

**Core Requirement Specification for Aircraft
Gas Turbine Engine Lubricants**

1. SCOPE:

This Core Specification is intended as a standardization document for the basic performance requirements for 5 cSt grade aircraft gas turbine engine lubricants. It will be subject to change to keep pace with experience and technical advances.

1.1 Purpose:

The purpose of this document is to present an industry wide core set of requirements which represent the minimum properties and characteristics that lubricants for aircraft gas turbine engines and related components should possess prior to more extensive evaluations of candidate products. The information contained herein consists of agreed properties and characteristics, test methods and requirements governing lubricants grades for aviation gas turbine engines. It is intended that this document reflect currently accepted thinking within industry and government agencies involved in the approval process of lubricants for aviation propulsion systems.

These requirements are intended to complement the full set of requirements of current specifiers. This Core Specification can be part of a lubricant approval and procurement process; by itself, it cannot be used for approval or procurement purposes.

Specifications from which some of the requirements in this document have been derived and/or those which benefit from the publication and maintenance of this document are listed in the reference section.

This issue covers the Standard Grade (STD) only. The STD grade is identified by the NATO Code Number O-156.

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1.2 Field of Application:

The requirements included herein focus primarily on the lubrication needs of aircraft gas turbine engines. The lubrication of associated equipment is included where specific compatible needs were identified for such equipment. Additional specific testing, tailored to the intended applications, will be considered by the industry and government agencies involved in the lubricant approval process.

2. REFERENCES:

2.1 Related Publications:

The following publications are provided for information purposes only.

2.1.1 Aircraft Lubricant Specifications:

MIL-PRF-23699F, Lubricating Oil, Aircraft Turbine Engine, Synthetic Base, STD Grade, 21 May 1997, US Department of Defense

DEF STAN 91-101/Issue 2 (DERD2499), Lubricating Oil Gas Turbine Engine, Synthetic Grade 5 cSt, JSD OX-27, 31 December 1997, UK Ministry of Defence

PWA521 (Type II, 5 cSt), Lubricant, Aircraft Turbine Engine, Synthetic Base, June 9, 1966, Pratt and Whitney

D50TF1, Lubricating Oil, Aircraft Gas Turbine, February 7, 1995, GE Aircraft Engine

2.1.2 Testing Standards:

FED-STD-791 - Lubricant, Liquid Fuel, and Related Products; Methods of Testing

ASTM - Committee D-2 Standards on Petroleum Products and Lubricants

IP - Institute of Petroleum Standards Methods

Def Stan 05-50 (Part 61) Methods for Testing Gas Turbine Engine Synthetic Lubricants

SAE - Standards and Practices

3. DEFINITIONS:

PERFORMANCE REQUIREMENTS: Requirements based on commonly used and/or accepted methods in the current process for the initial approval of the product.

STANDARD GRADE LUBRICANT: Standard Grade (STD) lubricant defined in the specifications listed in 2.1, also assigned NATO Code Number O-156.

4. COMMON PROPERTIES AND TEST:

This section lists the properties/characteristics, test methods and limits (requirements) considered the minimum that lubricants for aircraft gas turbine engine and related components typically associated should possess. The properties/characteristics are grouped into the following categories:

1. Materials/Chemistry
2. Physical Properties
3. Compatibility
4. Stability
5. Deposition and Degradation
6. Lubricating Characteristics

The requirements for testing in each of these categories are detailed in 4.1 to 4.6.

4.1 Materials and Chemical Properties:

- 4.1.1 **General:** This section contains requirements and regulatory information for the finished product and restrictions related to the materials used to manufacture the product.
- 4.1.2 **Regulatory Requirements:** Aviation turbine lubricants must comply with all legal, environmental, toxicological and regulatory requirements of the countries in which the products are manufactured and sold. A Materials Safety Data Sheet (MSDS) or other applicable document should be available to cover these regulatory requirements.
- 4.1.3 **Composition:** The composition of the lubricating oil is not limited, except that additives containing barium or organic compounds of titanium are prohibited. If a tricresyl phosphate (TCP) additive is used, the TCP additive shall not contain more than 1% by weight of the ortho isomer of tricresyl phosphate.

