

# Eastman

aviation solutions



## Product guide



Proven performance | Technical excellence | Dedicated support



With more than 150 years of combined aviation experience, our global team of aviation experts fosters strong relationships with airlines, equipment manufacturers, and other members of the industry to better understand current and future needs, enabling us to seek out innovative and flexible solutions to meet exacting requirements.

We are committed to supporting the industry with exceptional products and providing unparalleled technical services and engineering consultancy to our partners worldwide.

Eastman Aviation Solutions has a range of high quality turbine lubricants designed to suit your every need. With over a billion hours of proven performance, Eastman turbo oils are a highly trusted solution for aircraft turbine engine lubrication.

## Eastman Aviation Lubricants

<b>Eastman Turbo Oil 2197™</b>	The leading High Performance Capable (HPC) oil in service today, it was developed to meet the needs of the most demanding turbine engines, offering best-in-class high-temperature performance.
<b>Eastman Turbo Oil 2380™</b>	One of the most widely used turbo oils in commercial service, it is uniquely suited for turbo props, providing the highest high-load-carrying capability and advantaged low-temperature viscosity characteristics in its class.
<b>Eastman Turbo Oil 2389™</b>	The most widely used 3 cSt oil in aircraft APUs, it provides excellent "cold soak" reliability in aircraft accessories. It has excellent low-temperature fluidity characteristics with good thermal and oxidation stability.
<b>Eastman Turbo Oil 25™</b>	The industry leader for load-carrying capability, it is a Type II oil primarily used in helicopter gearboxes and transmissions.
<b>Eastman HALO 157™</b>	An advanced helicopter transmission oil with excellent load-carrying and antiwear performance, it is purpose-designed to offer maximum protection to helicopter transmission systems under extreme operating conditions.

## Tested above industry standards

Eastman's in-house formulation expertise enables us to design, develop, and evaluate our lubricant products in a unique manner, maximizing the performance benefits from the latest advances in additive and base stock technologies.

### Developing outstanding products for our customers

Our world-class technology team comprises chemists, engineers, and analytical experts respected industrywide in the fields of lubricant formulation research, analytical chemistry, and lubricant performance testing.

With more than 150 combined years of aviation lubricant experience, the team offers a winning combination of product and application expertise.

Our global research facility houses state-of-the-art analytical and performance-testing capabilities, including proprietary high-temperature dynamic deposition test equipment unique to Eastman and the aviation industry. These testing capabilities and the team of dedicated aviation scientists set Eastman apart from the competition and provide the highest level of confidence for customers using our products in the ever-demanding environments within the engine.

### Pioneering lubricant testing beyond aviation industry requirements

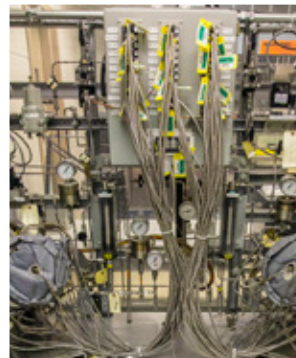
The jet engine presents one of the most demanding and stressful environments for lubricants for several interrelated reasons, including operating temperature extremes, lubricating system design, aircraft operation profiles, and maintenance practices. During the design, development, and testing stages for a new oil, many aviation industry standard tests are mandated—aimed at assessing future performance in a jet engine—and are covered within both MIL-PRF-23699 and SAE AS5780 specifications. Individual OEMs may then also require specific additional testing.

Despite this gamut of testing, Eastman considers these tests to be considerably removed and incomplete in terms of simulating jet engine conditions. Indeed, history supports this viewpoint with instances where new oils have passed all the required industry tests yet performed very differently and unexpectedly in service.

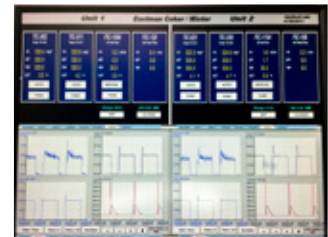
### Coker Mister

Given the credibility gap between industry tests and in-service performance, we developed an additional testing capability that offers a much closer simulation of in-service conditions based on the No. 5 bearing compartment of the P&W JT8D-200. The result is the Coker Mister, a high-temperature, dynamic lubricant-deposition test rig unique to Eastman and the industry.

Offering the best and closest in-service simulation possible, it has been used extensively in the development of high performance oils such as Eastman Turbo Oil 2197™ and for evaluating other commercial oils. The proven success of Turbo Oil 2197 is attributable to the performance validation testing undertaken in this test rig during its development.



