NATO STANDARD

AFLP-1385

GUIDE SPECIFICATION (MINIMUM QUALITY STANDARDS) FOR NAVAL DISTILLATE FUELS (F-75 AND F-76)

Edition C Version1
AUGUST 2020

NORTH ATLANTIC TREATY ORGANIZATION

ALLIED FUELS AND LUBRICANTS PUBLICATION

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NORTH ATLANTIC TREATY ORGANIZATION (NATO)

NATO STANDARDIZATION OFFICE (NSO)

NATO LETTER OF PROMULGATION

25 August 2020

1. The enclosed Allied Fuels and Lubricants Publication AFLP-1385, Edition C, Version 1, GUIDE SPECIFICATION (MINIMUM QUALITY STANDARDS) FOR NAVAL DISTILLATE FUELS (F-75 AND F-76), 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 1385.

2. AFLP-1385, Edition C, Version 1, is effective upon receipt and supersedes AFLP-1385 , Edition B, Version 1 which shall be destroyed in accordance with the local procedure for the destruction of documents.

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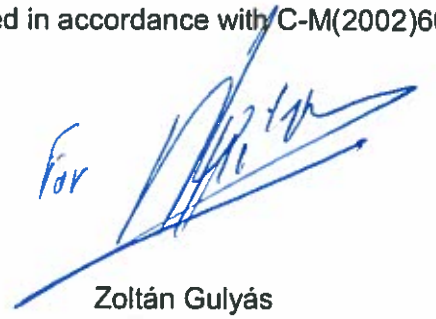
4. This publication shall be handled in accordance with C-M(2002)60.



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]
BEL	The Belgian specification BN PF 71I authorizes the use of Synthesized Paraffinic Diesel (SPD) and Hydro processed Renewable Diesel (HRD) as synthetic fuels, both up to 50% v/v. Synthesized iso pararaffins (SIP) are not included yet in BN PF 71.
FRA	France: - Does not deliver F-75 as prescribed by ALP-1385(C)(1), section 2; - Does not allow the use of synthetic fuels derived from biomass in F-76 as prescribed by AFLP-1385(C)(1), paragraphs 0106, 0107, 0108 and section 3; - Prohibits the use of additives in F-76 as stated in ALP-1385(C)(1), section 3; - Sets a minimal limit of 815 kg/m^3 for density at 15 °C of F-76 in accordance with the ISO 3675 method rather than according to ALP-1385(C)(1), section 3, point 2: Density.
GBR	Regarding ship stability, additional considerations may be required for the loading of fuels with densities below 820 kg/m3
GRC	a. F-76 composition exclusively from crude oil. Synthetic components not permitted (Content of Synthetic components: 0% v/v). b. Limits for Ser. 11 (Sulphur content) of Section 3: 0.05-0.1 % m/m. c. Ser. 16 (Storage Stability) of Section 3: Hellenic Navy accepts as alternative testing method for storage stability, (according to MIL-F-16884), the standard test method ASTM D 2274 for F-76. Requirements limit for total insoluble is 1.5 mg/100ml.
PRT	Portuguese Armed Forces does not have the capability to verify all requisites and specifications required by this STANAG, namely, what is written on the section 2.
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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SECTION 1 GENERAL

0101. It is agreed that nations' specifications shall comply with these minimum requirements before the subjects of these specifications are accepted as standardized products under NATO Code Numbers F-75 or F-76.

0102. It is agreed that in order to promote product development, any nation's specifications may include additional tests or improved quality requirements to those in the guide specification.

0103. It is agreed that this guide specification shall be subject to review with the object of improving product quality as required by operational use.

0104. AFLP-1135 lists under NATO Code Numbers F-75 and F-76, 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. The finished fuel described in this document may contain synthesized components, which shall conform to the requirements in either Section 4A or 4B.

0107. Finished fuel containing synthesized components shall conform to the properties listed in Section 3.

0108. Before any fuel containing synthetic components may be delivered to a nation, it must first be ascertained that the appropriate clearance document(s), permitting its use, have been obtained. Typically, clearances would be provided by the national technical authority for the fuel, in communication with e.g. the Original Equipment Manufacturer (OEM) and/or ship engineering officer.

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SECTION 2 NATO GUIDE SPECIFICATION FOR NAVAL DISTILLATE FUEL NATO CODE F-75

COMPOSITION F-75: Exclusive base materials Additives	 Distillate from crude oil. Approved additives, type and concentration shall be declared.

SER	PROPERTY	UNIT	METHOD(1)	LIMIT
1.	Appearance		Visual Examination or ASTM D4176	Clear and bright, free from impurities and separated water at temperatures between 10 °C and 25 °C
2.	Density at 15 °C	kg/m³	ISO 3675	815.0-880.0
3.	Colour	-	ISO 2049	Max. 3.5
4.	Ash content	% m/m	ISO 6245	Max. 0.010
5.	Carbon residue:			
5.1	Carbon residue, Ramsbottom (on 10% distillation residues)	% m/m	ISO 4262	Max. 0.2
	or 5.2			
5.2	Carbon residue, Conradson	% m/m	ISO 10370	Max. 0.16
6.	Copper corrosion (3hr at 100 °C)	class	ISO 2160	Max. 1
7.	Cloud point	° C	ISO 3015	Max. -12
8.	Pour point	° C	ISO 3016	Max. -18
9.	Flash point, closed cup	° C	ISO 2719	Min. 60
10.	Ignition quality (2):			
10.1	Cetane number	-	ISO 5165	Min. 40
	or 10.2			
10.2	Cetane index	-	ASTM D976	Min. 43
11.	Sulphur content (3)	% m/m	ISO 8754 or ISO 14596 or ASTM D4294 or ASTM D5453(4)	Max. 0.50
12.	Distillation:		ISO 3405	
12.1	5% recovered	°C		Report
12.2	10% recovered	°C		Report
12.3	50% recovered	°C		Report
12.4	90% recovered	°C		Max. 357
12.5	Final Boiling Point	°C		Max. 385
12.6	Residue plus loss at FBP	% v/v		Max. 3
13.	Viscosity, kinematic (40 °C)	mm²/s	ISO 3104	1.700 – 4.300
14.	Neutralisation:			
14.1	Acid number	mg KOH/g	ISO 6618	Max. 0.5
14.2	Inorganic acidity	mg KOH/g	IP 182	Nil
15.	Water and sediment by centrifuge(5)	% v/v	ISO 3734	Max. 0.05
16.	Storage stability:			
16.1	Oxidation stability of middle-distillate fuels	g/m³	ISO 12205	Max. 15
	or 16.2			
16.2	Distillate Fuel Storage Stability at 43°C (110°F)	mg/100 ml	IP 378 ASTM D4625	Max. 1.0

F-75

SER	PROPERTY	UNIT	METHOD(1)	LIMIT
17.	Water separation:			
17.1	Demulsibility or 17.2	minutes	ISO 6614	Max. 10
17.2	Water reaction	ml	Def.Stan 91-4 Annex A	Max. 2.0
18.	Lubricity(6): Wear scar diameter	µm	ISO 12156-1	Max 520
19.1	Particulate contamination or 19.2	mg/l	ASTM D6217 or ASTM D5452	Max. 15
19.2	Filter Blocking TendencyTest (7)	ml	IP 387 procedure A ASTM D2068	Min. 150
20.	FAME(8) content	% v/v	EN 14078 or ASTM D7963	Max. 0.10

NOTES:

1. Where possible, an international standard test method is listed for the specified fuel properties. A national standard test method may also be listed, but in all cases, each nation is free to use their own equivalent national test method.
2. The Ignition Quality limits are based on F-75 fuel not containing cetane improvers.
3. National/regional sulphur content limits may apply. NATO navies prefer to use fuel of lower sulphur content, but due to operational necessity this may not always be the case.
4. Test method ISO 14596 is recommended for the sulphur content range below 0.2 % m/m, ISO 8754 for the sulphur content range 0.2 % m/m to 1.0 % m/m. ASTM D4294 is recommended for the sulphur content range 0.015 to 1.00 % m/m, ASTM D5453 is recommended for the sulphur content range 0.0001 to 0.015 % m/m. The following other test methods may be used: ASTM D1552, depending on the sulphur content range.
5. This test should only apply if the fuel (sample) is not clear and bright.
6. The Lubricity requirement only applies if the sulphur content is equal or less than 500 mg/kg (0.05% m/m).
7. The Particulate Contamination test and the Filter Blocking Tendency test are separate tests of which the results do not correlate. Each nation specifies the test to be used in the national specification(s). For the Filter Blocking Tendency test both procedures A and B are permitted.
8. Deliberate blending of FAME into F-75 is not allowed. However, some F-75 may contain FAME as a result of cross contamination in refinery processes or transport vectors with distillate stocks containing FAME.

SECTION 3 NATO GUIDE SPECIFICATION FOR NAVAL DISTILLATE FUEL NATO CODE F-76

COMPOSITION F-76:	
Exclusive base materials	Distillate from crude oil or from blends of hydrocarbon distillates derived from crude oil and approved(2) synthetic fuel.
Content of synthetic components	Max. 50% v/v Synthesized Paraffinic Diesel(3) (SPD) derived from Fischer-Tropsch (FT) (4) or Hydro processed Renewable Diesel (HRD)(5) methods AND remainder: distillate derived from crude oil. or: Max. 20% v/v Synthesized Iso-Paraffins (6) derived from hydroprocessed fermented sugars AND remainder: distillate derived from crude oil.
Additives	Approved additives, type and concentration shall be declared.

SER	PROPERTY	UNIT	METHOD(1)	LIMIT
1.	Appearance		Visual Examination or ASTM D4176	Clear and bright, free from impurities and separated water at temperatures between 10 and 25 °C
2.	Density at 15 °C	kg/m³	ISO 3675	800.0-880.0
3.	Colour	-	ISO 2049	Max. 3.5
4.	Ash content	% m/m	ISO 6245	Max. 0.010
5.	Carbon residue:			
5.1	Carbon residue, Ramsbottom (on 10% distillation residues) or 5.2	% m/m	ISO 4262	Max. 0.2
5.2	Carbon residue, Conradson	% m/m	ISO 10370	Max. 0.16
6.	Copper corrosion (3hr at 100°C)	class	ISO 2160	Max. 1
7.	Cloud point	° C	ISO 3015	Max. -1
8.	Pour point	° C	ISO 3016	Max. -6
9.	Flash point, closed cup	° C	ISO 2719	Min. 60
10.	Ignition quality (7):			
10.1	Cetane number or 10.2	-	ISO 5165	Min. 40
10.2	Cetane index	-	ASTM D976	Min. 43
11.	Sulphur content (8)	% m/m	ISO 8754 or ISO 14596 or ASTM D4294 or ASTM D5453(9)	Max. 0.50
12.	Distillation:		ISO 3405	
12.1	10% recovered	°C		Report
12.2	50% recovered	°C		Report
12.3	90% recovered	°C		Max. 357
12.4	Final Boiling Point	°C		Max. 385
12.5	Residue plus loss at FBP	% v/v		Max. 3
13.	Viscosity, kinematic (40 ° C)	mm²/s	ISO 3104	1.700 – 4.300
14.	Neutralisation:			
14.1	Acid number	mg KOH/g	ISO 6618	Max. 0.5
14.2	Inorganic acidity or 14.3	mg KOH/g	IP 182	Nil
14.3	Neutrality	mg KOH/g	ASTM D1093	Neutral
15.	Water and sediment by centrifuge(10)	% v/v	ISO 3734	Max. 0.05

F-76

SER	PROPERTY	UNIT	METHOD(1)	LIMIT
16.	Storage stability:			
16.1	Oxidation stability of middle-distillate fuels	g/m^3	ISO 12205	Max. 25
	or 16.2			
16.2	Distillate Fuel Storage Stability at 43°C (110°F)	mg/100 ml	IP 378/ASTM D4625	Max. 1.0
17.	Water separation:			
17.1	Demulsibility	minutes	ISO 6614	Max. 10
	or 17.2			
17.2	Water reaction	ml	Def.Stan. 91-4 Annex A	Max. 2.0
18.	Lubricity:			
	Wear scar diameter(11)	µm	ISO 12156-1	Max 520
19.1	Particulate contamination	mg/l	ASTM D6217 or ASTM D5452	Max. 15
	or 19.2			
19.2	Filter Blocking TendencyTest (12)	ml	IP 387 procedure A ASTM D2068	Min. 150
20.	Aromatics(13)	% m/m	D6591, D2425	Min. 8.1
21.	FAME(14) content	% v/v	EN 14078 or ASTM D7963	Max. 0.10

NOTES:

1. Where possible, an international standard test method is listed for the specified fuel properties. A national standard test method may also be listed, but in all cases, each nation is free to use their own equivalent national test method.
2. Approved synthetic fuels derived from:
   - Hydro processing of animal fat, plant oil or algal oil triglycerides (esters and fatty acids) or
   - Synthesis gas using the Fisher-Tropsch (FT) process or
   - Synthesized iso-paraffins made from fermentable sugars

   within approved concentration limits as set in national specifications.
3. Synthetic diesel fuel, derived from biomass, coal or natural gas, which has similar characteristics to mineral based diesel fuel.
4. A catalysed chemical reaction in which synthesis gas, a mixture of carbon monoxide and hydrogen, is converted into liquid hydrocarbons of various forms.
5. Fuel produced from mono-, di- and triglycerides, free fatty acids and fatty acid esters from plant, algae oils or animal fats that have been hydroprocessed to remove essentially all oxygen
6. Synthesized Iso-paraffins (farnesane) are produced by fermentation of sugars (farnesene), and sequentially hydro processing and fractionation to farnesane.
7. The Ignition Quality limits are based on F-76 fuel not containing cetane improvers.
8. National/regional sulphur content limits may apply. NATO navies prefer to use fuel of lower sulphur content, but due to operational necessity this may not always the case
9. Test method ISO 14596 is recommended for the sulphur content range below 0.2 % m/m, ISO 8754 for the sulphur content range 0.2 % m/m to 1.0 % m/m. ASTM D4294 is recommended for the sulphur content range 0.015 to 1.00 % m/m, ASTM D5453 is recommended for the sulphur content range 0.0001 to 0.015 % m/m. The following other test methods may be used: ASTM D1552, depending on the sulphur content range
10. This test should only apply if the fuel (sample) is not clear and bright
11. The Lubricity requirement only applies if the sulphur content is equal or less than 500 mg/kg (0.05% m/m).
12. The Particulate Contamination test and the Filter Blocking Tendency test are separate tests of which the results do not correlate. Each nation specifies the test to be used in the national specification(s). For the Filter Blocking Tendency test both procedures A and B are permitted.
13. The test should apply if the F-76 contains synthetic components (the minimum aromatic content is needed for fuel system seal swell).
14. Deliberate blending of FAME into F-76 is not allowed. However, some F-76 may contain FAME as a result of cross contamination in refinery processes or transport vectors with distillate stocks containing FAME

SECTION 4A REQUIREMENTS SYNTHESIZED PARAFFINIC DIESEL (SPD)

