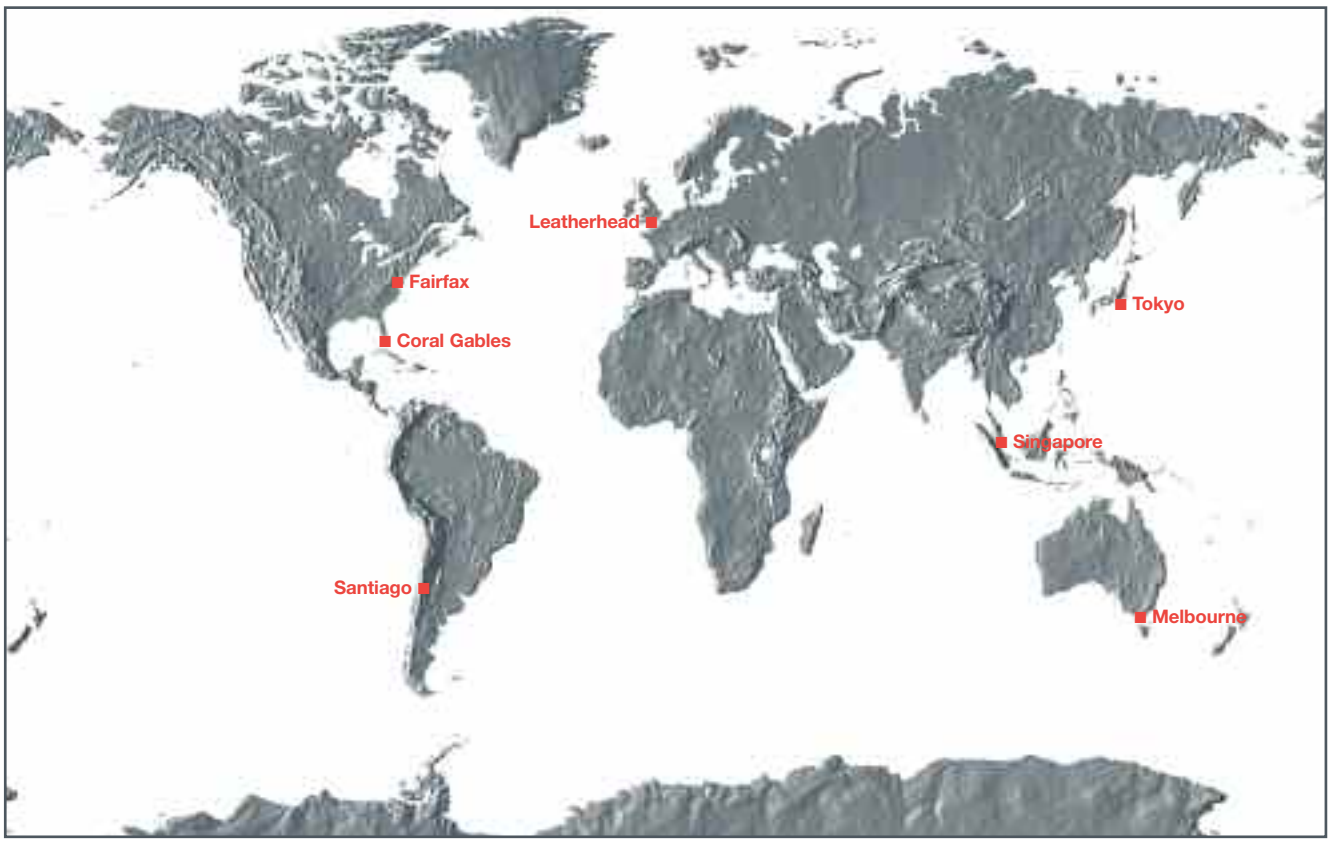
ExxonMobil Aviation

World Jet Fuel Specifications

with Avgas Supplement

2005 Edition

Foreword



ExxonMobil Aviation is a global organisation committed to providing high quality aviation products to customers worldwide. Our aim is to be the global supplier of choice offering solutions for all your aviation fuelling needs while protecting the safety and health of our employees and safeguarding the environment.

The Marketing Groups act as a global team providing service in all our markets to meet individual customer needs, while our skilled Operations Group provides advice and consultancy services to the industry on operations, technical and engineering issues.

If you have any queries or ideas about how we can better serve your business, please contact a member of the Operations Group at our Head Office in Leatherhead, UK on 44 1372 222 000.

Bryan Milton

Managing Director
ExxonMobil Aviation

The material presented in this brochure is intended to provide a handy and comprehensive source of information on specifications for aviation fuels used around the world. Every effort has been made to include the latest information available at the time of publication; however, since commercial and military specifications for aviation products are subject to change, this publication does not purport to be the official organ for any of the specifications listed. Inquiries concerning the latest official specifications should be directed to the issuing agency or organisation.

Whilst there are a considerable number of aviation turbine fuel specifications listed, all of these essentially define a similar product, a heart-cut kerosine. Some variations in test limits occur to meet specific customer applications; however, at many commercial airports where joint storage and hydrant systems are in place, industry has settled on using the Joint Fuelling System 'Check List' to define fuel quality. This checklist combines the most stringent requirements from ASTM D1655 and Defence Standard (Def Stan) 91-91 into one overall guideline that provides a common basis for commercial aviation turbine fuel quality in Jointly Operated Systems. There used to be an equivalent checklist for aviation gasoline, but this was discontinued in the early 1990s.

In addition to the fuel specifications, we have included for reference a summary of fuel types and additives in use in Russia and Eastern Europe (Appendix A), analytical test information (Appendix B) and guidance on contamination limits (Appendix C). Comments relating to impending change in the Jet fuel and Aviation Gasoline specifications expected to come into effect in 2005 have also been included where appropriate.

TEST METHOD STANDARDS

ASTM and IP test methods, as detailed in the following publications, are quoted whenever applicable in this compilation.

'2005 Annual Book of ASTM Standards, Petroleum Products and Lubricants 05.01, 05.02, 05.03, 05.04', published by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, USA.

'Standard Methods for the Analysis & Testing of Petroleum and Related Products, and British Standard 2000 Parts, 2005', 64th Edition, published by the Energy Institute, 61 New Cavendish Street, London, W1G 7AR, UK.

For quality parameters where more than one method is listed, the method to be used in case of dispute is listed in **red.**

APPROVED ADDITIVES

Appendix D gives a description of how additives can be used to enhance certain performance characteristics of jet fuels. Additive formulations approved in the different fuel specifications are tabulated. This list should not be considered official or necessarily complete. Specific information should be sought from issuing agencies. Note that there is a significant difference between the additive requirements for military and commercial fuels.

AVIATION GASOLINE

This brochure includes a section on gasoline fuels used in piston-engine aircraft, covering the common grades of AVGAS that are identified by differences in antiknock quality. Test and limit requirements for these fuels are illustrated by the two major specifications, issued respectively by ASTM International and the British Ministry of Defence.

Compiled by ExxonMobil Aviation International Ltd.
Technical Department
Leatherhead, UK

AVIATION PRODUCTS

ExxonMobil Aviation fuels comply with international specifications. Jet A is supplied in the U.S., while Jet A-1 is supplied throughout the rest of the World. Aviation Gasoline (AVGAS) is available on a regional basis. To view the airports at which we can service your fuelling needs, visit **www.exxonmobilaviation.com** and select the **Airport Network** tab.

Aviation Turbine Fuels (Jet A and Jet A-1)

Jet A and Jet A-1 are kerosine-type fuels. The primary physical difference between the two is freeze point (the temperature at which wax crystals disappear in a laboratory test).

Jet A, which is mainly used in the United States, must have a freeze point of -40 ºC or below, while Jet A-1 must have a freeze point of -47 ºC or below. Jet A does not normally contain a static dissipator additive, while Jet A-1 often requires this additive. Some of the other key differences between the manufacturing specifications within the United States and Europe/Africa/Middle East/Asia Pacific are:

ASTM D1655-04a:

- Has a maximum acidity limit of 0.10 mg KOH/g.
- Allows the use of Simulated Distillation via method ASTM D2887.

Defence Standard 91-91/5:

- Has a maximum acidity limit of 0.015 mg KOH/g.
- Allows for the measurement of Total Aromatics via method ASTM D6379/IP436.
- Has an additional requirement for measurement of lubricity for Jet A-1.

There are additional differences between the two primary specifications related to allowed test methods and the reader is urged to seek out the full specification for more detailed information.

ExxonMobil Jet A and Jet A-1 are typically produced to the requirements of ASTM D1655 and Def Stan 91-91 standards, respectively. ExxonMobil Jet A-1 may also be produced to the Joint Inspection Group (JIG) Check List. In all cases, the most recent issue of the relevant specification applies to the product supplied.

Military Turbine Fuel Grades

ExxonMobil Aviation is a leading supplier of military jet fuels (predominantly JP-5 and JP-8 as defined by Mil-DFL-5624 and Mil-DFL-83133, respectively). These fuels are kerosine type fuels made to more exacting specifications than the commercial jet fuels. They also contain unique performance enhancing additives.

Aviation Gasolines

ExxonMobil Aviation gasolines are leaded fuels satisfying the requirements of ASTM D910 or Def Stan 91-90 (DERD 2485). The properties of aviation gasoline are specified to give satisfactory performance of spark-ignition aviation engines over a wide range of operating conditions. ExxonMobil supplies AVGAS 100 (dyed green) and AVGAS 100LL (dyed blue), both of which are excellent for use in piston-engine powered private planes, most commercial aircraft and combat-type planes during military training procedures. Both grades are available in a number of regions internationally.

Aviation Lubricants

ExxonMobil Lubricants & Specialties supplies a full range of superior quality aviation lubricants for use in both piston-engine and jet aircraft. A sample of these products includes:

For piston-engine aircraft:	Exxon Aviation Oil Elite 20W-50 – *Semi-Synthetic, Ashless-Dispersant Oil*
For turbine-engine aircraft:	Mobil Jet Oil 254 – *Third Generation Synthetic Lubricant*
	Exxon HyJet V – *Synthetic Phosphate Ester Hydraulic Fluid*
	Mobil Aviation Grease SHC 100 – *Synthetic polyalphaolefin (PAO) base fluid*
	Exxon Coolanol – *Silicate Ester Synthetic Heat Transfer Fluid*

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SUPPLEMENT

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Table 1
Jointly Operated Systems

Issuing Agency:		Joint Inspection Group		
Specification:		Joint Fuelling System Check List (Issue 20)		
Latest Revision Date:		March 2005	**Test Method**	
Grade Designation:		Jet A-1 Kerosine	**ASTM**	**IP**
COMPOSITION		(1)		
Appearance		C & B (2)		
Colour, Saybolt		Report (3)	D156	
Acidity, Total (mg KOH/g)	Max.	0.015	D3242	354
Aromatics (vol %)	Max.	25.0	D1319	156
or Total Aromatics (vol %)	Max.	26.5 (4)	D6379	436
Sulphur, Total (wt %)	Max.	0.30	D1266, D2622 (5)	107
Sulphur, Mercaptan (wt %)	Max.	0.0030	D3227	342
or Doctor Test		Negative (6)	D4952	30
H/P Components (vol %)		Report (7)		
Severely H/P Components (vol %)		Report (7)		
VOLATILITY				
Distillation Temperature:			D86 (8)	
Initial BP (°C)		Report		
10% Recovery (°C)	Max.	205.0		
50% Recovery (°C)		Report		
90% Recovery (°C)		Report		
Final BP (°C)	Max.	300.0		
Distillation Residue (vol %)	Max.	1.5		
Distillation Loss (vol %)	Max.	1.5		
Flash Point (°C)	Min.	38.0 (9)	D3828	170 or 303
Density @ 15°C (kg/m^3)		775.0-840.0	D1298 or D4052	160 or 365
FLUIDITY				
Freezing Point (°C)	Max.	-47.0	D2386 or D5972 (10)	16 or 435
Viscosity @ -20°C (cSt)	Max.	8.000	D445	71
COMBUSTION				
Specific Energy, net. (MJ/kg)	Min.	42.80	D4529 (11)	381
Smoke Point (mm)	Min.	25.0	D1322	57
or Smoke Point (mm)	Min.	19.0	D1322	57
and Naphthalenes (vol %)	Max.	3.00	D1840	
CORROSION				
Copper Strip (2h ± 5 min @ 100°C ± 1°C)	Max.	1	D130	154
THERMAL STABILITY				
JFTOT _P @ 260 ºC (mm Hg)	Max.	25.0	D3241	323
Tube Deposit Rating (Visual)		<3 (12)		
CONTAMINANTS				
Particulates (mg/L) (13)	Max.	1.0	D5452	423
Existent Gum (mg/100 mL) (14)	Max.	7	D381	131
Water Reaction Interface	Max.	1b	D1094	
MSEP Rating (15)			D3948	
Fuel without SDA	Min.	85		
Fuel with SDA	Min.	70		
OTHER				
Electrical Conductivity (pS/m)		50-450 (16)	D2624	274
BOCLE wear scar diameter (mm)	Max.	0.85 (17)	D5001	
ADDITIVES				
Antioxidant (mg/L)				
In Hydroprocessed & Synthetic Fuels (Mandatory) (ppm)		17.0-24.0 (18)		
In Non-hydroprocessed Fuels (Optional) (ppm)	Max.	24.0		
Metal Deactivator (mg/L) (Optional)	Max.	5.7 (19)		
Static Dissipator (mg/L)				
First Doping (Stadis 450)	Max.	3.0		
Re-doping		(20)		
Corrosion Inhibitor		Agreement		
Anti-Icing		Agreement (21)		

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

(a) British Ministry of Defence Standard DEF STAN 91-91/Issue 5 of 8 February 2005 for Turbine Fuel, Aviation 'Kerosine Type', Jet A-1, NATO Code F-35, Joint Service Designation AVTUR.

(b) ASTM Standard Specification D1655-04a of 1 Nov 2004 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, generally, meets the requirements of both of the above specifications.

While the Table and Notes are central to the Joint Check List, fuels produced to this standard must satisfy the requirements detailed in the text of both primary specifications.

Table 1
Jointly Operated Systems

NOTES

(1) Attention is drawn to DEF STAN 91-91 Issue 5 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 DEF STAN 91-91 Issue 5. This particular semi-synthetic fuel meets the requirements of this Issue of Check List.

(2) Fuel should be clear, bright and visually free from solid matter and undissolved water at ambient temperature. For guidance on contamination limits for into-plane fuelling, refer to IATA Guidance Material for Aviation Turbine Fuels Specifications, 5th Edition, January 2004 (Part III).

(3) The requirement to report Saybolt Colour shall apply at the 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 E in Def Stan 91-91/5. To allow refineries time to modify procedures and testing, this requirement comes into effect for Check List Issue 20 on 1st June 2005.

(4) 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 D1319 and IP 436/ASTM D6379. Bias between the two methods necessitates different equivalence limits as shown. Testing laboratories are encouraged to measure and report total aromatics by the two methods to assist verification of the correlation.

(5) Alternative test methods are ASTM D4294, D1552 and D5453.

(6) The Doctor Test is an alternative requirement to the Sulphur Mercaptan Content. In the event of a conflict between Sulphur Mercaptan and Doctor Test results, the Sulphur Mercaptan result shall prevail.

(7) The need to report % 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 Issue 5. 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 vol % of severely hydroprocessed components as part of the lubricity requirement in DEF STAN 91-91 Issue 5. 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 7000 kPa (70 bar or 1015 psi) during manufacture.

(8) In method D86, all fuels certified to this specification shall be classed as group 4, with a condenser temperature of zero to 4 ºC. IP 406 and ASTM D2887 are alternative methods; however, there are different requirements for the use of these methods between ASTM D1655-04a and Def Stan 91-91/5. ASTM allows the use of simulated distillation results directly with different limits, while Def Stan requires a conversion of simulated distillation results to estimated IP 123 results using Annex G of IP 406. These different approaches were taken because of operations considerations rather than technical considerations; there is no intent that one approach is more restrictive than the other. IP 123 may also be used for the calculation of Specific Energy.

(9) Subject to a minimum of 40°C, results obtained by ASTM D56 (Tag) may be accepted.

(10) The automatic methods IP 528 and IP 529 are allowed by Def Stan 91-91/5.

(11) Alternative test methods are ASTM D3338 or D4809.

(12) 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. It is the Visual Tube Rating that should be reported. Attention is drawn to Note 10 in Def Stan 91-91/5 which stresses that only approved heater tubes shall be used. No peacock or abnormal colour deposits allowed.

(13) Applies at point of manufacture only. For more information on particulate contamination refer to Annex F of Def Stan 91-91 Issue 5. To allow refineries time to modify procedures and testing, this requirement comes into effect for Check List Issue 20 on 1st June 2005.

(14) Air may be used in place of steam as the evaporating medium so long as the temperatures remain as specified in IP 131/ASTM D381 for steam jet apparatus.

(15) Attention is drawn to Note 13 of Def Stan 91-91/5 that 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."

(16) Due to the requirements of DEF STAN 91-91/5, 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 20 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 be met at the point of delivery to aircraft.

(17) This requirement comes from DEF STAN 91-91/5. 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 6) 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 91-91/5.

(18) Approved antioxidant additives are listed in Annex A.1.4 of DEF STAN 91-91/5, together with the appropriate RDE/A/XXX- Qualification Reference for quoting on refinery Certificates of Quality.

(19) The approved Metal Deactivator Additive (MDA), RDE/A/650, appears in Annex A.2.2 of DEF STAN 91-91/5. 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 2 mg/L.

(20) Re-doping limits for Static Dissipator Additive are:
(a) Cumulative concentration Stadis 450 (RDE/A/621) 5.0 mg/L
(b) Original dosage not known: Additional concentration Stadis 450 (RDE/A/621) 2.0 mg/L

(21) 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.

(22) Attention is drawn to the new requirement in DEF STAN 91-91 Issue 5 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).

Table 2
International Air Transport Association

Issuing Agency:		IATA			
Specification:		Guidance Material (5th Edition)			
Latest Revision Date:		January 2004		Test Method	
Grade Designation:		Jet A Kerosine	Jet A-1 Kerosine	ASTM	IP
COMPOSITION					
Appearance		C & B (1)	C & B (1)		
Acidity, Total (mg KOH/g)	Max.	0.10	0.015	D3242	354
Aromatics (vol %)	Max.	25	25.0	D1319	156
or Total Aromatics (vol %)	Max.	---	26.5		436
Sulphur, Total (wt %)	Max.	0.30	0.30	D1266, D1552, D2622, D4294, D5453	107, 243, 336, 373
Sulphur, Mercaptan (wt %)	Max.	0.003	0.0030	D3227	342
or Doctor Test		Negative	Negative	D4952	30
H/P Components (vol%)		---	Report		
Severely H/P Components (vol%) (2)		---	Report		
VOLATILITY					
Distillation Temperature:				D86	123
Initial BP (°C)		---	Report		
10% Recovery (°C)	Max.	205	205.0		
50% Recovery (°C)	Max.	Report	Report		
90% Recovery (°C)	Max.	Report	Report		
Final BP (°C)	Max.	300	300.0		
Distillation Residue (vol %)	Max.	1.5	1.5		
Distillation Loss (vol %)	Max.	1.5	1.5		
Flash Point (°C)	Min.	38 (3)	38.0	D56, D3828	170, 303
Density @ 15°C (kg/m³)		775-840	775.0-840.0	D1298, D4052	160, 365
FLUIDITY					
Freezing Point (°C)	Max.	-40	-47.0	D2386, D5972	16
Viscosity @ -20°C (cSt)	Max.	8.0	8.000	D445	71
COMBUSTION					
Net Heat of Comb. (MJ/kg)	Min.	42.8	42.80	D3338, D4529, D4809	12, 381, 355
Smoke Point (mm)	Min.	25	25.0	D1322	57
or Smoke Point (mm)	Min.	18	19.0	D1322	57
and Naphthalenes (vol %)	Max.	3.0	3.00	D1840	
CORROSION					
Copper Strip (2h @ 100°C)	Max.	1	1	D130	154
THERMAL STABILITY					
JFTOT ΔP @ 260 °C(mm Hg)	Max.	25	25	D3241	323
Tube Deposit Rating (Visual)	Max.	<3 (4)	<3 (4)		
CONTAMINANTS (5)					
Existent Gum (mg/100 mL)	Max.	7	7	D381	131
Water Reaction Interface	Max.	1b	1b	D1094	289
MSEP Rating (6)				D3948	
Fuel without SDA	Min.	---	85		
Fuel with SDA	Min.	---	70		
OTHER					
Conductivity				D2624	274
At Point of Use	Max.	450			
At Time and Temp of Custody Transfer			50-450		
BOCLE wear scar diameter (mm)	Max.	---	0.85	D5001	
ADDITIVES					
Anti-icing (vol %)		Agreement	Agreement		
Antioxidant		Option	Option (7)		
Corrosion Inhibitor		Agreement	Agreement		
Metal Deactivator		Option	Option		
Static Dissipator		Option	Mandatory		

NOTES

(1) Clear, bright and visually free from solid matter and undissolved water at normal temperature.