Coker Mister test apparatus



Coker Mister advanced control and monitoring dashboard

The Coker Mister test chamber is rated and ranked following a 72-hour test program covering many cycles, simulating takeoff, cruise, reverse thrust on landing, taxiing, and shutdown (with heat-soak effect). All carbonaceous deposits are analyzed and weighed along with the residual oil after testing which is filtered and sediments weighed. Very clear coking-propensity differentiation is observed between STD/SPC and HTS/HPC lubricant classes and, more importantly, clear differentiation within classes.

# Eastman Turbo Oil 2197™

The world's leading high performance turbo oil

Built on more than 50 years of experience with industry-leading products, Eastman Turbo Oil 2197™ (ETO 2197) is designed to exceed the demands of current and future jet engines. ETO 2197 is the oil of choice for airlines choosing to operate their fleets on High Performance Capable (HPC) oils, with approximately 400 million engine/accessory hours of proven and trusted performance. It was the first oil approved to AS5780A specification and exceeds all the requirements of AS5780 HPC Class.

Approved by all leading engine manufacturers, ETO 2197 is qualified to MIL-PRF-23699 High Thermal Stability (HTS) class and is by far the most widely used HTS fleet oil in the world.

ETO 2197 is manufactured in our own facility, ensuring worldwide quality and consistency of this globally available product. A full list of approvals is available on request.



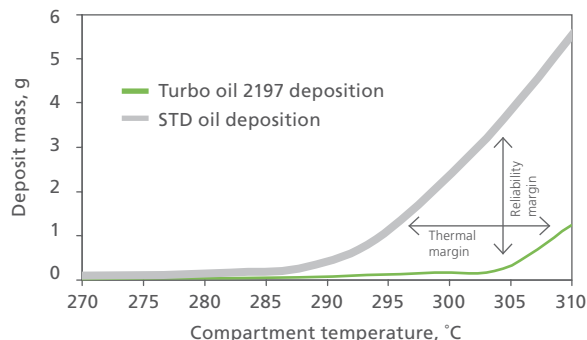
## Improved reliability

Eastman Turbo Oil 2197™ brings you exceptional performance which leads to extended on-wing engine life and improved reliability. The ability of ETO 2197 to maintain very low levels of deposition under severe thermal stress leads to significant improvements in engine cleanliness compared with all other commercially available oils. ETO 2197 is recognized as a problem solver for high-severity engines, i.e., PW JT8D-200, Trent 700, and V2500.



CF6-80C2, #6 bearing in D-sump

### Deposition comparison: Eastman Turbo Oil 2197 vs. STD



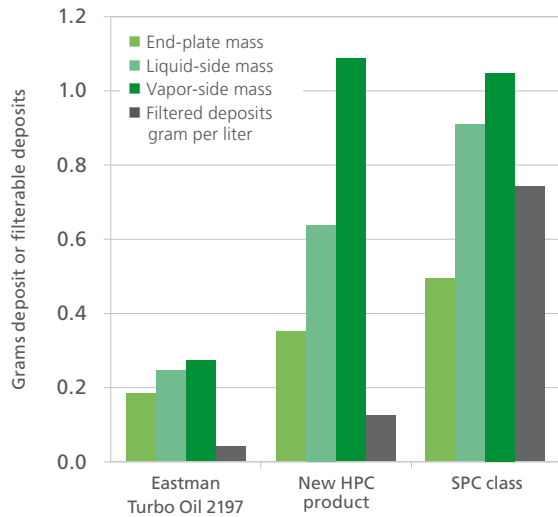
This demonstrated increased cleanliness can be seen in exacting laboratory testing and is reflected in significantly improved engine bearing compartment cleanliness, particularly in modern high-temperature, high-bypass turbofan power plants. Benefits of this include virtually eliminating oil coking and plugged filters (and hence oil coking-related delays), fewer diverted flights, and ultimately fewer in-flight shutdowns (IFSDs).

Your engines spend more time in the air and less time on the ground. Improved reliability also means less resources are required to resolve preventable unplanned maintenance. The end result? Less disruption for you and your customers.

