Ministry of Defence

Defence Standard

91-91/Issue 3 (DERD 2494) **12 November 1999**

TURBINE FUEL, AVIATION KEROSINE TYPE, JET A-1

NATO CODE: F-35

JOINT SERVICE DESIGNATION: AVTUR

Reprinted 31 May 2001
Incorporating Amendment 1

This Defence Standard supersedes
Def Stan 91-91/Issue 2
dated 5 May 1996

DEF STAN 91-91/3 (DERD 2494)

AMENDMENTS ISSUED SINCE PUBLICATION

AMD NO	DATE OF ISSUE	TEXT AFFECTED	SIGNATURE & DATE

Revision Note

This Defence Standard has been reprinted to incorporate Amendment 1 which revised clauses 4.1 and B.4.4

Historical Record

Def Stan 91-91 Issue 2 dated 8 May 1996
Def Stan 91-91 Issue 1 dated 1 September 1994
DERD 2494 Issue 10 dated 30 June 1988

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PREFACE

This Defence Standard supersedes
Defence Standard 91-91/2 dated 8 May 1996

i This Defence Standard specifies the requirements for Aviation Turbine Fuel, Kerosine Type, JET A-1.

ii This Standard has been produced for the Defence Materials Standardization Development and Management Committee (DMSDMC) in collaboration with the UK Aviation Fuels Committee (AFC).

iii 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 shall be informed so that a remedy may be sought.

iv 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.

v This Standard has been devised for the use of the Crown and its contractors in the execution of contracts for the Crown. The Crown hereby excludes all liability (other than liability for death or personal injury) whatsoever and howsoever arising (including, but without limitation, negligence on the part of the Crown its servants or agents) for any loss or damage however caused where the Standard is used for any other purpose.

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0 Introduction

Defence Standard 91-91 is the specification for aviation turbine fuel which the United Kingdom Civil Aviation Authority (CAA) has agreed is under the technical authority of DFS (Air).

1 Scope

This Defence Standard specifies the requirements for one grade of kerosine type aviation turbine fuel intended for use in aircraft gas turbine engines. Fuel provided to this Standard shall possess satisfactory performance and properties when used in appropriate aircraft or engines operated by the Crown, or for which the Civil Aviation Authority is the certificating agency.

2 WARNING

This Standard calls for the use of substances and/or procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and in no way absolves either the designer, the producer, the supplier or the user from statutory and all other legal obligations relating to health and safety at any stage of manufacture or use.

3 Related Documents

3.1 The documents and publications referred to in this Standard are listed in annex F.

3.2 Reference in this Standard to any related documents or test means the latest published versions at the time of test unless otherwise stated.

3.3 Related documents can be obtained from the addresses shown in annex F.

4 Materials

4.1 The fuel shall consist wholly of hydrocarbon compounds derived from conventional sources including crude oil, natural gas liquid condensates, heavy oil, oil shale and oil sands, and qualified additives as listed in annex A. Fuels containing synthetic components derived from non petroleum sources are only permitted provided that they meet the requirements defined in annexes A and D in addition to those defined in Section 5. Only additives and non-petroleum fuel components approved by and on behalf of the UK Aviation Fuels Committee shall be permitted.

4.2 Additives shall be identified by the appropriate RDE/A/XXX number shown in annex A. The amount, including NIL additions, of all additive additions shall be reported to the purchaser on batch quality certificates or as otherwise directed by the purchase and/or contract.

4.3 Additional information on aviation turbine fuel lubricity can be found in annex B.

5 Testing

5.1 Properties of the product shall not exceed the maximum nor be less than the minimum values set out in table A when tested by the methods refereed to therein or in annex C.

NOTE: The ISO 4259 procedure, which covers the use of precision data, may be used for the interpretation of test results in cases of dispute between purchaser and supplier.

5.2 Methods quoted in Table A are referee methods. Alternative technically equivalent methods may be used with agreement of the responsible technical or supervising authority. In cases of dispute the referee methods shall be used. Approved alternative methods are listed in annex C. A list of ISO test methods which were technically equivalent to the IP test methods at the time of issue of the specification can be found at annex E.

