your aircraft's piston engine? The answer is an unequivocal "absolutely" — and by a huge margin. But to arrive at that conclusion, you need to disregard intuitive myths to examine some hard evidence that has come out of what are called "humidity cabinet" testing protocols.

Here's the myth: Conventional monograde oils — including those used by many aircraft owners — are thicker; therefore, they take longer to drip off idle engine parts than thinner multi-grade oils and consequently leave more oil behind, to provide better protection against rust. Not true!

Here's the fact: Because they typically contain more effective rust inhibitors, multi-grade oils combat rust better, even though they are thinner at ambient temperatures than monograde oils.

Lab Tests and Real-World Performance

As counter-intuitive as this might seem, that's exactly what the humidity cabinet tests commissioned by ExxonMobil prove. In brand-against-brand comparisons, in which Textron Lycoming and Teledyne Continental tappets were soaked in various oils then exposed in a cabinet to 100 percent humidity at 120°F, different oils protected at measurably different rates. As a group, multi-grade oils fared better in preventing rust than did monograde oils, and of the multi-grades, the product that performed best in this testing was Exxon Aviation Oil Elite 20W-50.

What makes Exxon Elite especially effective is a proprietary additive package that is unprecedented in reducing wear and combating rust and corrosion.

If you own a piston-engine aircraft, this is far more than an arcane laboratory finding. Piston-engine aircraft are typically used intermittently, and when they sit idle, condensation can collect in the engine. This moisture spawns tiny rust spots that can grow bigger when the engine isn't getting a regular workout. The result can be increased wear and failure to reach TBO. For many aircraft owners, rust has become mechanical enemy number 1. Identifying the appropriate lubrication antidote is therefore a practical issue, involving real-time wear and tear, and real money out of your pocket.

Monogrades versus Multi-grades

To provide some clarification, aviation oils are sold in various viscosity grades, referring to the oil's thickness or resistance to flow. A monograde, or single grade, meets the requirements of one viscosity grade. A multi-grade meets the requirement of a summer and a winter viscosity grade and is used for a wider temperature range than a single grade. Among other advantages, multi-grade oils provide better cold-start protection and a stronger lubricant film at typical operating temperatures.

Exxon Aviation Oil Elite 20W-50 is a multi-grade oil; it is also a semi-synthetic — which means that it is a blend of synthetic and mineral-based oil, combining the best qualities of both.

As part of an additive package, multi-grade aviation oils typically contain rust inhibitors. These are chemicals added to the oil by the manufacturer to enhance the oil's ability to prevent rust. They are molecules that contain a polar head and water-repelling tails. The head forms a non-permanent bond with the metal, providing a secondary layer of protection against water penetration; moisture must now diffuse through the oil and the rust inhibitor layer — a process that will take longer because of the water-repelling nature of the additive.

Not all rust inhibitor combinations are as effective as others, however. For any consumer willing to delve into the often-difficult-to-understand chemistry of aviation oils, the challenge is how to evaluate the relative effectiveness of different brands in preventing rust.

For superior protection against rust, trust the proven performance of Exxon Elite. The oil is available at FBOs and distributors nationwide or by calling 1-800-44-EXXON (1-800-443-9966). For more information, visit www.exxonmobilaviationlubes.com.

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Science in the Humidity Cabinet

That's where the humidity cabinet tests come in. The test uses test equipment described in ASTM D 1748, the Standard Test Method for Rust Protection by Metal Preservatives in Humidity Cabinet, that has been used by companies over the years to demonstrate rust-protective properties of oils. Humidity cabinet testing protocols have a long track record and are dependable and accurate.

In conventional humidity cabinet test protocols, surfaces of steel panels are prepared and soaked in oil according to a standardized preparation procedure and exposed to humidity in the humidity cabinet.

Instead of using steel panels, technicians in this latest examination of aviation oils modified the procedure to test engine parts actually found in the crankcase. The idea was to make the test as real world as possible. Tappets were chosen because tiny rusted areas that form on their surface could grow bigger as the engine sits idle, and can cause catastrophic levels of damage.

The tappets tested came from commonly used Continental and Lycoming engines. To eliminate the possibility that metallurgical variations are producing misleading results, all tappets used in side-by-side comparisons of competitive oil performance were new, and came from the same engine part lot. Technicians prepared the tappet surfaces and coated the respective tappets with various brands of conventional monograde or multi-grade oils and placed them side-by-side in the humidity cabinet for 72 hours. The engine parts were subsequently removed and cleaned, exposing rusted areas so that the effectiveness of each oil could be compared and photographed.

Not All Oils Are Up to the Challenge

The findings are a result of a scientifically based measuring system — not myth. In contrast to what many pilots and mechanics had predicted, the monograde oils tested were not especially effective in preventing rust. As a class, multi-grade oils performed substantially better. And the best performance among the multi-grades was Exxon Elite.

As photos from the modified humidity cabinet test show *(next page)*, when it comes to rust protection, there are significant differences between brands of aviation oil. Those differences, as pilots who have switched to Exxon Elite have already discovered, can translate to better performance, both in the air and — increasingly important — on the ground during extended idle time between flights.