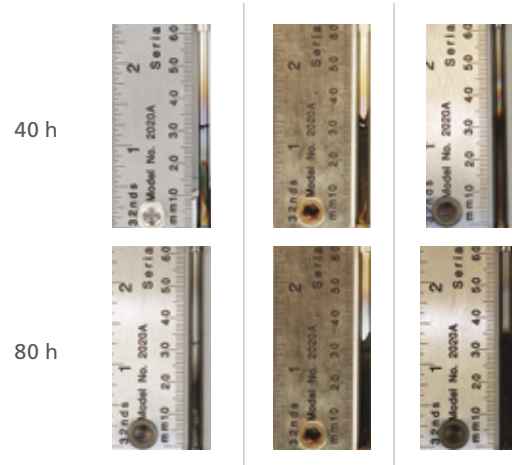
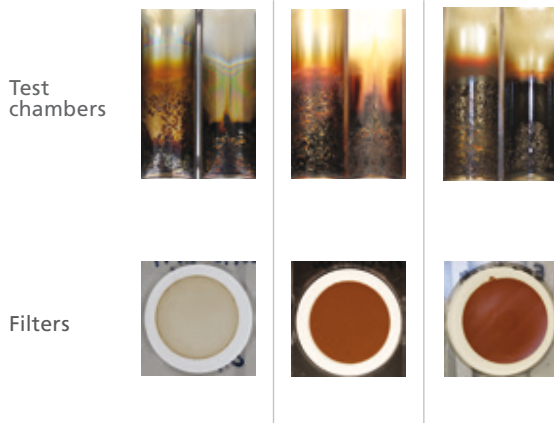
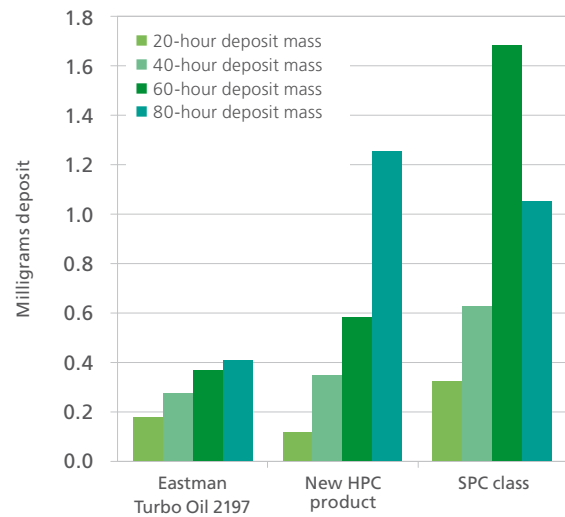
With standard oil, our CF6-80C2 engines on the B767 were on a routine 1500-cycle interval for turbine rear frame D-sump oil supply and scavenge tube removal and cleaning due to coke formation. After switching to Turbo Oil 2197, coke formation was no longer an issue and we stopped this routine cleaning. This took away a significant impact to our 767 maintenance burden with reduced labor hours and also one less item requiring downtime for a busy ETOPS aircraft.

—Senior CF6-80C2 propulsion engineer, major U.S. airline

**Cyclic Coker Mister performance**  
(520°/560°F soak-back simulation cycles)



**HLPS dynamic coking performance**  
(SAE ARP 5996 at 375°C—extended duration)



## HLPS

One of a large number of industry standard tests we have to undertake as part of the development and approval process is the Hot Liquid Process Simulator (HLPS) test which again measures deposition characteristics of an oil. Typical test duration is 40 hours but experience has shown that by extending the test to 80 hours, a much more significant performance differentiation is observed characterized by increased deposits on the tube. This extension of test duration is important as the results

provide great insight into likely performance of the lubricant either in a higher-severity turbine engine (more heat stress on the oil) or after prolonged use in a less-severe turbine engine.

The HLPS chart clearly shows that performance differentiation can easily be observed between lubricant classes (HPC vs. SPC) after 40 hours but comparing within the same class (i.e., HPC), the extended test duration provides a much better comparison of performance.

## Eastman Turbo Oil 2380™

A turbine oil uniquely suited for turbo props, this product's superior low-temperature characteristics, load-carrying capability, cleanliness, and elastomer compatibilities keep aircrafts in dangerously low temperatures running at the highest performance level possible. Eastman Turbo Oil 2380™ (ETO 2380) is one of the most widely used turbine oils in the commercial aviation industry with over one billion hours of operating experience.

ETO 2380 is among the first turbine oils to be qualified and approved for MIL-PRF-23699 STD (Standard) class and subsequently SAE AS5780 Standard Performance Capability (SPC) class. A full list of commercial approvals is available on request.

