Product Quality Bulletin

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Bulletin No 117	Aviation Fuel Quality Requirements for Jointly Operated Systems (AFQRJOS): Issue 30 – Nov 2018	12th November 2018

AVIATION FUEL QUALITY REQUIREMENTS FOR JOINTLY OPERATED SYSTEMS

(AFQRJOS): Issue 30 – Nov 2018 (supersedes Issue 29 – OCT 2016)

This document defines the fuel quality requirements for supply into Jointly Operated Fuelling Systems operated to JIG Standards. The Aviation Fuel Quality Requirements for Jointly Operated Systems (AFQRJOS) for Jet A-1 embodies the requirements of the following two specifications:

(a) British Ministry of Defence Standard DEF STAN 91-091/Issue 10, 28 September 2018 for Turbine Fuel, Kerosene Type, Jet A-1, NATO Code F-35, Joint Service Designation: AVTUR.

(b) ASTM Standard Specification D1655- for Aviation Turbine Fuels "Jet A-1" (Latest issue)

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, generally, meets the requirements of 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, which should be read in conjunction with the Notes that follow the table. The Notes highlight some of the main issues concerning the specification parameters. Specifically of note, Issue 30 introduces the following changes:

- Removal of maximum FAME content limit from Def Stan 91-091 Issue 10 Table 1 to Table 3 in Annex C Product Integrity Management
- New note with reporting procedures for fuels with freezing points below minus 65°C
- Addition of Afton AvGuard to the list of qualified Static Dissipator Additives.
- Inclusion of Pipeline Drag Reducer Incidental Materials Table with a maximum permitted level of 72µg/l, which is accepted by the approval authorities as the functional definition of 'nil addition'
- The reordering of the Annexes in Defence Standard 91-091 Issue 10
- Rewording of the Residual Tank Heel requirements in Annex D.3.2.1

Conformance to AFQRJOS requires conformance to the detail of both specifications listed above, not just the following table. See Notes 26 for further guidance on statements declaring conformance to these specifications. Airports operated to JIG Standards may supply jet fuel to either of the parent specifications listed above provided the participants agree.

It should be specifically noted that DEF STAN 91-091/10 requires traceability of product to point of manufacture and requirements applicable to fuels containing synthetic or renewable components. See

Annexes D and B of DEFSTAN 91-091/10 for more information. Annex B has been completely revised in issue 10 to state that all blend components listed in ASTM D7566 now and in the future are approved.

Note: Before fuel containing synthetic components may be delivered to a NATO aircraft it shall be ascertained that the appropriate clearance document(s) permitting its use have been obtained according to contract. This may restrict supply of fuel containing synthetic components in some pipeline systems with direct connections to NATO storage locations.

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JOINT FUELLING SYSTEM CHECK LIST FOR JET A-1

Issue 30 – October 2018

Supersedes Issue 29 - October 2016

Embodying the requirements of the following specifications for the grade shown:

(a) British MoD DEF STAN 91-091/Issue 10, dated 28th September 2018, Jet A-1

(b) ASTM D1655 – Jet A-1 Latest Issue

PROPERTY		LIMITS	TEST METHOD		REMARKS
			IP	ASTM	
APPEARANCE					
Visual appearance		Clear, bright and visually free from solid matter and un-dissolved water at ambient fuel temperature			
Colour		Report		D 156 or D 6045	See Note 1
Particulate contamination mg/L	max	1.0	423	D 5452	See Note 2
Particulate, cumulative channel particle counts, ISO Code & Individual Channel Counts			564 or 565 or 577		See Note 3
≥ 4 µm(c)		Report			
≥ 6 µm(c)		Report			
≥ 14 µm(c)		Report			
≥ 21 µm(c)		Report			
≥ 25 µm(c)		Report			
≥ 30 µm(c)		Report			
COMPOSITION					See Note 4
Total Acidity, mg KOH/g	max	0.015	354	D 3242	
Aromatics, % v/v.	max	25.0	156	D 1319	
OR Total Aromatics, % v/v	max	26.5	436	D 6379	See Note 5
Sulphur, Total, % m/m	max	0.30	336	D 1266 or D 2622	or D 4294 or D 5453
Sulphur, Mercaptan, % m/m	max	0.0030	342	D 3227	
OR Doctor Test		Negative	30	D 4952	See Note 6
Refinery Components at point of manufacture:					See Note 7
Non Hydroprocessed Components, %v/v		Report (incl. 'nil' or '100%')			
Mildly Hydroprocessed Components, % v/v		Report (incl. 'nil' or '100%')			
Severely Hydroprocessed Components, % v/v		Report (incl. 'nil' or '100%')			
Synthetic Components, %v/v		Report (incl. 'nil' or '50%')			See Note 4
INCIDENTAL MATERIALS					See Notes 8
VOLATILITY					
Distillation			123	D 86	or D7345, See Note 9
Initial Boiling Point, ºC		Report			
Fuel Recovered					See Note 9
10% v/v at ºC	max	205.0			Or IP 406 or D 2887, see Note 10
50% v/v at ºC		Report			
90% v/v at ºC		Report			
End Point, ºC	max	300.0			
Residue, % v/v	max	1.5			
Loss, % v/v	max	1.5			
Flash Point, ºC	min	38.0	170 or 523	D 56 or D 3828	See Note 11
Density at 15ºC, kg/m³		775.0 min to 840.0 max	160 or 365	D 1298 or D 4052	
FLUIDITY					
Freezing Point, ºC	max	- 47.0	16 or 435 or 528 or 529	D 2386 or D 5972 or D 7153 or D 7154	See Notes 12 and 13
Viscosity at -20ºC, mm²/s (cSt)	max	8.000	71	D 445	or D7042, See Note 14

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PROPERTY		LIMITS	TEST METHOD IP	TEST METHOD ASTM	REMARKS
COMBUSTION					
Specific Energy, net, MJ/kg	min	42.80	12 or 355	D 3338 or D 4809	See Note 15
Smoke Point, mm	min	25.0	598	D 1322	See Note 16
OR					
Smoke Point, mm	min	18.0	598	D 1322	See Note 16
AND Naphthalenes, % vol.	max	3.00		D 1840	
CORROSION					
Corrosion, Copper strip, classification (2 hours +/- 5 min. at 100 ºC +/- 1ºC)	max	1	154	D 130	
STABILITY					
Thermal Stability (JFTOT)			323	D 3241	See Note 17
Control temperature, ºC	min	260			
Filter Pressure Differential, mm Hg	max	25			
One of the following requirements shall be met:					
(1) Annex B VTR		Less than 3, no 'Peacock' or 'Abnormal' colour deposits			
(2) Annex C ITR or Annex D ETR, average over area of 2.5mm^2	nm max	85			
CONTAMINANTS					
Existent Gum, mg/100ml	max	7	540	D 381	
Microseparometer (MSEP), rating				D 3948	See Note 18
Fuel with Static Dissipator Additive	min	70			
OR					
Fuel without Static Dissipator Additive	min	85			
CONDUCTIVITY					
Electrical Conductivity, pS/m		50 min to 600 max	274	D 2624	See Note 19
LUBRICITY					
BOCLE wear scar diameter, mm	max	0.85		D 5001	See Note 20
ADDITIVES (Names and approval code from DEF STAN 91-091/9 should be quoted on quality certificates).					
Antioxidant, mg/l					
in final batch (Mandatory)	max	24.0			See Note 21
in hydroprocessed & synth. fuels (Mandatory)	min	17.0			See Note 22
in non-hydroprocessed fuels (Optional)	max	24.0			
Metal Deactivator, mg/l (Optional) *	max				See Note 23
First Doping		2.0			
Cumulative concentration after field re-doping		5.7			
Static Dissipator, mg/l *	max				
First Doping		3.0			
Cumulative concentration after field re-doping		5.0			

Antioxidants are mandatory in hydroprocessed fuels and synthetic fuels and **shall** be added prior to or during release from the manufacturing site.

Fuel System Icing Inhibitor is not permitted unless agreed by all the participants in a joint system (see also Note 24).

Corrosion Inhibitor/Lubricity Improver (CI/LI) additive may be added to the fuel without prior consent of the joint system participants (see also Note 20)

The types and concentrations of **all** additives used shall be shown on the original Certificates of Quality and on all other quality documents when they are added downstream of the point of manufacture. When additives are diluted (with hydrocarbon solvent only) to improve handling properties prior to addition, it is the concentration of active ingredient that shall be reported. See Annex A of DEF STAN 91-091/10 for detailed advice.

See Note 25 about requirements for management of change in refineries.

* When the original dosage of additives is unknown, it has to be assumed that first doping was applied at maximum dose rate.

Main Table Notes

1. The requirement to report Saybolt Colour shall apply at point of manufacture, thus enabling a colour change in distribution to be quantified. Where the colour of the fuel precludes the use of the Saybolt Colour test method, then the visual colour shall be reported. Unusual or atypical colours should also be noted and investigated. For further information on the significance of colour see Annex F in DEF STAN 91-091/10.
2. This limit shall apply at point of manufacture only. For more information on particulate contamination refer to Annex F of DEF STAN 91-091 Issue 10. For guidance on contamination limits for into-plane fuelling refer to 7th Edition IATA Guidance Material (Part III).
3. This requirement shall apply at point of manufacture only. Both the number of particles and the number of particles as a scale number as defined by Table 1 of ISO 4406:1999 shall be reported. It is the Specification Authority's intention to replace the gravimetric Millipore test with Particle Counting at the earliest opportunity.
4. Attention is drawn to DEF STAN 91-091 Issue 10, which approves both Semi-Synthetic and Fully Synthetic Jet Fuel produced by SASOL. It also approves all the generic components listed in the Annexes of ASTM D7566. For these fuels, additional testing requirements apply and reference should be made to DEF STAN 91-091/10 Annex B. These particular semi- and fully synthetic fuels may be certified against this Issue of Check List. The volume percentage of each synthetic blending component shall be recorded along with its corresponding release Specification and Annex number, product originator and originator's Certificate of Quality number. From the point of manufacture to the point of blending to meet this specification, the synthetic component shall be handled, transported and documented in the same manner as finished jet fuel in order to maintain product integrity. Special care shall be taken to ensure homogeneity when blending semi synthetic jet fuel, particularly where the component densities are significantly different. DEF STAN 91-091/10 also states that blending of synthetic fuels shall take place upstream of airports.
5. 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 / ASTM D 1319 shall be the referee method. It is the intention of the DEF STAN 91-091 Technical Authority to change the referee method to IP 436 at a later date.
6. 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.
7. The need to report the %v/v of non hydroprocessed, mildly hydroprocessed, severely hydroprocessed and synthetic components (including "nil", "50%"or "100%" as appropriate) on

refinery Certificates of Quality for Jet A-1 to Check List derives from DEF STAN 91-091/10. Each of the defined refinery components used in the make-up of the batch shall be reported on the certificate of quality as a percentage by volume of the total fuel in the batch. **Mildly hydroprocessed** components are defined as those petroleum derived hydrocarbons that have been subjected to a hydrogen partial pressure **less than** 7000 kPa (70 bar or 1015 psi) during manufacture. **Severely hydroprocessed** components are defined as those petroleum derived hydrocarbons that have been subjected to a hydrogen partial pressure of **greater than** 7000 kPa (70 bar or 1015 psi) during manufacture. The total of non-hydroprocessed plus mildly hydroprocessed plus severely hydroprocessed plus synthetic components shall equal 100%.

8. Table 2 Incidental materials

Material	Maximum permitted level	Test methods
Fatty acid methyl ester (FAME)[a,b,c,]	50 mg/kg	D7797/IP583, IP585[d], IP590, IP599
Pipeline Drag Reducer (DRA)	72 µg/l	D7872

a) For the purposes of meeting this requirement, FAME is defined as material meeting the limits of EN14214 or specification ASTM D6751. Fatty acid methyl esters that fail to meet biodiesel standards are not permitted in jet fuel.

b) Further guidance on how to verify compliance with this requirement is contained in DEF STAN 91-091/10 Annex G and JIG Bulletin 106.

c) On an emergency basis, up to 100 mg/kg FAME is permitted in jet fuel when authorised by the airframe and engine manufacturers and managed in compliance with airframe and engine requirements. For Military purposes an emergency basis can be defined as an unexpected and unforeseen situation that requires prompt action. For example, where FAME contamination has been introduced into part of an airport distribution system where it cannot be quickly segregated or isolated for remediation without halting airport refuelling operations. All such instances should be raised through the procurement Authority, Duty Holder or Aircraft Operator. For commercial operators refer to SAIB NE-09-25R2 dated May 19, 2016, which provides corrective actions and procedures to be followed in the event of FAME contamination.

d) Test method IP585 shall be the referee method.

e) DRA is not an approved additive for jet fuel. This level is accepted by approval authorities as the functional definition of 'nil addition'.

9. 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. Where ASTM D 7345 is used, results shall be corrected for relative bias as described in the test method.
10. If IP 406 or ASTM D 2887 are used to produce IP123 equivalent or ASTM D 86 correlated data, there is no requirement to report residue or loss.
11. Subject to a minimum of 40°C, results obtained by method ASTM D 56 (Tag) may be accepted. The referee test method is IP 170.
12. These automatic methods are permitted; IP 16/ASTM D 2386 remains the referee method.
13. During downstream distribution if the freezing point of the fuel is very low and cannot be reported when measured by IP 16 the limit is max -65 degrees C. If no crystals appear during cooling of the fuel and when the thermometer indicates a temperature of –65°C, the freezing point shall be recorded as below –65°C. This limit does not apply if the freezing point is measured by IP435/ASTM D5972, IP 529/ASTM D7153, IP528 or ASTM D7154.
14. Test method ASTM D 7042 results shall be converted to bias-corrected kinematic viscosity results as described in the precision and bias section of ASTM D7042.
15. ASTM D 4529/IP 381 may be used where local regulations permit.
16. The IP 598 test for smoke point includes both the standard manual method and an automatic method, with the automated method in IP 598 being the referee method.
17. The annexes referred to in the Table 1 and this note correspond to those in IP323. If the technically equivalent ASTM D3241 test method is used, the same protocol shall be followed using the appropriate annex that corresponds to the visual (VTR), interferometric (ITR) or ellipsometric (ETR) method. Tube deposit ratings shall be measured by IP323 Annex C ITR or Annex D ETR, when available. If the Annex C ITR device reports “N/A” for a tube’s volume measurement, the test shall be a failure and the value reported as >85 nm. Visual rating of the heater tube shall be by the method in IP323 Annex B is not required when Annex C ITR or Annex D ETR deposit thickness measurements are reported. In case of dispute between results from visual and metrological methods, the metrological method shall be considered the referee. Examination of the heater tube to determine the Visual Tube Rating using the Visual Tube Rater or deposit thickness by ETR or ITR shall be carried out within 120 minutes of completion of the test.
18. Attention is drawn to Note 17 of DEF STAN 91-091/10 that states "Where SDA is added at point of manufacture the MSEP limit of 70 shall apply. 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. A protocol giving guidelines on possible actions to be taken following failed MSEP testing can be found in the Joint Inspection Group's Bulletin Number 65, MSEP Protocol at www.jigonline.com. Where SDA is added downstream of point of manufacture, it is acknowledged that MSEP results may be less than 70.

19. Due to the requirements of DEF STAN 91-091/10, 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 30 except for electrical conductivity". In some situations, the conductivity can decrease rapidly and the fuel can fail to respond to additional dosing with Static Dissipator Additive(s). In such cases, fuel may be released with conductivity down to a minimum of 25pS/m provided that the fuel is fully tested against the specification and the Tank Release Note is annotated with the explanation "Product released below 50pS/m due to conductivity loss as per Annex F of DEFSTAN 91-091/10".

20. This requirement comes from DEF STAN 91-091/10. The requirement to determine lubricity applies only to fuels whose composition is made up of a) at least 20% of severely hydroprocessed components and less than 5% non-hydroprocessed components or b) includes synthetic fuel components. The limit applies only at the point of manufacture. For important advisory information on the lubricity of aviation turbine fuels see Annex F of DEF STAN 91-091/10. CI/LI additive (also known as LIA) may be used to improve lubricity; only those additives listed in Table 2 of ASTM D1655-/ Annex A of DEF STAN 91-091/10 are permitted. Note that two additional additives have been added to the list in DEF STAN 91-091/10. Refer also to Appendix A.5 of DEF STAN 91-091/10 for advice on point of addition. When injecting CI/LI downstream of point of manufacture, care shall be taken to ensure that maximum dose rates are not exceeded.