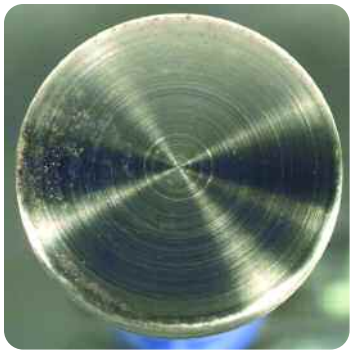
Humidity Cabinet Rust Test: Measuring Oil Effectiveness

Oil prevents rust by forming a barrier between water that can condense in an engine and metal parts. However, over time, the moisture will diffuse through the oil layer, touching the metal and promoting galvanic corrosion or rust. More effective oils maintain this barrier to moisture longer. To test the effectiveness of aviation oils against rust, our lab technicians conducted a testing protocol with equipment used in the Standard Test Method for Rust Protection by Metal Preservatives in Humidity Cabinet (ASTM D 1748). In this test, specially prepared steel panels are coated with oil and placed in a humidity cabinet at 120°F and 100 percent relative humidity. To replicate real-world conditions in aircraft, our technicians replaced the steel panels with actual engine parts, tappets from Teledyne Continental and Textron Lycoming engines. Using a lathe and an aluminum oxide cloth, they first removed a Ferrox™ protective coating on the new tappets, which would normally wear off in the engine during the break-in period. They then coated the respective tappets with the test oils and placed them in the humidity cabinet. After 72 hours, the tappets were removed from the cabinet, washed with petroleum naphtha and wiped gently with a soft paper towel so they could be photographed *(see photos, next page)* to illustrate relative levels of rusting. To ensure consistent results, from which we could draw reliable conclusions, we tested the oils being compared side-by-side, using new tappets from the same lot number. Several repeat tests were run on every oil, on both Continental and Lycoming tappets, to preclude variations in humidity cabinet conditions from affecting our conclusions. The results were consistent. The tappets protected with multi-grade oils fared much better than those protected with monograde oils. Of the multi-grades, Exxon Elite offered the best protection against rust.

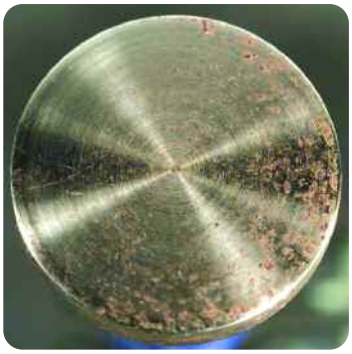
(Left) *When new, tappets are coated with Ferrox, a very effective protective coating to help prevent rust. It wears off during the break-in process.*
(Right) *Before conducting the humidity cabinet test we removed the Ferrox using a lathe and aluminum oxide cloth.*

In conventional humidity cabinet tests, sand-blasted steel panels, like the one pictured above, are soaked in oil according to a standardized surface preparation procedure and exposed to humidity. Technicians measure the amount of time it takes for the first appearance of rust.

Put to the test, multi-grade oils fared better in repelling rust on these Textron Lycoming tappets than did monograde oils, and of the multi-grades, Exxon Elite performed best.

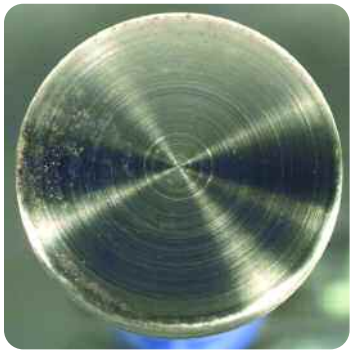


Exxon Elite



Commercial AD Monograde (SAE 50)

Contrary to popular belief, monograde oils are not as effective as multi-grade oils in combating rust. Because they typically contain more effective rust inhibitors, multi-grade oils provide a second layer of protection against water penetration.

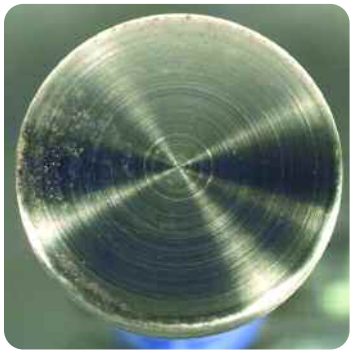


Exxon Elite

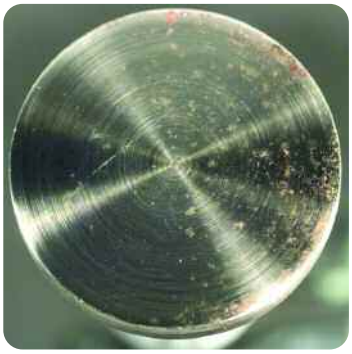
Commercial AD Monograde with Lycoming Additive (SAE 50)

Commercial AD Monograde claiming to meet the Lycoming antiwear-antiscuff additive requirement (SAE 50)

Even with the addition of the Lycoming Additive, monograde oils do not offer the rust protection of Exxon Elite, a multi-grade oil.



Exxon Elite



Competitive Semi-Synthetic 15W-50

Competitive Mineral 20W-50

When it comes to rust protection, there are significant differences between brands of aviation oil. As a class, multi-grades performed substantially better than monograde. The best performance among the multi-grades tested was Exxon Elite.

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