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# FUEL SELECTION STEYR-MOTORS MARINE ENGINES

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## Introduction

This document will give you an overview of the fuels released to be used in Steyr-Motors for Marine applications as well as operational requirements.

STEYR MOTORS M1 MARINE ENGINES are developed to meet the specified power, emissions and fuel consumption only with Diesel fuel according to **EN590**.
For any other fuel, restrictions in operational performance and restrictions of emission must be considered and accepted.

To achieve the specified engine power output when using fuel with different density then in the Diesel EN590 specification, Steyr-Motors developed a Fuel Density Compensation Kit.

For best performance and trouble-free engine operation, Steyr-Motors recommends that an adequately sized fuel filter system with water separator and including a water in fuel sensor is installed.
Furthermore, it is a basic requirement that the installed fuel system on the vessel meet´s the Steyr-Motors specification, please refer to the Installation Manual.

Under the „special requirements“ (labeled in each fuel type description) you can find information about the influences and requirements regarding engine-operation.

**Please NOTE:**

- Every fuel used must comply with the corresponding, released specification and the special, minimum requirements from Steyr-Motors
  (labeled with *)
- It is the responsibility of the fuel supplier to ensure, that the fuel can be used at the expected given geographical and other local conditions such as minimum temperatures, so that correct engine operation is guaranteed!
- An engine operation with low fuel quality can cause damage or functional disorders!
- Fuels with higher contamination, viscosity or lower lubricity (>460µm HFRR wear scar) will definitely decrease the lifetime of the fuel supply pump!
- High sulfur content (≥ 0,5%) may cause corrosion and more frequent engine oil change intervals
- Engine operation with fuels with higher sulfur content require an engine oil with higher base number (BN) to counteract the corrosion which may occur (e.g. Shell Rimula R6M 10W40)
- The Fuel Density Compensation Kit only compensates for the engine power output regarding fuel density, it is not a „Safety Tool“ where you can operate the Steyr-Motors engine with each fuel type!
  Biofuel usage: please consider that all components of the fuel system which are used on the vessel must be released for Biofuel usage. The 2aterial of the fuel tank, fuel pipes and other fuel components should not include copper, lead, or zinc. The material for O-ring seals or rubber gaskets should be FKM/FPM Viton®.

## Service interval

Further information can be found on our homepage:
http://www.steyr-motors.com/download/manuals-spare-parts/option-equipment

**Please also refer to the disclosures in the „Overview Fuel Data“**

This fuel selection document will be amended or supplemented when needed.
Before usage, please make sure that you have the latest version of this document.

## Fuel Density Compensation / Function

The fuel density sensor is a novel fluid property sensor that will directly and simultaneously measure the density and temperature of fluids. Kindly note that the sensor does not measure other fluid properties, sulphur, or contaminants!
The information about density and temperature is computed and engine injection quantity is corrected accordingly to achieve the specified rated power.
This device is an active sensor and is communicates with the ECU via the CAN
Bus system.

For further information please contact Steyr-Motors.

## Fuel Density Compensation Availability

NOTE: all content is subject to change due to further development.

Table 1

| Engine type | Fuel Density Compensation available |
|---|---|
| SE144E38 | X |
| SE164E40 | X |
| SE126E25 | ✓ |
| SE126E32 | ✓ |
| SE156E26 | ✓ |
| SE156E34 | ✓ |
| SE186E38 | ✓ |
| SE196E35 | ✓ |
| SE236E40 | ✓ |
| SE236S36 | ✓ |
| SE266E40 | ✓ |
| SE266S36 | ✓ |
| SE286E40 | ✓ |
| SE306J38 | ✓ |

## Measures for extended engine storage periods

Extended engine storage periods greater than 1 year lead to depletion of the fuel anti-oxidation and anti- corrosion additives especially with diesel/FAME blends.
Fuel ageing leads to the formation of gum and residue in the fuel. Such aged fuel may lead to sticking of moving parts in the fuel system and as a consequence to fuel system malfunction.
Therefore, during extended engine storage periods suitable measures have to be implemented: e.g. regularly check the diesel fuel ageing reserve and if necessary purge and replace with fresh fuel followed by flushing of the fuel system by a suitable engine run period.

## Overview Fuel Data

**Cetane:**

- Cetane number is a more accurate measurement than Cetane index (Cetan number and index do correlate)
- Cetane number is an indication of how easily diesel ignites under high pressure and compression temperature conditions
- Cetane number which is too low leads to starting difficulties and white smoke
- EN590: Cetane number min. 51 (cetane index min. 46)
- SMO experience: Cetane number min. 46 (cetane index min. 38) is adequate for cold starts based on jet fuel testing

**Density:**

- Mass per volume
- The higher, the more mass, the more energy
- Deviations outside the EN 590 specification lead to either too much or too little power
- EN590: 820 – 845 kg/m³ at 15°C
- Ca. -1kg/m³/°C
- SMO experience: Diesel fuel up to 852kg/m³ at 15°C and jet fuel at 790kg/m³ at 15°C may be used
- A Fuel Density Compensation Kit is available

**Aromatics:**

- Main focus is on emissions and this is usually not an issue with engine performance or durability if the total aromatic content is under 10% m/m
- EN590: max. 8% (m/m = mass %)

**Sulfur content:**

- A too high sulfur content (≥ 0,5%) may cause corrosion and thus more frequent engine oil change intervals are recommended
- A high sulfur content causes numerous problems if exhaust gas recirculation and particulate filters are used
- Engine operation with fuel with higher sulfur content requires an engine oil with higher base number (BN)
- Very low sulfur content can cause issues with fuel lubricity (depends on the fuel manufacturers blending and use of additives in the fuel)
- EN590: max. 10mg/kg (=10ppm=Ultra low sulfur diesel [ULSD])

**Flash Point:**

- No directly relevant for engine operation
- Defines the fuel classification in one of the hazard classes
- Not to be confused with self-ignition temperature
- EN590: min. 55°C

**Carbon residue:**

- Or coke residue
- Is a reference to the tendency of a specific fuel to form residues in the combustion chamber – also known as coking of the injector nozzle
- EN590: max. 0,3% (m/m = mass %)

**Ash content:**

- Is a carbon-free combustion residue
- Can lead to wear of engine parts and the turbocharger
- EN590: max. 0,01% (m/m = mass %)

**Water content:**

- Causes corrosion of the fuel system, especially if salt water is present
- Causes deposits, especially if salt water is present
- EN590: max. 200mg/kg (=200ppm)
- A water separator must be used in any case
- A water separator may become ineffective if the water content is above 2%

**Total contamination:**

- Sediment, overall solid particle count
- Dust, rust, organic matter, fibres, etc.
- Causes wear in the injection- and fuel supply system and of the valves and seats
- EN590: max. 24mg/kg

**Copper corrosion:**

- Represents the chemical stability of the fuel as regards the sulphur compound and acid corrosion tendency
- Should typically not be an issue with high quality fuels
- May be an issue in case of too high water content
- May be an issue in the case of bio-fuels
- EN590: max. class 1 (3h at 50°C)

**FAME content:**

- Should not be of an issue as long as the diesel meets EN590: max. 7% (V/V=vol.%), FAME according to EN14214
- Higher content up to 100% leads to issues regarding fuel ageing and fuel storage.
- STEYR M1 engines are essentially able to run on any content but with the following conditions:
  - Fuel ageing is not under control of STEYR MOTORS – any damages due to fuel ageing is not covered by warranty
  - All parts of the fuel and injection system (supplied by STEYR MOTORS) are capable of operating on biofuels meeting EN14214 (including any blends with EN590), but with reduced engine lifetime
  - A reduced engine oil change interval shall be considered as the oil is diluted by biofuel and there is a tendency for the oil to have a significant viscosity increase over time

**Oxidation stability:**

- Chemical stability against the formation of acids
- Especially a concern in case of biofuels and biofuel blends
- 20-30% biofuel blends are the worst case
- May decrease during storage (and therefore destroy the fuel)
- EN590: min. 20h
- EN14214: min. 6h

**Lubricity:**

- Wear scar diameter (wsd 1,4) at 60°C, also known as HFRR
- Defines the wear depth when lubricating with the fuel tested
- EN590: max. 460µm
- SMO experience: successfully tested values up to 750µm have shown that lubricity is not an issue for the STEYR MOTORS Unit Injector

**Viscosity:**

- „fluidity" of the fuel
- Correlates partly with the density
- However, should stay within certain limits
- EN590: min. 2,0mm²/s, max. 4,5mm²/s (at 40°C)
- Viscosity lower than 2,0mm²/s can lead to hot start problems and may increase wear rate in the fuel pump

**Distillation properties:**

- Describes, how the fuel evaporates as temperature increases
- Higher temperatures / higher residues mean more residues after combustion
- EN590:
  - Max. 65% (V/V=vol.%) at 250°C
  - Min. 85% (V/V=vol.%) at 350°C
  - 95% (V/V=vol.%) at max 360°C

**Cold filter plugging point (CFPP):**

- At temperatures below the CFPP, fuel filters (and fuel pipes) may get blocked by the fuel, even if the fuel is still liquid
- Several classes defined in EN590
- Engines shall not be used with fuel temperatures below CFPP
- Other definitions for cold temperature behaviour of fuels may be:
  - Solidification point: the fuel does not flow under its own weight
  - Pour point: 3°C above the solidification point
  - Cloud point: solid precipitation (paraffin wax becomes visible)
- It is the responsibility of the fuel supplier to ensure that the fuel can be used at the expected given geographical and other local conditions minimum temperatures, so that a correct engine operation is guaranted!

**Additives:**

- Most fuels contain additives for different reasons (lubricity, chemical stability, ignition improvers, etc.)
- Producers and suppliers of fuels must blend appropriate additives to ensure that specifications are met
- Good quality fuel supply therefore does not need additional additives
- After market additives are usually not effective, do not guarantee correct dosing and may interact with other additives
- After market additives must be avoided, unless if they are supplied or approved by STEYR MOTORS. Currently there are no additives approved respectively available from STEYR MOTORS.
- An engine operated with after market additives or additives which are not released from STEYR MOTORS can cause damage or functional disorders! If you use unsuitable additives, STEYR MOTORS are not liable for warranty claims!

# Diesel Fuels

**Legend:**

✓ Fuel density kit available

X Fuel density kit not available

☑ Fuel released

☒ Fuel not released

! Fuel released with special requirements (more information can be found in the description of each fuel type)

| Engine Type | Fuel Density Kit (FDK) available | Diesel EN 590 | Biodiesel EN14214 | ASTM D975 1-D S15, S500, S5000 | ASTM D975 2-D S15, S500, S5000 | GTL DIN15940 | C.A.R.E. DIN15940 |
|---|---|---|---|---|---|---|---|
| **SE144E38** | **x** | ☑ | ☒ | ☒ | ☒ | ☑ | ☑ |
| | | | | | | without FDK reduced power output | without FDK reduced power output |
| | | | | | | | |
| **SE164E40** | **x** | ☑ | ☒ | ☒ | ☒ | ☑ | ☑ |
| | | | | | | without FDK reduced power output | without FDK reduced power output |
| | | | | | | | |
| **SE126E25** | ✓ | ☑ | ! | ! | ! | ☑ | ☑ |
| | | | | | | | |
| **SE126E32** | ✓ | ☑ | ! | ! | ! | ☑ | ☑ |
| | | | | | | | |
| **SE156E26** | ✓ | ☑ | ! | ! | ! | ☑ | ☑ |
| | | | | | | | |
| **SE156E34** | ✓ | ☑ | ! | ! | ! | ☑ | ☑ |
| | | | | | | without FDK reduced power output | without FDK reduced power output |

| Engine Type | Fuel Density Kit (FDK) available | Diesel EN 590 | Biodiesel EN14214 | ASTM D975 | | GTL DIN15940 | C.A.R.E. DIN15940 |
|---|---|---|---|---|---|---|---|
| | | | | 1-D | 2-D | | |
| | | | | S15, S500, S5000 | | | |
| **SE186E38** | ✓ | ☑ | ! | ! | ! | ☑ | ☑ |
| | | | | | | | |
| **SE196E35** | ✓ | ☑ | ! | ! | ! | ☑ | ☑ |
| | | | | | | | |
| **SE236E40** | ✓ | ☑ | ! | ! | ! | ☑ | ☑ |
| | | | | | | | |
| **SE236S36** | ✓ | ☑ | ! | ! | ! | ☑ | ☑ |
| | | | | | | | |
| **SE266E40** | ✓ | ☑ | ! | ! | ! | ☑ | ☑ |
| | | | | | | | |
| **SE266S36** | ✓ | ☑ | ! | ! | ! | ☑ | ