



Ministry of Defence Defence Standard 91-98

Issue 2 Publication Date 7 December 2001

**Lubricating Oil, Gas Turbine
Engine, Synthetic Grade 7.5 cSt
NATO Code: O-149
Joint Service Designation: OX-38**



AMENDMENT RECORD

Amd No	Date	Text Affected	Signature and Date

REVISION NOTE

This Defence Standard has been revised to bring the test methods in to line with up to date requirements and to replace Product Qualification Approval (PQA) with Product Conformity Certification (PCC).

HISTORICAL RECORD

This standard supersedes the following:

Def Stan 91-98 Issue 1 dated 7 October 1994
DERD 2487 Issue 4 dated 16 May 1960

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PREFACE

LUBRICATING OIL, GAS TURBINE ENGINE: SYNTHETIC GRADE 7.5 cSt

NATO CODE: O-149

JOINT SERVICE DESIGNATION (JSD): OX-38

- a.** This standard provides requirements for a synthetic Gas Turbine Engine Lubricating Oil, Grade 7.5 cSt.
- b.** This standard has been produced on behalf of the Standardization Advisory Group (SAG) by the Joint Petroleum Products Subcommittee (JPPSC) (E10).
- c.** The Technical Authority of this Defence Standard is the Defence Fuels Group, Defence Petroleum Centre, Ministry of Defence.
- d.** This standard has been agreed by the authorities concerned with its use and is intended to be used whenever relevant in all future designs, contracts, orders etc. and whenever practicable by amendment to those already in existence. If any difficulty arises which prevents application of the Defence Standard, the Directorate of Standardization (DStan) shall be informed so that a remedy may be sought.
- e.** Any enquiries regarding this standard in relation to an invitation to tender or a contract in which it is incorporated are to be addressed to the responsible technical or supervising authority named in the invitation to tender or contract.
- f.** Compliance with this Defence Standard shall not in itself relieve any person from any legal obligations imposed upon them.
- g.** This standard has been devised solely for the use of the Ministry of Defence (MOD) and its contractors in the execution of contracts for the MOD. To the extent permitted by law, the MOD hereby excludes all liability whatsoever and howsoever arising (including, but without limitation, liability resulting from negligence) for any loss or damage however caused when the standard is used for any other purpose.

TEXT**LUBRICATING OIL, GAS TURBINE ENGINE: SYNTHETIC GRADE, 7.5 cSt****NATO CODE: O-149****JOINT SERVICE DESIGNATION (JSD): OX-38****SECTION 1 GENERAL REQUIREMENTS****1 SCOPE**

1.1 This Defence Standard specifies the requirements for one grade of synthetic lubricating oil intended primarily for use in aircraft gas turbine engines and relevant ancillary equipment.

1.2 Lubricating oil provided to this specification shall possess satisfactory performance and properties when used in appropriate vehicles and/or gas turbines and ancillary equipment operated by the Crown.

2 WARNING

The Ministry of Defence (MOD), like its contractors, is subject to both United Kingdom and European laws regarding Health and Safety at Work, without exemption. All Defence Standards either directly or indirectly invoke the use of processes and procedures that could be injurious to health if adequate precautions are not taken. Defence Standards or their use in no way absolves users from complying with statutory and legal requirements relating to Health and Safety at Work.

3 RELATED DOCUMENTS

3.1 The publications shown in **Annex B** are referred to in the text of this standard. Publications are grouped and listed in alphanumeric order.

3.2 Reference in this standard to any related document means in any invitation to tender or contract the edition and all amendments current at the date of such tender or contract unless a specific edition is indicated.

3.3 In consideration of **3.2** above, users shall be fully aware of the issue and amendment status of all related documents, particularly when forming part of an invitation to tender or contract. Responsibility for the correct application of standards rests with users.

3.4 DStan can advise regarding where related documents are obtained from. Requests for such information can be made to the DStan Helpdesk. How to contact the Helpdesk is shown on the outside rear cover of this Def Stan.

SECTION 1 GENERAL REQUIREMENTS

4 MATERIALS

4.1 The lubricating oil shall consist of a stable homogeneous blend of synthetic base oil and suitable additives.

4.2 The Ministry of Defence reserves the right to require that the oil and any components used are subjected to toxicological and physiological tests to ascertain their suitability for use.

5 PRODUCT CONFORMITY CERTIFICATION

5.1 Product Conformity Certification (PCC) procedure applies to product supplied for MoD use against this standard.

5.2 Before any product can be considered as complying with this standard, the manufacturer must demonstrate to the Technical Authority that the product meets all the requirements of this standard including those of **Annex A**. At this time a declaration, in confidence, of the formulation including source and identification of all components, and place of manufacture is required. The Technical Authority will then assign a unique identification reference to this product, which becomes a Technically Acceptable Product. The Authority will maintain a list of Technically Acceptable Products in a Technically Acceptable Products List (TAPL).