NOTE: Alternative properties identified in Table A, 5.1 or 5.2 are equal primary requirements. Compliance with either of the alternatives confirms acceptance of the parameter. The alternative method 2.5 is a secondary requirement to 2.4. In the event of conflict between Sulfur Mercaptan (2.4) and Doctor Test (2.5) results, method 2.4 shall prevail.

5.3 For synthetic blends referee methods will be used. Use of alternative technically equivalent methods may be used following the approval of the specification authority.

Table A - Test Requirements

Test No	Property	Units	Limits	Test Method
1	Appearance		Clear, bright and visually free from solid matter and undissolved water at ambient temperature	Visual
2	Composition			
2.1	Total Acidity	mg KOH/g	Max 0.015	IP354/ASTM D3242
2.2	Aromatics	% v/v	Max 25.0	IP156/ASTM D1319
2.3	Sulfur, Total	% m/m	Max 0.30	IP336
2.4 or 2.5	Sulfur, Mercaptan Doctor Test	% m/m	Max 0.0030 Doctor negative	IP342/ASTM D3227 IP30
2.6	Refining Components, at point of manufacture			
2.6.1	Hydroprocessed Components	% v/v	Report	(See NOTE 1)
2.6.2	Severely Hydroprocessed Components	% v/v	Report	
3.	Volatility:			
3.1	Distillation:			IP123/ASTM D86
3.1.1	Initial Boiling Point	°C	Report	
3.1.2	10% Recovery	°C	Max 205	
3.1.3	50% Recovery	°C	Report	
3.1.4	90% Recovery	°C	Report	
3.1.5	End Point	°C	Max 300	
3.1.6	Residue	% v/v	Max 1.5	
3.1.7	Loss	% v/v	Max 1.5	

Notes applicable to this table are on page 7. (Continued on page 6)

Table A - Continued

Test No	Property	Units	Limits	Test Method
3.2	Flash Point	°C	Min 38.0	IP170 (see NOTE 2)
3.3	Density at 15°C	kg/m^3	Min 775 Max 840	IP365/ASTM D4052 (see NOTE 3)
4	Fluidity:			
4.1	Freezing Point	°C	Max minus 47.0	IP16/ASTM D2386
4.2	Viscosity at Minus 20°C	$mm^2/_S$	Max 8.0	IP71/ASTM D445
5	Combustion:			
5.1 or	Smoke Point	mm	Min 25	IP57/ASTM D1322
5.2	Smoke Point	mm	Min 19	IP57/ASTM D1322
	and Naphthalenes	% v/v	Max 3.0	ASTM D1840
5.3	Specific Energy	MJ/kg	Min 42.8	(See NOTE 4)
6	Corrosion			
6.1	Copper Strip	Class	Max 1	IP154/ASTM D130
7	Thermal Stability, JFTOT at CONTROL TEMP of 260°C:			IP323/ASTM D3241
7.1	Tube Rating Visual		Less than 3. (No peacock (P) or Abnormal (A) deposits	(See NOTE 5)
7.2	Pressure Differential	mm Hg	Max 25	
8	Contaminants:			
8.1	Existent Gum	mg/100 ml	Max 7	IP131/ASTM D381

Notes applicable to this table are on page 7. (Concluded on page 7)

Table A - Concluded

Test No	Property	Units	Limits	Test Method
9	Water Separation Characteristics:			
9.1	Water Reaction Interface	Rating	Max 1b	IP289/ASTM D1094
9.2	Microseparometer, at Point of Manufacture:			ASTM D3948 (See NOTE 6)
9.2.1	MSEP Without SDA	Rating	Min 85	
or 9.2.2	MSEP With SDA	Rating	Min 70	
10	Conductivity			
10.1	Electrical Conductivity	pS/m	Min 50 Max 450	IP274/ASTM D2624 (See NOTE 7)
11	Lubricity	mm	Max 0.85	ASTM D5001 (See NOTE 8)

NOTE 1: Severely hydroprocessed components are defined as petroleum derived hydrocarbons that have been subjected to a hydrogen partial pressure of greater than 7000 kPa (70 bar or 1015 psi) during manufacture. This requirement comes into effect on 1st December 2000.