ETO 2380—More than 50 years of experience with more than 230 Part 121\* operators and countless Part 135\* and 91\* operators.

*\*Includes non-U.S. equivalents to Parts 121, 135, and 91.*

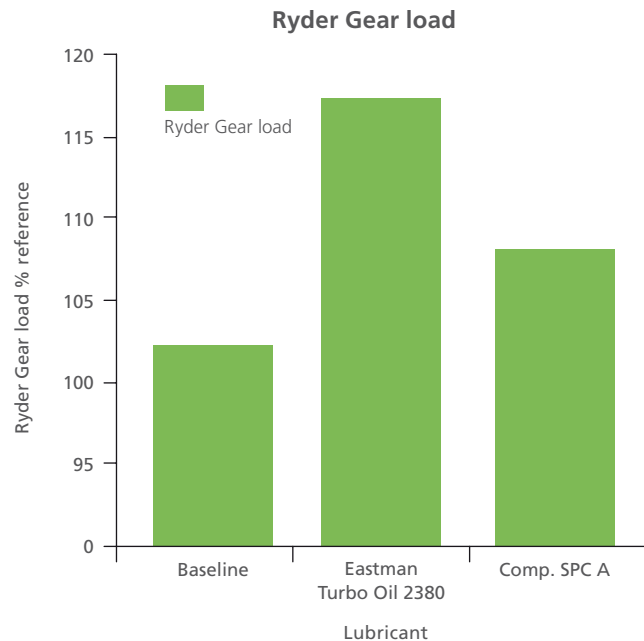


## Excellent load-carrying capability

One of the competitive attributes of ETO 2380 is its load-carrying capability. This parameter is calculated via the Ryder Gear test that is used to determine the antiscaffing property of a lubricant. The baseline measurement of this test is 102% of the reference oil. In the load-carrying test, ETO 2380 yielded results of 117% or 14.7% above the baseline versus the leading SPC competitive oil with a value of 108% or 5.9% above baseline. Clearly, Turbo Oil 2380 offers a greater margin of performance.

ETO 2380 has demonstrated superior competitive performance in many different types of engines, but specifically in the highly demanding environment of the turboprop engines. In particular, more than 70% of the PT6 engines are lubricated by ETO 2380.

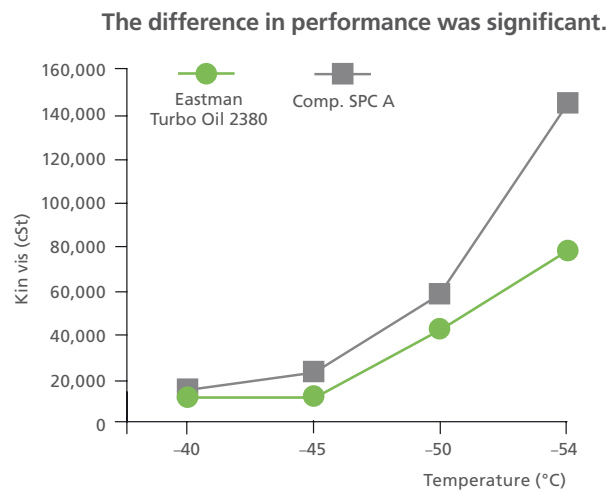
This means that ETO 2380 can generate savings to your fleet through better protection, potentially extending the life of your gears and bearings.



## Best low-temperature viscosity

ETO 2380 has demonstrated the best low-temperature viscosity performance of all 5 cSt turbine oils commercially available today. The low-temperature viscosity performance of turbine oils is determined by measuring the kinematic viscosity of the oil at colder ambient temperatures. Higher viscosities at colder temperatures can result in more difficult engine starts on cold winter days. This attribute improves the cold-soak start reliability. ETO 2380 tops the leading STD and SPC oils today in the area of low-temperature viscosity. A test was conducted comparing a competitor's leading STD/SPC turbine oil and ETO 2380. The following chart shows the results of this comparison test.

The competition was 40% more viscous at  $-40^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ ) and 71% at  $-53.4^{\circ}\text{C}$  ( $65^{\circ}\text{F}$ ). Pour point for ETO 2380 was measured at  $-59^{\circ}\text{C}$  ( $-74^{\circ}\text{F}$ ) versus  $-57^{\circ}\text{C}$  ( $-70^{\circ}\text{F}$ ) for the competition. The low-temperature performance of ETO 2380 translates into improved gear and bearing reliability in cold-soak condition due to better lubrication at start-up. In addition, high-oil-pressure events during start-up on cold days may be reduced significantly.



## Eastman Turbo Oil 2389™

Especially suited for APUs

Eastman Turbo Oil 2389 (ETO 2389) is an advanced gas turbine lubricant that has a viscosity of 3 centistokes at 99°C (210°F), which meets or exceeds the requirements of U.S. Military Specification MIL-PRF-7808 Grade 3 and incorporates a level of technology from Type II (5 cSt) commercial turbine lubricants.



## Product description

ETO 2389 is a low-viscosity gas turbine oil offering exceptional cold-start capability. Many large commercial airlines use ETO 2389 in their auxiliary power units (APUs) because of the reliability it affords this equipment when starting after long cold soaks at altitude. ETO 2389 is the only MIL-PRF-7808 Grade 3-qualified oil that is fully approved in all Honeywell and Hamilton Sundstrand APUs and is the factory fill of choice for B787 APS 5000 APU.

ETO 2389 is formulated from synthetic base stocks and advanced technology additives to provide the combined

thermal and oxidation stability properties of commercial Type II lubricants with the low-temperature fluidity characteristics of a 3-centistoke oil. It also has load-carrying ability equal to or better than other qualified MIL-PRF-7808 Grade 3 oils.

ETO 2389 is the only 3 cSt oil with significant commercial experience based on the same polyol ester technology as contemporary 5 cSt oils, which provides peace of mind if inadvertently mixed with main engine oil.

## Advanced APU performance oil

By using ETO 2389, your airline can meet the requirements from regulatory agencies for ETOPS operations. As an advanced APU performance oil, it improves performance during cold starts and creates a more reliable operation.



## Exceeding operational requirements

ETO 2389 is approved for use in all APUs and is the chosen factory fill for B787 APS 5000 APU, the first APU to mandate 3 cSt oil only. This oil's performance exceeds operational requirements, giving OEMs the confidence to use ETO 2389 in testing applications for the next generation of aircraft.

## Low-temperature viscosity

In low temperatures, good lubrication is critical in applications such as APUs and some aircraft accessories.

Reduced viscosity can have a dramatic impact on performance and cold-start reliability in these cases.

## Exceptional cleanliness

One of the characteristic advantages of ETO 2389 is the minimum formation of varnish or sludge deposits. Long periods of severe operation are possible without the danger of scavenge pump screen plugging or the corrosion that often accompanies excessive deposits.

## High-bulk stability

ETO 2389 has a high resistance to physical or chemical change resulting from oxidation. This permits long periods of severe operation without significant increase in viscosity or total acidity, the two principal indicators of product oxidation.

## Available worldwide

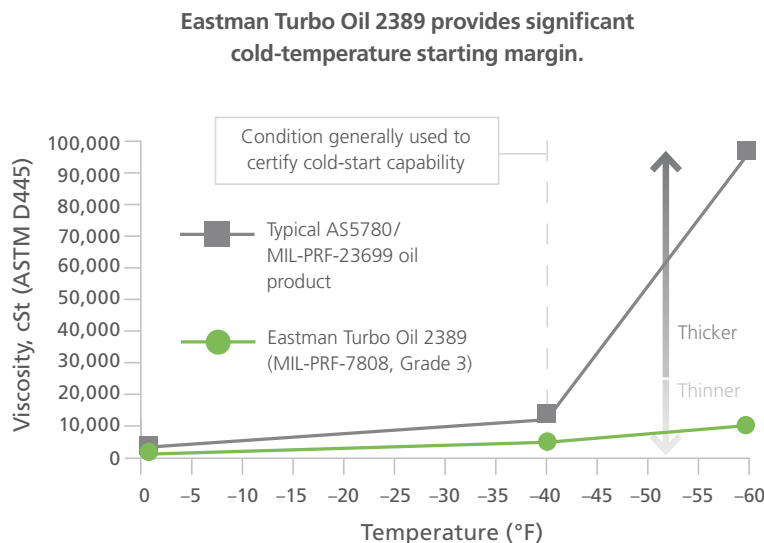
Eastman Aviation Solutions uses a robust global distribution network, which allows us to ship ETO 2389 around the world. We also offer a global team of aviation lubricant experts to support all Eastman Aviation Solutions.

## Long shelf life

The shelf life of ETO 2389 is 10 years or more when stored in original, unopened quart cans under recommended conditions, such as away from extreme heat and moisture.

## Excellent load carrying

ETO 2389 provides load-carrying ability well in excess of requirements established by engine and equipment manufacturers—as measured in the Ryder Gear test.



## Eastman Turbo Oil 25™

### Turbine engines and accessories

Eastman Turbo Oil 25™ (ETO 25) is a 5 cSt high-load-carrying lubricant designed to meet the severe requirements of helicopters and offers exceptional load-carrying ability over Type II oils in helicopter gearboxes and transmissions. ETO 25 was originally developed to meet the extreme demands of supersonic flight with the Concorde aircraft.



## Product description

The high-gear, load-carrying ability of ETO 25 earned its approval against U.S. Military specification DOD-PRF-85734 for helicopter transmission systems. The in-service experience of ETO 25 in this application has been proven over many years.

It is also approved against DEF STAN 91-100 (formerly DERD 2497) and was approved against the first and all subsequent issues of the Approved Products List.

## Eastman HALO 157™

### Advanced helicopter transmission oil

For many years MIL-PRF-23699 approved engine lubricants have been employed in helicopter applications where a common lubricant is required for both engines and transmission systems.

Alternatively, high-load-carrying engine oils have also been found to offer advantages over conventional load-carrying MIL-PRF-23699 oils. These high-load-carrying oils covered under specification DOD-PRF-85734 were, again, formulated to principally cover the performance needs of the engine more so than the transmission system. The oils covered under these two specifications, therefore, are based around common 5 cSt viscometric properties.

Removing the 5 cSt constraints typical of engine oils, it is considered that optimal lubrication performance of gearboxes could be achieved by using a higher-viscosity, high-load-carrying lubricant possessing other key features such as corrosion protection. HALO 157 represents many years of research and development utilizing this unconstrained approach and represents the very first advanced helicopter

## Advantages

ETO 25 incorporates high-oxidation resistance to minimize formation of carbon, coke, and sludge. It also provides high-load-carrying ability to satisfy the requirements of highly loaded gears and bearings operating in very demanding environments. This oil offers the best load-carrying ability in its class.

transmission lubricant meeting the needs of the new MIL-PRF-32528 specification. It is dedicated for use in helicopter transmission systems and therefore is not suitable for use in the engine itself.

HALO 157 is a 9 cSt, clear amber-colored fluid with a faintly aromatic odor reminiscent of turbine engine oils. It is based on selected polyol esters, the inherent characteristics of which are enhanced by additives. It is also fully compatible and miscible with other oils approved to engine oil specifications MIL-PRF-23699 and MIL-PRF-7808.

Many thousands of hours of in-service testing have been completed across many helicopter models culminating in approval against the NATO standard (AIR STANDARD ACS 4035) and the MIL-PRF-32538 specifications. HALO 157 also retains sole approval for use in the AgustaWestland SuperLynx and AW159 Wildcat helicopters.



# Helicopter oil guide

Why switch for more proven helicopter performance?

Eastman Aviation Solutions creates innovative solutions for high-severity engines providing industry leading products and services.

## Turbine engines

Leonardo		
Helicopter model	Engine	Approved engine lubricant
A109	A250-C20	ETO 2380 ETO 2197
A109A or A109A II	A250-C20B or -C20 R/1	ETO 2380 ETO 2197
A109E	PW206C	ETO 2380
A109E	Arrius 2K1	ETO 2380 ETO 2197
A109K2	Arriel 1K1	ETO 2380 ETO 2197
A109S or AW109SP	PW207C	ETO 2380
A119 or AW119 MK2	PT6B-37A	ETO 2380
Agusta-Bell 206B-1	A250-C20	ETO 2380 ETO 2197
AW139 or AB139	PT6C-67C	ETO 2380

Bell		
Helicopter model	Engine	Approved engine lubricant
Bell 206A	A250-C18	ETO 2380 ETO 2197
Bell 206B/B3 JetRanger	A250-C20	ETO 2380 ETO 2197
Bell 206L LongRanger	A250-C20B or -20J	ETO 2380 ETO 2197
Bell 206L-1, L-3, L-4 LongRanger	A250-28B or -C30P	ETO 2380 ETO 2197
Bell 212 Twin Huey	PT6T-3B	ETO 2380
Bell 222	LTS 101-650C-2, -650C-3	ETO 2197
Bell 222B, 222U	LTS 101-750C-1	ETO 2197
Bell 230	A250-C30G/2	ETO 2380 ETO 2197
Bell 407	A250-C47B	ETO 2380 ETO 2197
Bell 412, 412EP, 412CF	PT6T-3B or -3D	ETO 2380
Bell 427	PW207D	ETO 2380
Bell 429	PW207D	ETO 2380
Bell 430	A250-C40B	ETO 2380 ETO 2197