5.3 Once accepted as a Technically Acceptable Product, no change to the product so referenced shall be made without prior notification to the Technical Authority. Only those products that are listed on the TAPL may be stated as complying with the requirements of this specification.

5.4 Before any changes are made to the product, the supplier shall notify the Technical Authority of the proposed changes. The supplier shall also certify that the performance of the product as defined by **Table 1** has not been impaired by the changes. Evidence supporting this certification shall be provided to the Technical Authority and shall include the necessary OEM approvals (see **Annex A**). Once such certification and evidence has been received, the changed product will be assigned a new discrete identification reference number, and will be added to the TAPL.

5.5 When supplying products to the MoD, the supplier shall certify that:

5.5.1 The product delivered complies with the formulation declared under clause **5.2** or **5.4** of this specification.

5.5.2 Representative samples of the finished product comply with the requirements of tests 1 to 9 of **Table 1**. The Technical Authority reserves the right to require additional evidence that the product is compliant.

5.6 If any sample taken from the consignment is found not to comply with any of the requirements of this standard, the whole consignment may be rejected.

SECTION 2 TEST REQUIREMENTS

6 TESTING

6.1 Properties of the product shall not exceed the maximum nor be less than the minimum values set out in **Table 1**.

6.2 Methods quoted in the table are referee methods and shall be used in cases of dispute. Alternative technically equivalent methods may be used with the agreement of the responsible Technical Authority. Alternative methods that are jointed with the referee methods are identified in **Annex B**. Jointed methods may be used in lieu of the referee methods without restriction provided that their jointed status is in existence at the time of use.

6.3 IP 367, which covers the use of precision data, shall be used for the interpretation of test results.

7 KEEPING QUALITIES

The product, when suitably stored in its original sealed containers shall retain the properties described in this Standard for a period of not less than 12 months in temperate climates and not less than six months in tropical climates, from the date defined in the contract.

8 CONTAINERS AND MARKING OF CONTAINERS

8.1 The product shall be supplied in sound, clean and dry containers, suitable for the product and in accordance with the requirements of the contract or order.

8.2 Coatings and paint finishes shall comply with the requirements for the contract or order. Markings shall be in accordance with the requirements of Def Stan 05-52 (Part 1). The product identification shall be as specified in the contract or order.

8.3 It shall be the responsibility of the contractor to comply with any legal requirements for the marking of containers.

SECTION 2 TEST REQUIREMENTS

Table 1 Test Requirements				
Test	Property	Units	Limits	Method
1	Appearance		Clear, bright and free from undissolved water, sediments and other impurities	Visual examination
2	Density at 15 °C	kg m ⁻³	Report	IP 365
3	Flash Point	°C	Min 216	IP 36
4	Pour Point	°C	Max Minus 54	IP 15
5	Total Acid Number:			SAE ARP 5088
5.1	Base Stock	mg KOH g ⁻¹	Max 0.1	
5.2	Fully Formulated Oil	mg KOH g ⁻¹	Report	
6	Viscosity, Kinematic:			IP 71
6.1	at 100 °C	mm ² s ⁻¹	Min 7.35	
6.2	at 40 °C	mm ² s ⁻¹	Max 36.0	
6.3	at Minus 40 °C	mm ² s ⁻¹	Max 13000	
7	Foaming Characteristics Sequences I, II and III:			IP 146
7.1	Tendency	ml	Max 25	Report the Stability after 1 minute
7.2	Stability	ml	Max Nil	

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Table 1 Test Requirements (Continued)				
Test	Property	Units	Limits	Method
8	Solid Particle Contamination:			FED-STD-791 Method 3010
8.1	Sediment	mg l ⁻¹	Max 10	
8.2	Total Ash of Sediment (See NOTE 1)	mg l ⁻¹	Max 1	
9	Trace Element Content:			Atomic Emission Spectrometry (See NOTE 2)
	Aluminium	mg kg ⁻¹	Max 2	
	Iron	mg kg ⁻¹	Max 2	
	Chromium	mg kg ⁻¹	Max 2	
	Silver	mg kg ⁻¹	Max 1	
	Copper	mg kg ⁻¹	Max 1	
	Tin	mg kg ⁻¹	Max 4 (See NOTE 3)	
	Magnesium	mg kg ⁻¹	Max 2	
	Nickel	mg kg ⁻¹	Max 2	
	Titanium	mg kg ⁻¹	Max 2	
	Silicon	mg kg ⁻¹	Max 10	
	Lead	mg kg ⁻¹	Max 2	
	Molybdenum	mg kg ⁻¹	Max 3	
	Zinc	mg kg ⁻¹	Max 2	
10	Confined Heat Stability:			Def Stan 05-50 (Part 61) Method 1
10.1	S Temperature after 192 Hours (S ₃ ¹⁹²)	°C	Min 265	
10.2	Viscosity Stability at 100 °C: Viscosity Decrease	%	Max 5.0	