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TABLE 1 - Material and Chemical Properties

Standard Property/Characteristic	Performance Method	Performance Requirement
Basestock Characterization	FED-STD-791 Method 3500 (1)	Report Acid Assay
TAN mg KOH/g Finished Product	ARP5088	1.0 max
Contamination:		
Sediment	FED-STD-791 Method 3010	Sed: 10 mg/LI max Ash: 1 mg/L max (2) No undissolved water
Trace Metals (ppm, maximum)	See Note (3)	Al 2 Fe 2 Cr 2 Ag 1 Cu 1 Sn 11/4 (4) Mg 2 Ni 2 Ti 2 Si 10 Pb 2 Mo 3 Zn 2

NOTES:

1. Alternative methods may be applicable, e.g., Def. Stan 05-50, Part 61, Method 21 which is a method currently under development - FED-STD-791, Method 3500, shall be used as the reference method.
2. If the total sediment does not exceed 1 mg/L, the ash content requirement shall be waived.
3. The trace metal content of the lubricant shall be determined with an atomic emission spectrometer, using a facility which has been agreed upon with a qualifying activity. Appropriate spectrometric calibration standards, covering the concentration ranges of interest, should be utilized.
4. The limits apply to testing performed in the Department of Defense Joint Oil Analysis Program, Pensacola, FL. For other spectrometers and test methods, the Sn limit is 4 ppm.

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4.2 Physical Properties:

4.2.1 General: This section pertains to the requirements related to the general physical properties of the materials used to manufacture the product.

Those physical properties which relate specifically to the lubricating function of the product are included in the Lubricating Characteristics and Properties section.

TABLE 2 - Physical Properties

Standard Property/Characteristic	Performance Method	Performance Requirement
Density at 15 °C kg/m ³	ASTM D 4052	Report
Specific Heat joules/kg °C, at nominated temperature °C	ASTM D 2766	Report
Thermal Conductivity	Report	Report
Electrical Conductivity	Report	Report
Viscosity cSt @ 200 °C (392 °F)	ASTM D 341	Report
100 °C (212 °F)	ASTM D 445/IP71	4.9 to 5.4
40 °C (104 °F)	ASTM D 445/IP71	23.0 min
-40 °C (-40 °F)	ASTM D 445/IP71	13,000 max
Viscosity Stability % change at -40 °C (°F) (72 h)	ASTM D 2532	Max ±6
Pour Point °C (°F), max	ASTM D 97/IP15	-54 °C (-65 °F)
Flash Point °C (°F), min	ASTM D 92/IP36	246 °C (475 °F)
Auto Ignition °C	Report	Report
Evaporation Ambient: Sea level	ASTM D 972 @ 204 °C (400 °F), 6.5 h	10% max
Foaming Tendency Foaming Test, sequence I, II, III mL	ASTM D 892/IP146	25 to 0 max (1)
Shear Stability, Visc % change @ 40 °C (104 °F)	ASTM D 2603	4 max

NOTE:

1. Volume during aeration - Volume after 1 min settling.

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4.3 Compatibility:

TABLE 3 - Compatibility

Standard Property/Characteristic	Performance Method	Performance Requirement
Compatibility with Other Lubricants	FED-STD-791 Method 3403 mod (1)	10 mg/L max
Compatibility with Elastomers		
Fluorocarbon Elastomers - AMS 3217/4	FED-STD-791 Method 3604	Relevant MIL-PRF-23699 limit
NOTE:		
1. Per 4.4.1 of MIL-PRF-23699F.		

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4.4 Stability:

TABLE 4 - Stability

Standard Property/Characteristic	Performance Method	Performance Requirement
Thermal & Corrosivity 274 °C (525 °F) (96 h)	FED-STD-791 Method 3411	
Viscosity Change, %		±5.0
TAN Change		±6.0
Metal Wt. Change, mg/cm ²		±4.0
Corrosion & Oxidation	FED-STD-791 Method 5308 mod (1)	
175 °C, 72 h:		
Viscosity Change, %		-5 to +15
TAN Change, mg KOH/gm		2.0 max
Sediment, mg/100 mL		50 max
Metal Wt. Change, mg/cm ²		
Steel		±0.2
Silver		±0.2
Aluminum		±0.2
Magnesium		±0.2
Copper		±0.4
204 °C, 72 h:		
Viscosity Change, %		-5 to +25
TAN Change		3.0 max
Sediment, mg/100 mL		50 max
Metal Wt. Change, mg/cm ²		
Steel		±0.2
Silver		±0.2
Aluminum		±0.2
Magnesium		±0.2
Copper		±0.4
Titanium		
218 °C, 72 h:		
Viscosity Change, %		Report
TAN Change		Report
Sediment, mg/100 mL		50 max
Metal Wt. Change, mg/cm ²		
Steel		±0.2
Silver		±0.2
Aluminum		±0.2
Titanium		±0.2
Hydrolytic, 98 °C	DS 05-50 part 61 Meth. 6	Report