



# SkyKleen™ aviation solvent

A new generation aviation solvent that combines excellent cleaning performance with environmentally friendly characteristics

## Cleaning applications

- Skydrol™ removal
- Polysulfide sealant removal (cured/uncured)
- RTV removal
- Degreasing
- Carbon removal (brake and piston housings)
- Engine cleaning
- Final cleaning prior to painting and bonding
- General surface cleaning
- Carbon epoxy composite surface cleaning
- Fiberglass resin removal
- Adhesive/epoxy removal

## Environmentally friendly

- Inherently biodegradable
- Nonhalogenated
- Nonozone depleting
- Minimizes VOC emissions
- Nonhazardous waste per RCRA

## Productivity considerations

- Will not adversely affect metals
- Leaves no residue
- Slower evaporation minimizes solvent consumption
- Better penetration/minimizes waste
- Cost-effective vs. other replacement solvents

## Safety considerations

- Noncombustible (flash point = 102°C/216°F)
- Noncaustic
- Low odor
- Improved worker safety
- Nonhazardous by DOT shipping regulations

## Physical properties

- Clear, water-white liquid
- Low odor
- Distillation range: 195° to 216°C (383° to 421°F)
- Density @ 20°C (68°F): 1.09 g/mL (9.06 lb/gal)
- Viscosity @ 25°C (77°F): 3.88 cP
- Freezing point: -40°C (-40°F)
- Solubility in water: 5.5% (w/w)
- Flashpoint (Pensky-Martin CC): 99°C (210°F)
- Autoignition temperature: >400°C (>752°F)
- Vapor pressure: 0.08 hPa @ 20°C (68°F)
- AIT: 438°C (820°F)

## Qualifications

- Boeing BAC 5750, Airbus AIMS 09-03-001/IPS 09-03-001-02





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# Eastman turbo oils

**EASTMAN**

aviation solutions



Proven performance

Technical excellence

Dedicated support

## Trusted on the ground. Proven in the air.

Airlines looking for exceptional products, unparalleled technical service, and engineering advice can turn to Eastman Aviation Solutions. Our global team of experts has more than 150 years of combined aviation experience and is committed to understanding your current and future needs. With more than a billion hours of proven performance, Eastman turbo oils are the trusted solution for engine lubrication.

### Tested above industry standards

*Eastman's formulation expertise enables us to uniquely design, develop, and evaluate our lubricants. We use the latest advances in additive and base stock technologies to maximize performance.*

Our products will perform in the most demanding environments thanks to testing that sets us apart from the competition. Our global research facility houses state-of-the-art analytical and performance-testing capabilities, including proprietary high-temperature dynamic deposition test equipment. And our world-class technology team is respected throughout the industry, offering a winning combination of product and application expertise.

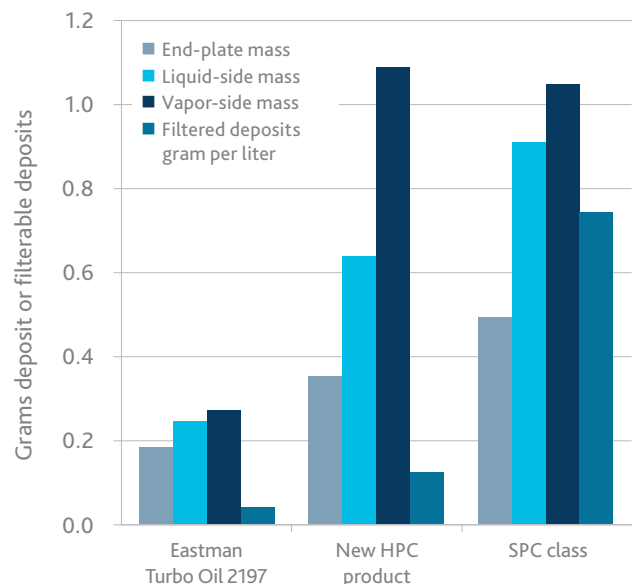


### Aviation Lubricant Advanced Deposition Simulator (ALADS)

Eastman has advanced testing capabilities, including a state-of-the-art, in-service bearing compartment simulator rig that offers the best and closest in-service simulation possible. The ALADS is a high-temperature, dynamic lubricant-deposition test rig unique to Eastman and recognized in the aviation OEM community.