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Table 1 Test Requirements (Continued)				
Test	Property	Units	Limits	Method
11	Corrosivity Weight Change:			Def Stan 05-50 (Part 61) Method 3
11.1	Procedure 1; Magnesium Alloy Aluminium Mild Steel Soldered Copper Lead Copper Brass	mg cm ⁻² mg cm ⁻² mg cm ⁻² mg cm ⁻² mg cm ⁻² mg cm ⁻² mg cm ⁻²	Report Minus 0.1 to Plus 0.1 Minus 0.1 to Plus 0.1 Minus 0.5 to Plus 0.1 Report Minus 0.2 to Plus 0.1 Minus 0.5 to Plus 0.1	
11.2	Procedure 2; Tin Nickel Silver Copper	mg cm ⁻² mg cm ⁻² mg cm ⁻² mg cm ⁻²	Minus 0.1 to Plus 0.1 Minus 0.1 to Plus 0.1 Minus 0.1 to Plus 0.1 Minus 0.1 to Plus 0.1	
11.3	Appearance of All the Metal Specimens After Test		Report	Visual examination (under 10 X magnification)
12	Elastomer Compatibility:			Def Stan 05-50 (Part 61) Method 22
12.1	Weight Change (after 24 hours); Nitrile Fluorocarbon LCS Fluorocarbon Silicone	% mass % mass % mass % mass	Report Report Report Report	.
12.2	Weight Change (after 120 hours); Nitrile Fluorocarbon LCS Fluorocarbon Silicone	% mass % mass % mass % mass	Report Report Report Report	
12.3	Embrittlement Procedure		Report	

(Continued on page 9)

Table 1 Test Requirements (Continued)				
Test	Property	Units	Limits	Method
13	Miscibility and Compatibility (See NOTES 4 and 5):			Def Stan 05-50 (Part 61): Method 8; Procedure A
13.1	Miscibility at 210 °C		There shall be no visible signs of separation, gelation or formation of insoluble matter	
13.2	Miscibility at Minus 40 °C		There shall be no visible signs of separation, gelation or formation of insoluble matter.	Procedure B
13.3	Compatibility, Increase in Toluene Insolubles	% mass	Max 0.05	Procedure C (See NOTE 5)
14	Hydrolytic Stability D ⁹⁰ _{1.5}	hours	Min 24	Def Stan 05-50 (Part 61) Method 6
15	Load Carrying Ability		Report	See NOTE 6
16	High Temperature Oxidative Stability:			Def Stan 05-50 (Part 61) Method 9
16.1	Temperature Parameters after 192 hours; E Temperature A Temperature V Temperature B Temperature Z Temperature	°C °C °C °C °C	Min 160 Min 150 Min 160 Min 170 Min 180	
17	Catalytic Oxidation: Solidus(Z ¹⁹²) Temperature Change	°C	Max 10	Def Stan 05-50(Part 61) Method 14
18	Viscosity Kinematic: High Temperature 200 °C	mm ² s ⁻¹	Min 2.00	IP 71 (See NOTE 7)

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Table 1 Test Requirements (Concluded)				
Test	Property	Units	Limits	Method
19	OEM Certification	N/A	OEM certification is required for unrestricted use in all relevant systems	Annex A
<p>NOTE 1 If the total sediment does not exceed 1 mg/l, the ash content requirement shall be waived.</p> <p>NOTE 2 The trace metal content of the lubricant shall be determined with an atomic emission spectrometer. Appropriate spectrometric calibration standards, covering the concentration ranges of interest, shall be used.</p> <p>NOTE 3 When testing is performed by a facility in the US Department of Defence Joint Oil Analysis Program, Pensacola, FL, USA, the limit for Tin is 11 mg/kg. For other spectrometers and test methods, the limit for tin is 4 mg/kg.</p> <p>NOTE 4 Miscibility and compatibility is to be shown for all oils complying with the requirements of this standard and Def Stan 91-94.</p> <p>NOTE 5 The test temperature shall be 170 °C for demonstrating compatibility with oils to this standard and Def Stan 91-94.</p> <p>NOTE 6 This Test Method is under review. Until further notice the test to be applied will be IP 166 Condition A and C with the procedures modified as follows:</p> <ol style="list-style-type: none"> 1. Test oil temperature of 110 °C for both conditions. 2. All four tests shall first be run on Reference oil RDE/O/623 and the reverse faces of the four gears used to determine the failure modes. Neither oil shall be changed for the other during the sequence of four tests with different gears. 3. All eight gears used (Condition A and C) shall be from the same batch of gears. 4. The test report shall identify each pair of results comprising the means of the initial and complete failure loads obtained for the reference oil and test oil on opposite faces of the same gear. 5. Calculate individual relative failure loads by expressing, for each paired result, the test oil results as a percentage of the reference oil results. <p>Alternatively, with the agreement of the technical authority, the Aviation Lubricant Tribology Evaluator (ALTE), SAE AIR 4978, may be used.</p> <p>NOTE 7 As an alternative to determining the viscosity at 200 °C by IP 71, the value may be estimated by extrapolation from viscosity determinations at 40 °C and 100 °C.</p>				