(2) Severe hydroprocessing refers to a hydrogen partial pressure of >7000 kPa (70 bar or 1015 psi) during manufacture.

(3) Results by method D56 are usually about 2°C above those obtained by D3828 and IP 170.

(4) No peacock or abnormal colour deposits allowed.

(5) For guidance on contamination limits for into-plane fuelling, refer to IATA Guidance Material for Aviation Turbine Fuels Specifications, 5th Edition, January 2004 (Part III).

(6) Applies only at point of manufacture.

(7) Mandatory in hydroprocessed fuels at 17.0-24.0 mg/L, and must be added immediately after processing.

Table 3
US Pipeline Specifications

Issuing Agency:		Buckeye P/L	Colonial P/L	Explorer P/L	
Specification:		Fungible Aviation Kerosine	Fungible Aviation Kerosine	Fungible Aviation Kerosine	
Latest Revision Date:		May 2004	February 2004	December 2003	Test Method
Grade Designation:		Grade 182 Kerosine	Grade 54 Kerosine	Codes 51,54	ASTM
COMPOSITION					
Appearance		C & B (1)	C & B (1)	C & B (1)	
Acidity, Total (mg KOH/g)	Max.	0.1	0.1	0.1	D974 (2), D3242
Aromatics (vol %)	Max.	25	25	25	D1319
Sulphur, Total (wt %)	Max.	0.30	0.30	0.30	D1266, D1552, D2622, D4294, D5453 (3)
Doctor Test		Negative	Negative	Negative	D4952
or Sulphur, Mercaptan (wt %)	Max.	0.003 (4)	0.003 (4)	0.003 (4)	D3227
Colour, Saybolt		Report	---	+21 (5)	D156, D6045 (6)
VOLATILITY					
Distillation Temperature:					D86
10% Recovery (°F)	Max.	400	400	400	
20% Recovery (°F)		Report	---	---	
50% Recovery (°F)		Report	Report	Report	
90% Recovery (°F)		Report	Report	Report	
Final BP (°F)	Max.	572	572	572	
Distillation Residue (vol %)	Max.	1.5	1.5	1.5	
Distillation Loss (vol %)	Max.	1.5	1.5	1.5	
Flash Point (°F)	Min.	108	108	108 (7)	D56, D3828
Gravity, API @ 60°F		37-51	37-51	37-51	D287, D1298, D4052
FLUIDITY					
Freezing Point (°C)	Max.	-40	-40	-40.0	D2386, D4305 (8), D5901 (8), D5972
Viscosity @ -20°C (cSt)	Max.	8	8.0	8.0 (9)	D445
COMBUSTION					
Net Heat of Comb. (BTU/lb)	Min.	18,400	18,400	18,400	D1405 (10), D3338, D4529 , D4809
Luminometer No.	Min.	---	45	45	D1740
or Smoke Point (mm)	Min.	25	25	25	D1322
or Smoke Point (mm)	Min.	18	18	18	D1322
and Naphthalenes (vol %)	Max.	3.0	3.0	3.0	D1840
CORROSION					
Copper Strip (2h @ 212 °F)	Max.	1	1	1	D130
THERMAL STABILITY					
JFTOT ΔP @ 275 ºC (mm Hg)	Max.	25	25	25	D3241 (11)
Tube Deposit Rating (Visual)	Max.	<3 (12)	<3 (12)	<3 (12)	
CONTAMINANTS					
Existent Gum (mg/100 mL)	Max.	7	7.0	7	D381
Particulates (mg/gal)		---	---	Report	D2276
Water Reaction Interface	Max.	1b	1b	1b	D1094
MSEP Rating	Min.	Report	85 (13)	85 (13)	D3948
Filtration Time (min)		---	Report (14)	---	MIL-T-5624P
Total Solids		---	Report (14)	---	MIL-T-5624P, D5452
OTHER					
Conductivity (pS/m)		Report	Report	Report	D2624
ADDITIVES		(15)	(15)	(15)	

NOTES

(1) Clear, bright and free of suspended matter.
(2) D974 only allowed in Colonial specification.
(3) D5453 only allowed in Colonial specification.
(4) Mercaptan sulphur waived if fuel is negative by Doctor test.
(5) Min. colour of +21 specified at origin, min. +18 at destination.
(6) D6045 only allowed in Explorer specification.
(7) Minimum 108°F applies at origin locations.
Minimum of 100°F will apply at destination.
(8) D4305 and D5901 only allowed in Buckeye specification.
(9) Max. of 8.0 at -4ºF and max. of 1.9 at 104ºF.
(10) D1405 only allowed in Explorer specification.
(11) For Colonial and Explorer, test for 2.5 hours at 275 ºC at origin.
At destination, test for 2.5 hours at 260 ºC.
(12) No peacock or abnormal colour deposits allowed.
(13) At origin, minimum 85 MSEP required.
At delivery, minimum 75 MSEP required.
(14) At this time, the test limits described in MIL-T-5624P, Appendix A, Parts 70.a(1) and 70.b will not be imposed.
(15) Only those additives specified and within the concentration noted in Section 5.2 through 5.2.2.1 of ASTM D1655 are permitted. The use of any other additives is prohibited.

Table 4
US Pipeline Specifications

Issuing Agency:		Centennial	Kinder Morgan	TEPPCO	
Specification:		Fungible Aviation Kerosine	Fungible Aviation Kerosine	Fungible Aviation Kerosine	
Latest Revision Date:		Dec 2001	Feb 2004	May 2004	Test Method
Grade Designation:		Code 510 Kerosine	Code 15 Kerosine	Code 510, 520 Kerosine	ASTM
COMPOSITION					
Appearance		C & B (1)	C & B (1)	C & B (1)	
Acidity, Total (mg KOH/g)	Max.	0.10	0.10	0.10	D3242
Aromatics (vol %)	Max.	25	25	25	D1319
Sulphur, Total (wt %)	Max.	0.30	0.3	0.30	D2622
Sulphur, Mercaptan (wt %)	Max.	0.003 (2)	0.003 (2)	0.003 (2)	D3227
Colour, Saybolt		Report	---	Report	D156
VOLATILITY					
Distillation Temperature: (3)					D86, D2887 (3)
10% Recovery (°F)	Max.	400	401	400 (185 °C)	
20% Recovery (°F)		---	---	---	
50% Recovery (°F)		Report	Report	Report	
90% Recovery (°F)		Report	Report	Report	
Final BP (°F)	Max.	572	572	572 (300 °C)	
Distillation Residue (vol %)	Max.	1.5	1.5	1.5	
Distillation Loss (vol %)	Max.	1.5	1.5	1.5	
Flash Point (°F)	Min.	110 (4)	105 (4)	110 (4)	D56
Gravity, API @ 60°F		37.0-51.0	37.0-51.0	37.0-51.0	D287
FLUIDITY					
Freezing Point (°C)	Max.	-40	-40	-40.0	D2386
Viscosity @ -20°C (cSt)	Max.	8.0	8.0	8.0	D445
COMBUSTION					
Net Heat of Comb. (BTU/lb)	Min.	18,400	18,400	18,400	D3338, D4529 (5), D4809
Smoke Point (mm)	Min.	25	25	25	D1322
or Smoke Point (mm)	Min.	18	18	18	D1322
and Naphthalenes (vol %)	Max.	3.0	3.0	3.0	D1840
CORROSION					
Copper Strip (2h @ 100°C)	Max.	1A or 1B	1	1A or 1B	D130
THERMAL STABILITY					
JFTOT ΔP (mm Hg)	Max.	25.0 (6)	25 (7)	25.0 (6)	D3241
Tube Deposit Rating (Visual)	Max.	<3 (8)	<3 (8)	<3 (8)	
CONTAMINANTS					
Existent Gum (mg/100 mL)	Max.	5.0 (9)	7	5.0 (9)	D381
Particulates (mg/gal)	Max.	Report	2.0	Report	D2276, D5452 (10)
Membrane Colour		Report	---	Report	
Water Reaction Interface	Max.	1b	1b	1b	D1094
MSEP Rating	Min.	85	85	85	D3948
OTHER					
Conductivity (pS/m)		Report	Report	Report	D2624, D4308 (11)
ADDITIVES		Report (12)	Report (13)	Report (12)	

NOTES

(1) Clear, bright and free from suspended matter.
(2) Mercaptan sulphur waived if fuel is negative by doctor test described in ASTM D4952.
(3) Simulated distillation by ASTM D2887 allowed by TEPPCO; test limits in parentheses.
(4) Minimum shown in table applies at origin locations. Minimum of 100°F will apply at destination.
(5) D4529 only allowed in Kinder Morgan specification.
(6) At origin, JFTOT must pass at 2.5 hours at 275ºC. At pipeline delivery point, JFTOT must pass at 2.5 hours at 260 ºC.
(7) JFTOT must pass at 2.5 hours at 260 ºC.
(8) No 'peacock' or 'abnormal' colour deposits allowed.
(9) Maximum shown in table at origin. A maximum existent gum of 7.0 mg/100 ml applies at destination.
(10) D5452 not allowed in Kinder Morgan specification.
(11) D4308 only allowed in Centennial specification.
(12) Only those additives specified and within the concentration noted in Section 5.2 through 5.2.2 of ASTM D1655 are permitted. The use of any other additives is prohibited.
(13) Requirements on additive use apply as stated in ASTM D1655.

Table 5
US Military Specifications

Issuing Agency:		US Navy		
Specification:		MIL-DTL-5624U		
Latest Revision Date:		5 January 2004		
Grade Designation:		JP-4 Wide-Cut Kerosine	JP-5 Kerosine	**Test Method**
NATO Code No.		F-40	F-44	**ASTM**
COMPOSITION				
Appearance		C & B (1)	C & B (1)	
Acidity, Total (mg KOH/g)	Max.	0.015	0.015	D3242
Aromatics (vol %)	Max.	25.0	25.0	D1319
Sulphur, Total (wt %)	Max.	0.40	0.30	D4294, D1266, D2622, D3120, D5453
Sulphur, Mercaptan (wt %)	Max.	0.002	0.002	D3227
or Doctor Test		Negative	Negative	D4952
Colour, Saybolt		Report	Report	D156, D6045
VOLATILITY				
Distillation Temperature:				D86, D2887 (2)
Initial BP (°C)		Report	Report	
10% Recovery (°C)	Max.	Report	205 (186)	
20% Recovery (°C)	Min.	100	Report	
50% Recovery (°C)	Min.	125	Report	
90% Recovery (°C)	Max.	Report	Report	
Final BP (°C)	Max.	270	300 (330)	
Distillation Residue (vol %)	Max.	1.5	1.5	
Distillation Loss (vol %)	Max.	1.5	1.5	
Flash Point (°C)	Min.	---	60 (3)	D56, D93, D3828
Density @ 15°C (kg/L)		0.751-0.802	0.788-0.845	D1298, D4052
or Gravity, API @ 60°F		57.0-45.0	48.0-36.0	
Vapour Pressure @ 37.8°C (kPa)		14-21	---	D323, D4953, D5190, D5191
FLUIDITY				
Freezing Point (°C)	Max.	-58	-46	D2386, D5972 (4)
Viscosity @ -20°C (cSt)	Max.	---	8.5	D445
COMBUSTION				
Net Heat of Comb. (MJ/kg)	Min.	42.8	42.6	D3338, D4809, D4529
Cetane Index (calculated) (5)			Report	D976, D4737
Smoke Point (mm)	Min.	20.0	19.0	D1322
Hydrogen Content (wt %)	Min.	13.5	13.4 (6)	D3343, D3701
CORROSION				
Copper Strip (2h @ 100°C)	Max.	1	1	D130
THERMAL STABILITY				
JFTOT ΔP (mm Hg)	Max.	25	25	D3241
Tube Deposit Rating (Visual)	Max.	<3 (7)	<3 (7)	
CONTAMINANTS				
Existent Gum (mg/100 mL)	Max.	7.0	7.0	D381 (8)
Particulates (mg/L)	Max.	1.0	1.0	D2276, D5452 (9)
Filtration Time (min)	Max.	10	15 (10)	(9)
Water Reaction Interface	Max.	1b	---	D1094
MSEP Rating	Min.	90 (11)	90 (11)	D3948
OTHER				
Conductivity (pS/m)		150-600 (12)	---	D2624
ADDITIVES				
Anti-icing (vol %)		0.10-0.15	0.10-0.15	D5006 (13)
Antioxidant (ppm)		17.2-24.0 (14)	17.2-24.0 (15)	
Corrosion Inhibitor		Required (16)	Required (16)	
Metal Deactivator		Agreement	Agreement	
Static Dissipator		Required	(17)	

NOTES

(1) In case of dispute, the fuel shall be clear and bright at 21°C and contain no more than 1.0 mg/L of particulate matter.
(2) D2887 may be used for JP-5 fuel only; test limits in parentheses.
(3) D3828 may give results up to 1.7°C below the D93 results. D56 may give results up to 1°C below the D93 results.
(4) D5972 may be used for freeze point determination of JP-5 only.
(5) Mid-boiling temperatures shall be obtained by either ASTM D86 or ASTM D2887 to perform the Cetane Index calculation. If ASTM D86 values are used, they shall be corrected to standard barometric pressure.
(6) For JP-5, only D3701 shall be used to measure the hydrogen content.
(7) No peacock or abnormal colour deposits allowed.
(8) If air is used instead of steam while performing ASTM D381, it shall be recorded. In case of a failure with air, the sample shall be retested using steam.
(9) Minimum sample size of 1 US gallon shall be filtered. Filtration time determined according to procedure in Appendix A of specification.
(10) Flow reducer ring of Appendix A, section A.3.c is not required for JP-5.
(11) Limit for fuel containing antioxidant and metal deactivator. Minimum limit reduced to 85 when third additive is fuel system icing inhibitor; to 80 when third additive is corrosion inhibitor; to 70 with all four additives present.
(12) Conductivity must be within range at ambient fuel temperature or 29.4°C, whichever is lower.
(13) Tests shall be performed with ASTM D5006 using the DiEGME scale of the refractometer.
(14) Limits of active ingredient for JP-4 fuels containing hydrotreated blend stocks. For JP-4 fuels that do not contain any hydrotreated blend stocks, antioxidant may be added to a max. 24 ppm.
(15) Required for all JP-5 fuels. .
(16) Allowable concentration limits listed in latest revision of QPL-25017.
(17) Static dissipator additive shall not be used in JP-5 unless written consent has been obtained from NAVAIR 4.4.5.

Table 6
US Military Specifications

Issuing Agency:		US Air Force	US Air Force	
Specification:		MIL-DTL-38219D	MIL-DTL-83133E	
Latest Revision Date:		21 August 1998	1 April 1999	
Grade Designation:		JP-7 Low Volatility Kerosine	JP-8 (1) Kerosine	Test Method
NATO Code No.			F-34/F-35	ASTM
COMPOSITION				
Appearance		C & B (2)	C & B (2)	
Acidity, Total (mg KOH/g)	Max.	---	0.015	D3242
Aromatics (vol %)	Max.	5	25.0	D1319
Sulphur, Total (wt %)	Max.	0.1	0.30	D4294 (3)
Sulphur, Mercaptan (wt %)	Max.	0.001	0.002	D3227
or Doctor Test		Negative	Negative	D4952
Colour, Saybolt		---	Report	D156, D6045
VOLATILITY				
Distillation Temperature:				D86, D2887 (JP-8 only, limits in parenthesis)
Initial BP (°C)	Min.	182	Report	
10% Recovery (°C)		196 min.	205 (186) max.	
20% Recovery (°C)	Min.	206	Report	
50% Recovery (°C)		Report	Report	
90% Recovery (°C)	Max.	260	Report	
Final BP (°C)	Max.	288	300 (330)	
Distillation Residue (vol %)	Max.	1.5	1.5	
Distillation Loss (vol %)	Max.	1.5	1.5	
Flash Point (°C) (4)	Min.	60	38	D56, D93, D3828
Density @ 15°C (kg/L)		0.779-0.806	0.775-0.840	D1298, D4052
or Gravity, API @ 60°F		50.1-44.0	51.0-37.0	D1298
Vapour Pressure @ 149°C (kPa)	Max.	20.7	---	(5)
Vapour Pressure @ 260°C (kPa)	Max.	331	---	(5)
FLUIDITY				
Freezing Point (°C)	Max.	-43.3	-47	D2386, D5901 (JP-8 only), D5972 (JP-8 only)
Viscosity @ -20°C (cSt)	Max.	8.0	8.0	D445
COMBUSTION				
Net Heat of Comb. (MJ/kg)	Min.	43.5	42.8	D2382 (JP-7 only), D3338, D4809 (JP-8 only)
Cetane Index (calculated)		---	Report	D976
Smoke Point (mm)	Min.		25.0	D1322
or Smoke Point (mm)	Min.		19.0	D1322
and Naphthalenes (vol%)	Max.		3.0	D1840
Hydrogen Content (wt %)	Min.	14.40	13.4	D3701, D3343 (6)
CORROSION				
Copper Strip (2h @ 100°C)	Max.	1b	1	D130
THERMAL STABILITY				
JFTOT ΔP (mm Hg)	Max.	25.0	25	D3241 (7)
Tube Deposit Rating	Max.	12 TDR	<3 Visual (8)	
CONTAMINANTS				
Existent Gum (mg/100 mL)	Max.	5.0 (9)	7.0	D381
Particulates (mg/L)	Max.	0.3 (10)	1.0	D2276, D5452
Filtration Time (min)	Max.	---	15	(11)
Water Reaction Interface	Max.	1b	1b	D1094
Water Reaction Separation	Max.	2	---	D1094
MSEP Rating	Min.	85	90 (12)	D3948
OTHER				
Conductivity (pS/m)			(13)	D2624
ADDITIVES				
Anti-icing (vol %)		0.10-0.15	0.10-0.15 (14)	D5006
Antioxidant (ppm)		24.0	Required (15)	
Corrosion Inhibitor (ppm)		200-250 (16)	Required (16)	
Metal Deactivator		Agreement	Agreement	
Static Dissipator		---	Required	

NOTES

(1) JP-8 fuel with an approved thermal stability improver additive is designated JP-8+100.
(2) Fuel shall be clear and bright at 21°C; JP-8 may contain no more than 1.0 mg/L of particulate matter.
(3) D1266, D2622 and D3120 are permitted alternatives for JP-7 and JP-8 (which also accepts D129 and D5453).
(4) For JP-7, only D93 may be used. For JP-8, D56 may give results up to 1°C below D93 results; D3828 may give results up to 1.7°C below D93 results; method IP170 is also permitted.
(5) Vapour pressure tested according to Appendix A or Appendix C of MIL-DTL-38219D.
(6) May use calculation (D3343) or measurement method (D3701).
(7) Test conditions for JP-7 fuel of 355°C for 5h; for JP-8 fuel at 260°C for 2.5h.
(8) No peacock or abnormal colours allowed.
(9) If air is used instead of steam, it must be reported. In case of failure with air, the sample must be retested with steam.
(10) Limit applies at origin. At destination, max. limit is 0.5 mg/L.
(11) Filtration time determined according to procedure in Appendix A of MIL-DTL-83133E.
(12) Limit for fuel containing antioxidant and metal deactivator. Limit reduced to 85 when third additive is icing inhibitor; to 80 when third additive is corrosion inhibitor; to 70 with all four additives present.
(13) Conductivity limits are 150-450 pS/m for F-34 (JP-8), 50-450 pS/m for F-35, and 150-700 pS/m for JP-8+100 fuel. Conductivity must be within range at ambient fuel temperature or 29.4°C, whichever is lower.
(14) Fuel system icing inhibitor is mandatory for F-34 grade, by agreement in F-35.
(15) Required for fuel containing hydrogen-treated blending stocks. Optional for fuel not containing hydrogen-treated blending stocks.
(16) PWA-536 lubricity additive shall be added to JP-7 fuel. Corrosion inhibitor conforming to MIL-PRF-25017 shall be added to F-34 fuel, but is optional for F-35.

Table 7
Brazil

Issuing Agency:		National Petroleum Agency		
Specification:		QAV-1		
Latest Revision Date:		12 May 2003	**Test Method**	
Grade Designation:		Jet A-1 Kerosine	**ASTM**	**ABNT NBR** (1)
COMPOSITION				
Appearance		C & B (2)	D4176	
Acidity, Total (mg KOH/g)	Max.	0.015	D3242	
Aromatics (vol %)	Max.	25.0	D1319	
Or Total Aromatics (vol %)	Max.	26.5	D6379	
Sulphur, Total (wt %)	Max.	0.30	D1266, D1552, D2622, D4294, D5453	6563, 14533, 14875
Sulphur, Mercaptan (wt %)	Max.	0.0030	D3227	6298
or Doctor Test		Negative	D4952	14642
H/P components (vol%) (3)		Report (incl. 'nil' or 100%)		
Severely H/P components (vol%) (3)		Report (incl. 'nil' or 100%)		
VOLATILITY				
Distillation Temperature:			D86	9619
Initial BP (°C)		Report		
10% Recovery (°C)	Max.	205		
50% Recovery (°C)	Max.	Report		
90% Recovery (°C)	Max.	Report		
Final BP (°C)	Max.	300		
Distillation Residue (vol %)	Max.	1.5		
Distillation Loss (vol %)	Max.	1.5		
Flash Point (°C)	Min.	40	D56	7974
		or 38	D3828	
Density @ 20°C (kg/m³) (4)		771.3-836.6	D1298, D4052	7148, 14065
FLUIDITY				
Freezing Point (°C)	Max.	-47	D2386, D5972	7975
Viscosity @ -20°C (cSt)	Max.	8.0	D445	10441
COMBUSTION				
Net Heat of Comb. (MJ/kg)	Min.	42.8	D3338, D4529, D4809	
Smoke Point (mm)	Min.	25	D1322	11909
Or Smoke Point (mm)	Min.	19	D1322	11909
And Naphthalenes (vol %)	Max.	3.0	D1840	
CORROSION				
Copper Strip (2h @ 100°C)	Max.	1	D130	14359
Silver Strip (4h @ 50°C) (5)	Max.	1		
THERMAL STABILITY				
JFTOT ΔP @ 260 ºC (mm Hg)	Max.	25.0	D3241	
Tube Deposit Rating (Visual)	Max.	<3 (6)		
CONTAMINANTS				
Existent Gum (mg/100 mL)	Max.	7	D381	14525
Water Reaction Interface	Max.	1b	D1094	6577
MSEP Rating (7)			D3948	
Fuel without SDA	Min.	85		
Fuel with SDA	Min.	70		
OTHER				
Conductivity (pS/m)		50-450 (8)	D2624	
Lubricity (BOCLE wear scar diameter, mm) (9)	Max.	0.85	D5001	
ADDITIVES (10)				
Antioxidant (mg/L)		17.0-24.0 (11)		
Metal Deactivator		Option (12)		
Static Dissipator		Option (13)		
Anti-Icing		Agreement		
Leak Check		Option		
Lubricity Improver		Agreement		

NOTES

(1) Normas Brasileiras (NBR) da Associacao Brasileira de Normas Tecnicas (ABNT)
(2) Clear, bright and visually free of undissolved water and solid material at normal, ambient temperature.
(3) Severely hydroprocessed components are defined having been subjected to a hydrogen partial pressure of greater than 7000 kPa (70 bar or 1015 psi) during manufacture.
(4) The value for density shall be reported at 20 °C. A density at 15 °C may be reported to facilitate commercial transactions. The limits that apply at 15 °C are from 775.0 to 840.0 kg/m3.
(5) Test (as per IP 227) is only required for military contracts.
(6) No peacock or abnormal colour deposits allowed.
(7) MSEP is required only at point of manufacture. Failure to comply at later stages of distribution shall be cause for investigation, but not rejection in the first instance.
(8) Limit applies at point, time and temperature of delivery to buyer if fuel contains static dissipator additive.
(9) The requirement to determine lubricity applies only to fuels containing more than 95% hydroprocessed material and where at least 20% is severely hydroprocessed, at point of manufacture.
(10) The Certificate of Quality shall indicate the types and concentrations of additives used, inclusive of no addition. Only approved additives listed in the Annex of DEF STAN 91-91 are allowed.
(11) For fuel containing hydroprocessed components. Antioxidant is optional for fuels having no hydroprocessed components.
(12) The maximum allowed concentration on initial doping is 2.0 mg/L. Cumulative addition of MDA upon redoping shall not exceed 5.7 mg/L. JFTOT results must be reported before and after addition of the additive.
(13) The maximum allowed concentration on initial doping is 3.0 mg/L. The cumulative concentration of additive upon redoping to maintain conductivity shall not exceed 5.0 mg/L.

Table 8
Canada

Issuing Agency:		Canadian General Standards Board		
Specification:		CAN/CGSB-3.23-02		
Latest Revision Date:		1, July 2002 (Amendment 3)		
Grade Designation:		Jet A/A-1 Kerosine	**Test Method**	
NATO Code No.		F-34 (1)	**ASTM**	**IP**
COMPOSITION				
Appearance		C & B (2)		
Acidity, Total (mg KOH/g)	Max.	0.10	D3242	
Aromatics (vol %)	Max.	25	D1319	
Sulphur, Total (wt %)	Max.	0.30	D1266, D2622, D4294, D5453 (3)	
Sulphur, Mercaptan (wt %)	Max.	0.003	D3227	
or Doctor Test		Negative	D4952	
VOLATILITY				
Distillation Temperature:			D86	
Initial BP (°C)		Report		
10% Recovery (°C)	Max.	205		
20% Recovery (°C)		--- (1)		
50% Recovery (°C)		Report		
90% Recovery (°C)		Report		
Final BP (°C)	Max.	300		
Distillation Residue (vol %)	Max.	1.5		
Distillation Loss (vol %)	Max.	1.5		
Flash Point (°C)	Min.	38	D56, D3828 (4)	
Density @ 15°C (kg/m³)		775-840	D1298, D4052	
FLUIDITY				
Freezing Point (°C)	Max.	-40 (Jet A) -47 (1) (Jet A-1)	D2386, D4305 (5), D5901, D5972	
Viscosity @ -20°C (cSt)	Max.	8	D445	
COMBUSTION				
Net Heat of Comb. (MJ/kg)	Min.	42.8	D3338, D4529, D4809	
Smoke Point (mm)	Min.	25	D1322	
or Smoke Point (mm)	Min.	18	D1322	
and Naphthalenes (vol%)	Max.	3.0	D1840	
CORROSION				
Copper Strip (2h @ 100°C)	Max.	1	D130	
THERMAL STABILITY				
JFTOT ΔP @ 260 °C (mm Hg)	Max.	25	D3241	
Tube Deposit Rating (Visual)	Max.	<3 (6)		
CONTAMINANTS				
Existent Gum (mg/100 mL)	Max.	--- (1)	D381	
Particulates (mg/L)	Max.	0.44 (7)	D2276, D5452	
Water Reaction Interface	Max.	1b	D1094	
MSEP Rating	Min.	85 (8)	D3948	
OTHER				
Conductivity (pS/m)		50-450 (1)	D2624	
ADDITIVES (9)				
Anti-icing (vol %)		0.10-0.15 (1) (10)	D5006	277 (Method C)
Antioxidant		Option (11)		
Corrosion Inhibitor		Agreement (1)		
Metal Deactivator		Option		
Static Dissipator		Required (12)		
Leak Detector		Option		

NOTES

(1) For designation as F-34, the following changes apply: Freezing Point is -47°C max, Existent Gum is 7 mg/L max, 20% Distillation Recovery needs to be reported and conductivity range is 50-600 pS/m. Anti-icing and corrosion inhibitor additives are mandatory.
(2) Fuel shall be visually clear and free from undissolved water and particulate matter.
(3) CAN/CGSB 3.0 No. 16 can also be used.
(4) The results obtained by ASTM D3828 may be up to 2 ºC lower than those obtained by D56.
(5) With D4305, use Procedure A only; this method shall not be used on samples with viscosities greater than 5.0 cSt at -20°C.
(6) No peacock or abnormal colour deposits allowed.
(7) Limit at aircraft and refuellers. Limit into purchaser's storage is 2.2 mg/L max.
(8) Rating applies at the point immediately before the fuel enters dedicated transportation to airport storage. A minimum rating of 70 applies for fuel containing static dissipator additive.
(9) When used, additive names and amounts shall be reported on the test certificate.
(10) By agreement, the inhibitor shall be added to Jet A and Jet A-1 fuels. Additive should conform to CAN/CGSB-3.526 (EGME) or ASTM D4171 Type III (DiEGME).
(11) Antioxidant at 17.2-24 ppm must be added to the hydroprocessed component of F-34.
(12) When additive depletion is evident, further addition is allowed provided original concentration is 3 mg/L max. and cumulative concentration is 5 mg/L max. If initial concentration is not known, further additions shall not exceed 2 mg/L.

Table 9
Canada

Issuing Agency:		Canadian General Standards Board	Canadian General Standards Board	
Specification:		CAN/CGSB-3.22-2002	3-GP-24d	
Latest Revision Date:		1, July 2002	1, July 2002	
Grade Designation:		Jet B Wide-Cut Kerosine	High Flash Kerosine	**Test Method**
NATO Code No.		F-40 (1)		**ASTM**
COMPOSITION				
Appearance		C & B (2)	C & B (2)	
Acidity, Total (mg KOH/g)	Max.	0.10	0.03	D3242
Aromatics (vol %)	Max.	25	25	D1319
Sulphur, Total (wt %)	Max.	0.40	0.40	D1266, D2622, D4294, D5453 (3)
Sulphur, Mercaptan (wt %)	Max.	0.003	0.002	D3227
or Doctor Test		Negative	Negative	D4952
VOLATILITY				
Distillation Temperature:				D86
Initial BP (°C)		Report	Report	
10% Recovery (°C)	Max.	Report	205	
20% Recovery (°C)		100 min 145 max	Report	
50% Recovery (°C)		125 min 190 max	Report	
90% Recovery (°C)		Report	Report	
Final BP (°C)	Max.	270	300	
Distillation Residue (vol %)	Max.	1.5	1.5	
Distillation Loss (vol %)	Max.	1.5	1.5	
Flash Point (°C)	Min.	---	60	D93
Density @ 15°C (kg/m³)		750-801	788-845	D1298, D4052
Vapour Pressure (kPa)	Max.	21 (1)	---	D5191
FLUIDITY				
Freezing Point (°C)	Max.	-51 (1)	-46	D2386, D4305 (4), D5901, D5972 (5)
Viscosity @ -20°C (cSt)	Max.	---	8.8	D445
COMBUSTION				
Net Heat of Comb. (MJ/kg)	Min.	42.8	42.6	D3338, D4529, D4809
Smoke Point (mm)	Min.	25	19	D1322
or Smoke Point (mm)	Min.	20	---	D1322
and Naphthalenes (vol%)	Max.	3.0	---	D1840
Hydrogen Content		---	Report	D1322, D3343, D3701
CORROSION				
Copper Strip (2h @ 100°C)	Max.	1	1	D130
THERMAL STABILITY				
JFTOT ΔP @ 260 °C (mm Hg)	Max.	25	25	D3241
Tube Deposit Rating (Visual)	Max.	<3 (6)	<3 (6)	
CONTAMINANTS				
Existent Gum (mg/100 mL)	Max.	--- (1)	7	D381
Particulates (mg/L)	Max.	0.44 (7)	0.50 (7)	D2276, D5452
Water Reaction Interface	Max.	1b	1b	D1094
MSEP Rating	Min.	85 (8)	85 (8)	D3948
OTHER				
Conductivity (pS/m)		50-500 (1)	50-600	D2624
ADDITIVES (9)				
Anti-icing (vol %)		0.10-0.15 (1) (10)	0.15-0.20 (10)	D5006 (11)
Antioxidant		Option	Option (12)	
Corrosion Inhibitor		Option (1) (13)	Required (13)	
Metal Deactivator		Option	Option	
Static Dissipator		Required (14)	Required (14)	

NOTES

(1) For designation as F-40, the following changes apply: Freezing Point is -58°C max, Vapour Pressure has a range of 14 -21 kPa, Existent Gum is 7 mg/L max, and conductivity range is 100-600 pS/m. Anti-icing and corrosion inhibitor additives are mandatory.
(2) Fuel shall be visually clear and free from undissolved water, sediment and suspended matter.
(3) CAN/CGSB 3.0 No.16 is also allowed.
(4) Not for use with High Flash Kerosine. For Jet B (F-40), use Procedure A only; this method shall not be used on samples with viscosities greater than 5.0 cSt at -20°C. Report viscosity with this result.
(5) Method D5972 may produce a higher (warmer) result than D2386 on wide-cut fuels such as Jet B or F-40.
(6) No peacock or abnormal colour deposits allowed.
(7) Limit at aircraft and refuellers. Limit into purchaser's storage is 2.2 mg/L max. A minimum of 4L shall be filtered.
(8) Rating applies at the point immediately before the fuel enters dedicated transportation to airport storage. A minimum rating of 70 applies for fuel containing static dissipator additive.
(9) When used, additive names and amounts shall be reported on the test certificate.
(10) Optional for Jet B. Additive should conform to CAN/CGSB-3.526 (EGME) or ASTM D4171, Type III (DiEGME).
(11) Alternative method is IP 277 (Method C).
(12) Antioxidant at 17.2-24 ppm must be added to any hydroprocessed component.
(13) Only corrosion inhibitors qualified to MIL-PRF-25017 and listed in QPL 25017 shall be used.
(14) When additive depletion is evident, further addition is allowed provided original concentration is 3 mg/L max. and cumulative concentration is 5 mg/L max. If initial concentration is not known, further additions shall not exceed 2 mg/L.

Table 10
Colombia

Issuing Agency:		ICONTEC		
Specification:		NTC 1899		
Latest Revision Date:		30 October 2002		**Test Method**
Grade Designation:		Jet A/A-1 Kerosine	Jet B Wide-Cut Kerosine	**ASTM**
COMPOSITION				
Appearance		C & B (1)	C & B (1)	D4176
Acidity, Total (mg KOH/g)	Max.	0.1	---	D3242
Aromatics (vol %)	Max.	25	25	D1319
Sulphur, Total (wt %)	Max.	0.3	0.3	D1266, D2622, D1552, D4294, D5243
Sulphur, Mercaptan (wt %)	Max.	0.003	0.003	D3227
or Doctor Test		Negative	Negative	D4952
Colour, Saybolt		Report	Report	D156
VOLATILITY				
Distillation Temperature:				D86
Initial BP (°C)			Report	
10% Recovery (°C)	Max.	205	---	
20% Recovery (°C)	Max.	---	145	
50% Recovery (°C)	Max.	Report	190	
90% Recovery (°C)	Max.	Report	245	
Final BP (°C)	Max.	300	---	
Distillation Residue (vol %)	Max.	1.5	1.5	
Distillation Loss (vol %)	Max.	1.5	1.5	
Flash Point (°C)	Min.	38	---	D56, D3828
Density @ 15°C (kg/m³)		775-840	751-802	D1298, D4052
or Gravity, API @ 60°F		51-37	57-45	
Vapour Pressure @ 38°C (kPa)	Max.	---	21 (3.0 psi)	D323, D5191
FLUIDITY				
Freezing Point (°C)	Max.	-40 (2)	-50	D2386, D4305 (3), D5901, D5972
Viscosity @ -20°C (cSt)	Max.	8.0	---	D445
COMBUSTION				
Net Heat of Comb. (MJ/kg)	Min.	42.8	42.8	D4529, D3338, D4809
Smoke Point (mm)	Min.	25	25	D1322
or Smoke Point (mm)	Min.	18	18	D1322
and Naphthalenes (vol %)	Max.	3	3	D1840
CORROSION				
Copper Strip (2h @ 100°C)	Max.	1	1	D130
THERMAL STABILITY				
JFTOT ΔP @ 260 °C	Max.	3.3 kPa/25 mm Hg	3.3 kPa/25 mm Hg	D3241
Tube Deposit Rating (Visual)	Max.	<3	<3	
CONTAMINANTS				
Existent Gum (mg/100 mL)	Max.	7	7	D381
Water Reaction Interface	Max.	1b	1b	D1094
MSEP Rating	Min.	85 (4)	---	D3948, D2550
Filter Membrane Colour	Max.	5 (5)	---	D2276
OTHER				
Conductivity (pS/m)		50-450 (6)	50-450 (6)	D2624
ADDITIVES				
Anti-icing (vol %)		0.10-0.15 (7)	0.10-0.15 (7)	D5006
Antioxidant		Option	Option	
Corrosion Inhibitor		Option	Option	
Metal Deactivator		Option	Option	
Static Dissipator		Option	Option	
Leak Detector		Option	Option	

NOTES

(1) Fuel shall be free from water, sediment and suspended matter. Odour shall not be nauseating or irritating.
(2) For Jet A-1, Freezing Point is -47°C max.
(3) Use Procedure A only; this method shall not be used on samples with viscosities greater than 5.0 cSt at -20°C. Report the viscosity on the test certificate.
(4) This requirement is for control at the storage tank on a sample taken after 24 hours settling time. At the refinery, a minimum of 90 applies.
(5) This requirement applies to fuel at point of entry into aircraft.
(6) Conductivity limits apply to fuel at point of entry into aircraft and only when conductivity additive is used.
(7) Additive should conform to ASTM D4171, Type III (DiEGME).

Table 11
France

Issuing Agency:		Service des Essences des Armées		
Specification:		DCSEA 134/A		
Latest Revision Date:		January 2000		
Grade Designation:		Jet A-1 Kerosine	**Test Method**	
NATO Code No.		F-34/F-35 (1)	**ASTM**	**NF**
COMPOSITION				
Appearance		C & B (2)		LSEA D 14
Acidity, Total (mg KOH/g)	Max.	0.015	D3242	
Aromatics (vol %)	Max.	25.0		M 07-024
Hydrogen Content (vol %)	Min.	(3)		M 07-024
Sulphur, Total (wt %)	Max.	0.30		EN ISO 8754 M 07-059
Doctor Test		Negative		M 07-029
or Sulphur, Mercaptan (wt %)	Max.	0.0030		ISO 3012
VOLATILITY				
Distillation Temperature:				M 07-002
Initial BP (°C)		Report		
10% Recovery (°C)	Max.	205.0		
20% Recovery (°C)		(3)		
50% Recovery (°C)		Report		
90% Recovery (°C)	Max.	Report		
Final BP (°C)	Max.	300.0		
Distillation Residue (vol %)	Max.	1.5		
Distillation Loss (vol %)	Max.	1.5		
Flash Point (°C)	Min.	38 (4)		ISO 13736
Density @ 15°C (kg/m³)		775.0-840.0		EN ISO 12185
FLUIDITY				
Freezing Point (°C)	Max.	-47		ISO 3013
COMBUSTION				
Net Heat of Comb. (MJ/kg)	Min.	42.8	D4529, D4809	
Aniline (°C)		(3)		M 07-021
Smoke Point (mm)	Min.	25		M 07-028
or Smoke Point (mm)	Min.	19		M 07-028
and Naphthalenes (vol%)	Max.	3.0	D1840	
CORROSION				
Copper Strip (2h @ 100°C)	Max.	1		EN ISO 2160
THERMAL STABILITY				
JFTOT ΔP @ 260 ºC	Max.	3.33 kPa		
25.0 mm Hg		M 07-051		
Tube Deposit Rating (Visual)	Max.	<3 (5)		
Peroxide Number (mEq/dm3)	Max.	(6)		LSEA-D-29
CONTAMINANTS				
Existent Gum (mg/100 mL)	Max.	7		ISO 6246
Water Reaction Interface	Max.	1b	D1094	
Water Reaction Separation	Max.	(7)	D1094	
MSEP Rating (8)			D3948	
Fuel without SDA	Min.	85		
Fuel with SDA	Min.	70		
OTHER				
Lubricity		(3)	D5001	
Conductivity (pS/m)		50-450	D2624	
ADDITIVES				
Anti-icing (vol %)		0.10-0.15 (1)		
Antioxidant		Required (9)		
Corrosion Inhibitor		Required (10)		
Metal Deactivator		Optional		
Static Dissipator		Required		
Biocide		Option (11)		

NOTES

(1) Addition of icing inhibitor changes fuel designation from F-35 to F-34.
(2) Fuel to be free from water, other petroleum products and suspended matter. Colour to be noted.
(3) Requirement is optional; result to be reported.
(4) Result of 40°C accepted with method D56. Result of 41°C accepted with methods NF EN 22719, ASTM D93 and IP 34.
(5) No peacock or abnormal deposits allowed.
(6) Test is optional with a maximum of 2 mEq/dm3 if determined.
(7) Test is optional with a maximum rating of (2) if determined.
(8) These limits apply only at point of manufacture. If MSEP is measured in distribution system, no limits apply, and results shall not be cause for rejection of product.
(9) To be added to all hydroprocessed and synthetic components at a concentration between 17.0 and 24.0 mg/L. Optional at up to 24.0 mg/L for fuels not containing any hydroprocessed components.
(10) Required as lubricity improver in F-34 for military use. Optional in F-35.
(11) Concentration of biocide in fuel entering aircraft must not exceed 50 ppm. Kathon FP 1.5 is the only additive meeting requirements of DCSEA 754. Biobor JF additive may be used by agreement.

Table 12
Japan

Issuing Agency:		Petroleum Association of Japan			
Specification:		Joint Fuelling System Check List (Issue 16) (1)			
Latest Revision Date:		April 2004	**Test Method**		
Grade Designation:		Jet A-1 Kerosine	**ASTM**	**IP**	**JIS**
COMPOSITION					
Appearance		(2)			K2276
Acidity, Total (mg KOH/g)	Max.	0.015	D3242	354	K2276
Aromatics (vol %)	Max.	25.0	D1319	156	K2536
or Total Aromatics (vol %)	Max.	26.5	D6379	436	
Sulphur, Total (wt %)	Max.	0.30	D1266, D2622 (3)	107, 336	K2541
Sulphur, Mercaptan (wt %)	Max.	0.0030	D3227	342	K2276
or Doctor Test		Negative (4)	D4952	30	K2276
H/P Components (vol %)		Report (5)			
Severely H/P components (vol%)		Report			
VOLATILITY					
Distillation Temperature:			D86		K2254
Initial BP (°C)		Report			
10% Recovery (°C)	Max.	205			
50% Recovery (°C)		Report			
90% Recovery (°C)		Report			
Final BP (°C)	Max.	300			
Distillation Residue (vol %)	Max.	1.5			
Distillation Loss (vol %)	Max.	1.5			
Flash Point (°C)	Min.	38.0 (6)	D3828	170, 303	K2265
Density @ 15°C (kg/m^3)		775.0-840.0	D1298, D4052	160, 365	K2249
FLUIDITY					
Freezing Point (°C)	Max.	-47.0	D2386 (7)	16	K2276
Viscosity @ -20°C (cSt)	Max.	8.000	D445	71	K2283
COMBUSTION					
Net Heat of Comb. (MJ/kg)	Min.	42.80	D4809 (8)	381	K2279
Smoke Point (mm)	Min.	25.0	D1322	57	K2537
or Smoke Point (mm)	Min.	19.0	D1322	57	K2537
and Naphthalenes (vol %)	Max.	3.00	D1840		K2276
CORROSION					
Copper Strip (2h @ 100°C)	Max.	1	D130	154	K2513
THERMAL STABILITY					
JFTOT ΔP @ 260 °C (kPa)	Max.	3.3	D3241	323	K2276
Tube Deposit Rating (Visual)		<3 (9)			
CONTAMINANTS					
Existent Gum (mg/100 mL)	Max.	7	D381	131	K2261
Water Reaction Interface	Max.	1b	D1094		K2276
OTHER					
Conductivity (pS/m)		50-450 (10)	D2624	274	K2276
BOCLE wear scar (mm)	Max.	0.85	D5001		
ADDITIVES					
Antioxidant (11)		17.0 - 24.0			
Metal Deactivator		Option			
Static Dissipator		Required (12)			

NOTES

(1) An ExxonMobil Research & Engineering review of JIS test methods used in the Japanese Joint Fuelling System Check List 16 has demonstrated effective technical equivalency to ASTM standards used in the Joint Inspection Group Check List 19.
(2) Fuel should be clear, bright and visually free from solid matter and undissolved water at normal ambient temperature.
(3) Alternative test methods are ASTM D1552, D4294, D5453.
(4) In the event of conflict between Sulphur Mercaptan and Doctor Test results, the Sulphur Mercaptan result shall prevail.
(5) Report total vol % of hydroprocessed fuel (including 'nil' or 100%), to include hydrotreated, hydrofined and hydrocracked material.
(6) Subject to minimum of 40°C if results obtained by (Tag) method ASTM D56, JIS K2265.
(7) Alternative test methods are ASTM D4305, D5901 and D5972.
(8) Calculated Specific Energy by one of the following methods is also acceptable: D3338, D4529.
(9) No peacock or abnormal colour deposits allowed.
(10) Conductivity limits apply at the point, time and temperature of delivery to the user.
(11) Antioxidants are mandatory for hydroprocessed and synthetic fuel components at a concentration between 17.0 and 24.0 mg/L. They are optional in non-hydroprocessed components at up to 24.0 mg/L and must be added immediately after processing.
(12) Concentration of SDA on first doping of fuel is 3.0 mg/L max. Cumulative concentration allowed when re-doping fuel is 5.0 mg/L max.

Table 13
Japan

Issuing Agency:		Japan Defense Agency		
Specification:		DSP K2206D		
Latest Revision Date:		25 June 2003		
Grade Designation:		JP-4 Wide-Cut Kerosine	JP-5 Kerosine	**Test Method**
COMPOSITION				
Appearance		C & B (1)	C & B (1)	Visual
Colour		Report	Report	JIS K2580
Acidity, Total (mg KOH/g)	Max.	0.015	0.015	JIS K2276
Aromatics (vol %)	Max.	25.0	25.0	JIS K2536-1
Olefins (vol %)	Max.	5.0	5.0	JIS K2536-1
Sulphur, Total (wt %)	Max.	0.40	0.40	JIS K2541
Sulphur, Mercaptan (wt %)	Max.	0.002	0.002	JIS K2276
or Doctor Test		Negative	Negative	
VOLATILITY				
Distillation Temperature:				JIS K2254
Initial BP (°C)		Report	Report	
10% Recovery (°C)	Max.	Report	205	
20% Recovery (°C)	Max.	145	Report	
50% Recovery (°C)	Max.	190	Report	
90% Recovery (°C)	Max.	245	Report	
Final BP (°C)	Max.	270	300	
Distillation Residue (vol %)	Max.	1.5	1.5	
Distillation Loss (vol %)	Max.	1.5	1.5	
Flash Point (°C)	Min.	---	61	JIS K2265
Density @ 15°C (kg/m³)		751-802	788-845	JIS K2249
Vapour Pressure @ 37.8°C (kPa)		14-21	---	JIS K2258
FLUIDITY				
Freezing Point (°C)	Max.	-58 (2)	-46 (2)	JIS K2276
Viscosity @ -20°C (cSt)	Max.	---	8.5	JIS K2283
COMBUSTION				
Aniline-Gravity Product	Min.	5250	4500	JIS K2206
or Net Heat of Comb. (MJ/kg)	Min.	42.8	42.6	JIS K2279
Hydrogen Content (wt %)	Min.	13.6	13.4	JIS K2276
Smoke Point (mm)	Min.	20.0	19.0	JIS K2537
CORROSION				
Copper Strip (2h @ 100°C)	Max.	1	1	JIS K2513
THERMAL STABILITY				
JFTOT ΔP @ 260 °C (kPa)	Max.	3.3	3.3	JIS K2276
Tube Deposit Rating (Visual)	Max.	<3	<3	
Peroxide Number (mass ppm)	Max.	---	8.0	JIS K2276
CONTAMINANTS				
Existent Gum (mg/100 mL)	Max.	7.0	7.0	JIS K2261
Particulates (mg/L)	Max.	1.0	1.0	JIS K2276 (3)
Filtration Time (min)	Max.	10	15	(3)
Water Reaction Interface	Max.	1b	1b	JIS K2276
MSEP Rating	Min.	(4)	70	JIS K2276
OTHER				
Conductivity (pS/m)		150-600 (5)	---	JIS K2276
ADDITIVES				
Anti-icing (vol %)		0.10-0.15	0.15-0.20	FED-STD-791, (method 5327, 5340 or 5342) (6)
Antioxidant		Option	Option	
Corrosion Inhibitor		Option	Option	
Metal Deactivator		Option	Option	
Static Dissipator		Required	Required	

NOTES

(1) Fuel shall be clear, bright and visually free from solid matter and undissolved water.

(2) If no hydrocarbon is crystallized even when the sample is cooled down more than 4.5 °C below the regulation value, the report is allowed to describe just as 'below the regulation temperature'.

(3) Method detailed in Appendix 2 of DSP K2206D. Sampling point at tank, shipping pipeline, tanker or tank car, with 4 L sample required.

(4) MSEP rating is 70 min. for fuel with static dissipator additive, and 85 min. without static dissipator additive.

(5) Applies at ambient fuel temperature or 29.4°C, whichever is lower.

(6) Sampling point to be at end user vessel.

Table 14
Peoples' Republic of China

Issuing Agency:		National Technology Supervisory Bureau		
Specification:		GB 6537-94		
Latest Revision Date:		1 June 1995	**Test Method**	
Grade Designation:		No. 3 Kerosine	**GB/T**	**SH/T**
COMPOSITION				
Appearance		C & B (1)	(2)	
Colour		Report	3555	
Acidity, Total (mg KOH/g)	Max.	0.015	12574	
Aromatics (vol %)	Max.	20.0	11132	
Olefins (vol%)	Max.	5.0	11132	
Sulphur, Total (wt %)	Max.	0.20	380	
Sulphur, Mercaptan (wt %)	Max.	0.0020	1792	
or Doctor Test		Negative		0174
VOLATILITY				
Distillation Temperature:			6536 (3)	
Initial BP (°C)		Report		
10% Recovery (°C)	Max.	205		
20% Recovery (°C)		Report		
50% Recovery (°C)	Max.	232		
90% Recovery (°C)		Report		
Final BP (°C)	Max.	300		
Distillation Residue (vol %)	Max.	1.5		
Distillation Loss (vol %)	Max.	1.5		
Flash Point (°C)	Min.	38	261	
Density @ 20°C (kg/m^3)		775-830	1884, 1885	
FLUIDITY				
Freezing Point (°C)	Max.	-47	2430	
Viscosity @ 20°C (cSt)	Min.	1.25	265	
Viscosity @ -20°C (cSt)	Max.	8.0	265	
COMBUSTION				
Net Heat of Comb. (MJ/kg)	Min.	42.8	384, 2429	
Smoke Point (mm)	Min.	25	382	
or Luminometer Number	Min.	45	11128	
or Smoke Point (mm)	Min.	20	382	
and Naphthalenes (vol %)	Max.	3.0		0181
CORROSION				
Copper Strip (2h @ 100°C)	Max.	1	5096	
Silver Strip (4h @ 50°C)	Max.	1		0023
THERMAL STABILITY				
Filter ΔP (kPa)	Max.	3.3	9169	
Tube Deposit Rating (Visual)	Max.	<3 (4)		
CONTAMINANTS				
Existent Gum (mg/100 mL)	Max.	7	8019 (5)	
Water Reaction:			1793	
Interface Rating	Max.	1b		
Separation Rating		Report		
Particulates (mg/L)		Report		0093
OTHER				
Conductivity @ 20°C (pS/m)		50-450 (6)	6539	
ADDITIVES		(7)		

NOTES

(1) Product should be clear and bright, without undissolved water and sediment.
(2) Sample should be placed in a 100 mL glass graduated cylinder and observed at room temperature. In case of dispute, test procedures GB/T 511 and GB/T 260 should be used.
(3) Alternative test method is GB/T 255 Petroleum Distillation Test.
(4) No peacock or abnormal colour deposits allowed.
(5) Alternative test method is for Existent Gum is GB/T 509.
(6) If static dissipator additive is not required and no request is made on this specification item, fuel leaving the refinery should have conductivity of 150 pS/m min.
(7) It is permitted to add approved additives.

Table 15
Russia

Issuing Agency:			State Standard Committee		
Specification:			GOST 10227-86		
Latest Revision Date:			August 1995		Test Method
Grade Designation:		TS-1 Premium Kerosine	TS-1 Regular Kerosine	T-1 Regular Kerosine	GOST
COMPOSITION					
Appearance		C & B (1)	C & B (1)	C & B (1)	
Acidity, Total (mg KOH/100 cm3)	Max.	0.7	0.7	0.7	5985-79
Aromatics (wt %)	Max.	22	22	20	6994-74
Iodine Number (g/100 g)	Max.	2.5	3.5	2.0	2070-82
Sulphur, Total (wt %)	Max.	0.20	0.25	0.10	19121-73
Sulphur, Mercaptan (wt %)	Max.	0.003	0.05	---	17323-71
Hydrogen Sulphite (wt %)		Nil	Nil	Nil	17323-71
VOLATILITY					
Distillation Temperature:					2177-82
Initial BP (°C)	Max.	150	150	150	
10% Recovery (°C)	Max.	165	165	175	
50% Recovery (°C)	Max.	195	195	225	
90% Recovery (°C)	Max.	230	230	270	
98% Recovery (°C)	Max.	250	250	280	
Flash Point (°C)	Min.	28	28	30	6356-75
Density @ 20°C (kg/m³)	Min.	780	775	800	3900-85
FLUIDITY					
Freezing Point (°C)	Max.	-60 (2)	-60 (2)	-60 (2)	5066-91
Viscosity @ 20°C (cSt)	Min.	1.30	1.25	1.50	33-82
Viscosity @ -40°C (cSt)	Max.	8	8	16	33-82
COMBUSTION					
Net Heat of Comb. (kJ/kg)	Min.	43,120	42,900	42,900	11065-90 (3)
Smoke Point (mm)	Min.	25	25	20	4338-91
CORROSION					
Copper Strip (3h @ 100°C)	Max.	Pass	Pass	Pass	6321-92
THERMAL STABILITY					
Static Thermal Test @ 150°C					11802-88
Deposit (mg/100 cm3)	Max.	18	18	35	
CONTAMINANTS					
Ash Content (%)	Max.	0.003	0.003	0.003	1461-75
Water Soluble Acids & Alkalis		Nil	Nil	Nil (4)	6307-75
Sum of Water-Soluble Alkalines		---	---	Nil	(5)
Naphthenic Acid Soaps		Nil	Nil	Nil	21103-75
Existent Gum (mg/100 cm3)	Max.	3	5	6	1567-83 or 8489-85
Water Reaction Interface	Max.	1	1	---	27154-86
Water Reaction Separation	Max.	1	1	---	27154-86
OTHER					
Conductivity (pS/m)		50-600 (6) (7)	50-600 (6) (7)		
ADDITIVES		(8)	(8)	(8)	

NOTES

(1) Fuel to be clear and free from suspended and settled solid matter when viewed in glass cylinder of 45-55 mm diameter.

(2) Temperature for start of crystallisation. TS-1 fuels with freezing point not above -50°C intended for use in all climatic zones except zone 11 (GOST 16350-80). In zone 11 TS-1 fuel with freezing point above -50°C may be used when ground temperature is below -30°C for 24 hours before take-off. TS-1 fuel with freezing point not above -60°C intended for use in zone 11 shall be produced as required by the consumers.

(3) In case of dispute, the heat of combustion shall be determined by GOST 21261-91.

(4) Water-soluble acids to be determined by an indicator method for T-1 fuel.

(5) Sum of water-soluble alkaline compounds to be determined according to a procedure described in the specification.

(6) Minimum conductivity limit at temperature of fuelling, maximum limit at 20°C.

(7) Conductivity is limited only for fuels containing Sigbol antistatic additive.

(8) Additives which have been qualified in accordance with established procedures may be used to improve performance characteristics of fuels.