It was used extensively in the development of high-performance oils such as Eastman Turbo Oil 2197™, providing valuable thermal stability assessments against other commercial oils during the product development process. The proven success of ETO 2197 in service can be directly attributed to ALADS validation testing.

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





# 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 operating their fleets on HPC oils, with approximately 450 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. It is used and trusted by engine OEMs when certifying engines with high thermal stress loads.

## Improved engine reliability

A hot-liquid process simulator (HLPS) test is an industry test used to measure deposition characteristics of an oil; a typical test run is 40 hours. However, our 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. These results provide a better insight into likely performance of the lubricant in a higher-severity turbine engine (more heat stress on the oil) or after prolonged use in a less severe turbine engine.



**Optimal engine cleanliness**—better engine health due to best-in-class thermal stability

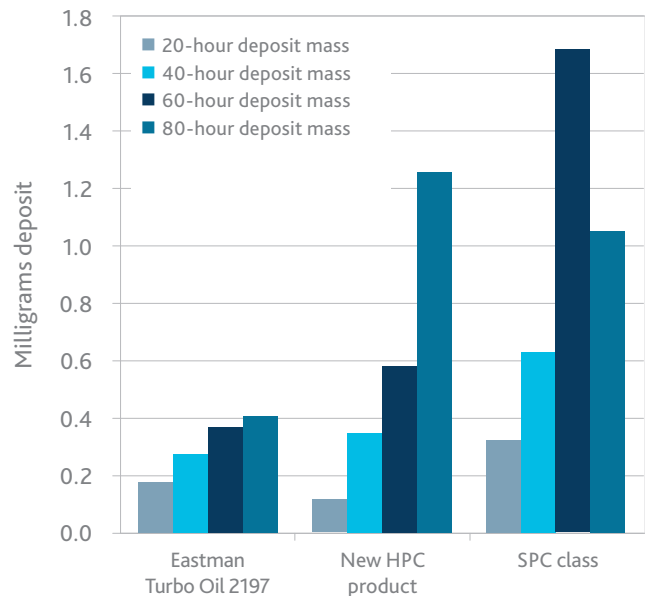


**Improved engine reliability**—excellent lubrication performance in mild to severe operating environments



**Longer fluid life**—best-in-class hydrolytic and thermal stability help prevent oil breakdown.

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



# Eastman Turbo Oil 2380™

Long-standing heritage



**Avoid premature diode failures**—optimal electrical conductivity provides reliable generator performance.



**Reduced hard starts**—engine can be started at low temperatures without fear of component damage due to excessive wear.

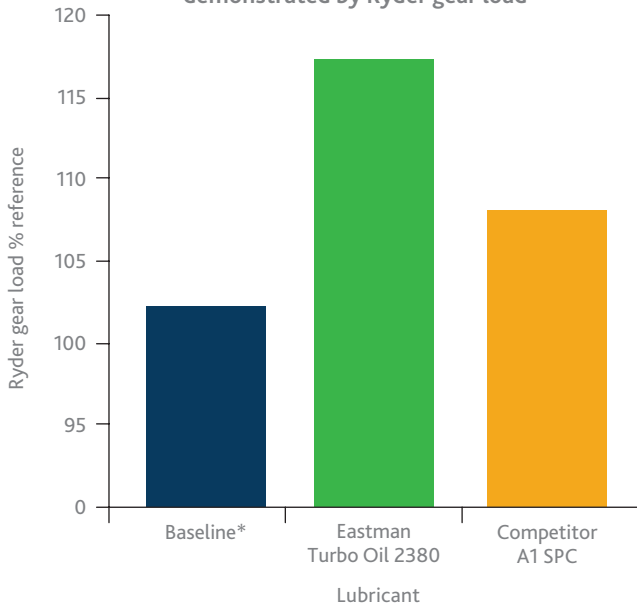


**Maximum bearing protection**—best-in-class load-carrying ability

A turbine oil uniquely suited for turboprops, ETO 2380's superior low-temperature characteristics, high load-carrying capability, cleanliness, and elastomer compatibilities keep aircraft running at the highest performance level possible, even in dangerously low temperatures. It is one of the most widely used turbine oils in the commercial aviation industry, especially in business jets with billions of hours of operating experience.



Excellent high load-carrying capability demonstrated by Ryder gear load



\*The baseline measurement of this test is 102% of the reference oil.

In the high 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 the baseline).

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

ETO 2380 has demonstrated the best low-temperature viscosity performance of all 5-cSt turbine oils commercially available today.

The competition was 40% more viscous at  $-40^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ ) and 71% more viscous 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.

Best low-temperature viscosity



# Eastman Turbo Oil 2389™

Advanced APU performance oil



**Reduced hard starts**—engine can be started at low temperatures without fear of wear issues due to the oil's low viscosity.



**Trusted solution**—meets or exceeds the requirements of U.S. Military Specification MIL-PRF-7808 Grade 3

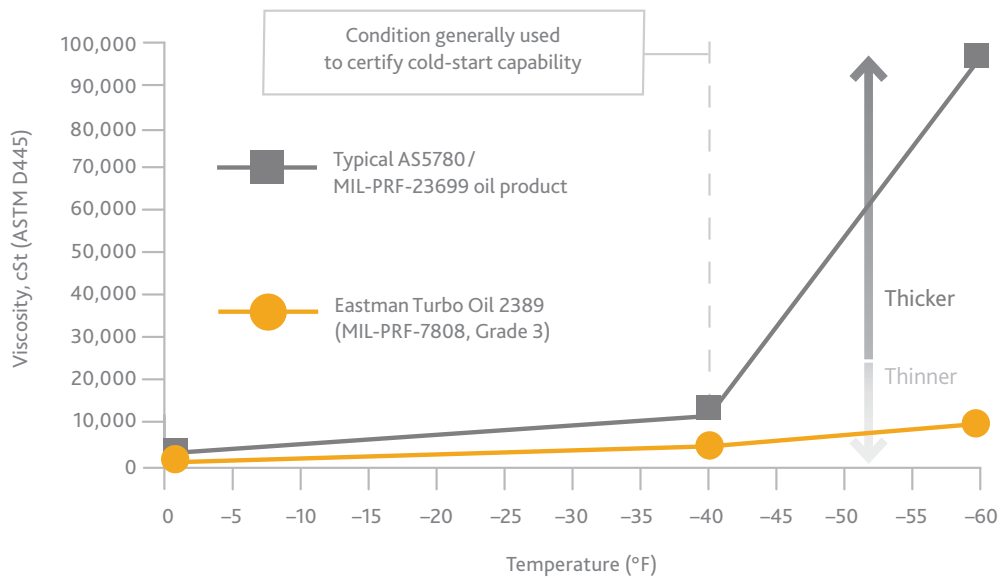


**Advanced APU performance**—provides excellent "cold soak" reliability in aircraft APUs



**Performs well in long periods of severe operation**—high-bulk stability offers high resistance to physical or chemical change resulting from oxidation.

Eastman Turbo Oil 2389 provides significant cold-temperature starting margin.



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. By using ETO 2389, your airline can meet the requirements from regulatory agencies for ETOPS operations.

ETO 2389 is the only 3-cSt oil with significant commercial experience. It is based on similar synthetic base stock technology as contemporary 5-cSt oils, which provides peace of mind if inadvertently mixed with main engine oil.



## Eastman Turbo Oil 25™

*Formulated for the high load-carrying demands of today's helicopter transmission systems*



**Optimal transmission and gearbox life**—high-gear load-carrying capability protects against wear in critical systems.



**Reliable performance**—proven performance in helicopter transmissions and enhanced gear wear protection

Eastman Turbo Oil 25 (ETO 25) is a 5-cSt lubricant offering exceptional high load-carrying ability over Type II oils in helicopter gearboxes and transmissions. ETO 25 was originally developed to meet the extreme demands of the Concorde's supersonic flight.

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.



# Eastman HALO 157™

## Advanced helicopter transmission oil



**Optimal transmission and gearbox life**—high-gear load-carrying capability protects against wear in critical systems.



**Dependable protection**—corrosion resistance provides essential component protection.

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 also offer advantages over conventional load-carrying MIL-PRF-23699 oils. Removing the 5-cSt constraints typical of engine oils, optimal lubrication performance of gearboxes can be achieved by using a higher-viscosity, high load-carrying lubricant with other key features such as corrosion protection.

HALO 157 represents many years of research and development using this approach and is the first advanced helicopter transmission lubricant to meet the needs of the new MIL-PRF-32528 specification.

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 whose inherent characteristics are enhanced by additives.



HALO 157 is the only transmission lubricant approved for AgustaWestland Super Lynx 200 and AgustaWestland Super Lynx 300 helicopters.

**Do your aviation fluids cost more than you realize?** Turbo oils can significantly impact maintenance and aircraft performance. That's why it's important to work with an industry leader that understands your need to operate as efficiently and cost-effectively as possible.

**Visit [Eastman.com/Aviation](http://Eastman.com/Aviation) to see which turbo oils are approved for your fleet, or contact us to speak with an expert in aviation turbine oil technology.**

## EASTMAN

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# Skydrol™ aviation hydraulic fluids

*Formulated to meet the changing demands of the aviation industry*



**EASTMAN**

aviation solutions

 **SKYDROL**  
HYDRAULIC FLUIDS  
from eastman



Before the invention of Type V hydraulic fluids, the aviation market offered three fluids, each approved by every manufacturer. With multiple phosphate ester fluids now available, airlines have more options than ever before when it comes to optimizing fluid use to best meet the needs of their fleets.

In some cases, one fluid can provide optimal operation for all aircraft in the fleet. However, use of two or even three different fluids to reach peak performance across a fleet is more common today. With more than 100 years of combined industry experience among Eastman's technical services team members, we are uniquely able to provide personalized expertise to support your fluid selection.

## The Eastman advantage

### Sample analysis program

- Complimentary sample bottle kits ease the process, assuring clean and safely transported samples.
- Testing is performed at company-operated labs which use methods custom designed for phosphate ester hydraulic fluids.
- Helpful analysis reports include recommendations to improve your operations and data that other fluid analysis labs don't offer.
- Fluid analysis results are reviewed by Eastman technical experts.
- This is offered at no cost to Skydrol customers, including our distributors' customers.
- MySkydrol site offers convenient access to tools, including sample kit order forms, sample results, and fleet analysis. Visit [Eastman.com/MySkydrol](http://Eastman.com/MySkydrol).

### Technical expertise

- Dedicated aviation hydraulic fluid experts skilled at solving customer problems
- Answers to questions specific to your fleets' systems
- Innovative fluid development laboratory, advancing the science of fire-resistant hydraulic fluids
- Root-cause analysis supported by our expert staff of research scientists





# What's the right Skydrol fluid(s) for your fleet?

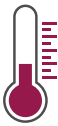
## Skydrol™ PE-5 aviation hydraulic fluid

*World's best-selling Type V aviation hydraulic fluid*

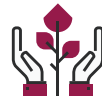
### Key benefits



**Reduced maintenance and increased performance**—longest fluid life of any phosphate ester fluid under high-moisture, low-moisture, high-temperature, and mild-temperature conditions



**Faster cold starts**—ideal combination of density (specific gravity) and low-temperature viscosity, allowing up to 25% better hydraulic system efficiency



**Reduced waste**—longer fluid life reduces volume for disposal as waste

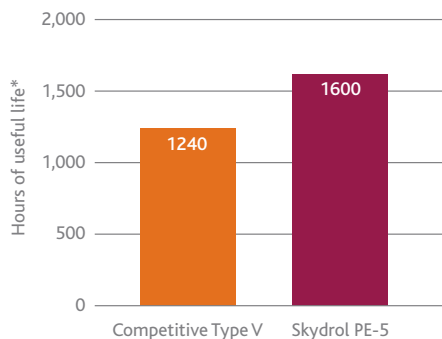


**System reliability**—offers erosion protection at 3000 and 5000 psi, allowing decreased maintenance and downtime



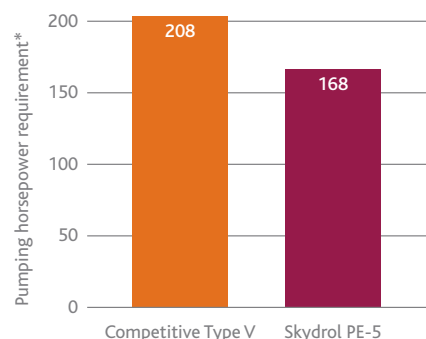
**Compatible with your fleet**—normal fluid top-up for conversion and fully compatible with existing Type IV and V fluids

### Longest fluid life



\*Fluid tested @ 257°F (125°C) and 0.5% H<sub>2</sub>O, laboratory conditions

### Low-temperature performance



\*At -65°F (-54°C) viscosity



## Skydrol™ 5 aviation hydraulic fluid

*Lighter weight and the first Type V fluid on the market*

### Key benefits



**Fuel savings**—lowest-density phosphate ester hydraulic fluid, offering weight reductions



**Paint compatibility**—less aggressive toward aircraft paints



**System reliability**—higher-temperature capability than Type IV fluids, offering thermal stability and erosion resistance



**Fire resistance**—improved fire resistance over Type IV fluids in spray ignition tests



**Safety**—base stock reduces potential health concerns

Most phosphate ester products use tributyl phosphate as a major ingredient, but Skydrol 5 has a unique formulation built on a new base stock, triisobutyl phosphate. This makes Skydrol 5 the lightest weight of any phosphate ester hydraulic fluid, allowing weight savings on the plane and fuel savings for the bottom line.

