NATO STANDARD

AFLP-3747

GUIDE SPECIFICATIONS (MINIMUM QUALITY STANDARDS) FOR AVIATION TURBINE FUELS (F-24, F-27, F-34, F-35, F-37, F-40 AND F-44)

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NORTH ATLANTIC TREATY ORGANIZATION

ALLIED FUELS AND LUBRICANTS PUBLICATION

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NATO LETTER OF PROMULGATION

23 April 2019

1. The enclosed Allied Fuels and Lubricants Publication AFLP-3747, Edition C, Version 3, GUIDE SPECIFICATIONS (MINIMUM QUALITY STANDARDS) FOR AVIATION TURBINE FUELS (F-24, F-27, F-34, F-35, F-37, F-40 AND F-44) which has been approved by the nations in the Petroleum Committee, is promulgated herewith. The agreement of nations to use this publication is recorded in STANAG 3747.

2. AFLP-3747 Edition C, Version 3 is effective upon receipt and supersedes AFLP-3747, Edition C, Version 2, which shall be destroyed in accordance with the local procedure for the destruction of documents.

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Dieter Schmaglowski
Deputy Director NSO
Branch Head P&C

Zoltán GULYÁS
Brigadier General, HUNAF
Director, NATO Standardization Office

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RECORD OF RESERVATIONS

CHAPTER	RECORD OF RESERVATION BY NATIONS
Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.	

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RECORD OF SPECIFIC RESERVATIONS

[nation]	[detail of reservation]
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SECTION 1 GENERAL

0101. This Guide Specification represents the minimum quality standards acceptable under the appropriate NATO Code Numbers.

0102. Nation's specifications shall comply with the minimum requirements before being acceptable as standardized products under the appropriate NATO Code Number. The test methods shown in AFLP-3747 are for reference only. The fuel shall comply with the specified limiting values. The specified limiting values must not be changed. This precludes any allowance for the test method precision and significant figures.

0103. In order to promote product development, any nation's specifications may include additional tests or improved quality requirements to those listed in AFLP-3747. However, nations are not allowed to add additives to F-24, F-27, F-34, F-35, F-37, F-40, and F-44 unless approved in AFLP-3747.

0104. STANAG 1135/AFLP-1135, Section 4, lists under individual product descriptions, national specifications which have been agreed as interchangeable.

0105. The quality standards contained in this document are to be used by Member Nations (MNs) in the preparation and maintenance of their individual procurement specifications and standards. A MNs' individual procurement document may be more stringent depending upon its equipment. This document is not designed to be used in the direct procurement of products.

0106. Synthetic components meeting the requirements of ASTM D7566 (Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons) are allowed by several fuel specifications such as ASTM D1655, DEF STAN 91-091, MIL-DTL-5624, and MIL-DTL-83133, which characterize aviation turbine fuels defined by this publication. Before any fuel containing synthetic components may be delivered to a NATO aircraft it must first be ascertained that the appropriate clearance document(s) permitting its use have been obtained. Typically, clearances would be provided by the technical authority for the fuel in concert with the Original Equipment Manufacturers (OEM), weapon system manager, airworthiness authority and/or aircraft engineering officer.

0107. Fuels transported through multi-product pipelines, and other non-dedicated modes of transportation, may become incidentally contaminated with low levels of Fatty Acid Methyl Ester (FAME) from diesel fuel containing this material. Research conducted by the Energy Institute has led to ASTM International, the U.K. Ministry of Defence, some MNs, and OEM approval of up to 50 mg/kg (ppm by weight) of incidental FAME contamination in jet fuel with the intent to ultimately adopt a 100 mg/kg

limit. Meanwhile, incidental contamination up to 100 mg/kg FAME emergency use limits may be approved on a case by case basis by the appropriate authorities. Typically, clearances would be provided by the technical authority for the fuel in concert with the OEM, weapon system manager, airworthiness authority and/or aircraft engineering officer. FAME content can be determined by test methods ASTM D7797, IP 583, IP 585 (referee test method), IP 590, or IP 599. Joint Inspection Group (JIG) Bulletin No. 75 can be utilized to determine when FAME testing should be conducted. MNs are encouraged to address incidental FAME contamination in their jet fuel National specifications.