Table 16
Russia

Issuing Agency:		State Standard Committee			
Specification:		GOST 10227-86			
Latest Revision Date:		August 1995			Test Method
Grade Designation:		T-1S Special Kerosine	T-2 Wide-Cut Kerosine	RT Premium Kerosine	GOST
COMPOSITION					
Appearance		C & B (1)	C & B (1)	C & B (1)	
Acidity, Total (mg KOH/100 cm3)	Max.	0.7	0.7	0.2 - 0.7	5985-79
Aromatics (wt %)	Max.	20	22	22	6994-74
Iodine Number (g/100 g)	Max.	2.0	3.5	0.5	2070-82
Sulphur, Total (wt %)	Max.	0.10	0.25	0.10	19121-73
Sulphur, Mercaptan (wt %)	Max.	0.001	0.005	0.001	17323-71
Hydrogen Sulphite (wt %)		Nil	Nil	Nil	17323-71
VOLATILITY					
Distillation Temperature:					2177-82
Initial BP (°C)	Min.	---	60	135	
	Max.	150	---	155	
10% Recovery (°C)	Max.	175	145	175	
50% Recovery (°C)	Max.	225	195	225	
90% Recovery (°C)	Max.	270	250	270	
98% Recovery (°C)	Max.	280	280	280	
Flash Point (°C)	Min.	30	---	28	6356-75
Density @ 20°C (kg/m³)	Min.	810	755	775	3900-85
Vapour Pressure (mm Hg)	Max.	---	100	---	1756-52
FLUIDITY					
Freezing Point (°C)	Max.	-60 (2)	-60 (2)	-55 (2)	5066-91
Viscosity @ 20°C (cSt)	Min.	1.50	1.05	1.25	33-82
Viscosity @ -40°C (cSt)	Max.	16	6	16	33-82
COMBUSTION					
Net Heat of Comb. (kJ/kg)	Min.	42,900	43,100	43,120	11065-90 (3)
Smoke Point (mm)	Min.	20	25	25	4338-91
Naphthalenes (wt %)	Max.	---	---	1.5	17749-72
Luminometer No.	Min.	---	---	50	17750-72
CORROSION					
Copper Strip (3h @ 100°C)	Max.	Pass	Pass	Pass	6321-92 (4)
THERMAL STABILITY					
Static Oxidation Test @ 150°C					11802-88
Deposit (mg/100 cm3)	Max.	6	18	6	
Soluble Gum (mg/100 cm3)	Max.	---	---	30	
Insoluble Gum (mg/100 cm3)	Max.	---	---	3	
Dynamic Test @ 150-180°C, 5h					17751-79 (5)
Filter ΔP (kPa)	Max.	---	---	10	
Heater Deposit, Number	Max.	---	---	2	
CONTAMINANTS					
Ash Content (%)	Max.	0.003	0.003	0.003	1461-75
Water Soluble Acids & Alkalis		Nil	Nil	Nil	6307-75
Sum of Water-Soluble Alkalines		Nil	Nil	---	(6)
Naphthenic Acid Soaps		Nil	Nil	---	21103-75
Existent Gum (mg/100 cm3)	Max.	6	5	4	1567-83 or 8489-85
Water Reaction Interface	Max.	---	---	1	27154-86
Water Reaction Separation	Max.	---	---	1	27154-86
OTHER					
Conductivity (pS/m)		---	50-600 (7) (8)	50-600 (7) (8)	25950-83
ADDITIVES		(9)	(9)	(9)	

NOTES

(1) Fuel to be clear and free from suspended and settled solid matter when viewed in glass cylinder of 45-55 mm diameter.

(2) Temperature for start of crystallisation. T-2 and RT fuels with freezing point not above -50°C intended for use in all climatic zones except zone 11 (GOST 16350-80). In zone 11 RT fuel with freezing point above -50°C may be used when ground temperature is below -30°C for 24 hours before take-off. RT fuel with freezing point not above -55°C intended for use in zone 11 shall be produced as required by the consumers.

(3) In case of dispute, the heat of combustion shall be determined by GOST 21261-91.

(4) Colour change and separate spots of the same colour on a plate permitted for RT fuel with additives.

(5) For RT fuel, 100 dm3 of sample to be taken in containers made of galvanised iron, aluminium or stainless steel.

(6) Sum of water-soluble alkaline compounds to be determined according to a procedure described in the specification.

(7) Minimum conductivity limit at temperature of fuelling, maximum limit at 20°C.

(8) Conductivity is limited only for fuels containing Sigbol antistatic additive.

(9) Additives which have been qualified in accordance with established procedures may be used to improve performance characteristics of fuels.

Table 17
Russia

Issuing Agency:		State Standard Committee	
Specification:		GOST R 52050-2003	
Latest Revision Date:		3 Nov 2003	**Test Methods**
Grade Designation:		Jet A-1 Kerosine	**ASTM**
COMPOSITION			
Appearance		C & B (1)	
Acidity, Total (mg KOH/100 cm3)	Max.	0.10	D3242
		0.015 (2)	IP354
Aromatics (wt %)	Max.	25	D1319
Sulphur, Total (wt %)	Max.	0.25	D1266, D1552, D2622, D4294, GOST R 51947
Sulphur, Mercaptan (wt %)	Max.	0.003	D3227
or Doctor Test		Negative	D4952
VOLATILITY			
Distillation Temperature:			D86
10% Recovery (°C)	Max.	205	
50% Recovery (°C)		Report	
90% Recovery (°C)		Report	
Final BP (°C)	Max.	300	
Distillation Residue (vol %)	Max.	1.5	
Distillation Loss (vol %)	Max.	1.5	
Flash Point (°C)	Min.	38	D56, D3828
Density @ 20°C (kg/m³)		775 - 840	D1298, D4052, GOST R 51069
FLUIDITY			
Freezing Point (°C)	Max.	-47 (3)	D2386, D5972
Viscosity @ -20°C (cSt)	Max.	8	D445
COMBUSTION			
Net Heat of Comb. (MJ/kg)	Min.	42.8 (4)	D3338, D4529, D4809
Smoke Point (mm)	Min.	25	D1322
or Smoke Point (mm)	Min.	19	D1322
and Naphthalenes (wt %)	Max.	3	D1840
CORROSION			
Copper Strip (2h @ 100°C)	Max.	No. 1	D130
THERMAL STABILITY			
JFTOT ΔP @ 260 °C (mm Hg)	Max.	25	D3241
Tube Rating (Visual)	Max.	<3 (5)	
CONTAMINANTS			
Existent Gum (mg/100 cm3)	Max.	7	D381
Water Reaction Interface	Max.	1b	D1094
MSEP Rating			D3948
Fuel without SDA	Min.	85	
Fuel with SDA	Min.	70	
OTHER			
Conductivity (pS/m)		50-450	D2624, GOST 25950
Without SDA	Max.	10	
Lubricity (wear scar) (mm)	Max.	0.85 (6)	D5001
ADDITIVES			
Antioxidant (ppm)	Max.	24	
Static Dissipator (ppm)	Max.	3 (7)	

NOTES

(1) Fuel should be clear, bright and free from undissolved water and particulate contamination at ambient air temperature.
(2) Limit to be met to satisfy MOD Def Stan 91-91 requirements.
(3) A lower freezing point may be agreed by the supplier and purchaser.
(4) When determining the Net Heat of Combustion by ASTM D4529, use equation 1 or Table 1, and when using D3338, use equation 2.
(5) No peacock or abnormal colour deposits allowed.
(6) Determination of lubricity is the responsibility of the fuel supplier.
(7) Maximum initial doping. Upon redoping the fuel, the maximum cumulative concentration is 5.ppm.

Table 18
Sweden

Issuing Agency:		Swedish Defence Materiel Administration	
Specification:		FSD 8607 E	
Latest Revision Date:		10 February 1995	
Grade Designation:		Flygfotogen 75 Kerosine	**Test Method**
COMPOSITION			
Appearance		C & B (1)	Visual
Colour		Report	ASTM D156
Acidity, Total (mg KOH/g)	Max.	0.015	ASTM D3242
Aromatics (vol %)	Max.	25	ASTM D1319, IP 391
Olefins (vol%)	Max.	5	ASTM D1319, D1159
Sulphur, Total (wt %)	Max.	0.10	ASTM D129, D1266, D2622, IP 243
Sulphur, Mercaptan, Doctor Test		Negative	ASTM D4952
VOLATILITY			
Distillation Temperature:			SIS 15 51 46 (ISO 3405), ASTM D86
Initial BP (°C)		Report	
10% Recovery (°C)	Max.	205	
20% Recovery (°C)		Report	
50% Recovery (°C)		Report	
90% Recovery (°C)		Report	
Final BP (°C)	Max.	300	
Distillation Residue (vol %)	Max.	1.5	
Distillation Loss (vol %)	Max.	1.5	
Flash Point (°C)	Min.	38	ASTM D93, D3828
Density @ 15°C (kg/m^3)		775-840	ASTM D287, D4052
FLUIDITY			
Freezing Point (°C)	Max.	-50	ASTM D2386
Viscosity @ -20°C (cSt)	Max.	8	SS 02 35 10 (ISO 3104), ASTM D445
COMBUSTION			
Net Heat of Comb. (MJ/kg)	Min.	42.8	SIS 15 51 55 (ISO 3648), ASTM D3338
Smoke Point (mm)	Min.	19	ASTM D1322
Naphthalenes (vol %)	Max.	3.0	ASTM D1840
Hydrogen Content (wt %)	Min.	13.4	ASTM D3343
CORROSION			
Copper Strip (2h @ 100°C)	Max.	1b	SS-ISO 2160, ASTM D130
Silver Strip (4h @ 50°C)	Max.	1	IP 227
THERMAL STABILITY			
JFTOT ΔP @ 260 °C (mm Hg)	Max.	25	ASTM D3241
Tube Deposit Rating (Visual)	Max.	2 (2)	
CONTAMINANTS			
Existent Gum (mg/100 mL)	Max.	7	ASTM D381
Particulates (mg/L)	Max.	1	MIL-T-83133, App A
Filtration Time (min)	Max.	15	MIL-T-83133, App A
Water Reaction Interface	Max.	1b	ASTM D1094
MSEP Rating	Min.	70 (3)	ASTM D3948
OTHER			
Conductivity (pS/m)		200-600	ASTM D2624
ADDITIVES			
Antioxidant		Required (4)	IP 343
Corrosion Inhibitor		Required (5)	
Static Dissipator		Required (6)	

NOTES

(1) Clear, bright and free of undissolved water.
(2) No abnormal or peacock colour deposits allowed.
(3) Limit is valid for fuel containing all additives, except static dissipator additive.
(4) Antioxidant in accordance with MIL-T-83133 required at 17-24 mg/L.
(5) Corrosion inhibitor/lubricity improver Hitec 580 required at 15-22.5 mg/L.
(6) Static dissipator additive in accordance with MIL-T-83133 required.

Table 19
United Kingdom

Issuing Agency:		Ministry of Defence (Procurement Agency)				
Specification:		Def Stan 91-86/4	Def Stan 91-88/2	Def Stan 91-91/5		
Latest Revision Date:		30 Aug 2002	30 Aug 2002	8 Feb 2005		
Grade Designation:		AVCAT/FSII High Flash Kerosine	AVTAG/FSII Wide-Cut Kerosine	AVTUR Kerosine		
NATO Code No.		F-44	F-40	F-35 (1)	Test Method (2) ASTM	IP
COMPOSITION						
Appearance		C & B (3)	C & B (3)	C & B (3)		
Colour, Saybolt		---	---	Report (4)	D156	
Acidity, Total (mg KOH/g)	Max.	0.015	0.015	0.015	D3242	354
Aromatics (vol %)	Max.	25.0	25.0	25.0	D1319	156
or Total Aromatics (vol%)	Max.	26.5	26.5	26.5	D6379	436
Sulphur, Total (wt %)	Max.	0.30	0.30	0.30		336
Sulphur, Mercaptan (wt %)	Max.	0.0030	0.0030	0.0030	D3227	342
or Doctor Test (5)		Negative	Negative	Negative		30
H/P Components (vol %)		---	---	Report		
Severely H/P Components (vol%)		---	---	Report (6)		
VOLATILITY						
Distillation Temperature: (7)					D86	123
Initial BP (°C)		Report	Report	Report		
10% Recovery (°C)	Max.	205.0	Report	205.0		
20% Recovery (°C)	Min.	---	100.0	---		
50% Recovery (°C)	Min.	Report	125.0	Report		
90% Recovery (°C)	Max.	Report	Report	Report		
Final BP (°C)	Max.	300.0	270.0	300.0		
Distillation Residue (vol %)	Max.	1.5	1.5	1.5		
Distillation Loss (vol %)	Max.	1.5	1.5	1.5		
Flash Point (°C)	Min.	61.0	---	38.0 (8)	D93	34
Density @ 15°C (kg/m^3)		788-845	751.0-802.0	775.0-840.0	D4052	365
Vapour Pressure @ 37.8°C (kPa)		---	14.0-21.0	---		69
FLUIDITY						
Freezing Point (°C)	Max.	-46.0	-58.0	-47.0	D2386	16
Viscosity @ -20°C (cSt)	Max.	8.800	---	8.000	D445	71
COMBUSTION						
Net Heat of Comb. (MJ/kg)	Min.	42.60	42.80	42.80	(9)	(9)
Smoke Point (mm)	Min.	25.0	25.0	25.0	D1322	57
or Smoke Point (mm)	Min.	19.0	19.0	19.0	D1322	57
and Naphthalenes (vol %)	Max.	3.00	3.00	3.00	D1840	
CORROSION						
Copper Strip (2h @ 100°C)	Max.	1	1	1	D130	154
THERMAL STABILITY						
JFTOT ΔP @ 260 °C (mm Hg)	Max.	25	25	25	D3241	323
Tube Deposit Rating (Visual)	Max.	<3 (10)	<3 (10)	<3 (10)		
CONTAMINANTS						
Particulates (mg/l)	Max.	---	---	1.0 (11)	D5452	423
Existent Gum (mg/100 mL)	Max.	7	7	7 (12)	D381	131
Water Reaction Interface	Max.	1b	1b	---	D1094	289
MSEP Rating	Min.	85 (13)	---	85 (13)	D3948	
OTHER						
Conductivity (pS/m)		---	50-600	50-450 (14)	D2624	274
Lubricity (mm)		---	---	0.85 (15)	D5001	
ADDITIVES						
Anti-icing (vol %)		0.12-0.15	0.10-0.15	Agreement		
Antioxidant		Option (16)	Option (16)	Option (16)		
Corrosion Inhibitor		Required (17)	Required (17)	Option (17)		
Metal Deactivator		Option	Option	Option		
Static Dissipator		---	Required (18)	Required (18)		

Updates of Def Stan 91-86, 91-87 and 91-88 are expected during the summer of 2005. The intent of these revisions is to bring the specifications into alignment with Def Stan 91-91 (i.e. new Colour and Particulate requirements; use of Existent Gum with Air; elimination of the Water Reaction test). The only other significant change will be to Def Stan 91-86 (AVCAT) which will include a reduction in the sulphur limit to 0.20 wt% to account for the possible future use of AVCAT as a substitute for marine diesel fuel.

Table 19
United Kingdom

NOTES

(1) F-35 fuel plus specified additives is denoted as F-34. Refer to Def Stan 91-87 specification for details of F-34.
(2) For alternative test methods, consult the specification.
(3) Fuel should be clear, bright and visually free from solid matter and undissolved water at ambient temperature.
(4) 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. For further information on the significance of colour see Annex E.
(5) In the event of dispute, Mercaptan Sulphur shall prevail.
(6) 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.
(7) All fuels certified to this specification shall be classed as group 4, with a condenser temperature of zero to 4°C.
(8) For F-35, fuel is subject to minimum of 40°C if results obtained by (Tag) method ASTM D56.
(9) Any of the following calculation methods is acceptable: IP12, IP355 (not allowed for F-40), ASTM D3338, D4529/IP381, D4809.
(10) Heater tube deposit rating using the Visual Tuberator to be carried out within 120 minutes of completion of test. No 'peacock' or 'abnormal' colour deposits should be present.
(11) Applies only at point of manufacture. Refer to the information on Particulate Contamination in Annex F.
(12) Air may be used in place of steam as the evaporating medium so long as the temperatures remain as specified in IP131/ASTM D381, Table 1-Test conditions for Aircraft/Aviation Turbine Fuel, for steam jet apparatus. When carrying out this procedure the following points should be noted: 1) even though well and bath temperatures are as for steam-jet, air flow calibration should still be adjusted to give an air flow of 600 ml/s at ambient conditions 2) The beakers should still undergo the same pre-heating as in steam-jet procedure (clause 10.5 in IP 131).
(13) For fuel without static dissipator additive (SDA). For fuel with SDA the minimum limit is reduced to 70. These MSEP requirements apply only at point of manufacture. If testing is carried out downstream, no specification limits apply and the results are not to be used as the sole reason for rejection of a fuel.
(14) Limits must be met at point of delivery into aircraft.
(15) Applies at point of manufacture only to fuels containing more than 95% hydroprocessed material where at least 20% of this is severely hydroprocessed (see Note 7) and for all fuels containing synthetic components.
(16) Required for a fuel (or component) which has been hydroprocessed. Hydroprocessed components shall be treated at 17.0 - 24.0 mg/l while non-hydroprocessed components may be treated at up to 24.0 mg/l.
(17) Additive of type and concentration detailed in QPL 68-251. For F-35, corrosion inhibitor may be added.
(18) Concentration of SDA on first doping of fuel is 3.0 mg/L max. Cumulative concentration allowed when re-doping fuel is 5.0 mg/L max.

Table 20
USA

Issuing Agency:		ASTM International		
Specification:		D1655-04a	D6615-04a	
Latest Revision Date:		1 Nov 2004	14 Nov 2004	Test Method
Grade Designation:		Jet A/A-1 Kerosine (1)	Jet B Wide-Cut Kerosine	ASTM
COMPOSITION				
Appearance		C & B (2)	C & B (2)	
Acidity, Total (mg KOH/g)	Max.	0.10	---	D3242
Aromatics (vol %)	Max.	25	25	D1319
Sulphur, Total (wt %)	Max.	0.30	0.3	D1266, D2622, D4294, D5453
Sulphur, Mercaptan (wt %)	Max.	0.003	0.003	D3227
or Doctor Test		Negative	Negative	D4952
VOLATILITY				
Distillation Temperature:				D86, D2887 (3)
10% Recovery (°C)	Max.	205 (185)	---	
20% Recovery (°C)	Max.	---	145	
50% Recovery (°C)	Max.	Report	190	
90% Recovery (°C)	Max.	Report	245	
Final BP (°C)	Max.	300 (340)	---	
Distillation Residue (vol %)	Max.	1.5	1.5	
Distillation Loss (vol %)	Max.	1.5	1.5	
Flash Point (°C)	Min.	38	---	D56, D3828 (4)
Density @ 15°C (kg/m³)		775-840	751-802	D1298, D4052
Vapour Pressure @ 38°C (kPa)		---	14 - 21	D323, D5191
FLUIDITY				
Freezing Point (°C) (5)	Max.	-40 Jet A -47 Jet A-1	-50	D2386, D4305 (6) D5901, D5972 (7)
Viscosity @ -20°C (cSt)	Max.	8.0	---	D445
COMBUSTION				
Net Heat of Comb. (MJ/kg)	Min.	42.8	42.8	D3338, D4529, D4809
Smoke Point (mm)	Min.	25	25	D1322
or Smoke Point (mm)	Min.	18	18	D1322
and Naphthalenes (vol %)	Max.	3.0	3.0	D1840
CORROSION				
Copper Strip (2h @ 100°C)	Max.	1	1	D130
THERMAL STABILITY				
JFTOT ΔP @ 260 °C (mm Hg)	Max.	25	25 (8)	D3241
Tube Deposit Rating (Visual)	Max.	<3 (9)	<3 (9)	
CONTAMINANTS				
Existent Gum (mg/100 mL)	Max.	7	7	D381
Water Reaction Interface	Max.	1b	1b	D1094
MSEP Rating	Min.	85 (10)	---	
OTHER				
Conductivity (pS/m)		50-450 (11)	50-450 (11)	D2624
ADDITIVES				
Anti-icing (vol %)		Agreement (12)	Agreement (12)	
Antioxidant		Option	Option	
Corrosion Inhibitor		Agreement	Agreement	
Leak Detector		Option	Option	
Metal Deactivator		Option	Option	
Static Dissipator		Option (13)	Option (13)	

NOTES

(1) Jet A-1 is similar to Jet A in all properties except Freezing Point at -47°C max.
(2) Fuel shall be visually free of undissolved water, sediment and suspended matter.
(3) Simulated distillation by ASTM D2887 allowed for Jet A/A-1; test limits in parentheses.
(4) Results obtained by method D3828 may be may be up to 2°C lower than those obtained by method D56.
(5) Other Freezing Points may be agreed upon between supplier and purchaser.
(6) With method D4305, use procedure A only. This method shall not be used on samples with viscosities greater than 5.0 cSt at -20°C.
(7) D5972 may produce a higher (warmer) result than D2386 on wide-cut fuels.
(8) Test at control temperature of 260°C, but if requirements are not met, the test may be conducted at 245°C. In this case report results at both temperatures.
(9) No abnormal or peacock colour deposits allowed.
(10) For fuel without static dissipating additive. For fuel containing static dissipator additive, a minimum MSEP rating of 70 applies. Limits apply only at point of manufacture.
(11) When electrical conductivity additive is specified by the purchaser, conductivity shall be 50-450 pS/m under the conditions at point of delivery.
(12) DiEGME additive conforming to requirements of D4171, Type III, may be used at 0.10-0.15 vol % concentration.
(13) Stadis 450 additive limited to 3 mg/L max. at manufacture, and cumulative total 5 mg/L max. on retreatment.