ANNEX A

**ORIGINAL EQUIPMENT MANUFACTURER (OEM) APPROVAL OF THE
PRODUCT**

A.1 PRODUCTS ASSIGNED JSD OX-38

The products defined by this specification shall be approved by the appropriate OEMs for use in certain aircraft systems operated by the MoD. Details of the OEMs and the systems for which approval must be sought may be obtained from the address below.

AFTM
Defence Fuels Group
Defence Petroleum Centre
West Moors
Wimborne
Dorset
BH21 6QS

ANNEX B

RELATED DOCUMENTS

Designation	Title
IP 15 (ASTM D97, ISO 3016, BS2000:Part 15)	Determination of Pour Point.
IP 36 (ASTM D92)	Determination of Open Flash and Fire Point – Cleveland Method.
IP 71 (ASTM D445, ISO 3104 BS2000: Part 71)	Determination of Kinematic Viscosity and Calculation of Dynamic Viscosity.
IP 146 (ASTM D892, BS2000: Part 146)	Determination of Foaming Characteristics of Lubricating Oils.
IP 166	Determination of Load-Carrying Capacity of Lubricants – IAE Gear Machine Method.
IP 365 (ISO 12185, BS2000: Part 365)	Determination of Density – Oscillating U-Tube Method.
IP 367 (BS2000: Part 367 BS EN ISO 4259)	Method for Determination and Application of Precision Data in Relation to Methods of Test for Petroleum Products.
Def Stan 05-50: (Part 61); Method 1 Method 3 Method 6 Method 8 Method 9 Method 14 Method 22	Methods for Testing Fuels, Lubricants, and Associated Products: Methods for Testing Gas Turbine Engine Synthetic Lubricants; Confined Heating Stability. Corrosivity. Hydrolytic Stability. Miscibility and Compatibility. Resistance to Oxidation and Thermal Decomposition. Catalytic Oxidation Test. Assessment of the Compatibility of Gas Turbine Lubricants with Elastomers.
Def Stan 05-52 (Part 1)	Markings for the Identification of Fuels, Lubricants and Associated Products: Containers Holding 216.5 Litres or Less.
Def Stan 91-94	Lubricating Oil, Gas Turbine Engine, Synthetic Grade 3 cSt. Joint Service Designation OX-7.
FED-STD-791 No 3010	Solid Particle Contamination in Aircraft Turbine Engine Lubricants (Gravimetric Procedure).
SAE AIR 4978	Temporary Methods for Assessing the Load Carrying Capacity of Aircraft Propulsion Systems.
SAE ARP 5088	Test Method for the Determination of Total Acidity in Polyol Ester and Diester Gas Turbine Lubricants by Automatic Potentiometric Titration.

Inside Rear Cover

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Defence Standards are Published by and Obtainable from:

Defence Procurement Agency
An Executive Agency of The Ministry of Defence
Directorate of Standardization
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File Reference

The DStan file reference relating to work on this standard is D/DStan/91/98.

Contract Requirements

When Defence Standards are incorporated into contracts users are responsible for their correct application and for complying with contractual and statutory requirements. Compliance with a Defence Standard does not in itself confer immunity from legal obligations.

Revision of Defence Standards

Defence Standards are revised as necessary by up issue or amendment. It is important that users of Defence Standards should ascertain that they are in possession of the latest issue or amendment. Information on all Defence Standards is contained in Def Stan 00-00 Standards for Defence Part 3 , Index of Standards for Defence Procurement Section 4 'Index of Defence Standards and Defence Specifications' published annually and supplemented regularly by Standards in Defence News (SID News). Any person who, when making use of a Defence Standard encounters an inaccuracy or ambiguity is requested to notify the Directorate of Standardization (DStan) without delay in order that the matter may be investigated and appropriate action taken.