0108 Jet A-1 procured to ASTM D1655 and additized with the Military additive package (Lubricity Improving Additive (LIA)/Fuel System Icing Inhibitor (FSII)/Static Dissipater Additive (SDA)) should be considered technically equivalent to F-34. The difference in these fuels is that Jet A-1 may, or may not, contain Anti-Oxidants (AO). It is recommended that nations monitor hydroperoxide levels in Jet A-1 with LIA/FSII/SDA stored longer than 6 months (dormant storage). Hydroperoxides can form in fuels stored for long periods, and are capable of damaging the elastomers used in fuel systems. ASTM D3703 is an accepted method for measuring hydroperoxide levels. 16 mg/kg of hydroperoxide is considered the maximum limit for fuel based upon USA Naval research. If hydroperoxides are trending higher in a storage tank, an approved AO can be added to prevent additional hydroperoxide formation.

SECTION 2 NATO GUIDE SPECIFICATION FOR AVIATION TURBINE FUEL: NATO CODE No F-24

0201. Product complying with this Guide Specification shall consist of kerosene type turbine fuel conforming to ASTM D1655 (Standard Specification for Aviation Turbine Fuels), Type Jet A, containing the following additives: treated with 0.07-0.10% by volume S-1745 Fuel System Icing Inhibitor (FSII), S-1747 Lubricity Improving Additive (LIA) per STANAG 3390, and Static Dissipater Additive (SDA), Stadis 450 or AvGuard SDA, blended into the fuel in sufficient concentration to increase the conductivity of the fuel to between 50 and 600 pS/m at ambient temperature or 29°C whichever is lower, when tested in accordance with ASTM D2624. Stadis 450 is manufactured by Innospec Fuel Specialties LLC. AvGuard SDA is manufactured by Afton Chemical Corporation.

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SECTION 3 NATO GUIDE SPECIFICATION FOR AVIATION TURBINE FUEL: NATO CODE No F-27

0301. Product complying with this Guide Specification shall consist of kerosene type turbine fuel F-24 treated with 256 mL of S-1749 jet fuel thermal stability improver additive (+100 additive) per 1000 L of fuel (256 parts per million by volume (ppmv)).

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SECTION 4 NATO GUIDE SPECIFICATION FOR AVIATION TURBINE FUEL: NATO CODE No F-34

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
1	Appearance	Visual		Clear & bright at ambient temperature	In case of dispute and unless specified to the contrary, a maximum particulate contamination of 1.0 mg/L when tested to ASTM D2276, or ASTM D5452, or MIL-DTL-83133K Appendix A.
2	Total Acid Number	mg KOH/g	ASTM D3242	0.015 Max.	
3	Aromatics or Aromatics	% v/v % v/v	ASTM D1319 (Note 1) ASTM D6379	25.0 Max 26.5 Max	
4	Mercaptan Sulphur or Doctor Test	% m/m	ASTM D3227 ASTM D4952	0.003 Max. Negative	For routine purposes, Doctor Test may be performed in lieu of the Mercaptan Sulphur analysis. Doctor positive fuels must comply with Mercaptan Sulphur limit.

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
5	Sulphur, Total	% m/m	ASTM D129, D1266, D2622, D3120, D4294 (Note 1), or D5453, IP 336	0.30 Max.	The sulfur content detection range for ASTM D3120 is 3.0 mg/kg to 1000 mg/kg.
6	Distillation		ASTM D86		Use Group 4 test conditions. A condenser temperature of 0 °C to 5 °C should be used.
	Initial Boiling Point	°C		Report	
	10% Recovered	°C		205 Max.	
	20% Recovered	°C		Report	
	50% Recovered	°C		Report	
	90% Recovered	°C		Report	
	Final Boiling Point	°C		300 Max.	
	Residue	% v/v		1.5 Max.	
	Loss	% v/v		1.5 Max.	
7	Flash Point	°C	ASTM D56, D93 (Note 1), D3828, or IP 170	38 Min.	D56 may give results up to 1 °C below D93. D3828 may give results up to 1.7 °C below D93.
8	Density at 15°C	kg/m^3	ASTM D1298 or D4052 (Note 1)	775 - 840	

