JET A1

ANCAP specifications are updated in accordance with "Check List Jet A-1" de la AFQRJOS Issue 33- April 2022

PROPERTY	*LIMITS*	*TEST METHOD*
APEARANCE		
Visual appearance **(1)**	Clear, bright, and visually free from solid matter and un-dissolved water at ambient fuel temperature	
Colour **(2)**	Report	ASTM D156 or ASTM D6045
Particulate Contamination, mg/L **(3) or**	Max 1.0	ASTM D5452
Particulate, cumulative channel particle counts. ISO Code & Individual Channel Counts **(3, 4)**		IP 565 or IP 577 or ASTM D7619
≥ 4 µm (c)	Report / Máx. 19	
≥ 6 µm (c)	Report / Max. 17	
≥ 14 µm (c)	Report / Max. 14	
≥ 21 µm (c)	Report	
≥ 25 µm (c)	Report	
≥ 30µm (c)	Report / Max. 13	
COMPOSITION (5, 6)		
Total acidity, mg KOH/g	Max. 0.015	ASTM D3242
Aromatics, % in volume **(7)** or	Max. 25.0	ASTM D1319
Total aromatics, % in volume	Max. 26.5	ASTM D6379
Sulphur, Total, % in mass	Max. 0.30	ASTM D2622 or ASTM D4294 or ASTM D5453
Sulphur, Mercaptan, % in mass or	Max. 0.0030	ASTM D3227
Doctor Test **(8)**	Negative	ASTM D4952
Components at point of manufacture:		
Non Hydroprocessed Components, % in volume **(9)**	Report (inclusive "0" or "100%")	

Asistencia Comercial
Ventas Mercado Interno
Gerencia Comercial
Tel.: (+598)2 1931-2006
Email: asesoramiento@ancap.com.uy

PROPERTY (continuation)	*LIMITS*	*TEST METHOD*
Severely Hydroprocessed Components, % in volume	Report (inclusive "0" or "100%")	
Synthetic Components, % in volume **(5)**	Report (inclusive "0" or "50%")	
INCIDENTAL MATERIALS (10)		
VOLATILITY		
Distillation		ASTM D86 or ASTM D7345
Initial Boiling Point, ºC **(11)**	Report	
Fuel Recovered		
10% recovered, ºC	Max. 205.0	
50% recovered, ºC **(12)**	Report	
90% recovered, ºC	Report	
End Point, ºC	Max. 300.0	
Residue, % in volume	Max. 1.5	
Loss, % in volume	Max. 1.5	
Flash Point, ºC	Min. 38.0	ASTM D3828 or ASTM D56
Density at 15 ºC, kg/m^3	775.0 Min. to 840.0 Max.	ASTM D4052
FLUIDITY		
Freezing Point, ºC **(13), (14)**	Max. -47.0	ASTM D2386 or ASTM D7153
Viscosity –20ºC, cSt **(15)**	Max. 8.000	ASTM D445, ASTM D7945 or ASTM D7042
COMBUSTION		
Specific Energy, net, MJ/kg **(16)**	Min. 42.80	ASTM D3338 or ASTM D4809
Smoke Point, mm **(17)** or	Min. 25.0	ASTM D1322
Smoke Point, mm and	Min. 18.0	ASTM D1322
Naphthalenes, % in volume	Max. 3.00	ASTM D1840
CORROSION		
Corrosion, Copper strip, classification max (2 hours +/- 5 min. at 100 ºC +/- 1 °C)	Max. 1	ASTM D130
STABILITY		
Thermal Stability Control Temperature, ºC **(18)**	Min. 260	ASTM D3241
Filter Pressure Differential, mmHg max	Max. 25.0	

PROPERTY (continuation)	*LIMITS*	*TEST METHOD*
One of the following requirements shall be met:		
Annex B (VTR) or	Less than3	ASTM D3241
	No “Peacock” or “Abnormal” colour deposits	
Annex C ITR or Annex D ETR, average over area of 2.5 mm^2 (nm)	Max. 85	
CONTAMINANTS		
Existent Gum, mg/100 mL	Max. 7	ASTM D381 or IP 540
Microseparometer (MSEP) **(19)**		ASTM D3948
Fuel with Static Dissipator additive	Min. 70	
Fuel without Static Dissipator additive	Min. 85	
CONDUCTIVITY (20)		
Electrical Conductivity, pS/m	50 Min. to 600 Max.	ASTM D2624
LUBRICITY (21)		
BOCLE Wear Scar Diameter, mm	Max. 0.85	ASTM D5001
ADDITIVES (Names and approval code from DEF-STAN 91-091/14 should be quoted on Quality Certificates)		
Antioxidant Additive, mg/L		
In final batch, optional **(22)**	Max. 24.0	
Metal Deactivator, optional, mg/L **(23) (*)**		
First Doping	Max. 2.0	
Cumulative concentration after field re-doping	Max. 5.7	
Static Dissipator, mg/L		
First Doping	Max. 3.0	
Cumulative concentration after field re-doping	Max. 5.0	

Antioxidants are mandatory for synthetic blend components and shall be added prior to or during release from the designated manufacturing site of the ASTM D7566 component.

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

Lubricity Improver Additive (LIA) additive may be added to the fuel without prior consent of the joint system participants (see also Note 21).

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 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 method for visual appearance in DEF STAN 90-091 is Visual (assessment). Alternative methods are D4176 Procedure 1 and D6986 Procedure A, Section 8.1.1.1.

(2) The requirement to report Saybolt Colour shall apply at point of manufacture. Unusual or atypical colours should also be noted and investigated. For further information on the significance of colour see Annex F in DEF STAN 91-091/14.

(3) This limit shall apply at point of manufacture only. The limits of either particulate contamination or particulate counts shall be met and it is only necessary to report whichever property is being used to support release of the fuel. It is the Specification Authority's intention to replace gravimetric Millipore test with Particle counting from April 2025. For more information on particulate contamination refer to Annex F of DEF STAN 91-091 Issue 14. For guidance on contamination limits for into-plane fuelling refer to 7th Edition IATA Guidance Material (Part III).

(4) The number of particles and the number of particles as a scale number as defined by Table 1 of ISO 4406 shall be reported where this method is being used to release the fuel (see also Note 3). If limits are exceeded, Annex B of IP 565 or IP 577 or Annex X2 of D7619 may be applied to eliminate trace free water, and cleanliness re-determined. In such cases, results before and after application of annex shall be reported

(5) Attention is drawn to DEF STAN 91-091 Issue 14 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 91-091/14 Annex B. These semi- and fully synthetic fuels may be certified against this Issue of Checklist.

(6) The Coprocessing of mono-, di- and triglycerides, free fatty acids and fatty acid esters and the Coprocessing of hydrocarbons derived from synthesis gas via Fisher Tropsch process have been approved in Defence Standard 91-091 Issue 14 in alignment with ASTM D1655. The requirements for coprocessing are detailed in Annex B4 of Defence Standard 91-091 Issue 14 and Annex A1.1.2.2 of ASTM D1655.
The Certificate of Quality (CoQ) shall include wording to reflect that the batch may contain up to 5 % by volume co-hydroprocessed synthesized kerosene.

(7) 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. 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.

Due to technical issues, the proprietary dyes with lot numbers 3000000975 through to and including 000000982 are unacceptable for use when conducting IP156/ASTM D1319 and shall not be used in conjunction with these test methods.

When the aromatic level is needed to be determined, Jet A-1 fuel will only meet the aviation fuel operating limitations of airplanes certificated to operate on Jet A-1 fuel and the requirements of Def Stan 91-091 if:

1) the fuel has been tested for aromatics concentration in accordance with ASTM D1319/IP156 with a dye other than from lot number 3000000975 through 3000000982
   or
2) the fuel has been tested for aromatics concentration in accordance with the alternative test methods ASTM D6379/ IP436.

No other alternative test method, or method of deriving the aromatic content, is acceptable.

(8) The Doctor Test is an alternative requirement to the Sulphur Mercaptan Content. However, if the Doctor Test is positive, Sulphur Mercaptan Test shall be carried out and reported. In the event of conflict between the Sulphur Mercaptan and Doctor Test results, the Sulphur Mercaptan result shall prevail.

(9) The need to report the %v/v of non hydroprocessed, severely hydroprocessed and synthetic components (including "nil", “50%” or "100%" as appropriate) on point of manufacture Certificates of Quality for Jet A-1 to Checklist derives from DEF STAN 91-091/14. Each of the defined 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. (See Note 21 below).