COMPOSITION SPD:	
Exclusive base materials	Approved [2] synthetic fuel derived from biomass, coal or natural gas.
Manufacture	Synthesized Paraffinic Diesel[3] (SPD) derived from Fischer-Tropsch (FT)[4] or Hydro processed Renewable Diesel (HRD)[5] methods.
Additives	Approved additives, type and concentration shall be declared.
Antioxidants	Concentration: 17.2-24.0 mg/L[6]

SER	PROPERTY	UNIT	METHOD[1]	LIMIT
1.	Appearance		Visual Examination or ASTM D4176	Clear and bright, free from impurities and separated water at temperatures between 10 and 25 °C
2.	Density at 15 °C	kg/m³	ISO 3675	770-805
3.	Carbon residue:			
3.1	Carbon residue, Ramsbottom (on 10% distillation residues)	% m/m	ISO 4262	Max. 0.20
	or 3.2	% m/m	ISO 6615	Max. 0.14
3.2	Carbon residue, Conradson			
4.	Copper corrosion (3hr at 100°C)	class	ISO 2160	Max. no. 1
5.	Cloud point	°C	ISO 3015	Max. -1
6.	Flash point, closed cup	°C	ISO 2719	Min. 60.0
7.	Derived Cetane Number	-	ASTM D6890, ASTM D7170	42-80
8.	Sulphur content	mg/kg	ASTM D5453[7] or ASTM D2622	Max. 15
9.	Distillation:		ISO 3405	
9.1	10% recovered	°C		191-290
9.2	50% recovered	°C		Report
9.3	90% recovered	°C		290-357
9.4	Final Boiling Point	°C		300-385
9.5	T90-T10	°C		Min. 20
9.6	Residue plus loss at FBP	% v/v		Max. 3.0
10.	Viscosity, kinematic (40 °C)	mm²/s	ISO 3104	1.700 – 4.300
11.	Neutralisation:			
11.1	Acid number	mg KOH/g	ISO 6618	Max. 0.08
11.2	Inorganic acidity or 11.3	mg KOH/g	IP 182	Nil
11.3	Neutrality	mg KOH/g	ASTM D1093	Neutral
12.	Water separation characteristics [8]	-	ASTM D7261	Min. 85
13.	Particulate contamination	mg/l	ASTM D6217 or ASTM D5452	Report
14.	Aromatics	%m/m	ISO 12916, ASTM D2425	Max. 0.5
15.	Heat of Combustion	MJ/kg	ASTM D4809	Min. 43.5
16.	Hydrogen Content	% m/m	ASTM D7171, ASTM D4808, ASTM D5291	Min. 14.5

SYNTHESIZED PARAFFINIC DIESEL

SER	PROPERTY	UNIT	METHOD[1]	LIMIT
17. 17.1 17.2	Thermal Stability: Change in Pressure Drop Tube rating: One of the following requirements shall be met [10] :	mm Hg	ASTM D3241[9]	Max. 25
17.2.1	Visual Tube Rating or 17.2.2		Annex A1 (ASTM D3241)	Max. 3 No peacock or abnormal color deposits
17.2.2	Interferometric Rating or Ellipsometric Rating	nm average over area of 2.5 mm^2	Annex A2/A3 (ASTM D3241)	Max. 85
18.	Total Water	mg/kg	ASTM D6304	Max. 100
19.	Metals (Al, Ca, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, P, Pb, Pd, Pt, Sn, Sr, Ti, V, Zn)	mg/kg	ASTM D7111	Max. 0.1 for each element

NOTES:

1. Where possible, an international standard test method is listed for the specified fuel properties. A national standard test method may also be listed, but in all cases, each nation is free to use their own equivalent national test method.
2. Approved synthetic fuels: derived from hydro processing of animal fat, plant oil or algal oil triglycerides (esters and fatty acids) or from synthesis gas using the Fisher-Tropsch (FT) process within approved concentration limits as set in national specifications. Any synthetic blend components must be tested to and certified to existing national standards.
3. Synthetic diesel fuel, derived from biomass, coal or natural gas, which has similar characteristics to mineral based diesel fuel.
4. A catalysed chemical reaction in which synthesis gas, a mixture of carbon monoxide and hydrogen, is converted into liquid hydrocarbons of various forms.
5. Fuel produced from mono-, di- and triglycerides, free fatty acids and fatty acid esters from plant, algae oils or animal fats that have been hydroprocessed to remove essentially all oxygen.
6. Antioxidant shall be added as soon as practicable after hydroprocessing or fractionation synthesizing and prior to the product or component being passed into storage to prevent peroxidation and gum formation after manufacture. Not less than 17.2 mg/L or more than 24.0 mg/L of active ingredient shall be used. The following antioxidant formulations are approved:
   a. 2,6-di-tert-butyl-4-methylphenol.
   b. 6-tert-butyl-2,4-dimethylphenol.
   c. 2,6-di-tert-butylphenol.
   d. 75 percent minimum 2,6-di-tert-butylphenol and;
      25 percent maximum tert-butylphenols and tri-tert-butylphenols.
   e. 72 percent minimum 6-tert-butyl-2,4-dimethylphenol and;
      28 percent maximum tert-butyl-methylphenols and tert-butyl-dimethylphenols.
   f. 55 percent minimum 2,4-dimethyl-6-tert-butylphenol and;
      15 percent minimum 2,6-di-tert-butyl-4-methylphenol and;
      30 percent maximum mixed methyl and dimethyl tert-butylphenols
7. ASTM D5453 is recommended for the sulphur content range 0.0001 to 0.015 % m/m. ASTM D2622 is recommended for the sulphur content range 3 mg/kg to 4,6 % m/m.
8. At point of Manufacture.
9. Test performed at 325°C.
10. Tube deposit ratings shall be measured by Interferometric Rating or Ellipsometric Rating, when available. If the Interferometric Rating reports “N/A” for a tube’s volume measurement, the test shall be a failure and the value reported as >85 nm. Visual rating of the heater tube by the method in D3241 Annex A1 is not required when Annex A2 or Annex A3 deposit thickness measurements are reported. In case of dispute between results from visual and metrological methods, the referee shall be considered the Annex A3 method if available, otherwise Annex A2

SECTION 4B REQUIREMENTS SYNTHESIZED ISO-PARAFFINS

COMPOSITION SIP:	
Exclusive base materials	Farnesene produced from fermentable sugars[2].
Manufacture	Synthesized iso-paraffins are produced by fermentation, hydro processing and fractionation of the base materials [3].
Additives	Approved additives, type and concentration shall be declared.
Antioxidants	Concentration: 17.2-24.0 mg/L[4]

SER	PROPERTY	UNIT	METHOD[1]	LIMIT
1.	Appearance		Visual Examination or ASTM D4176	Clear and bright, free from impurities and separated water at temperatures between 10 and 25 °C
2.	Density at 15 °C	kg/m³	ISO 3675	765-780
3.	Cloud point	°C	ISO 3015	Max. -70
4.	Flash point, closed cup	°C	ISO 2719	Min. 100.0
5.	Derived Cetane Number	-	ASTM D6890, ASTM D7170	42-80
6.	Sulphur content	mg/kg	ASTM D5453[5] or ASTM D2622	Max. 2
7.	Distillation:		ISO 3405	
7.1	10% recovered	°C		250
7.2	50% recovered	°C		Report
7.3	90% recovered	°C		Report
7.4	Final Boiling Point	°C		255
7.5	T90-T10	°C		Max. 5.0
	Residue plus loss at FBP	% v/v		Max. 3.0
8.	Neutralisation:			
8.1	Acid number	mg KOH/g	ISO 6618	Max. 0.015
8.2	Inorganic acidity or 8.3	mg KOH/g	IP 182	Nil
8.3	Neutrality	mg KOH/g	ASTM D1093	Neutral
9.	Heat of Combustion	MJ/kg	ASTM D4809	Min. 43.5
10.	Water separation characteristics [6]	-	ASTM D7261	Min. 85
11.	Particulate contamination	mg/l	ASTM D6217 or ASTM D5452	Max. 1.0
12.	Total Water	mg/kg	ASTM D6304	Max. 75
13.	Thermal Stability:			
13.1	Change in Pressure Drop	mm Hg	ASTM D3241[7]	Max. 25
13.2	Tube rating: One of the following requirements shall be met [8] :			
13.2.1	Visual Tube Rating or 13.2.2		Annex A1 (ASTM D3241)	Max. 3 (No peacock or abnormal color deposits)
13.2.2	Interferometric Rating or Ellipsometric Rating	nm average over area of 2.5 mm2	Annex A2/A3 (ASTM D3241)	Max. 85
14.	Aromatics	%m/m	ISO 12916, ASTM D2425	Max. 0.5