Table 21
Venezuela

Issuing Agency:		Covenin		
Specification:		1023-00 Revision 5		
Latest Revision Date:		2000		Test Method
Grade Designation:		Jet A-1 Kerosine	JP-5 High Flash Kerosine	Covenin
COMPOSITION				
Colour, Saybolt		Report	Report	894
Acidity, Total (mg KOH/g)	Max.	0.10	0.015	1934
Aromatics (vol %)	Max.	25	25	887
Olefins (vol%)	Max.	---	5.0	887
Sulphur, Total (wt %)	Max.	0.30	0.40	870, 1826
Sulphur, Mercaptan (wt %)	Max.	0.003	0.001	ASTM D3227
VOLATILITY				
Distillation Temperature:				850
Initial BP (°C)			Report	
10% Recovery (°C)	Max.	205	205	
20% Recovery (°C)	Max.	---	Report	
50% Recovery (°C)	Max.	Report	Report	
90% Recovery (°C)	Max.	Report	Report	
Final BP (°C)	Max.	300	290	
Distillation Residue (vol %)	Max.	1.5	1.5	
Distillation Loss (vol %)	Max.	1.5	1.5	
Flash Point (°C)	Min.	38	60	896 (1)
Density @ 15°C (kg/m^3)		775-840	778-840	1143
FLUIDITY				
Freezing Point (°C)	Max.	-47	-46	881
Viscosity @ -20°C (cSt)	Max.	8.0	8.5	424
COMBUSTION				
Net Heat of Comb. (J/g)	Min.	42,800	42,600	1098 (2)
Smoke Point (mm)	Min.	25	19	895
or Smoke Point (mm)	Min.	18	---	895
and Naphthalenes (vol %)	Max.	3	---	2873
CORROSION				
Copper Strip (2h @ 100°C)	Max.	1	1	872
THERMAL STABILITY				
JFTOT ΔP @ 260 °C (mm Hg)	Max.	25	25	1112
Tube Deposit Rating (Visual)	Max.	<3 (3)	---	
Peroxide Number (meq/Kg)	Max.	---	1.0 (4)	2874
CONTAMINANTS				
Particulates (mg/L)	Max.	---	1.0	2297
Filtration Time (min.)	Max.	---	15	2297
Existent Gum (mg/100 mL)	Max.	7	7	874
Water Reaction Interface	Max.	1b	1b	2047
Microseparometer (4)				2045
MSEP without SDA	Min.	85		
MSEP with SDA	Min.	70	70	
MSEP w/o Corrosion Inhibitor	Min.		85	
ADDITIVES				
Anti-icing (vol %)			0.15-0.20	2835

NOTES

(1) For routine laboratory analysis, COVENIN 2766 and COVENIN 2765 can be used for determination of the flash point.
(2) For routine laboratory analysis, COVENIN 1098 can be used for determining net heat of combustion.
(3) No abnormal colours or deposits allowed.
(4) Requirement applies only at the point of manufacture.

Table 22
Engine Manufacturer's Requirements

Issuing Agency:			General Electric		
Specification:			D50TF2-S14		
Latest Revision Date:			9 Feb 2005		
Grade Designation:		Class A / C Kerosine (1)	Class B Wide-Cut Kerosine	Class D High Flash Kerosine	Test Method ASTM
COMPOSITION					
Appearance		C & B (2)	C & B (2)	C & B (2)	
Acidity, Total (mg KOH/g)	Max.	0.10	---	0.10	D3242
Aromatics (vol %)	Max.	25	25	25	D1319
Sulphur, Total (wt %)	Max.	0.30	0.40	0.40	D1266, D1552, D2622, D4294, D5453
Sulphur, Mercaptan (wt %)	Max.	0.003	0.005	0.003	D3227(3)
or Doctor Test		Negative	Negative	Negative	D4952
VOLATILITY					
Distillation Temperature:					D86
10% Recovery (°C)	Max.	205	Report	205	
20% Recovery (°C)	Max.	---	90-145	Report	
50% Recovery (°C)	Max.	Report	110-190	Report	
90% Recovery (°C)	Max.	Report	245	Report	
Final BP (°C)	Max.	300	---	300	
Distillation Residue (vol %)	Max.	1.5	1.5	1.5	
Distillation Loss (vol %)	Max	1.5	1.5	1.5	
Flash Point (°C)	Min.	38	…	60	D56, D3828
Density @ 15.6°C (kg/m³)		775-840	751-802	788-845	D1298, D4052
Vapour Pressure @ 38°C (kPa)	Max.	---	21	---	D323, D5191
FLUIDITY					
Freezing Point (°C)	Max.	(1)	-50	-46	D2386, D5972
Viscosity @ -20°C (cSt)	Max.	8.0	---	8.5	D445
COMBUSTION					
Net Heat of Comb. (MJ/kg)	Min.	42.8	42.8	42.6	D3338, D4529, D4809
Smoke Point (mm)	Min.	25	25	25	D1322
or Smoke Point (mm)	Min.	18	18	18	D1322
and Naphthalenes (vol %)	Max.	3.0	3.0	3.0	D1840
CORROSION					
Copper Strip (2h @ 100°C)	Max.	1	1	1	D130
THERMAL STABILITY					
JFTOT ΔP @ 260 °C (mm Hg)	Max.	25 (4)	25 (4)	25 (4)	D3241
Tube Deposit Rating (Visual)	Max.	<3 (5)	<3 (5)	<3 (5)	
CONTAMINANTS (6)					
Existent Gum (mg/100 mL)	Max.	7	7	7	D381
Water Reaction Interface	Max.	1b	1b	1b	D1094
ADDITIVES (7)					
Anti-icing (vol %)	Max.	0.15		0.20	
Antioxidant (mg/L)	Max.	24.0	24.0	24.0	
Corrosion Inhibitor		(8)	(8)	(8)	
Metal Deactivator (mg/L)	Max.	5.7	5.7	5.7	
Static Dissipator		(9)	(9)	(9)	
Biocide		(8)	(8)	(8)	
Thermal Stability Improver		(8)	(8)	(8)	
Leak Detection (mg/kg)	Max.	1.0	1.0		

NOTES

(1) Class A and Class C requirements are equivalent except for freezing point. Class A fuel has a freezing point of -40°C while Class C fuel has a freezing point of -47°C.

(2) Fuel shall contain no visible free water, sediment or suspended matter.

(3) The mercaptan sulfur determination may be waived if the fuel is considered 'sweet' by the Doctor test.

(4) ASTM D3241 test (JFTOT) shall be conducted for 2.5 hours at a control temperature of 260°C.

(5) Tube deposits shall always be reported by the visual method. If the deposit includes peacock (rainbow) colours, rate these as code 'P'. Fuels that produce peacock colours fail to meet the thermal stability requirements.

(6) ASTM D3948 is applicable at point of manufacture. The microseparometer rating (without electrical conductivity additive) must have a minimum value of 85. The microseparometer rating (with electrical conductivity additive) must have a minimum value of 70.

(7) Use of additives is optional, but when used, must be declared by the supplier. Table II in the specification contains a list of approved additives.

(8) Refer to Table II in the specification for specific additive concentrations.

(9) Stadis 450, maximum concentration at initial doping is 3.0 ppm and cumulative 5.0 ppm upon redoping.

Table 23
Engine Manufacturer's Requirements

Issuing Agency:		Pratt & Whitney	Pratt & Whitney Canada		
Specification:		SB No.2016	CPW 204	CPW 46	
Latest Revision Date:		9 January 2003 (Revision 27)	27 July 2000 (Revision B)	27 July 2000 (Revision F)	
Grade Designation		Wide-Cut Kerosine	Wide-Cut Kerosine	Arctic Kerosine	Test Method ASTM
COMPOSITION					
Appearance		C & B (1)	C & B (1)	C & B (1)	
Acidity, Total (mg KOH/g)	Max.	0.10	---	---	D974, D3242
Aromatics (vol %)	Max.	25	25	20	D1319
Sulphur, Total (wt %)	Max.	0.30	0.4	1.0	D1266 (2)
Sulphur, Mercaptan (wt %)	Max.	0.005	0.005	0.005	D1219, D3227 (3)
or Doctor Test		Negative	Negative	Negative	D4952
VOLATILITY					
Distillation Temperature:					D86
10% Recovery (°C)	Max.	204.4	205	---	
50% Recovery (°C)	Max.	232.2	232	Report	
90% Recovery (°C)	Max.	---	---	315.6	
Final BP (°C)	Max.	300	300	338.0	
Distillation Residue (vol %)	Max.	1.5	1.5	---	
Distillation Loss (vol %)	Max.	1.5	1.5	---	
Gravity, API		57 - 37 @ 60°F	57 - 37 @15°C	57 - 37 @15°C	D287 (4)
Vapour Pressure @ 38°C (psi)	Max.	3 (5)	3	---	D323
Freezing Point (°C)	Max.	(6)	-40	---	D2386
Pour Point (°C)	Max.	---	---	-40	D97
Cloud Point (°C)	Max.	---	---	-34.4	D2500
Viscosity (cSt)		8.5 max @ -20 °C	16.5 max @ -34.4 °C	1.4 min @ 37.8 °C	D445
COMBUSTION					
Net Heat of Comb. (MJ/kg)	Min.	42.8	42.6	42.8	D240, D2382 (7)
Luminometer No.	Min.	---	45	---	D1740
or Smoke Point (mm)	Min.	25	25	---	D1322
or Smoke Point (mm)	Min.	20 (8)	20	---	D1322
and Naphthalenes (vol %)	Max.	3.0	3	---	D1840
CORROSION					
Copper Strip (2h @ 100°C)	Max.	1	1b	1	D130
THERMAL STABILITY					
JFTOT ΔP @ 260 °C (mm Hg)	Max.	25	25 (9)	25 (9)	D3241
Tube Deposit Rating (Visual)	Max.	<3	<3	<3	
Potential Gum (mg/100 mL)	Max.	---	---	14.0	D873
Carbon Residue (10% btm), %	Max.	---	---	0.2	D524
CONTAMINANTS					
Existent Gum (mg/100 mL)	Max.	7	---	---	D381
Ash (wt %)	Max.	---	---	0.01	D482
Water Reaction Interface	Max.	1b	1b	1b	D1094
Water Reaction, Vol. Chg. (mL)	Max.	1	1	1	D1094
ADDITIVES					
Anti-icing (vol %)		Option (10)	Option	Option	
Antioxidant		Option	Option	Option	
Corrosion Inhibitor		Option	Option	Option	
Metal Deactivator		Option	Option	Option	
Static Dissipator		Option (11)	---	---	
Biocide		Option (12)	---	---	
Thermal Stability Improver		Option (13)	Option	Option	
Leak Detection		Option (14)	---	---	

NOTES

(1) Fuel shall be free from water, sediment and suspended matter. Odor shall not be nauseating or irritating.
(2) CPW204 and CPW46 specifications also allow D1552, D2622, D4294 or D5453.
(3) SB No.2016 specifies only D1219 or D1323. Only D3227 is specified for CPW204 and CPW46 fuels.
(4) CPW204 and CPW46 specifications also allow D1298 or D4052.
(5) Wide-cut fuels characterized by a Reid Vapour Pressure in the range 2.0-3.0 psi, or a Flash Point less than 28°C, are not acceptable for use in some specific Pratt & Whitney engine models.
(6) The freezing point shall be equal to or below the minimum engine fuel inlet temperature.
(7) CPW204 and CPW46 specifications also allow D1405, D3338, D4529 or D4809.
(8) Waiver currently in effect permits relaxation of Smoke Point down to 18 mm min. with naphthalenes of 3.0% max.
(9) If test at 260°C fails, repeat at 245°C. Report results of both tests.
(10) DiEGME conforming to Mil-DTL-85470 at 0.15 vol.% max.; Russian Additive "I" (EGME) at 0.15 vol.% max.; Russian Additive "I-M" (50/50 blend of "I" with methyl alcohol) at 0.15 vol.% max.
(11) Octel Stadis 450 at 3.0 ppm max. and Russian Additive "Sigbol" at 3.0 ppm max. are approved to increase electrical conductivity to a range of 150-600 pS/m at point of injection agreed by purchaser and supplier.
(12) May be used on limited basis to sterilize aircraft fuel systems contaminated by microbial organisms. Approved additives are Biobor JF at 270 ppm max and Kathon FP 1.5 at 100 ppm max.
(13) Approved additives are listed in SB No.2016.
(14) Tracer A (SF_6) at 1 ppm max may be used for purpose of detecting leaks in airport fuel distribution systems.

Appendix A
Fuels and Additives Available in Eastern Europe

The contents of this appendix were developed with guidance and review kindly provided by Peter S. Brook of Qinetiq Fuels and Lubricants Centre. All information contained within this appendix is believed to be current as of December 31, 2004.

FUELS AND ADDITIVES AVAILABLE IN EASTERN EUROPE

Many of the names and grades of jet fuels and additives are carried over from the days of the Warsaw Pact and Russian domination.

Russian fuel grades

GOST Standard 10227-86 lists four grades of fuel, TS-1, T-1, T-2 and RT. Each has a category of quality with TS-1 having both a higher and first category, of which only the first category appears to be in use. An update of Table 1 of this specification, listing TS-1, RT and two Military fuels, T-8V and T-6, requires an antioxidant and a lubricity improver in RT, T-8V and T-6. Another amendment noted is a change in the Crystallization Point (similar to our freezing point) in TS-1 and RT to -50 °C with -60 °C and -55 °C respectively being produced by user demand.

TS-1 (TC-1) is produced by straight atmospheric distillation from a high sulphur crude, 50% being hydrotreated and blended with remaining 50% straight run product, which may have mild caustic treatment. Although the specification lacks a dynamic thermal stability test, all airfield samples tested to Def Stan 91-91 (with the exception of one) pass the JFTOT at 260 °C and all other requirements (except mercaptan sulphur and flash point). TS-1 is the most widely used fuel in the C.I.S.

RT (PT) can be produced from straight run or hydrotreated kerosine and certain additives are included to improve its properties. This fuel has improved lubricity properties (by use of a lubricity improver) and a wider boiling range.

T-8V and T-6 to GOST 12308-89 are military supersonic fuels. T-8V is a heavier, higher flash point (45 °C), low volatility kerosine while T-6 is a very heavy, high flash (62 °C), low aromatic, hydrotreated low sulphur fuel which cannot be used in engines designed for use on ordinary kerosine.

T-1 is a straight distillation of low sulphur, high naphthalene crude. This fuel is a relatively high-density fuel with poor thermal stability and has no mercaptan sulphur limit. Its production is now very limited and may even be obsolete. (It is not found at International Airports and as such British Airways have not uplifted or used this fuel since the sixties apart from the occasional use of Polish PSM2).

T-2 is a wide-cut Fuel very similar to JP-4, except for lower vapour pressure limits. Western wide-cut fuels could fail to satisfy the aromatic and sulphur limit of T-2. Again this fuel may now be obsolete and is not found at International Airports.

The new Russian Jet A-1 specification GOST R 52050-2003 will become available from January 2004 at some international gateway airports. The specification is developed on the basis of ASTM D1655 and Def Stan 91-91 and is largely equivalent to these specifications.

ExxonMobil Aviation gratefully acknowledges the input received from:

QinetiQ

Appendix A
Fuels and Additives Available in Eastern Europe

FUEL GRADES AVAILABLE IN FORMER EASTERN BLOC COUNTRIES
(with local names and specifications where known)

Many of the specifications listed below are old and/or obsolete. The majority of fuel produced in these countries for use at major airports is made to either Def Stan 91-91 (or its predecessor) or to the Joint Checklist. Local names continue to be used and are listed for information only.

COUNTRY	FUEL (SPECIFICATION)	FUEL (SPECIFICATION)	FUEL (SPECIFICATION)	FUEL (SPECIFICATION)
Bulgaria	RT (BDS 5075)	TS-1 (BDS 5075)	JFSCL (Def Stan 91-91)	
Czech and Slovak Republics	PL-5 (ČSN 65 6519)	PL-6 (PND25-005-76)	PL-7 (Based on JFSCL)	
Yugoslavia	GM-1 (JUS B.H2.331)	GM-4 (JUS B.H2.334)		
Poland	P-3 (PN-72/C-96026)	P-2 (PN-72/C-96026)	PSM-2 (PN-72/C-96026)	ATK (BN-76/0533-01)
Romania	T-1 (STAS 5639)	TH (STAS 5639)		

Additives

Anti-Oxidants

2,6-ditertiary-butyl-4-methyl-phenol (BHT) is the most commonly used anti-oxidant. One local trade name is Agidol-1. A similar material, RDE/A/607, is an approved anti-oxidant in Def Stan 91-91. An anti-oxidant is required in RT fuel.

Anti-Static Additive

The anti-static additive available is known as SIGBOL. It is similar to the now withdrawn/obsolete Shell ASA3, but has never been in regular use. It is available upon customer request.

Lubricity Improver

The common lubricity improver is a Naphthenic Acid and is required in all RT Fuel. Since 1991, Ethyl's Hitec 580 has increasingly being used, but at a much higher treat rate (0.0030-0.0035% mass) than permitted in the West.

SPECIFIC INFORMATION ON ANTI-ICING INHIBITORS

Bikanol E-1, Western names – cellosolve, ethylene glycol ethyl ether (EGEE)

COUNTRY	POLAND	EAST GERMANY	ROMANIA	RUSSIA
Local name	Bikanol E-1	Äthylglycol rein	Solvid	Ethylcellosolv
Specification	WT-ICSO-1983	TGL 8116	NID 4142-68	GOST-8313-76
Purity, %m	99	95	99	99
Distillation range °C	127 - 140	127 - 138	---	---
Refractive index	0.928 - 0.933	0.930 - 0.933	0.930 - 0.935	0.928 - 0.933
Water content (% max)	0.2	1.0	0.5	0.2
Acidity as acetic acid (% max)	0.01	---	0.01	0.005

Fluid E (I'- M), is an Ether (perhaps an ethyl cellosolve) with Methanol 50/50. It is believed to be similar to EGME (ethylene glycol monomethyl ether).