Airframe manufacturers and operators are becoming more conscious of the benefits of weight savings in today's competitive environment. Skydrol 5 sets a new standard as the lowest-density phosphate ester-based hydraulic fluid. The use of Skydrol 5 can translate into 5 to 120 lb of weight savings, depending on the aircraft model, directly leading to reduced fuel burn.

### Lower density equates to annual fuel savings.





## Skydrol™ LD-4 aviation hydraulic fluid

*World's best-selling Type IV aviation hydraulic fluid*

### Key benefits



**System reliability**—high-temperature capability offers thermal stability and erosion protection in valves



**Proven formulation**—reputation as the premier aviation hydraulic fluid, with no change in formulation since its inception more than 35 years ago



## Skydrol™ 500B-4 aviation hydraulic fluid

*Longest service history in phosphate ester products*

### Key benefits



**Proven track record**—longest service history among phosphate ester fluids



**System reliability**—contains the same breakthrough anti-erosion additive and acid scavenger found in Skydrol LD-4

## Which hydraulic fluids are approved for your fleet?

| Manufacturer                | Skydrol PE-5 | Skydrol 5 | Skydrol LD-4 | Skydrol 500B-4 |
|-----------------------------|--------------|-----------|--------------|----------------|
| Airbus <sup>1</sup>         | ✓            |           | ✓            | ✓              |
| Antonov (An-148 and 158)    |              |           | ✓            |                |
| ATR                         | ✓            |           | ✓            | ✓              |
| Beriev (Be-200)             |              |           | ✓            |                |
| Boeing <sup>2</sup>         | ✓            | ✓         | ✓            | ✓              |
| Bombardier <sup>3</sup>     |              |           | ✓            | ✓              |
| British Aerospace           |              |           | ✓            | ✓              |
| Cessna                      |              | ✓         | ✓            | ✓              |
| COMAC                       | ✓            |           | ✓            |                |
| Embraer                     | ✓            |           | ✓            | ✓              |
| Fokker                      |              | ✓         | ✓            | ✓              |
| Gulfstream <sup>4</sup>     | ✓            | ✓         | ✓            | ✓              |
| Ilyushin (IL-86 and 96)     |              |           | ✓            |                |
| Lockheed                    |              | ✓         | ✓            | ✓              |
| McDonnell Douglas Corp.     | ✓            | ✓         | ✓            | ✓              |
| Mitsubishi                  |              |           | ✓            |                |
| SAE International           | ✓            | ✓         | ✓            | ✓              |
| Irkut Sukhoi Superjet       |              |           | ✓            |                |
| Tupolev (Tu-204 and Tu-214) |              |           | ✓            |                |

<sup>1</sup>Skydrol 500B-4 is not approved in A320NEO family. Skydrol 500B-4 and LD-4 are not approved in A350 or A380. All Skydrol fluids, including Skydrol 5, are approved in A220.

<sup>2</sup>Skydrol hydraulic fluids are not approved in B787.

<sup>3</sup>Skydrol 500B-4 is not approved in Global Express.

<sup>4</sup>Skydrol 5 and Skydrol 500B-4 are not approved in G6 series.