NOTE 2: Subject to a minimum of 40°C, if results obtained by (Tag) method ASTM D56.

NOTE 3: The referee method is normally IP 365 but for operational quality control purposes IP 160 may be agreed between purchaser and supplier.

NOTE 4: Specific Energy by one of the calculation methods listed at annex C will be acceptable. Where a measurement of Specific Energy is deemed necessary, the method to be used shall be agreed between the purchaser and supplier.

NOTE 5: Examination of the heater tube to determine the Visual Tube Rating using the Visual Tuberator shall be carried out within 120 minutes of completion of the test.

NOTE 6: No precision data are available for fuels containing SDA; if MSEP testing is carried out during downstream distribution no specification limits apply and the results are not to be used as the sole reason for rejection of a fuel.

NOTE 7: The conductivity limits are mandatory for product to meet this specification. However it is acknowledged that in some manufacturing and distribution systems it is more practical to inject Static Dissipator Additive (SDA) further downstream. In such cases the Certificate of Quality for the batch should be annotated thus: "Product meets requirements of Defence Standard 91-91 except for electrical conductivity". Due to the high flow rates and very fine filtration used when fuelling aircraft, it is absolutely essential that these conductivity limits are met at the point of delivery into aircraft.

NOTE 8: This requirement comes into effect on 1st December 2000. The requirement to determine lubricity applies only to fuels containing more than 95% hydroprocessed material where at least 20% of this is severely hydroprocessed (see NOTE 1) and for all fuels containing synthetic components. The limit applies only at the point of manufacture.

6 Containers and Marking of Containers

6.1 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.

6.2 Coatings and paint finishes shall comply with the requirements of 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.

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

List of Qualified Additives

A.1 Antioxidants

A.1.1 Antioxidants or mixtures of antioxidants, of a type detailed in **A.1.4** and at a concentration detailed in **A.1.5**, shall be added to a fuel (or component) which has been hydroprocessed (ie manufactured using a catalytic hydrogen process such as hydrotreating, hydrofining, hydrocracking, etc) or has been synthesised as defined in Annex D. This must be done immediately after hydroprocessing or synthesising and prior to the product or component being passed into storage in order to prevent peroxidation and gum formation after manufacture.

A.1.2 Where a finished fuel comprises a blend of several different components, the requirement for mandatory addition of antioxidant applies only to the portion of the blend that has been hydroprocessed. In such cases, the proportion of the blend which has been hydroprocessed shall be reported.

A.1.3 For fuel (or fuel component) which has not been hydroprocessed, such addition is optional.

A.1.4 The following antioxidant formulations are qualified:

Formulation	Qualification Reference
(a) 2,6-ditertiary-butyl-phenol	RDE/A/606
(b) 2,6 ditertiary-butyl-4-methyl-phenol	RDE/A/607
(c) 2,4-dimethyl-6-tertiary-butyl-phenol	RDE/A/608
(d) 75 percent minimum, 2,6-ditertiary-butyl-phenol 25 percent maximum, tertiary and tritertiary-butyl-phenols	RDE/A/609
(e) 55 percent minimum, 2,4-dimethyl-6-tertiary-butyl-phenol 15 percent minimum, 4 methyl-2,6-ditertiary-butyl-phenol Remainder, 30 percent maximum, as a mixture of monomethyl and dimethyl-tertiary-butyl-phenols	RDE/A/610
(f) 72 percent minimum, 2,4-dimethyl-6-tertiary-butyl-phenol 28 percent maximum, mixture of tertiary-butyl-methyl-phenols and tertiary-butyl dimethyl phenols	RDE/A/611

A.1.5 The concentrations in which the qualified materials shall be used are as follows:

A.1.5.1 Fuels or fuel components which have been hydroprocessed: the total concentration of active material(s) in fuel or that proportion of the fuel blend that has been hydroprocessed shall not be less than 17.0 mg/1 nor exceed 24.0 mg/1.

A.1.5.2 Fuels which have not been hydroprocessed: the total concentration of active material(s) shall not exceed 24.0 mg/1.

A.2 Metal Deactivator (MDA)

A.2.1 An MDA, of a type detailed in **A.2.2** and at a concentration detailed in **A.2.3,** may be added to fuel to counteract the effects of metals known to be deleterious to thermal stability, such as Copper, Cadmium, Iron, Cobalt and Zinc, provided that the nature of the contamination is reported. Where metallic contamination is unproven, an MDA may be used to recover thermal stability provided that the JFTOT Test (in accordance with table A test 7) is determined before and after MDA addition and reported accordingly.

A.2.2 The following material is qualified:

NN'-disalicylidene 1,2-propanediamine.

A.2.3 The concentration of active material used on initial batching of the fuel at the refinery shall not exceed 2.0 mg/l. Cumulative addition of MDA when redoping the fuel shall not exceed 5.7 mg/l. The requirements of **A.2.1** shall be met when redoping.

A.3 Static Dissipator Additive (SDA)

A.3.1 Where necessary an SDA, of a type detailed in **A.3.2** and at a concentration detailed in **A.3.3,** shall be added to the fuel to impart electrical conductivity in accordance with property 10.1 of table A.

A.3.2 The following material is qualified:

Product	Manufacturer	Qualification Reference
Stadis 450	Octel America	RDE/A/621

A.3.3 Concentration and redoping limits:

A.3.3.1 The concentration of SDA to be used in newly manufactured, or on first doping of, fuel is 3.0 mg/l maximum.

A.3.3.2 The cumulative concentration of SDA allowed when redoping fuel to maintain conductivity is 5.0 mg/l maximum.

A.4 Corrosion Inhibitor/Lubricity Improver Additive (CI/LIA)

A.4.1 A CI/LIA, of a type and at a concentration detailed in QPL 68-251 may be added to fuel by agreement between purchaser and supplier. Further information on Aviation Turbine Fuel Lubricity is available at annex B. A suitable method for determining the additive concentration is contained in Defence Standard 05-50 (Part 66).

A.4.2 Because CI/LIA exists in equilibrium with the metal surfaces of fuel distribution systems as well as those of aircraft systems, correct delivery to aircraft can be assured only by equilibration of the supply system downstream of the CI/LIA addition or by additive injection at the point of entry to the aircraft.

A.4.3 Qualified materials, their respective qualification references, quality assurance requirements and the concentration limits applicable at the time of delivery to the purchaser, are listed in QPL 68-251. In civil use other additives may be used provided

that they have been adequately approved in accordance with the certifying authorities and the appropriate aircraft and engine manufacturer.

A.5 Fuel System Icing Inhibitor (FSII)

A.5.1 An FSII, of a type and at a concentration detailed in **A.5.2**, may be added to the fuel by agreement between purchaser and supplier.

A.5.2 The only allowable material is diethylene glycol monomethyl ether (DiEGME) complying with Def Stan 68-252 (DERD 2451) in a concentration not less than 0.10% nor more than 0.15% by volume at the time of delivery to the purchaser. Suitable methods for determining the additive concentration are IP 424 and ASTM D5006.

A.6 Additive Mixtures

A.6.1 When CI/LIA (clause **A.4)** and FSII (clause **A.5**) are to be used together it may be found convenient to add the CI/LIA in a mixture with FSII.

A.6.2 The combined additive concentrate for this purpose is Joint Service Designation AL-48 controlled by Defence Standard 68-150. Whatever blending procedure is adopted, the supplier shall satisfy the purchaser that the correct concentration of additives have been incorporated homogeneously.

A.7 Leak Detection Additives

A.7.1 Where necessary a leak detection additive may be added to the fuel to assist in detecting and locating leaks in ground based fuel storage, delivery and dispensing systems.

A.7.2 The following material is qualified:

Product	Manufacturer	Qualification Reference
Tracer A(LDTA-A®)	Tracer Research Corporation	RDE/A/640

A.7.3 The concentration of Tracer A shall not exceed 1.0 mg/kg.

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Information Statement on Aviation Turbine Fuel Lubricity

B.1 Aircraft/engine fuel system components and fuel control units rely on the fuel to lubricate their moving parts. The effectiveness of a jet fuel as a lubricant in such equipment is referred to as its 'lubricity'. Differences in component design and materials result in varying degrees of equipment sensitivity to fuel lubricity. Similarly, jet fuels vary in their level of lubricity. In-service problems experienced have ranged in severity from reductions in pump flow to unexpected mechanical failure leading to in-flight engine shutdown.