TGF is a tetrahydrofurfuryl alcohol, but is apparently no longer used.

Appendix A
Fuels and Additives Available in Eastern Europe

FUEL GRADES AVAILABLE AT SOME LARGER EAST EUROPEAN AIRPORTS

COUNTRY	AIRPORT (IATA CODE)	FUEL GRADES AVAILABLE (1)
Albania	Tirana-Rinas (TIA)	Jet A-1, Avgas
Armenia		TS-1 (Jet A-1)
Belarus	Minsk (MSQ)	RT
Bosnia-Herzegovina	Banja Luka (BNX)	Jet A-1
	Mostar (OMO)	Jet A-1
	Sarajevo (SJJ)	Jet A-1
	Tuzla (TZL)	Jet A-1
Bulgaria	Bourgas (BOJ)	RT (Jet A-1)
	Sofia (SOF)	RT (Jet A-1)
	Varna (VAR)	RT (Jet A-1)
Croatia	Dubrovnik (DBV)	Jet A-1/GM-1, Avgas
	Osijek (OSI)	Jet A-1/GM-1, 100LL
	Rijeka (RJK)	Jet A-1/GM-1, 100LL
	Split (SPU)	Jet A-1/GM-1
	Zadar (ZAD)	Jet A-1/GM-1, 100LL
	Zagreb (ZAG)	Jet A-1/GM-1, 100LL
Czech Republic	Brno (BRQ)	Jet A-1, 100LL
	Karlovy Vary (KLV)	Jet A-1, 100LL
	Ostrava (OSR)	Jet A-1, 100LL
	Prague (PRG)	Jet A-1, 100LL
Estonia	Kardla (KDL)	Jet A-1 (TS-1), 100LL
	Kuressaare (URE)	Jet A-1 (TS-1), 100LL
	Tartu (TAY)	Jet A-1 (TS-1), 100LL
Georgia	Tbilisi (TBS)	Jet A-1 (TS-1)
Hungary	Budapest (BUD)	Jet A-1, 100LL
Latvia	Riga (RIX)	Jet A-1 (TS-1), 100LL
Lithuania	Vilnius (VNO)	Jet A-1 (TS-1)
Moldova		TS-1
Poland	Gdansk (GDN)	Jet A-1, 100LL
	Katowice (KTW)	Jet A-1, Avgas
	Krakow (KRK)	Jet A-1, 100LL
	Poznan (POZ)	100LL
	Rzeszow-Jasionka (RZE)	100LL
	Szczecin (SZZ)	Jet A-1
	Warsaw (WAW)	Jet A-1, Avgas
Romania	Bucharest Baneasa (BBU)	TH/Jet A-1, 100LL
	Bucharest Otopeni (BUH)	TH/Jet A-1, 100LL
	Constana (CND)	TH/Jet A-1, 100LL
	Timisoara (TSR)	TH/Jet A-1, 100LL
	Turgu-Mures (TGM)	TH/Jet A-1
Russia	Moscow (SVO)	Jet A-1 (TS-1), RT
Serbia & Montenegro	Belgrade (BEG)	GM-1/Jet A-1, RT, 100LL
	Tivat (TIV)	GM-1/Jet A-1
Slovak Republic	Bratislava (BTS)	Jet A-1
	Kosice-Barca (KSC)	100LL
	Piestany (PZY)	Jet A-1, 100LL
	Poprad-Tatry (TAT)	Jet A-1, 100LL
	Sliac (SLD)	Jet A-1, 100LL
Slovenia	Ljubliana (LJU)	Jet A-1, 100LL
	Maribor (MBX)	Jet A-1
	Portoroz (POW)	100LL
Ukraine		TS-1

(1) Fuel grades separated by a "/" are considered nearly equivalent; fuel grades in ( ) may be available.

Appendix B
Significance of Aviation Fuel Test Requirements

SIGNIFICANCE OF AVIATION FUEL TEST REQUIREMENTS

The significance of each of the properties that must be tested under fuel specification requirements is briefly described. The conventional test method for each property is shown, together with the minimum sample volume of fuel required by the method. This does not take into account any extra margin needed to cover handling losses or repeat determinations. Note that for a group of tests, volumes are not necessarily cumulative. The fuel from a non-destructive test, e.g. from the Appearance test, can generally be reused for a different test.

FUEL PROPERTY AND SIGNIFICANCE	TEST METHOD ASTM/IP	SAMPLE VOLUME REQUIRED FOR TEST (mL)
COMPOSITION		
Appearance is visually assessed in a qualitative pass/fail test of fuel cleanliness, to preclude free water, sediment and suspended matter.	D4176	1000
Total Acidity of combined organic and inorganic acids indicates the corrosive potential of fuel to metals. Trace organic acids can affect water separation properties.	D3242/IP354	100
Aromatics Content relates directly to flame radiation, carbon deposition and smoke. Also affects swelling of elastomers in the fuel system.	D1319/IP156 D6379/IP436	<1 <1
Hydrogen Content contributes to combustion cleanliness and is broadly related to Aromatics Content.	D3701/IP338	30
Olefins are unsaturated hydrocarbons, which are potential contributors to instability in storage.	D1319/IP156	5
Total Sulphur (1) is controlled because sulphur oxides formed during combustion can cause corrosion of turbine metal parts.	D4294/IP336	20
Mercaptan Sulphur compounds are limited because they have a very unpleasant odour and attack certain elastomer materials.	D3227/IP342	55
Doctor Test detects the presence of reactive sulphur compounds, and is an alternative method of measuring Mercaptan Sulphur.	D4952/IP30	10
VOLATILITY		
Distillation curve defines the kerosine boiling range, which needs to be appropriate for balanced vaporisation of the whole fuel volume.	D86/IP123 D2887	100 5
Flash Point (2) is related to volatility and therefore affects combustibility. It is a leading factor determining fire safety in fuel handling.	D3828/IP303	50
Density (3) must be known for aircraft weight loading calculations, since fuel is customarily metered by volume. Also relates to Specific Energy.	D4052/IP365	5
Vapour Pressure (4) is significant for wide-cut fuels. Indicates venting loss of light ends at altitude and in hot climates. Also relates to cold starting.	D5191 IP69	10 800
FLUIDITY		
Freezing Point (5) limits higher molecular weight hydrocarbons that crystallise at low temperatures; it therefore influences low temperature pumpability during flight.	D2386/IP16	30
Viscosity affects fuel pumpability over the operating temperature range, and relates to droplet size in sprays produced by burner nozzles.	D445/IP71	50
COMBUSTION		
Specific Energy (Net Heat of Combustion) denotes the amount of heat energy obtainable from a fuel to provide power (value is calculated).	D3338	---
Smoke Point indicates the tendency of a fuel to form soot, which is related to the type of hydrocarbons making up its composition.	D1322/IP57	20
Naphthalenes are polycyclic aromatics high in carbon content, exacerbating the problems of carbon formation, flame radiation and smoke.	D1840	5

Appendix B
Significance of Aviation Fuel Test Requirements

FUEL PROPERTY AND SIGNIFICANCE	TEST METHOD ASTM/IP	SAMPLE VOLUME REQUIRED FOR TEST (mL)
CORROSION		
Copper Strip Corrosion test pass ensures that organic sulphur compounds will not corrode copper components in the fuel system.	D130/IP154	50
STABILITY		
Thermal Stability (JFTOT) measurements relate to the amount of deposits formed at high temperature in the engine fuel system.	D3241/IP323	600
CONTAMINANTS		
Existent Gum is a non-volatile residue left on evaporation of a fuel. Also serves as a check for fuel contamination within product distribution systems.	D381/IP131	50
Particulates such as dirt and rust are undesirable and are detected by filtration through a membrane filter.	D5452/IP423	5000
Filtration Time is measured by the same test procedure as Particulates.	D5452/IP423	5000
Water Reaction determines the presence of materials that react with water and affect the stability of the fuel-water interface.	D1094/IP289	100
Water Separation (MSEP) index rates the ability of fuel to release entrained or emulsified water when passed through a fibreglass filter coalescer.	D3948	50
OTHER		
Electrical Conductivity needs to be high enough to dissipate any electrostatic charges generated during fuel handling operations, so as to prevent fire or explosion hazards.	D2624/IP274	1000
Lubricity (BOCLE) refers to the effectiveness of lubricating moving parts in engine fuel system components such as pumps and control units.	D5001	50

VOLUME REQUIREMENTS FOR ALTERNATIVE TEST METHODS

(1) **Total Sulphur**	Lamp Combustion	IP107/D1266	20
	Wickbold Combustion	IP243	5
	Microcoulometry	IP373	<1
	High Temperature Combustion	D1552	300
	X-ray Spectrometry	D2622	100
	Ultraviolet Fluorescence	D5453	<1
(2) **Flash Point**	Tag Closed Cup Tester	D56	50
	Abel Closed Cup Tester	IP170	250
(3) **Density**	Hydrometer Method	D1298/IP160	500
(4) **Vapour Pressure**	Reid Method	D323	800
	Automatic Method	D5190	800
	Air Saturation Vapour Pressure	IP394	800
(5) **Freezing Point**	Setapoint Filter Flow	D4305	5
	Automated Optical Method	D5901	30
	Automatic Phase Transition	D5972	<1

NOTES

Recertification tests must be carried out on aviation fuel after transportation in non-dedicated/non-segregated systems (e.g. in ocean tankers or multi-product pipelines) to verify that the quality has not changed and remains within specification limits. The following tests are required to recertify Jet A-1 fuel batches (6):

Appearance/Colour; Distillation; Flash Point; Density; Freezing Point; Copper Corrosion; Existent Gum; Water Reaction.

These tests require a combined sample volume of 2L minimum. Test results should be compared with data from original test certificates using accepted variability limits.

(6) JIG Guidelines for Aviation Fuel Quality Control & Operating Procedures for Jointly Operated Supply & Distribution Facilities, Issue 9, January 2004.

Appendix C
Guidance on Contamination Limits

Guidance on fuel contamination is provided by both the IATA Guidance Material 5th Edition and Defence Standard 91-91 Issue 5. Details of both documents are provided here for reference.

IATA GUIDANCE MATERIAL 5TH EDITION

The international airlines have recommended standards and test methods used to define cleanliness limits for fuels supplied into-plane. A monitoring system composed of spot and continuous testing shall be used to evaluate the quality and cleanliness of the fuel and the efficiency of the defence system. Fuel shall be sampled and tested regularly for both particulate matter and undissolved water contamination. The limits set out in the Table below are those detailed in IATA's Guidance Material for Aviation Turbine Fuels Specifications, 5th Edition, Part III – Cleanliness and Handling. The limits are intended to apply to fuels at the point of delivery into the aircraft. Two categories of contamination limits are defined – 'Notification' and 'Rejection', which determine the course of action to be followed.

The intention of the 'Notification' limit is to cause the fuel supplier to alert the airline without delay, but to continue fuelling. The airline and supplier would confer on results between 'Notification' and 'Rejection' limits to agree a course of action.

Results of tests that are above the 'Rejection' limits should also be immediately notified to the airline and fuelling terminated. Urgent action should be taken to provide fuel for the airline's use for which test results fall below the 'Rejection' limits. It is possible for the airline to release or accept delivery of stocks that by test are beyond the rejection limits, but it is not intended to release the supplier from an obligation to provide fuel free of contaminant and preferably below the 'Notification' limits.

SAMPLING PATTERN	SAMPLING FREQUENCY (MINIMUM)		TEST METHOD	LIMITS
	Particulate Matter	Undissolved Water		
Refueller Truck	After Loading	Before Fuelling	Visual Inspection of fuel in glass jar (minimum 1 L)	Clear & Bright
			Visual Inspection & Water Detector (1)	30 ppm maximum at the temperature of delivery
	Monthly Colourimetric Six Monthly Gravimetric (2)		ASTM D2276/IP216 (5L sample) (3)	Notification Limit 0.2 mg/L Rejection Limit 1.0 mg/L
Hydrant Dispenser	Daily	During Fuelling	Visual Inspection of fuel in glass jar (minimum 1 L)	Clear & Bright
			Visual Inspection & Water Detector (1)	30 ppm maximum at the temperature of delivery
	Monthly Colourimetric Six Monthly Gravimetric (2)		ASTM D2276/IP216 (5L sample) (3)	Notification Limit 0.2 mg/L Rejection Limit 1.0 mg/L

(1) The presence of moisture shall be determined by visually inspecting the sample in good light to determine brightness, cleanliness, transparency and uniformity. The presence of insoluble material shall be determined as well. In addition to checking the absence of water by visual check, other effective methods of checking the presence of water are used. The following are approved methods that guarantee the detection of 30 ppm or greater of free water.

Shell Water Detector: Faint colour change occurs with water contents as low as 5 ppm, which is acceptable under this specification. Free water amounts of 30 ppm or greater changes the indicator to a definite green or blue-green colour.

Velcon Hydrokit: If no colour change occurs within two minutes or if the powder colour is lighter than the dark colour of the Colour Card, then the sample contains less than 30 ppm of free water. At 30 ppm or greater of free water, the powder colour matches or is darker than the dark colour (marked 'Fail') on the Colour Card.

Mobil Moisture Detector: Isolated purplish-blue spots appear on the pad as low as 5 ppm of free water. At 30ppm of free water, large purplish-blue spots are apparent. **This test is no longer available**.

Aqua-Glo: Directly measures the free water content of a measured sample of fuel. When a 100 mL sample is taken, the measurable free water content ranges from 5 to 60 ppm.

POZ-T: Measures the emulsified water content and suspended solid content in fuel (In use at Russian airports). The device can measure water content of less than 10 ppm, less than 20 ppm (notification) or 30 ppm or higher (rejection). The limits for particulate matter are established by the civil aviation authority in Russia by colourimetric comparison to standards, similar to colourimetric membrane ratings.

(2) A gravimetric test may not be required at regular intervals provided the following conditions are met:

1) When fixed inbound and outbound filtration is by API/IP 1581 (Filter/water separators) qualified filtration; storage tanks are fully epoxy-lined, have coned-down bottoms and floating suctions; and into-plane filtration also meets API/IP 1581 or API/IP 1583 (Filter monitors).

2) A colourimetric membrane rating of 3-Dry or less. If a colour rating of 4-Dry or greater is observed, proceed as follows (a colour rating of 4-Dry or greater may indicate a particulate contamination problem):

Perform a subsequent particulate test consisting of two membranes in the plastic holder to compare colour differences between top and bottom membranes. If top and bottom membranes have a colour rating difference of 2 or less, fuel is to be considered clean and acceptable. If difference is 3 or greater, conduct a gravimetric analysis. Fuel is acceptable if less than 0.20 mg/L; above 0.20 mg/L, further investigation is required and if above 1.0 mg/L, the fuel should be rejected.

A gravimetric membrane test must be carried out on all new or re-commissioned vehicles, when new hoses or filters are fitted and on new hydrant lines and storage tanks before commissioning.

(3) Periodic gravimetric and colourimetric membrane testing.

Method A: Gravimetric determination of Total Contamination shall be determined at least once every six months on each refueller/dispenser.

Method B: Colourimetric membrane ratings may be determined (by agreement between buyer/consumer and seller/supplier) monthly on a rotating basis where the number of refuellers/dispensers is such that:

1) At least one dispenser is tested successively by Method 1 and Method 2 in the same test group.

2) Membranes for tests on the other refuellers/dispensers visually match the colourimetric check in paragraph 1).

Any test showing an unusual colourimetric result shall be immediately retested gravimetrically (Method 1). A colour difference of 2 or more is considered unusual.

Note that Joint Guidelines requires monthly colourimetric membrane tests to be determined downstream of all filters on vehicles supplying jet fuel.

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F.1 The visual appearance of the product is a good indication of contamination and remains a key requirement for fuel throughout the distribution system. However, interpretation of the Appearance requirement can lead to problems due to the subjective nature of the visual assessment. Therefore, a quantitative limit has been established for particulate contamination. A maximum particulate contamination of 1.0 mg/l, when tested to IP 423/ ASTM D 5452, shall apply at point of manufacture only.

F.2 Fuels containing visual particulate or with particulate levels greater than 1.0 mg/l will require additional handling procedures, such as extended settling and/or filtration.

F.3 Where fuel is being delivered into aircraft, the IATA Guidance Material for Aviation Turbine Fuels Part III – Cleanliness and Handling, shall be referred to for appropriate information on contamination limits.

F.4 It is the intent of the Specification Authority to extend particulate contamination limits throughout the distribution system at a later date.

Appendix D
Additives in Aviation Fuel

As the aviation industry's jet kerosine demands have increased to more than 5% of all refined products derived from crude, it has been necessary for the refiner to optimize the yield of jet kerosine, a high value product, by varying process techniques. New processes have allowed flexibility in the choice of crudes, the use of coal tar sands as a source of molecules and the manufacture of synthetic blend stocks. Due to the number and severity of the processes used, it is often necessary and sometimes mandatory to use additives. These additives may, for example, prevent the formation of harmful chemical species or improve a property of a fuel to prevent further engine wear. In all cases, the additives have undergone an extensive and often expensive process by which their effects on all fuel properties and acceptability for use is studied. This process can literally take decades before an additive is approved.

Approval may be subdivided into two levels.

1. Acceptance by turbine and airframe manufacturers with listing/recognition in their certification of the aircraft.

2. Listing in major specifications.

Additives must always have the approval of the major turbine and airframe manufacturers before they can be included in the specifications.

Additives are generally given one of three statuses when included in specifications.

Required
The additive must be introduced at the level specified to meet a specific handling requirement. The point of addition is not necessarily into refinery production.

Optional
The additive may be added by the fuel manufacturer to the extent permitted by specification without consulting customers. The supplier may be required to declare its presence.

Agreement
Purchasing authorities may require that an additive be used to the extent permitted by specification. If the fuel supplier desires to add it, agreement by the customer must be secured.

There are exceptions where the manufacturers of aircraft approve additives but these are not approved by specification writing authorities. Biocides are an example.

ADDITIVES FOUND IN AVIATION FUEL

The following additives are either required or added by agreement for use in aviation fuel.

Static Dissipator
Refinery processing can remove naturally present polar species generating fuels with poor conductivity. These fuels have an increased risk of charge generation and ultimately static discharge, especially during loading or as the fuel passes through filters. To virtually eliminate this risk, static dissipator additive is widely used in jet kerosine. The minimum and maximum fuel conductivity requirements for Def Stan 91-91, JP-8 and JFSCL are 50 to 450 pS/m. The addition of static dissipator is not mandatory under ASTM D1655. Stadis® 450 is the only additive currently manufactured for use in aviation turbine fuels approved by the major turbine and airframe manufacturers.

Appendix D
Additives in Aviation Fuel

Metal Deactivators

Metal ions in fuel can catalyze oxidation reactions that contribute to poor thermal stability. Copper and zinc are the two most common metal contaminants found in jet fuel. Metal deactivator additive (MDA) is a chelating agent that binds metal ions and prevents fuel degradation. It has also been observed that MDA improves thermal stability in the JFTOT test in the absence of metal ions. MDA can be used to improve thermal stability provided that the JFTOT test is determined before and after MDA addition and reported accordingly.

Antioxidants

Hydroprocessing of aviation fuels removes naturally occurring antioxidants that provide protection from peroxidation. Peroxides are known to attack elastomers causing embrittlement while also contributing to gum and particulate formation. The use of antioxidants effectively prevents peroxidation from occurring and under JFSCL and Def Stan 91-91, 17 to 24 mg/L of an approved antioxidant must be added to the proportion of the fuel blend that has been hydroprocessed. All of the additives are approved by chemistry and so there may be any number of suppliers for each individual antioxidant type. The use of antioxidants is optional under ASTM D1655.