21. Approved antioxidant additives are listed in Annex A.2.5 of DEF STAN 91-091/10, together with the appropriate RDE/A/XXX- Qualification Reference for quoting on refinery Certificates of Quality. Refer also to Annex A.2.7 for requirements for reporting additions on the CoQ. This requires two indications of the antioxidant concentrations to be reported: firstly, expressed as a proportion of the total hydro-processed and synthetic material, in order to ensure the minimum effective amount is used; and secondly as a total proportion of the final blended fuel batch of all components, in order to ensure that the maximum overall concentration has not been exceeded.

22. When it is required, DEF STAN 91-091/10 permits the addition of Anti-Oxidant up to the point of release of the fuel from the manufacturing site. In cases where Anti-Oxidant is added after the certification testing, but prior to delivery, see DEF STAN 91-091/10 Annex A.2.2 for guidance on the appropriate wording for the Certificate of Quality.

23. The approved Metal Deactivator Additive (MDA), RDE/A/650 appears in Annex A.3 of DEF STAN 91-091/10 Annex A3.1 of DEF STAN 91-091/10 contains restrictions on the use of MDA at the point of manufacture and also directs the producer to the reporting requirements when MDA is used at the point of manufacture. Note that routine use of MDA (>5% of batches) at the point of manufacture is not permitted. The use of MDA at the point of manufacture is limited to 2.0 mg/l, except when copper contamination within the supply chain is known. See also Annex A.3.1 for the use of MDA in the supply chain, which includes the need to report thermal stability before and after MDA use.

24. Concentrations of Fuel System Icing Inhibitor (FSII) less than 0.02% by volume may 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 permit the continuous addition of FSII at these low concentrations. Attention is drawn to the note in Annex A.6 in DEF STAN 91-091/10highlighting that filter monitors cannot be used with fuel containing FSII.

25. Attention is drawn to the guidance in DEF STAN 91-091/10 and ASTM D1655- 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 shall be considered (for example, experience has shown that some process additives might be carried over in trace quantities into aviation fuels).

26. It is normal to certify conformance to a primary specification. The following statements should be used.

"It is certified that the samples have been tested using the Test Methods stated and that the Batch represented by the samples conforms with DEF STAN 91-091 Issue 10 and AFQRJOS Checklist Issue 30".
Or
"It is certified that the samples have been tested using the Test Methods stated and that the Batch represented by the samples conforms with ASTM D1655 and AFQRJOS Checklist Issue 30".

The minimum requirements of information to be included on the fuel's refinery batch certificate of quality shall be:

- Specification name, issue and any amendment number;
- Name, telephone number, fax number, email address and postal address of testing laboratory;
- Tank Number;
- Batch number or unique identifier;
- Quantity of fuel in the batch;
- Properties tested and including specification limit, test method and result of test;
- Additives, including qualification reference and quantity added;
- Name and position of authorised test certificate signatory or an electronic signature;
- Date of certification.

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Actions to Implement this Bulletin (See Table 2 for Action Type Codes)

Action Description	Action Type	Target Completion Date
In-scope Operations, testing laboratories and other entities using or referring to JIG AFQRJOS Checklist shall implement JIG AFQRJOS Issue 30, with an implementation date no later than 28 December 2018.	JS	28th Dec 2018

Table 2 Action Type Codes

Action Types	JIG Bulletin Action Type Definition
JS	Change to JIG Standard – to be adopted by JV and/or Operator to continue to meet the JIG Standard(s) (JIG 1, 2, 4, EI/JIG 1530 and the JIG HSSE Management System).
RA	Required Action to implement one off verification or checks outlined in the table of actions.
RP	JIG Recommended Practice which the JV should consider adopting as its own practice (**).
I	Issued for information purposes only.
Note (**) - If the JV agreements require any of the JIG Standards and/or any of the JIG Common Processes as the governing operational standard then adoption of changes to applicable JIG Standards and/or Common Processes should not be considered optional by the JV Board.	