B.2 The chemical and physical properties of jet fuel cause it to be a relatively poor lubricating material under high temperature and high load conditions. Severe hydroprocessing removes trace components, resulting in fuels which tend to have a lower lubricity than straight-run or wet-treated fuels. Certain additives, for example corrosion inhibitors, can improve the lubricity and are widely used in military jet fuels. They have been used occasionally in civil jet fuel to overcome aircraft problems, but only as a temporary remedy while improvements to the fuel system components or changes to fuel were achieved. Because of their polar nature, these additives can have adverse effects on ground-based filtration systems and on fuel-water separation characteristics.

B.3 Some modern aircraft fuel system components have been and are being designed to operate on poor lubricity fuel. With the participation of the international aviation industry the SAE AE-5B group has revised the procedure for the Low Lubricity Endurance Test for aircraft engine fuel pumps, ARP 1797. The procedure now specifies that the test fluid used shall produce a wear scar diameter (wsd) between 0.85 and 0.96 mm as measured by ASTM D5001. The introduction of a lubricity requirement maximum of 0.85 mm wsd is to provide a limit to the fuel lubricity which attempts to ensure that future equipment proven against ARP 1797 procedure does not suffer lubricity related problems in use. The requirement only applies to fuels containing more than 95% hydroprocessed material where at least 20% of this is severely hydroprocessed. All the fuels which have caused problems have been in this category. It has been noted that not all fuels containing severely hydroprocessed components produce a wsd greater than 0.85 mm and this has been taken into account in setting the requirement.

B.4 There are older fuel system components still in use which are more sensitive to fuel lubricity. In these cases the aircraft operator should consult with the equipment manufacturer and fuel supplier to determine the best course of action which may include the use of an approved lubricity additive to enhance the lubricity of a particular fuel, a measure which is already permitted by the specification.

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Alternative Test Methods for use with Table A Test Requirements

Table B

Alternative Test Methods

Table A Test No	Property	Alternative
1	Appearance	ASTM D4176 Procedure 1
2.3	Total Sulfur	IP 107 IP 243 IP 373 ASTM D1266 ASTM D1552 ASTM D2622 ASTM D4294 ASTM D5453
2.5	Doctor Test	ASTM D4952
3.2	Flash Point	IP303/ASTM D3828
3.3	Density at 15°C	IP160/ASTM D1298 (NOTE 1)
4.1	Freezing Point	ASTM D4305 (NOTE 2) ASTM D5901 ASTM D5972
5.3	Specific Energy	IP 12 IP 355 ASTM D3338 IP381/ASTM D4529 ASTM D4809

NOTE 1: The referee method is normally IP 365 but for operational quality control purposes IP 160 may be agreed between purchaser and supplier.

NOTE 2: When using Test Method D4305, use Procedure A only; do not use Procedure B. Test Method D4305 shall not be used on samples with viscosities greater than 5.0 $mm^2/_S$ at -20°C. If the viscosity of the sample is not known and cannot be obtained via the batch certificate(s), then it shall be measured. The viscosity shall be reported when reporting the D4305 result. In case of dispute, Test Method IP 16 shall be the referee method.

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Additional Requirements Applicable to Fuels Containing Synthetic Components

D.1 Background

D.1.1 Previous issues of this Standard permitted only those fuels solely derived from petroleum sources. There is now a requirement for the Standard to encompass and control the use of fuel blends containing components synthesised from non-petroleum sources. The use of synthetic blends represents a departure from experience and also from some of the key assumptions on which the requirements of this Standard have so far been based. The longer term strategy is to revise the Standard to fully encompass such fuels but this has yet to be defined. As an interim solution it has been deemed necessary to approve fuels containing synthetic components on an individual basis and identify test requirements specific to synthetic blends. Applications for approval of synthetic fuels or blends should be made to the technical authority.