Corrosion Inhibitors (Lubricity Improvers)

Corrosion inhibitors were originally added to military jet fuels to protect the fuel distribution system and aircraft engines from corrosion. Many aircraft fuel system components, especially pumps, rely on the fuel to lubricate moving parts. Hydroprocessing of fuels removes components that provide the fuel with natural lubricating properties. As military aircraft are most susceptible to lubricity problems, it is required under UK and US Military specifications to add corrosion inhibitors/lubricity additives. Civilian fuel specifications do not require the use of lubricity additives and fuel produced to ASTM D1655-04a must obtain agreement between purchaser and supplier prior to the addition of any lubricity improving additive. Def Stan 91-91/5 allows the use of approved lubricity improvers without prior agreement between purchaser and supplier.

The following corrosion inhibitors/lubricity improvers are qualified for use by Def Stan 91-91/5 at the specified concentrations:

PRODUCT	MANUFACTURER	QUALIFICATION REFERENCE	MINIMUM MG/L	MAXIMUM MG/L
Apollo PRI-19	Apollo Technologies Intl. Corp.	RDE/A/660	18	23
Hitec 580	Afton Chemical Ltd.	RDE/A/661	15	23
Octel DCI-4A	Octel Starreon LLC	RDE/A/662	9	23
Octel DCI-6A	Octel Starreon LLC	RDE/A/663	9	9
Nalco 5403	Nalco Chemical Co.	RDE/A/664	12	23
Tolad 4410	Baker Petrolite	RDE/A/665	9	23

Appendix D
Additives in Aviation Fuel

Fuel System Icing Inhibitors (FSII)

Water dissolved in fuel can come out of solution at low temperatures in the form of very fine droplets. Although the amounts are small, the droplets formed can freeze at altitude and cause filter plugging. Fuel system icing inhibitors have been developed to protect the system from this problem. The most widely used additive is diethylene glycol monomethyl ether (DiEGME). The use of FSII is required in UK and US military jet kerosine and although optional in many civilian specifications is very seldom used.

Note: As allowed in Def Stan 91-91/5, concentrations of 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.

Thermal Stability Additive (Only allowed for use in certain military jet kerosines)

Modern military jet engines require aviation fuel that has a higher thermal stability and heat sink capacity than is currently available. The US Military has in conjunction with additive suppliers developed an additive package that provides these benefits when added to jet fuel. The additive is not compatible with current commercially available filter/water separators and is not approved for use in Jet A or Jet A-1. Manufacturers are currently looking at alternative filter/water separator designs that will overcome this problem.

The following additives may be found in aviation fuels, but are not necessarily discussed under current specifications.

Tracer A

Tracer A (Sulphur hexafluoride, SF6) is used as a part of a tracer system for fuel system leak detection at major airports. Airports occasionally run leak detection testing of hydrants, which may be carried out monthly or quarterly. Current use requires agreement by purchasers on a case by case basis.

Biocides

Biocides are permitted by engine and airframe manufacturers for intermittent use during maintenance turnaround. The aircraft are refilled and fully dosed and, as a general rule, will fly on the treated fuel until it is fully used up. Fuel System Icing Inhibitor may also serve to inhibit fungal and bacterial growth in aircraft fuel systems, but may not do so reliably. As an example, it is known that fuels containing FSII, which have not been stored or handled properly, are susceptible to microbiological contamination.

Appendix D
Additives in Aviation Fuel

KEY ADDITIVES APPROVED IN AVIATION TURBINE SPECIFICATION

ADDITIVE TYPE Chemical or Brand Name	ISSUING AGENCY	AFQRJOS Jet A-1 (JOINT CHECK LIST)	ASTM (Jet A)	DEF STAN 91-91 (Jet A-1)	DEF STAN 91-86 (F-44)	DEF STAN 91-88 (F-40)	IATA (Jet A-1)	MILSPEC 5624U (JP-4/JP-5)	MILSPEC 38219D (JP-7)	MILSPEC 83133E (JP-8)	CAN-CGSB 3.22 (Jet B)	CAN-CGSB 3.23 (Jet A/A-1)	GE D50TF2	P&W SB. No. 2016
ANTI-OXIDANT		R	0	R	R	R	R	R	R	R	0	R	0	R
2,6-Ditertiary-butyl phenol		•	•	•	•	•	•	•	•	•	•	•	•	•
2,6-Ditertiary-butyl-4-methyl phenol		•	•	•	•	•	•	•	•	•	•	•	•	•
2,4-Dimethyl-6-tertiary-butyl phenol		•	•	•	•	•	•	•	•	•	•	•	•	•
Mix 75%(min) 2,6-Ditertiary-butyl phenol		•	•	•	•	•	•	•	•	•	•	•	•	•
25%(max) Teriary and Tritertiary butyl phenols		•	•	•	•	•	•	•	•	•	•	•	•	•
Mix 72%(min) 2,4-Dimethyl-6-tertiary-butyl phenol		•	•	•	•	•	•	•	•	•	•	•	•	•
28%(max) Methyl and Dimethyl teriary-butyl phenols		•	•	•	•	•	•	•	•	•	•	•	•	•
Mix 55%(min) 2,4-Dimethyl-6-tertiary-butyl phenol		•	•	•	•	•	•	•	•	•	•	•	•	•
15%(min) 2,6-Ditertiary-butyl-4-methyl phenol		•	•	•	•	•	•	•	•	•	•	•	•	•
30%(max) Methyl and Dimethyl tertiary-butyl phenols		•	•	•	•	•	•	•	•	•	•	•	•	•
STATIC DISSIPATOR ADDITIVE		R	0	R		R	R	R/A		R	R	R	0	R
Stadis 450		•	•	•		•	•	•		•	•	•	•	•
ANTI-ICING ADDITIVE		A	A	0	R	R	A	R	R	R	0	A	0	0
Ethylene glycol monomethyl ether											•	•		
Diethylene glycol monomethyl ether		•	•	•	•	•	•	•	•	•	•	•	•	•
CORROSION INHIBITORS			A	0	R	R	A	R	R	R	A	A	0	0
Apollo PRI-19				•	•	•	•	•		•	•	•	•	•
Hitec 580				•	•	•	•	•		•	•	•	•	•
Nalco 5403				•	•	•	•	•		•	•	•	•	•
DCI-4A				•	•	•	•	•		•	•	•	•	•
DCI-6A				•	•	•	•	•		•	•	•	•	
Nalco 5405							•	•		•	•	•	•	
Spec-Aid 8Q22							•	•		•	•	•		
Unicor J							•	•		•	•	•		
Tolad 351							•	•		•	•	•		
Tolad 4410				•	•	•	•	•		•	•	•		
RPS-613							•	•		•	•	•		
Hitec 515													•	
Tolad 245													•	
Mobilad F-800														•
PWA-536									•					
METAL DEACTIVATOR		0	0	0	0	0	0	A	A	A	0	0	0	0
N,N'-Disalicylidene-1,2-propanediamine		•	•	•	•	•	•	•	•	•	•	•	•	•
N,N'-Disalicylidene-1,2-cyclohexanediamine													•	
THERMAL STABILITY ADDITIVE			A							A			0	0
Spec-Aid 8Q462										•			•	•
AeroShell Performance Additive 101										•			•	•
Turboline FS100C													•	•
Turboline FS100													•	•
JFA-5														•
LEAK DETECTION ADDITIVE			0	0							0	0	0	0
Tracer A			•	•							•	•	•	•
BIOCIDE			E										0	0
Biobor JF													•	•
Kathon FP 1.5													0	0

LEGEND:

OPTION (O): The additive may be added by the fuel manufacturer to the extent permitted by specification without consulting customers. The supplier may be required to declare its presence.

AGREEMENT (A): Purchasing authorities may require that an additive be used to the extent permitted by specification. If the fuel supplier desires to add it, he must secure agreement of the customer.

ENGINE MANUFACTURER'S AGREEMENT (E): Specification authorities may require agreement by engine manufacturers.

REQUIRED (R): The additive must be introduced at the level specified to meet a specific handling requirement. The point of addition is not necessarily into refinery production. (R for anti-oxidant treatment refers to hydrotreated fuel)

NOTE: Not all additives approved by specification and engine manufacturers have necessarily been listed. Consult the Issuing Authority for full details.

SUPPLEMENT AVIATION GASOLINE

Fuel grades

ExxonMobil Aviation Gasolines are leaded fuels satisfying the requirements of ASTM D910 and Def Stan 91-90 (DERD 2485). Critical properties must be controlled within defined limits for Aviation Gasoline to comply with these specifications.

The properties of aviation gasoline are specified to give satisfactory performance of spark-ignition aviation engines over a wide range of operating conditions. Specifications cover antiknock quality, which differs between grades of fuel, and other requirements that are common to all grades.

Four grades of aviation gasoline are identified, with names based on their antiknock quality as measured by Octane Number:

Grade 80
Grade 91
Grade 100
Grade 100LL (Low Lead)

Different colours, obtained by the use of specific dyes, are used to differentiate the fuel grades. Service experience has indicated that only certain dyes and concentration levels can be tolerated without causing deposition in engine fuel induction systems. ExxonMobil supplies Grades 100 and 100LL, which are identical in antiknock quality but differing in maximum lead content, the lower the lead content being suitable for engines having a low tolerance for lead.

Antiknock characteristics

Although the grade designations show only a single octane rating, antiknock quality is expressed by two values, the lean mixture motor rating and the rich mixture supercharge rating. Both values are determined in standardized laboratory single-cylinder test engines that are operated under prescribed conditions. The lean rating method is intended to simulate the lean air/fuel mixture of aircraft at cruise conditions, whereas the rich rating method simulates the rich air/fuel mixture under take-off conditions.

Common quality requirements

Requirements common for all grades either prescribe a balance of properties to ensure satisfactory engine performance, or limit the concentrations of components that could have an adverse effect on engine performance.

Use of automotive gasoline (mogas) in aircraft engines

The question of whether light aircraft engines can be operated on automotive fuel is often raised. It is, however, a practice that is discouraged and even forbidden by most engine manufacturers, fuel suppliers and government regulatory authorities. Some of the reasons for this are as follows:

1. The distillation characteristics of automotive gasoline are different than those of aviation gasoline. Mogas includes heavier petroleum fractions that tend to include hydrocarbons less stable to oxidation, less clean-burning and more prone to form combustion chamber and induction system deposits.

2. Automotive gasoline normally has a much higher vapour pressure, which varies seasonally. With a high RVP fuel the risk of vapour lock during take-off and climb increases, particularly if the aircraft had been parked in high ambient temperatures and does not have a gravity-fed fuel system.

3. Automotive gasolines may contain many different types of additives not permitted in aviation gasoline. There is no consistency or control on mogas additives between different suppliers. Aviation gasoline, regardless of where it is manufactured or purchased, is limited to certain specific additives.

Many properties critical to aviation use (for example, vapour pressure and cleanliness) are not controlled to the same degree in automotive gasoline manufacture and handling.

ExxonMobil Aviation does not support or approve the use of automotive gasoline or diesel fuel in piston-engine powered aircraft.

Table 24
Aviation Gasoline

Issuing Agency:				ASTM		
Specification:				D910-04a		
Latest Revision Date:				1 June 2004		
Grade Designation		Grade 80	Grade 91	Grade 100	Grade 100LL	**Test Method ASTM**
PERFORMANCE						
Knock Value, lean mixture:						
Octane Number	Min.	80.0	91.0	99.5	99.5	D2700
Knock Value, rich mixture:						
Octane Number	Min.	87.0	98.0			D909
Performance Number (1) (2)	Min.			130.0	130.0	D909
TETRAETHYL LEAD						
mL TEL/L	Max.	0.13	0.53	1.06	0.53	D3341, D5059
g Pb/L	Max.	0.14	0.56	1.12	0.56	
COLOUR		Red	Brown	Green	Blue	D2392
Dye Content: (3)						
Blue dye (mg/L)	Max.	0.2	3.1	2.7	2.7	
Yellow dye (mg/L)	Max.	None	None	2.8	None	
Red dye (mg/L)	Max.	2.3	2.7	None	None	
Orange dye (mg/L)	Max.	None	6.0	None	None	
APPEARANCE						
Visual				C & B (4)		
VOLATILITY						
Distillation:						D86
Initial Boiling Point (°C)				Report		
Fuel Evaporated						
10% volume at °C	Max.			75		
40% volume at °C	Min.			75		
50% volume at °C	Max.			105		
90% volume at °C	Max.			135		
Final Boiling Point (°C)	Max.			170		
Sum of 10%+50% evaporated						
temperatures (°C)	Min.			135		
Recovery Volume (%)	Min.			97		
Residue (vol %)	Max.			1.5		
Loss (vol %)	Max.			1.5		
Vapour Pressure at 38°C (kPa)				38.0 - 49.0		D323, D5190, D5191
OTHER						
Density @ 15°C (kg/m^3)	Max.			Report		D1298, D4052
Freezing Point (°C)	Max.			-58 (5)		D2386
Sulphur (wt %)	Max.			0.05		D1266, D2622
Net Heat of Comb. (MJ/kg) (6)	Min.			43.5		D4529, D3338, D4809
Corrosion, Copper (2h @ 100°C)	Max.			1		D130
Oxidation Stability, 5 hours: (7) (8)						D873
Potential Gum (mg/100 mL)	Max.			6		
Lead Precipitate (mg/100 mL)	Max.			3		
Water Reaction:						D1094
Volume Change (mL)	Max.			±2		
Conductivity (pS/m)	Max.			50-450 (9)		D2624
ADDITIVES:						
Anti-icing (vol %)				Option (10)		
Antioxidant				Option		
Corrosion Inhibitor				Option (11)		
Static Dissipator				Option (12)		

NOTES

(1) A performance number of 130.0 is equivalent to a knock value determined using iso-octane plus 0.34 mL TEL/L.

(2) Knock ratings shall be reported the nearest 0.1 Octane/Performance Number.

(3) The maximum dye concentrations shown do not include solvent in dyes supplied in liquid form.

(4) Fuel shall be free from undissolved water, sediment and suspended matter. The odour of the fuel shall not be nauseating or irritating.

(5) If no crystals have appeared on cooling to -58 ºC, the freezing point may be reported as less than -58 ºC.

(6) For all grades use either Eq 1 or Table 1 in D4529, or Eq 2 in D3338. Test method D4809 may be used as an alternative.

(7) If mutually agreed upon between purchaser and supplier, a 16 hour aging gum requirement may be specifiedinstead of the 5 h aging gum test; in such case the gum content shall not exceed 10 mg/100 mL and the visible lead precipitate shall not exceed 4 mg/ 100mL. In such fuel the permissible antioxidant shall not exceed 24 mg/L.

(8) Test method D381 existent gum test can provide a means of detecting quality deterioration or contamination, or both, with heavier products following distribution from refinery to airport.

(9) Limits apply only at point of use when a customer specifies the use of an electrical conductivity additive.

(10) Isopropyl Alcohol, conforming to D4171 (Type II), or DiEGME, conforming to D4171 (Type III) may be used.

(11) Corrosion inhibitor of a type and amount specified in Section 6.3.4 of ASTM D910 may be added.

(12) Stadis 450 up to 3 mg/L is permitted. When necessary, further addition to cumulative total of 5 mg/L is permissible.

Table 25
Aviation Gasoline

Issuing Agency:	Ministry of Defence (Procurement Executive)
Specification:	Def Stan 91-90/1
Latest Revision Date:	8 May 1996

Grade Designation		Grade 80	Grade 100	Grade 100LL	Test Method ASTM	Test Method IP
PERFORMANCE						
Knock Value, lean mixture:						
Octane Number	Min.	80.0	99.5	99.5	D2700	236
Knock Value, rich mixture:						
Octane Number	Min.	87.0			D909	119
Performance Number (1)	Min.		130	130	D909	119
TETRAETHYL LEAD						
g Pb/L	Max.	0.14	0.85	0.56	(2)	270 (2)
COLOUR		Red	Green	Blue	D2392	
Dye Content: (3)						
Blue dye (mg/L)	Max.	0.2	2.2	2.7		
Yellow dye (mg/L)	Max.	None	2.8	None		
Red dye (mg/L)	Max.	2.3	None	None		
Colour, Lovibond						17
Blue		-	1.7 - 2.9	1.7 - 3.5		
Yellow		-	1.5 - 2.7	-		
Red		6.7 - 9.1	-	-		
APPEARANCE						
Visual			C & B (4)		(5)	
VOLATILITY						
Distillation:					D86	123
Initial Boiling Point (°C)			Report			
Fuel Evaporated						
10% volume at °C	Max.		75			
40% volume at °C	Min.		75			
50% volume at °C	Max.		105			
90% volume at °C	Max.		135			
Final Boiling Point (°C)	Max.		170			
Sum of 10%+50% evaporated						
temperatures (°C)	Min.		135			
Residue (vol %)	Max.		1.5			
Loss (vol %)	Max.		1.5			
Vapour Pressure at 37.8°C (kPa)			38.0 - 49.0		D323 (6)	69 (6)
OTHER						
Density @ 15°C (kg/m³)	Max.		Report		D1298 (7)	160 (7)
Freezing Point (°C)	Max.		-60		D2386	16
Sulphur (wt %)	Max.		0.05		D1266 (8)	107 (8)
Existent Gum (mg/100 mL)	Max.		3		D381	131
Specific Energy (MJ/kg)	Min.		43.5		(9)	12 (9)
Corrosion, Copper (2h @ 100°C)	Max.		1		D130	154
Oxidation Stability, 16 hours:					D873	138
Potential Gum (mg/100 mL)	Max.		6			
Precipitate (mg/100 mL)	Max.		2			
Water Reaction:					D1094	289
Interface Rating	Max.		2			
Volume Change (mL)	Max.		2			
Conductivity (pS/m)	Max.		(10)		D2624	274
ADDITIVES:						
Antioxidant			Option			
Static Dissipator			Option (11)			

An update of Def Stan 91-90 is due in 2005. Anticipated changes include 1) when applicable, reporting of Freezing Point as below -58° C 2) deletion of the Water Reaction interface rating 3) allowance of Corrosion Inhibitors and 4) allowance of Icing Inhibitors.

NOTES

(1) Knock rating shall be reported to the nearest 0.1 for Octane Number and nearest whole number for Performance Number.
(2) Alternative test methods for tetraethyl lead content are IP 228/ASTM D5059 and IP 248/ASTM D3341.
(3) The visual colour must comply with limits for Lovibond test method (IP 17, Method A) using a 50.8 mm cell.
(4) Fuel shall be clear, bright and visually free from solid matter and undissolved water at ambient temperature.
(5) Alternative test method for Appearance is ASTM D4176, Procedure 1.
(6) Alternative test methods for Vapour Pressure are ASTM D5190, D5191 and IP 394.
(7) Alternative test method for Density is ASTM D4052/IP 365.
(8) Alternative test methods for Total Sulphur are ASTM D2622 and IP 243.
(9) Alternative test methods for Specific Energy are ASTM D3338, D4809 and D4529/IP 381.
(10) When a static dissipator additive has been added to the fuel the conductivity at the point, time and temperature of delivery to the purchaser shall be in the range 50-600 pS/m.
(11) Stadis 450 may be added at concentration not exceeding 3 mg/L.

NOTES

NOTES

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Aviation

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