SYNTHESIZED ISO-PARAFFINS

SER	PROPERTY	UNIT	METHOD(1)	LIMIT
15.	Bromine number	mg Br2/100g	ASTM D2710	Max. 300
16.	Hexahydrofarnesol	%m/m	ASTM D7974	Max. 1.5
17.	Farnesane	%m/m	ASTM D7974	Min. 97
18.	Metals (Al, Ca, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, P, Pb, Pd, Pt, Sn, Sr, Ti, V, Zn)	mg/kg	ASTM D7111	Max. 0.1 for each element

NOTES:

1. Where possible, an international standard test method is listed for the specified fuel properties. A national standard test method may also be listed, but in all cases, each nation is free to use their own equivalent national test method.
2. Synthetic iso-paraffins (farnasene) are manufactured from fermented sugars derived from lignocellolosic biomass or sugarcane.
3. Farnesene is produced through fermentation of sugars by a special yeast. Target genes are selected to change the yeast's metabolism, converting the yeast from an ethanol-producing organism into a hydro-carbon producing organism. The unsaturated Farnesene will be hydroprocessed which will result in the saturated Farnesane.
4. Antioxidant shall be added as soon as practicable after hydroprocessing or fractionation synthesizing and prior to the product or component being passed into storage to prevent peroxidation and gum formation after manufacture. Not less than 17.2 mg/L or more than 24.0 mg/L of active ingredient shall be used. The following antioxidant formulations are approved:
   a. 2,6-di-tert-butyl-4-methylphenol.
   b. 6-tert-butyl-2,4-dimethylphenol.
   c. 2,6-di-tert-butylphenol.
   d. 75 percent minimum 2,6-di-tert-butylphenol and;
      25 percent maximum tert-butylphenols and tri-tert-butylphenols.
   e. 72 percent minimum 6-tert-butyl-2,4-dimethylphenol and;
      28 percent maximum tert-butyl-methylphenols and tert-butyl-dimethylphenols.
   f. 55 percent minimum 2,4-dimethyl-6-tert-butylphenol and;
      15 percent minimum 2,6-di-tert-butyl-4-methylphenol and;
      30 percent maximum mixed methyl and dimethyl tert-butylphenols
5. ASTM D5453 is recommended for the sulphur content range 0.0001 to 0.015 % m/m. ASTM D2622 is recommended for the sulphur content range 3 mg/kg to 4,6 % m/m.
6. At point of Manufacture.
7. Test performed at 325°C.
8. Tube deposit ratings shall be measured by Interferometric Rating or Ellipsometric Rating, when available. If the Interferometric Rating reports "N/A" for a tube's volume measurement, the test shall be a failure and the value reported as >85 nm. Visual rating of the heater tube by the method in D3241 Annex A1 is not required when Annex A2 or Annex A3 deposit thickness measurements are reported. In case of dispute between results from visual and metrological methods, the referee shall be considered the Annex A3 method if available, otherwise Annex A2

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