D.2 Investigation for Approval

D.2.1 The following paragraphs are intended to give guidance on the basis upon which individual fuels containing synthetic blends will be approved in the interim period. Testing may also be required to demonstrate satisfactory operational performance. The requirement and scope of such testing will be defined by agreement with the specification authority in conjunction with the appropriate certifying authority, aircraft and engine manufacturers. Such testing may include but not be limited to evaluation of prototype blends to assess the impact of synthetic components on the following operational parameters:

D.2.1.1 Correlation between results achieved using referee and technically equivalent methods.

D.2.1.2 Compatibility with elastomeric materials.

D.2.1.3 Lubricity, including response to CI/LIA.

D.2.1.4 Electrical properties (dielectric constant, conductivity and response to SDA).

D.2.1.5 Additive miscibility and compatibility.

D.2.1.6 Compatibility and miscibility with other fuels.

D.2.1.7 Combustion properties including impact on starting and relight performance and emissions.

D.2.1.8 Bulk physical properties including bulk modulus, specific heat, thermal conductivity, low temperature/freezing point, viscosity, volatility characteristics, density/temperature characteristics and true vapour pressure.

D.2.1.9 Trace contaminants and controls thereof including dissolved metals, non-metals and organic species and particulates.

D.2.1.10 Behaviour under test rig and/or whole engine conditions.

D.2.1.11 Storage stability.

D.2.1.12 Thermal stability.

D.3 Manufacturing

D.3.1 Synthetic fuel blends must be manufactured according to declared procedures defined during the manufacture of prototype batches which have been submitted for examination and approval. Prototype batches must be shown to comply with all the requirements defined in clause **6**. Changes to declared production procedures may only be undertaken following agreement with the specification authority. Such change may require additional testing, as in clause **D.2**, to be carried out before approval is given.

D.4 Specific Approvals

D.4.1 Semi-synthetic fuel containing synthetic kerosine manufactured by Sasol, see clause **D.4.3**, blended with kerosine manufactured by Natref, see clause **D.4.4**, with a maximum of 50% synthetic product is currently the only fuel containing synthetic components which has been approved for use, see approval reference FS(Air)/ssjet/1.

D.4.2 The aromatic content of the semi-synthetic fuel shall be not less than 8.0% nor greater than 22.0% by volume and the fuel shall exhibit a maximum wear scar diameter of less than 0.85 mm when tested by ASTM D5001/95. Analysis for these properties shall be made at point of manufacture. These results shall be included on the batch certificate for the fuel.

D.4.3 Synthetic kerosine manufactured by Sasol is defined as that material manufactured at the Secunda plant by the Fischer - Tropsch process as described in the Southwest Research Institute (SwRI) report number 8531. The synthetic component shall be derived solely from products of the Fischer - Tropsch process which have been polymerised and hydrogenated and consist entirely of n-paraffins and iso-paraffins. The use of synthetic aromatic compounds is not permitted. The amount of synthetic fuel in the final blend shall be included on the batch certificate for the fuel.

D.4.4 Natref kerosine is a blend of Merox treated kerosine, mild-hydrotreated kerosine (MHT), and hydrocracked kerosine (DHC), manufactured at the Natref Refinery, South Africa. If Natref kerosine contains DHC, the final blend must contain at least 25% (Merox and/or MHT).

Table C: Technically Equivalent ISO Methods for Table A and Table B Test Methods

IP/ASTM Test Method	ISO Method
IP16/ASTM D2386	ISO 3013
IP71/ASTM D445	ISO 3105
IP57/ASTM D1322	ISO 3014
IP131/ASTM D381	ISO 6246
IP154/ASTM D130	ISO 2160
IP156/ASTM D1319	ISO 3837
IP243	ISO 4260
IP336	ISO 8754
IP342/ASTMD3227	ISO 3012
IP365/ASTMD4052	ISO 12185
IP381/ASTMD4529	ISO 3684

The methods listed above were technically equivalent at the date of issue of the specification.