Mil		
Helicopter model	Engine	Approved engine lubricant
Mi-8 or Mi-17 (export)	TV3-117	ETO 2380

Robinson		
Helicopter model	Engine	Approved engine lubricant
R66	RR300	ETO 2197

Sikorsky		
Helicopter model	Engine	Approved engine lubricant
S-76 A	A250-C30	ETO 2380 ETO 2197
S-76 A+, A++, C	Arriel 1S or 1S1	ETO 2380 ETO 2197
S-76 B	PT6B-36A or 36B	ETO 2380
S-76 C+, C++	Arriel 2S1 or 2S2	ETO 2380 ETO 2197
S-76D	PW210S	ETO 2380
S-92A	CT7-8, -8A	ETO 2380

### High-performing products

Whatever your turbine oil requirements, we have the lubrication products designed to meet your needs.

- 1 Main transmission
- 2 Turbine engine
- 3 Tail Rotor gearbox
- 4 Intermediate gearbox

Airbus		
Helicopter model	Engine	Approved engine lubricant
AS332C, L, L1 Super Puma	Makila 1A, 1A1	ETO 2380 ETO 2197
AS332L2 Super Puma	Makila 1A2	ETO 2380 ETO 2197
AS350 B3 Ecureuil	Arriel 2B, 2B1, 2B2	ETO 2380 ETO 2197
AS350B, B1, B2 Ecureuil	Arriel 1B, 1D, 1D2	ETO 2380 ETO 2197
AS350C, D ASTAR	LTS 101-600 or -700	ETO 2197
AS355E, E, F1 Twinstar	A250-C20F	ETO 2380 ETO 2197
AS355N, NP Twinstar	Arrius 1A, 1A1	ETO 2380 ETO 2197
BK 117A-1, A-3, A-4	LTS 101-650B-1	ETO 2197
BK 117B-1, B-2	LTS 101-750B-1	ETO 2197
BK 117C1	Arriel 1E	ETO 2380 ETO 2197
BK 117C2 (aka EC145)	Arriel 1E2	ETO 2380 ETO 2197
BO-105 A	A250-C18	ETO 2380 ETO 2197
BO-105 C, S, LS-A1	A250-C20, -C20B, -C28C	ETO 2380 ETO 2197
BO-105 LS-A1, LS-A3	A250-C28C	ETO 2380 ETO 2197
EC120B/HC120B	Arrius 2F	ETO 2380 ETO 2197
EC130 B4, T2	Arriel 2B1, 2D	ETO 2380 ETO 2197
EC135/H135 P1, P2, P2+	PW206B, B2	ETO 2380
EC135/H135 T1, T2, T2+	Arrius 2B, 2B1, 2B2	ETO 2380 ETO 2197
EC155B/H155B, B1	Arriel 2C1, 2C2	ETO 2380 ETO 2197
EC225/H225 Super Puma	Makila 2A, 2A1	ETO 2380 ETO 2197
SA330	Turmo IVC	ETO 2380 ETO 2197
SA/SA-365C, C1, C2, N, N1, N2 Dauphin	Arriel 1A, 1A1, 1A2, 1C, 1C1, 1C2	ETO 2380 ETO 2197
SA-366G1 Dauphin	LTS 101-750B-2	ETO 2197

MD Helicopters		
Helicopter model	Engine	Approved engine lubricant
MD 500C	A250-C20	ETO 2380 ETO 2197
MD 520E	A250-C20B	ETO 2380 ETO 2197
MD 530F	A250-C30	ETO 2380 ETO 2197
MD 600	A250-C47	ETO 2380 ETO 2197
MD 900 or MD 902 Explorer	PW206A	ETO 2380
MD 901 Explorer	Arrius	ETO 2380 ETO 2197
MD 902	PW206E or PW207E	ETO 2380



Contact your local representative for further details, or visit [www.EastmanAviationSolutions.com](http://www.EastmanAviationSolutions.com).

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