## What physical properties does your fleet require in a hydraulic fluid?

| Property  | Units           | Skydrol PE-5                     | Skydrol 5                        | Skydrol LD-4                     | Skydrol 500B-4                   | Test method     |
|---|-----------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|-----------------|
| <b>Viscosity</b><br>-65°F/-54°C<br>100°F/38°C<br>210°F/99°C | cSt             | 1068<br>9.75<br>3.38             | 2085<br>9.23<br>3.13             | 1164<br>11.10<br>3.91            | 2678<br>11.67<br>3.84            | ASTM D445       |
| <b>Pour point</b>   | °F<br>°C        | <-80<br><-62                     | <-80<br><-62                     | <-80<br><-62                     | <-80<br><-62                     | ASTM D97        |
| <b>Specific gravity @ 25°C</b>                              | °C              | 0.996                            | 0.977                            | 1.011                            | 1.056                            | Eastman 116-B   |
| <b>Density @ 25°C</b>                                       | g/cc<br>lb/gal  | 0.9927<br>8.284                  | 0.9737<br>8.126                  | 1.0080<br>8.412                  | 1.0532<br>8.789                  | Eastman 116-B   |
| <b>Acid number</b>  | mg KOH/g        | 0.03                             | 0.03                             | 0.03                             | 0.03                             | ASTM D974       |
| <b>Moisture content</b>                                     | %w/w            | 0.07                             | 0.07                             | 0.07                             | 0.07                             | ASTM D1744      |
| <b>Foaming</b><br>Sequence 1<br>Sequence 2<br>Sequence 3    | mL, sec         | 109, 53<br>54, 30<br>157, 59     | 79, 30<br>57, 32<br>81, 32       | 50, 25<br>10, 5<br>40, 20        | 100, 35<br>20, 15<br>110, 40     | ASTM D892-63    |
| <b>Particle count</b>                                       |                 | AS4059 Class 7 or better         |                                  |                                  |                                  | SAE ARP598      |
| <b>Specific heat</b><br>38°C<br>93°C<br>120°C<br>149°C      | cal/g/°C        | 0.453<br>—<br>0.461<br>—         | 0.402<br>0.437<br>—<br>0.472     | 0.437<br>0.472<br>—<br>0.507     | 0.418<br>0.453<br>—<br>0.487     | ASTM D2766      |
| <b>Thermal conductivity</b><br>100°F<br>200°F<br>300°F      | cal/(sec·cm·°C) | 0.000344<br>0.000289<br>0.000263 | 0.000283<br>0.000259<br>0.000246 | 0.000326<br>0.000298<br>0.000277 | 0.000315<br>0.000299<br>0.000278 | ASTM D2717      |
| <b>Surface tension @ 25°C</b>                               | dynes/cm        | 29.4                             | —                                | 28.2                             | 26.7                             | Du Noüy balance |
| <b>Heat of combustion</b>                                   | BTU/lb          | 13,291                           | 13,100                           | 13,700                           | 13,400                           | ASTM D240       |
| <b>Bulk modulus</b>   | psi             | 235,000                          | 210,000                          | 231,000                          | 242,000                          | BMS3-11         |
| <b>Four-ball wear test</b><br>4 kg<br>10 kg<br>40 kg        | mm              | 0.30<br>0.41<br>0.65             | 0.20<br>0.46<br>0.77             | 0.33<br>0.43<br>0.69             | 0.36<br>0.45<br>0.68             | ASTM D4172      |

## Fire-resistance properties

| Property                   | Units | Skydrol PE-5          | Skydrol 5             | Skydrol LD-4          | Skydrol 500B-4        | Test method |
|----------------------------|-------|-----------------------|-----------------------|-----------------------|-----------------------|-------------|
| <b>Flash point</b>         | °F/°C | 339/171               | 331/166               | 346/174               | 366/186               | ASTM D92    |
| <b>Fire point</b>          | °F/°C | 376/191               | 362/183               | 360/182               | 410/210               | ASTM D92    |
| <b>AIT</b>                 | °F/°C | 796/424               | 871/466               | 877/469               | 957/514               | ASTM D2155  |
| <b>Hot manifold drip</b>   |       | Does not burn in tray | Does not burn in tray | Does not burn in tray | Does not burn in tray | AMS 3150C   |
| <b>High-pressure spray</b> |       | Will not ignite       | Will not ignite       | Will not ignite       | Will not ignite       | AMS 3150C   |
| <b>Low-pressure spray</b>  |       | No increase           | No increase           | No increase           | No increase           | AMS 3150C   |
| <b>Wick flammability</b>   |       | >40 cycles            | >40 cycles            | >40 cycles            | >40 cycles            | AMS 3150C   |

*These data are based on samples tested in the laboratory and are not guaranteed for all samples. Contact us for complete sales specifications. Does not constitute an express warranty. See disclaimer on the back of this bulletin.*

If you'd like help selecting the best fluid for your fleet, contact your Eastman aviation representative or contact us at [Eastman.com/Aviation](http://Eastman.com/Aviation).



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