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Related Documents List

F.1 The following documents and publications are referred to in this Standard:

ISO 4259	Method for Determination and application of Precision Data in Relation to Methods of Test for Petroleum Products.
Def Stan 05-50 (Part 66)	Determination of Corrosion Inhibitor/Lubricity Improver Additive (CI/LIA) in Aviation Turbine Fuel by Gel Permeation Chromatography
Def Stan 05-52 (Part 1)	Markings for the Identification of Fuels Lubricants and Associated Products: Containers Holding 210 Litres or Less.
Def Stan 68-150	Mixture of Fuel System Icing Inhibitor and Corrosion Inhibitor/Lubricity Improving Additive JSD: AL-48
Def Stan 68-251	Fuel Soluble Pipeline Corrosion Inhibitors/Lubricity Improving Additives for Aviation Turbine Fuels
Def Stan 68-252	Fuel System Icing Inhibitor
QPL 68-251	Qualified Products List of Aircraft Materials to Def Stan 68-251
IP 12	Determination of Specific Energy
IP 16	Petroleum Products - Determination of the Freezing Point of Aviation Fuels
IP 30	Detection of Mercaptans, Hydrogen Sulfide, Elemental Sulfur and Peroxides - Doctor Test Method
IP 57	Petroleum Products - Determination of the Smoke Point of Kerosine
IP 71	Petroleum Products - Transparent and Opaque Liquids Determination of Kinematic Viscosity and Calculation of Dynamic Viscosity
IP 107	Determination of Sulfur - Lamp Combustion Method
IP 123	Petroleum Products - Determination of Distillation Characteristics
IP 131	Petroleum Products - Motor Gasoline and Aviation Fuels - Determination of Existent Gum - Jet Evaporation Method
IP 154	Petroleum Products - Corrosiveness to Copper - Copper Strip Test
IP 156	Liquid Petroleum Products - Determination of Hydrocarbon Types - Fluorescent Indicator Absorption Method
IP 160	Determination of Density - Hydrometer Method
IP 170	Petroleum Products - Determination of Flash Point - Abel Closed Cup Method
IP 243	Petroleum Products and Hydrocarbons - Determination of Sulfur Content - Wickbold Combustion Method
IP 274	Determination of Electrical Conductivity of Aviation and Distillate Fuels
IP 289	Determination of Water Reaction of Aviation Fuels
IP 303	Determination of Closed Flash Point - Mini Equilibrium Method
IP 323	Determination of Thermal Oxidation Stability of Gas Turbine Fuels - JFTOT Method
IP 336	Petroleum Products - Determination of Sulfur Content - Energy - Dispersive X-Ray Fluorescence Method

IP 342	Gasoline, Kerosine and Distillate Fuels - Determination of Mercaptan Sulfur - Potentiometric Method
IP 354	Determination of the Acid Number of Aviation Turbine Fuels - Colour-Indicator Titration Method
IP 355	Calculation of Net Specific Energy of Aviation Turbine Fuels, using Hydrogen Content Data
IP 365	Crude Petroleum and Petroleum Products - Determination of Density - Oscillating U-tube Method
IP 373	Determination of Sulfur Content-Microcoulometry (Oxidative) Method
IP 381	Aviation Fuels - Estimation of Net Specific Energy
IP 424	Determination of Fuel System Icing Inhibitor Content of Aviation Turbine Kerosines by High Performance Liquid Chromatography
IP 436	Determination of Aromatic Hydrocarbon Types in Aviation Fuels and Petroleum Distillates - High Performance Liquid Chromatography Method with Refractive Index Detection.
ASTM D56	Standard Test Method for Flash Point by Tag Closed Tester
ASTM D86	Standard Test Method for Distillation of Petroleum Products
ASTM D130	Standard Test Method for Detection of Copper Corrosion from Petroleum Products by The Copper Strip Tarnish Test
ASTM D381	Standard Test Method for Existent Gum in Fuels by Jet Evaporation
ASTM D445	Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (the Calculation of Dynamic Viscosity)
ASTM D1094	Standard Test Method for Water Reaction of Aviation Fuels
ASTM D1266	Standard Test Method for Sulfur in Petroleum Products (Lamp Method)
ASTM D1298	Standard Practice for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
ASTM D1319	Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption
ASTM D1322	Standard Test Method for Smoke Point of Kerosine and Aviation Turbine Fuel
ASTM D1552	Standard Test Method for Sulfur in Petroleum Products (High Temperature Method)
ASTM D1840	Standard Test Method for Naphthalene Hydrocarbons in Aviation Turbine Fuels by Ultraviolet Spectrophotometry
ASTM D2386	Test Method for Freezing Point of Aviation Fuels
ASTM D2622	Test Method for Sulfur in Petroleum Products by X-Ray Spectrometry
ASTM D2624	Standard Test Method for Electrical Conductivity of Aviation and Distillate Fuels
ASTM D3227	Standard Test Method for Mercaptan Sulfur in Gasoline, Kerosine, Aviation Turbine, and Distillate Fuels(Potentiometric Method)
ASTM D3241	Standard Test Method for Thermal Oxidation Stability of Aviation Turbine Fuels (JFTOT Procedure)

ASTM D3242	Standard Test Method for Acidity in Aviation Turbine Fuel
ASTM D3338	Standard Test Method for Estimation of Net Heat of Combustion of Aviation Fuels
ASTM D3828	Standard Test Methods for Flash Point by Small Scale Closed Tester
ASTM D3948	Standard Test Method for Determining Water Separation Characteristics of Aviation Turbine Fuels by Portable Separometer
ASTM D4052	Standard Test Method for Density and Relative Density of Liquids by Digital Density MeterASTM D4176
ASTM D4176	Standard Test Method for Free Water and Particulate Contamination in Distillate Fuels(Visual Inspection Procedures)
ASTM D4294	Standard Test Method for Sulfur in Petroleum Products by Energy-Dispersive X-Ray Fluorescence Spectroscopy
ASTM D4305	Standard Test Method for Filter Flow of Aviation Fuels at Low Temperatures
ASTM D4529	Standard Test Method for Estimation of Net Heat of Combustion of Aviation Fuels
ASTM D4809	Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method)
ASTM D4952	Standard Test Method for Qualitative Analysis for Active Sulfur Species in Fuels and Solvents (Doctor Test)
ASTM D5001	Standard Test Method for Measurement of Lubricity of Aviation Turbine Fuels by the Ball-on-Cylinder Lubricity Evaluator (BOCLE)
ASTM D5006	Standard Test Method for Measurement of Fuel System Icing Inhibitors (Ether Type) in Aviation Fuels
ASTM D5453	Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Motor Fuels and Oils by Ultraviolet Fluorescence
ASTM D5901	Standard Test Method for Freezing Point of Aviation Fuels (Automated Optical Method)
ASTM D5972	Standard Test Method for Freezing Point of Aviation Fuels (Automatic Phase Transition Method)
FS(Air)/ssjet/1	Sasol Semi - synthetic Fuel Approval Qualification of Sasol
SwRI - 8531	Semi - synthetic JET A-1 as Commercial Jet Fuel

F.2 Copies of the related documents may be obtained from:

DOCUMENT	SOURCE
British Standards (ISO and BS)	British Standards Institution Sales Department 389 Chiswick High Road LONDON W4 4AL
Defence Standard (Def Stan)	Directorate of Standardization Kentigern House 65 Brown Street GLASGOW G2 8EX
IP Standard	Institute of Petroleum 61 New Cavendish Street LONDON W1M 8AR
ASTM Standard	American Technical Publishers Ltd 27-29 Knowl Piece Wilbury Way HITCHIN SG4 0SX
QPL 68-251	Defence Evaluation and Research Agency Fuels and Lubricants Centre Building 442 DERA Pyestock FARNBOROUGH Hampshire GU14 OLS
FS(Air)/ssjet/1 SwRI - 8531	DFS (Air) 42 Maple 0a # 45, Abbey Wood BRISTOL BS34 8JH

Collation Page

DEF STAN 91-91/3 (DERD 2494)

Published by and obtainable from:
Ministry of Defence
Directorate of Standardization
Kentigern House
65 Brown Street
GLASGOW G2 8EX

Tel No: 0141 224 2531/2
Fax No: 0141 224 2503

The following Defence Standard file reference relates to the work on this Standard –
D/D Stan/91/91.

Contract Requirements

When Defence Standards are incorporated into contracts users are responsible for their correct application and for complying with contract requirements.

Revision Requirements

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