

**AVIATION FUEL QUALITY REQUIREMENTS FOR
JOINTLY OPERATED SYSTEMS
(AFQRJOS)**

This document has the agreement of: Agip, BP, ChevronTexaco, ExxonMobil, Kuwait Petroleum, Shell, Statoil, and TotalFinaElf.

The Aviation Fuel Quality Requirements for Jointly Operated Systems (AFQRJOS) for Jet A-1 represent the most stringent requirements of the following two specifications:

- (a) British Ministry of Defence Standard DEF STAN 91-91/Issue 4 of 14 June 2002 for Turbine Fuel, Aviation "Kerosene Type", Jet A-1, NATO Code F-35, Joint Service Designation AVTUR.

- (b) ASTM Standard Specification D 1655 - 01 for Aviation Turbine Fuels "Jet A-1".

Jet fuel that meets the AFQRJOS is usually referred to as "Jet A-1 to Check List", or "Check List Jet A-1" and, by definition, meets both of the above specifications.

The main table requirements in IATA Guidance Material for Aviation Turbine Fuels Specifications (GM) are no longer part of the Check List because Part I of the IATA GM is now a guide to specifications rather than a specification itself. However, the water and dirt limits for fuel at the point of delivery into aircraft, which are embodied in Part III of the IATA GM, remain part of Check List.

The Aviation Fuel Quality Requirements for Jointly Operated Systems for Jet A-1 are defined in the following table that should be read in conjunction with the notes on pages 3 and 4 of this document. The notes highlight some of the main issues concerning the specification parameters. However, it should be stressed that conformance to AFQRJOS requires conformance to the detail of both specifications listed above, not just the following table.

It should be specifically noted that DEF STAN 91-91/4 requires traceability of product to point of manufacture.

JOINT FUELLING SYSTEM CHECK LIST FOR JET A-1

Issue 19 - September 2002
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Embodying the most stringent requirements in the following specifications for the grade shown:

- (a) British MoD DEF STAN 91-91/Issue 4, dated 14 June 2002, Jet A-1.
(b) ASTM D 1655 - 01, Jet A-1.

PROPERTY	LIMITS	TEST METHOD		REMARKS
		IP	ASTM	
APPEARANCE	Clear, bright and visually free from solid matter and undissolved water at ambient temperature			See note 1
COMPOSITION				See note 2
Total Acidity, mg KOH/g	max 0.015	354	D 3242	See note 3 or D 4294 or D 1552 or D 5453
Aromatics, % vol.	Max 25.0	156	D 1319	
OR Total Aromatics, % vol	max 26.5	436	D 6379	
Sulphur, Total, % mass	max 0.30	107	D 1266 or D 2622	
Sulphur, Mercaptan, % mass	max 0.0030	342	D 3227	
OR Doctor Test	Negative	30	D 4952	
Hydroprocessed components in batch, % vol.	Report (incl. 'nil' or '100%')			
Severely hydroprocessed components, % vol.	Report (incl. 'nil' or '100%')			
VOLATILITY				
Distillation			D 86	See note 6
Initial Boiling Point, °C	Report			
Fuel Recovered				
10% vol. at °C	max 205.0			
50% vol. at °C	Report			
90% vol. at °C	Report			
End Point, °C	max 300.0			
Residue, % vol.	max 1.5			
Loss, % vol.	max 1.5			
Flash Point, °C	min 38.0	170 or 303	D 3828	See note 7
Density at 15°C, kg/m³	775.0 min to 840.0 max	160 or 365	D1298 or D4052	
FLUIDITY				
Freezing Point, °C	max - 47.0	435	D2386 or D5972	Note that D5901 and D4305 are no longer allowed methods
Viscosity at -20°C, cSt (mm²/s)	max 8.000	71	D445	
COMBUSTION				
Specific Energy, net, MJ/kg	min 42.80	381	D4529	or D3338 or D4809
Smoke Point, mm	min 25.0	57	D1322	
OR				
Smoke Point, mm	min 19.0	57	D1322	
AND Naphthalenes, % vol.	max 3.00		D1840	
CORROSION				
Corrosion, Copper strip, classification (2hours +/- 5 min. at 100 °C +/- 1°C)	max 1	154	D130	
STABILITY				
Thermal Stability (JFTOT) <u>Control Temp. 260°C</u>		323	D3241	
Filter Pressure Differential, mm Hg	max 25.0			
Tube Deposit Rating (Visual)	max Less than 3, no 'Peacock' or 'Abnormal' colour deposits			
CONTAMINANTS				
Existent Gum, mg/100ml	max 7	131	D381	See note 8
Water Reaction			D1094	
Interface Rating	max 1b			
Microseparator (MSEP), rating			D3948	
Fuel with Static Dissipator Additive	min 70			
OR				
Fuel without Static Dissipator Additive	min 85			
CONDUCTIVITY				
Electrical Conductivity, pS/m	50 min to 450 max	274	D2624	See note 9
LUBRICITY				
BOCLE wear scar diameter, mm	max 0.85		D5001	See note 10
ADDITIVES (Names and approval code from DEF-STAN 91-91/4 should be quoted on quality certs).				
Antioxidant , mg/l				
in Hydroprocessed & synthetic Fuels (Mandatory)	max 17.0 min to 24.0 max			See note 11
in Non-hydroprocessed Fuels (Optional)	max 24.0			
Metal Deactivator , mg/l (Optional)	max 5.7			See note 12
Static Dissipator , mg/l				
First Doping Stadis 450	max 3.0			See note 13
Re-doping				
<p>Antioxidants are mandatory in hydroprocessed fuels and synthetic fuels and must be added 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</p> <p>The types and concentrations of all additives used are to be shown on refinery Certificates of Quality and other quality documents.</p>				
<p>Corrosion inhibitor/lubricity improver is not permitted unless agreed by all the participants in a joint system.</p> <p>Fuel System Icing Inhibitor is not permitted unless agreed by all the participants in a joint system (see also note 14).</p> <p>See note 15 about new requirements for management of change in refineries.</p>				

Main Table Notes

1. For guidance on contamination limits for into-plane fuelling refer to 4th Edition IATA Guidance Material (Part 3).
2. Attention is drawn to DEF STAN 91-91 Issue 4 which approves the Semi- Synthetic Jet Fuel (SSJF) produced by SASOL Oil under approval reference FS(Air)ssjet/1. For SSJF additional testing requirements apply and reference should be made to Issue 4 of DEF STAN 91-91. This particular semi-synthetic fuel meets the requirements of this Issue of Check List.
3. Testing for Total Aromatics has been introduced into DEF STAN 91-91. It is included in Check List to promote the adoption of more modern test methods. The DEF STAN note reads : “Round robin testing has demonstrated the correlation between total aromatics content measured by IP 156/ASTM D 1319 and IP 436/ASTM D 6379. Bias between the two methods necessitates different equivalence limits as shown. Testing laboratories are encouraged to measure and report total aromatics content by the two methods to assist verification of the correlation. In cases of dispute IP 156 will be the referee method”.
4. The Doctor Test is an alternative requirement to the Sulphur Mercaptan Content. In the event of conflict between the Sulphur Mercaptan and Doctor Test results, the Sulphur Mercaptan result shall prevail.
5. The need to report the % vol. of hydroprocessed and severely hydroprocessed components (including "nil" or "100%" as appropriate) on refinery Certificates of Quality for Jet A-1 to Check List derives from DEF STAN 91-91/4. It relates to:
 - (a) antioxidant additives - additive dose rate cannot be interpreted unless the proportion of hydroprocessed fuel is known and therefore recipients of Jet A-1 cannot check or demonstrate that fuel complies with Check List if this information is omitted from refinery Certificates of Quality),
 - (b) the requirement to report the volume % of severely hydroprocessed components as part of the lubricity requirement in DEF STAN 91-91/4. Note that "hydroprocessed" includes hydrotreated, hydrofined and hydrocracked. Severely hydroprocessed components are defined as petroleum derived hydrocarbons that have been subjected to hydrogen partial pressure of greater than 7000kPa (70bar or 1015psi) during manufacture.
6. In methods IP 123 and ASTM D 86 all fuels certified to this specification shall be classed as group 4, with a condenser temperature of zero to 4°C.
7. Subject to a minimum of 40°C, results obtained by method ASTM D 56 (Tag) may be accepted.
8. MSEP is required only in DEF STAN 91-91/4. Note 9 of that specification states "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".
9. Due to the requirements of DEF STAN 91-91/4, 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 SDA further downstream. In such cases the Certificate of Quality for the batch should be annotated thus: “ Product meets the requirements of AFQRJOS Check List 19 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 to aircraft
10. This requirement comes from DEF STAN 91-91/4. The requirement to determine lubricity applies only to fuels containing more than 95% hydroprocessed material and where at least 20% is severely hydroprocessed (see NOTE 3 above) and for all fuels containing synthetic components. The limit applies only at the point of manufacture. For important advisory information on the lubricity of aviation turbine fuels see Annex B of DEF STAN 91-91/4.
11. Approved antioxidant additives are listed in Annex A.1.4 of DEF STAN 91-91/4, together with the appropriate RDE/A/XXX- Qualification Reference for quoting on refinery Certificates of Quality.

12. The approved Metal Deactivator Additive (MDA), RDE/A/650 appears in Annex A.2.2 of DEF STAN 91-91/4. See also Annex A.2.1 about the need to report thermal stability before and after using when contamination of Jet A-1 by any of the trace metals listed in this Annex is unproven. Note also in A.2.3 that maximum doping at the point of manufacture or on initial doping is limited to 2mg/l.
13. Re-doping limits for Static Dissipator additive are:
- | | | |
|----------------------------|------------------------|----------|
| Cumulative concentration | Stadis 450 (RDE/A/621) | 5.0 mg/l |
| Original dosage not known: | | |
| Additional concentration | Stadis 450 (RDE/A/621) | 2.0 mg/l |
14. Concentrations of Fuel System Icing Inhibitor (FSII) less than 0.02% by volume can be considered negligible and do not require agreement/notification. The assent to allow these small quantities of FSII without agreement/notification is to facilitate the changeover from fuels containing FSII to those not containing FSII where the additive may remain in the fuel system for a limited time. This does not allow the continuous addition of FSII at these low concentrations.
15. Attention is drawn to the new requirement in DEF STAN 91-91 Issue 4 concerning the need for appropriate management of change measures in refineries manufacturing jet fuel. The implications of any changes to feedstock, processing conditions or process additives on finished product quality and performance need to be considered (for example, experience has shown that some process additives might be carried over in trace quantities into aviation fuels).