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
9	Freezing Point	°C	ASTM D2386 (Note 1)/IP 16, D5972/IP 435, D7153/IP 529, D7154/IP 528	-47 Max.	
10	Viscosity at -20°C	mm^2/s	ASTM D445	8.0 Max.	
11	Heating Value Net Heat of Combustion	MJ/kg	ASTM D3338, D4529 or D4809 (Note 1), or IP 12	42.8 Min.	
12	Smoke Point or Smoke Point & Naphthalenes	mm mm % v/v	ASTM D1322 ASTM D1322 ASTM D1840	25 Min. 19 Min. 3.0 Max.	
13	Copper Corrosion	Classification	ASTM D130	1 Max.	2 Hours at 100 °C
14	Thermal Stability @ 260°C Delta P Tube rating: One of the following requirements shall be met: (1) Annex A1 VTR Tube Deposit Rating Or (2) Annex A3 ETR or Annex A2 ITR, average deposit thickness over area of 2.5 mm^2	 mm Hg (kPa) Classification nm	 ASTM D3241 ASTM D3241 ASTM D3241	 25.0 (3.33) Max Less than 3 85 Max.	(Note 2) No Peacock or Abnormal Deposits.

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
15	Existent Gum	mg/100 mL	ASTM D381 or IP 540	7 Max	
16	Microseparometer (MSEP)		ASTM D3948	85 Min	If Static Dissipater Additive (SDA), Fuel System Icing Inhibitor (FSII), or Lubricity Improving Additive (LIA) is present singly at point of manufacture, a MSEP rating of 70 or better is consistent with 85 for untreated product. When SDA and LIA are present together, no meaningful MSEP rating can be obtained.
17	Lubricity Improver				Only additives approved under NATO Code S-1747 (as listed in AFLP - 3390) may be used. Section 5 to AFLP - 3390 documents a method for determining the concentration of a known lubricity improver in a fuel.

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
18	Antioxidant			As required by national specification	Approved antioxidant required if fuel has been hydroprocessed. See Section 1, paragraph 0108
19	Metal Deactivator			Max treat rate 5.7 mg/L	(Note 3)
20	Fuel System Icing Inhibitor	% v/v	ASTM D5006	0.07 – 0.15 (Note 4)	Shall conform to one of the specifications under NATO Code S-1745 (Note 5)
21	Electrical Conductivity at the Point, Time & Temperature of Delivery to the User	pS/m	ASTM D2624 (Note 1), D4308 or IP 274	50 – 600	Static Dissipater Additive (SDA) (Innospec Fuel Specialties LLC, Stadis 450 or Afton Chemical Corporation, AvGuard SDA) as limited by national specification (Note 6)

Note 1: In case of dispute, this is the referee method.

Note 2: Tube deposit failures by Ellipsometric Tube Rating (ETR) or Interferometric Tube Rating (ITR) shall be reported as “>85nm”. If the ITR reports “N/A” for the tube’s volume thickness, the result constitutes a failure and the result will be reported as “>85nm”. If test results by either ETR or ITR are reported then results by Annex A1 Visual Tube Rating (VTR) are not required. In case of dispute, ETR is the referee method.

Note 3: “A Metal Deactivator (MDA), NN’-disalicylidene 1,2 propane diamine, may be added to fuel to counteract the effects of metals known to be deleterious to thermal stability, such as Copper, Cadmium, Iron, Cobalt and Zinc, provided that the nature of the contamination is reported. MDA may

be added in amount not to exceed 2.0 mg/L (not including weight of solvent) on initial fuel manufacture at the refinery. Higher initial concentrations are permitted in circumstances where metallic contamination is suspected to occur during distribution. Cumulative concentration of MDA when re-treating the fuel shall not exceed 5.7 mg/L. The addition of MDA in aviation turbine fuel is only authorized by agreement between the supplier and the user."

Note 4: Recommended level of FSII for military aircraft is 0.10 – 0.15% vol. Approval by the technical authority is necessary for FSII below 0.10% vol.

Note 5: The recommended location for the injection of additives to convert F-35 into F-34 is upstream of a pump (or additive injector fluid drive motor) as fuel is being delivered into bulk storage tanks, forward operating base storage bladders, or refueling vehicles. This will ensure that the additives are adequately mixed into the base fuel. Refer to AFLP-7071 for technical details on additive injection equipment and the required additive treatment rates.

Note 6: The concentration of SDA to be used in newly manufactured, or on first doping of, fuel is 3.0 mg/L maximum. The cumulative concentration of SDA allowed when re-doping fuel to maintain conductivity is 5.0 mg/L maximum.

SECTION 5 NATO GUIDE SPECIFICATION FOR AVIATION TURBINE FUEL: NATO CODE No F-35

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
1	Appearance	Visual		Clear & bright at ambient temperature	In case of dispute and unless specified to the contrary, a maximum particulate contamination of 1.0 mg/L when tested to ASTM D2276, or ASTM D5452, or MIL-DTL-83133K Appendix A.
2	Total Acid Number	mg KOH/g	ASTM D3242	0.015 Max	
3	Aromatics or Aromatics	% v/v % v/v	ASTM D1319 (Note 1) ASTM D6379	25.0 Max 26.5 Max	
4	Mercaptan Sulphur or Doctor Test	% m/m	ASTM D3227 ASTM D4952	0.003 Max Negative	For routine purposes, Doctor Test may be performed in lieu of the Mercaptan Sulphur analysis. Doctor positive fuels must comply with Mercaptan Sulphur limit.

NATO CODE No F-35

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
5	Sulphur, Total	% m/m	ASTM D129, D1266, D2622, D3120, D4294 (Note 1), D5453, or IP 336	0.30 Max	The sulfur content detection range for ASTM D3120 is 3.0 mg/kg to 1000 mg/kg.
6	Distillation		ASTM D86		Use Group 4 test conditions. A condenser temperature of 0 °C to 5 °C should be used.
	Initial Boiling Point	°C		Report	
	10% Recovered	°C		205 Max	
	20% Recovered	°C		Report	
	50% Recovered	°C		Report	
	90% Recovered	°C		Report	
	Final Boiling Point	°C		300 Max	
	Residue	% v/v		1.5 Max	
	Loss	% v/v		1.5 Max	
7	Flash Point	°C	ASTM D56, D93 (Note 1), D3828, or IP 170	38 Min	D56 may give results up to 1°C below D93. D3828 may give results up to 1.7 °C below D93.

NATO CODE No F-35

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
8	Density at 15°C	kg/m^3	ASTM D1298 or D4052 (Note 1)	775 – 840	
9	Freezing Point	°C	ASTM D2386 (Note 1)/IP 16, D5972/IP 435, D7153/IP 529, D7154/IP 528	-47 Max	
10	Viscosity at -20°C	mm^2/s	ASTM D445	8.0 Max	
11	Heating Value Net Heat of Combustion	MJ/kg	ASTM D3338, D4529 or D4809 (Note 1) or IP 12	42.8 Min	
12	Smoke Point or Smoke Point & Naphthalenes	mm mm % v/v	ASTM D1322 ASTM D1322 ASTM D1840	25 Min 19 Min 3.0 Max	
13	Copper Corrosion	Classification	ASTM D130	1 Max	2 Hours at 100 °C

NATO CODE No F-35

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
14	Thermal Stability @ 260°C				(Note 2)
	Delta P	mm Hg (kPa)	ASTM D3241	25.0 (3.33) Max	
	Tube rating: One of the following requirements shall be met:				
	(1) Annex A1 VTR Tube Deposit Rating	Classification	ASTM D3241	Less than 3	No Peacock or Abnormal Deposits.
	Or				
	(2) Annex A3 ETR or Annex A2 ITR, average deposit thickness over area of 2.5 mm^2	nm	ASTM D3241	85 Max.	
15	Existent Gum	mg/100 mL	ASTM D381 or IP 540	7 Max	

NATO CODE No F-35

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
16	Microseparometer (MSEP)		ASTM D3948	85 Min	If SDA or LIA is present singly at point of manufacture, a MSEP rating of 70 or better is consistent with 85 for untreated product. When SDA and LIA are present together, no meaningful MSEP rating can be obtained.
17	Lubricity Improver				May be added at the discretion of the procuring agency. Only additives approved under NATO Code S-1747 (as listed in AFLP- 3390) may be used. Section 5 to AFLP - 3390 documents a method for determining the concentration of a known lubricity improver in a fuel.

NATO CODE No F-35

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
18	Antioxidant			As required by national specification	Approved antioxidant required if fuel has been hydro processed. See Section 1, paragraph 0108.
19	Metal Deactivator			Max treat rate 5.7 mg/L	(Note 3)
20	Electrical Conductivity at the Point, Time & Temperature of Delivery to the User	pS/m	ASTM D2624 (Note 1), D4308, or IP 274	50 – 600	SDA (Innospec Fuel Specialties LLC, Stadis 450 or Afton Chemical Corporation, AvGuard SDA) as limited by national specification (Note 4).

Note 1: In case of dispute, this is the referee method.