(10)

Material	Maximum permitted level	Detection level	Test methods
Fatty acid methyl ester (FAME) a, b, c	50 mg/kg		ASTM D 7797/IP 585[d]. IP 590. IP 599
Pipeline Drag Reducer (DRA) a	Nil	72 µg/L (e,f)	ASTM D 7872

Table 2. Incidental Materials

a) Post manufacture each custodian shall undertake a risk assessment to quantify the potential risk of incidental material carry over. Where such assessments indicate that there could be a potential risk in jet fuel supplies, additional quality assurance procedures shall be introduced to increase control in order to mitigate the risk. Where the risk of incidental material carryover exists and it is not possible to control with additional quality assurance procedures, testing shall be instigated.

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

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 at any concentration. Dilution of fuels with known levels of DRA is not permitted, even to levels below the level stated in table 2. Where the level of DRA is otherwise unknown a result at or below the level in table 2 would support an assumption of nil addition

f) There is no need to report the DRA level at the point of manufacture. However, DRA content testing is required as part of a Risk Assessment where DRA is or is to be added into other products in a multiproduct pipeline system which is also transporting jet fuel.

(11) 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.

(12) If IP 406 or ASTM D 2887 are used to produce IP123 equivalent or ASTM D 86 correlated data, residue or loss shall be reported as ‘not applicable’ (NA).

(13) These automatic methods are permitted; IP 16/ASTM D 2386 remains the referee method.

(14) 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.

(15) 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.

(16) ASTM D 4529/IP 381 may be used where local regulations permit.

(17) 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.

(18) 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.

(19) Water separation property testing by ASTM D3948 is a mandatory requirement only at point of manufacture. Note that neither of the primary Standards mandate the testing of water separation properties downstream of the point of manufacture. Where it is required by JIG Standards for the purposes of product quality management, the following methods and limits should apply:

Test Method	Limits
ASTM D7224	85 Min.
ASTM D8073	88 Mín.

Table 3. Water Separation Limits Downstream of Point of Manufacture

Alternatively, testing may also be conducted using ASTM D3948 (still the intent of JIG to withdraw this method in the future). For further information on water separation testing refer to JIG Bulletins 129 and 142-Testing Water Separation Properties of Jet Fuel (Revised MSEP Protocol).

This protocol is also referenced in Note 18 of Def Stan 91-091/14.

(20) Due to the requirements of DEF STAN 91-091/14, 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 Defence Standard 91-091/14 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 91-091/14".

(21) This requirement comes from DEF STAN 91-091/14. 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 91-091/14. LIA 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 91-091/14 are permitted (note that the list of approved LIAs has been revised and reduced with the change to Def Stan 91-091 Issue 14). Refer also to Appendix A.5 of DEF STAN 91-091/14 for advice on point of addition. When injecting LIA downstream of point of manufacture, care shall be taken to ensure that maximum dose rates are not exceeded.

(22) The use of anti-oxidant is optional for jet fuels containing only conventional components. Anti-oxidant continues to be mandatory as part of the production process for synthetic components (see ASTM D7566). If antioxidant is added the maximum limit is 24 mg/l in the finished fuel. Approved antioxidant additives are listed in Annex A.2.5 of DEF STAN 91-091/14, together with the appropriate RDE/A/XXX-Qualification Reference for quoting on Certificates of Quality or Certificates of Analysis.

(23) The approved Metal Deactivator Additive (MDA), RDE/A/650 appears in Annex A.3 of DEF STAN 91-091/14 Annex A3.1 of DEF STAN 91-091/14 contains restrictions on the use of MDA at the point of manufacture and 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 91-091/14 highlighting that filter monitors cannot be used with fuel containing FSII.

(25) Attention is drawn to the guidance in DEF STAN 91-091/14 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) Test certificates shall state conformance to a primary specification. Checklist is not a specification and manufacturing locations shall not release fuel only to Checklist. If reference to Checklist is to be made the following statement should be used if the fuel meets the requirements of this bulletin.

"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 14 and AFQRJOS Checklist Issue 33".

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 Jet A-1 and AFQRJOS Checklist Issue 33".

The minimum requirements of information to be included on the fuel's point of manufacture 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.