Note 2: Tube deposit failures by Ellipsometric Tube Rating (ETR) or Interferometric Tube Rating (ITR) shall be reported as “>85nm”. If the ITR reports “N/A” for the tube’s volume thickness, the result constitutes a failure and the result will be reported as “>85nm”. If test results by either ETR or ITR are reported then results by Annex A1 Visual Tube Rating (VTR) are not required. In case of dispute, ETR is the referee method.

Note 3: “A Metal Deactivator (MDA), NN’-disalicylidene 1,2 propane diamine, may be added to fuel to counteract the effects of metals known to be deleterious to thermal stability, such as Copper, Cadmium, Iron, Cobalt and Zinc, provided that the nature of the contamination is reported. MDA may be added in amount not to exceed 2.0 mg/L (not including weight of solvent) on initial fuel manufacture at the refinery. Higher initial concentrations are permitted in circumstances where metallic contamination is suspected to occur during distribution. Cumulative concentration of MDA when re-treating the fuel shall not exceed 5.7 mg/L. The addition of MDA in aviation turbine fuel is only authorized by agreement between the supplier and the user.”

Note 4: The concentration of SDA to be used in newly manufactured, or on first doping of, fuel is 3.0 mg/L maximum. The cumulative concentration of SDA allowed when re-doping fuel to maintain conductivity is 5.0 mg/L maximum.

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SECTION 6 NATO GUIDE SPECIFICATION FOR AVIATION TURBINE FUEL: NATO CODE No F-37

0601. Product complying with this Guide Specification shall consist of kerosene turbine fuel F-34 treated with 256 mL of S-1749 jet fuel thermal stability improver additive (+100) per 1000 L of fuel (256 ppmv).

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SECTION 7 NATO GUIDE SPECIFICATION FOR AVIATION TURBINE FUEL: NATO CODE No F-40

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
1	Appearance	Visual		Clear & bright at ambient temperature	In case of dispute and unless specified to the contrary, a maximum particulate contamination of 1.0 mg/L when tested to ASTM D2276, or ASTM D5452, or MIL-DTL-5624W Appendix A.
2	Total Acid Number	mg KOH/g	ASTM D3242	0.015 Max	
3	Aromatics or Aromatics	% v/v % v/v	ASTM D1319 (Note 1) ASTM D6379	25.0 Max 26.5 Max	
4	Mercaptan Sulphur or Doctor Test	% m/m	ASTM D3227 ASTM D4952	0.003 Max Negative	For routine purposes, Doctor Test may be performed in lieu of the Mercaptan Sulphur analysis. Doctor positive fuels must comply with Mercaptan Sulphur limit.

NATO CODE No F-40

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
5	Sulphur, Total	% m/m	ASTM D129, D1266, D2622, D3120, D4294 (Note 1), D5453, or IP 336	0.40 Max	The sulfur content detection range for ASTM D3120 is 3.0 mg/kg to 1000 mg/kg.
6	Distillation		ASTM D86		Use Group 3 test conditions.
	Initial Boiling Point	°C		Report	
	10% Recovered	°C		Report	
	20% Recovered	°C		145 Max	
	50% Recovered	°C		190 Max	
	90% Recovered	°C		245 Max	
	Final Boiling Point	°C		270 Max	
	Residue	% v/v		1.5 Max	
	Loss	% v/v		1.5 Max	
7	Vapour Pressure at 38°C	kPa	ASTM D323, D4953, or D5191	14 - 21	

NATO CODE No F-40

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
8	Density at 15°C	kg/m^3	ASTM D1298 or D4052 (Note 1)	751 - 802	
9	Freezing Point	°C	ASTM D2386 (Note 1)/IP 16, D5972, D7153, D7154, IP 528 or IP 529	-58 Max	
10	Heating Value Net Heat of Combustion	MJ/kg	ASTM D3338, D4529 or D4809 (Note 1)	42.8 Min	
11	Smoke Point or Smoke Point & Naphthalenes	mm mm % v/v	ASTM D1322 ASTM D1322 ASTM D1840	25 Min 20 Min 3 Max	
12	Copper Corrosion	Classification	ASTM D130	1 Max	2 Hours at 100 °C
13	Thermal Stability Delta P Tube Deposit Rating	 mm Hg (kPa) Classification	 ASTM D3241 ASTM D3241	 25.0 (3.33) Max Less than 3	 No Peacock or Abnormal Deposits.
14	Existent Gum	mg/100 mL	ASTM D381 or IP 540	7 Max	

NATO CODE No F-40

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
15	Microseparometer (MSEP)		ASTM D3948	85 Min	If SDA, FSII, or LIA is present singly at point of manufacture, a MSEP rating of 70 or better is consistent with 85 for untreated product. When SDA and LIA are present together, no meaningful MSEP rating can be obtained.
16	Lubricity Improver				Only additives approved under NATO Code S-1747 (as listed in AFLP - 3390) may be used. Section 5 to AFLP - 3390 documents a method for determining the concentration of a known lubricity improver in a fuel.

NATO CODE No F-40

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
17	Antioxidants			As required by national specification	Approved antioxidant required if fuel has been hydro processed. See Section 1, paragraph 0108.
18	Metal Deactivator			Max treat rate 5.7 mg/L	(Note 2)
19	Fuel System Icing Inhibitor	% v/v	ASTM D5006	0.10 – 0.15	Shall conform to one of the specifications under NATO Code S-1745.
20	Electrical Conductivity at the Point, Time & Temperature of Delivery to the User	pS/m	ASTM D2624 (Note 1), D4308, or IP 274	150 – 600	SDA (Innospec Fuel Specialties LLC, Stadis 450 or Afton Chemical Corporation, AvGuard SDA) as limited by national specifications. The minimum limit of 150 pS/m need not be mandatory at the time of procurement, providing nations can guarantee a conductivity minimum of 100 pS/m upon delivery to aircraft. (Note 3)

Note 1: In case of dispute, this is the referee method.

Note 2: “A Metal Deactivator (MDA), NN’-disalicylidene 1,2 propane diamine, may be added to fuel to counteract the effects of metals known to be deleterious to thermal stability, such as Copper, Cadmium, Iron, Cobalt and Zinc, provided that the nature of the contamination is reported. MDA may be added in amount not to exceed 2.0 mg/L (not including weight of solvent) on initial fuel manufacture at the refinery. Higher initial concentrations are permitted in circumstances where metallic contamination is suspected to occur during distribution. Cumulative concentration of MDA when re-treating the fuel shall not exceed 5.7 mg/L. The addition of MDA in aviation turbine fuel is only authorized by agreement between the supplier and the user.” It is commonly known that on-specification fuel stored on board dedicated ship tanks may fail thermal oxidative stability testing after being exposed to metallic species such as copper, at which point, the fuel can be treated with MDA to satisfy airworthiness authorities.

Note 3: The concentration of SDA to be used in newly manufactured, or on first doping of, fuel is 3.0 mg/L maximum. The cumulative concentration of SDA allowed when re-doping fuel to maintain conductivity is 5.0 mg/L maximum.

SECTION 8 NATO GUIDE SPECIFICATION FOR AVIATION TURBINE FUEL: NATO CODE No F-44

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
1	Appearance	Visual		Clear & bright at ambient temperature	In case of dispute and unless specified to the contrary, a maximum particulate contamination of 1.0 mg/L when tested to ASTM D2276, or ASTM D5452, or MIL-DTL-5624W Appendix A.
2	Total Acid Number	mg KOH/g	ASTM D3242	0.015 Max	
3	Aromatics or Aromatics	% v/v % v/v	ASTM D1319 (Note 1) ASTM D6379	25.0 Max 26.5 Max	
4	Mercaptan Sulphur or Doctor Test	% m/m	ASTM D3227 ASTM D4952	0.003 Max Negative	For routine purposes, Doctor Test may be performed in lieu of the Mercaptan Sulphur analysis. Doctor positive fuels must comply with Mercaptan Sulphur limit.

NATO CODE No F-44

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
5	Sulphur, Total	% m/m	ASTM D129, D1266, D2622, D3120, D4294 (Note 1), D5453, or IP 336	0.30 Max	The sulfur content detection range for ASTM D3120 is 3.0 mg/kg to 1000 mg/kg.
6	Distillation		ASTM D86		Use Group 4 test conditions. A condenser temperature of 0 °C to 5 °C should be used.
	Initial Boiling Point	°C		Report	
	10% Recovered	°C		205 Max	
	20% Recovered	°C		Report	
	50% Recovered	°C		Report	
	90% Recovered	°C		Report	
	Final Boiling Point	°C		300 Max	
	Residue	% v/v		1.5 Max	
	Loss	% v/v		1.5 Max	
7	Flash Point	°C	ASTM D56, D93 (Note 1) or D3828	60 Min	D56 may give results up to 1 °C below D93. D3828 may give results up to 1.7 °C below D93.

NATO CODE No F-44

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
8	Density at 15°C	kg/m^3	ASTM D1298 or D4052 (Note 1)	788 – 845	
9	Freezing Point	°C	ASTM D2386 (Note 1)/IP 16, D5972, D7153, D7154, IP 528, or IP 529	-46 Max	
10	Viscosity at -20°C	mm^2/s	ASTM D445	8.5 Max	
11	Heating Value Net Heat of Combustion	MJ/kg	ASTM D3338, D4529, or D4809 (Note 1)	42.6 Min	
12	Smoke Point	mm	ASTM D1322	19 Min	
13	Copper Corrosion	Classification	ASTM D130	1 Max	2 Hours at 100 °C

NATO CODE No F-44

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
14	Thermal Stability @ 260°C				(Note 2)
	Delta P	mm Hg (kPa)	ASTM D3241	25.0 (3.33) Max	
	Tube rating: One of the following requirements shall be met:				
	(1) Annex A1 VTR Tube Deposit Rating	Classification	ASTM D3241	Less than 3	No Peacock or Abnormal Deposits.
	Or				
	(2) Annex A3 ETR or Annex A2 ITR, average deposit thickness over area of 2.5 mm^2	nm	ASTM D3241	85 Max.	
15	Existent Gum	mg/100 mL	ASTM D381 or IP 540	7 Max	

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No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
16	Microseparometer (MSEP)		ASTM D3948	85 Min	If SDA, FSII, or LIA is present singly at point of manufacture, a MSEP rating of 70 or better is consistent with 85 for untreated product. When SDA and LIA are present together, no meaningful MSEP rating can be obtained.
17	Lubricity Improver				Only additives approved under NATO Code S-1747 (as listed in AFLP-3390) may be used. Section 5 to AFLP-3390 documents a method for determining the concentration of a known lubricity improver in a fuel.

No	REQUIREMENT	UNIT OF MEASURE	TEST METHODS	LIMITS	NOTES
18	Antioxidants			As required by national specification	Approved antioxidant required if fuel has been hydro processed. See Section 1, paragraph 0108
19	Metal Deactivator			Max treat rate 5.7 mg/L	(Note 3), (Note 4)
20	Fuel System Icing Inhibitor	% v/v	ASTM D5006	0.08 – 0.15 (Note 5)	Shall conform to one of the specifications under NATO Code S-1745.
21	Electrical Conductivity at the Point, Time & Temperature of Delivery to the User				(Note 6)

Note 1: In case of dispute, this is the referee method.

Note 2: Tube deposit failures by Ellipsometric Tube Rating (ETR) or Interferometric Tube Rating (ITR) shall be reported as “>85nm”. If the ITR reports “N/A” for the tube’s volume thickness, the result constitutes a failure and the result will be reported as “>85nm”. If test results by either ETR or ITR are reported then results by Annex A1 Visual Tube Rating (VTR) are not required. In case of dispute, ETR is the referee method.

Note 3: “A Metal Deactivator (MDA), NN’-disalicylidene 1,2 propane diamine, may be added to fuel to counteract the effects of metals known to be deleterious to thermal stability, such as Copper, Cadmium, Iron, Cobalt and Zinc, provided that the nature of the contamination is reported. MDA may be added in amount not to exceed 2.0 mg/L (not including weight of solvent) on initial fuel manufacture at the refinery. Higher initial concentrations are permitted in circumstances where metallic contamination is suspected to occur during distribution. Cumulative concentration of MDA when re-treating the fuel shall not exceed 5.7 mg/L. The addition of MDA in aviation turbine fuel is only authorized by agreement between the supplier and the user.”

Note 4: It is commonly known that on-specification fuel stored on board dedicated ship tanks may fail the Thermal Stability test after being exposed to metallic species such as copper, at which point, the fuel can be treated with MDA to satisfy airworthiness authorities.

Note 5: Recommended level of FSII for military aircraft is 0.10 – 0.15% vol. Approval by the technical authority is necessary for FSII below 0.10% vol.

Note 6: The F-44 requirement for Electrical Conductivity has been removed because most of the National Specifications do not require it. Most National Specifications for F-44 do not allow the addition of Static Dissipater Additive (SDA) so Member Nations permitting SDA in their F-44 should note that on their Ratification response.

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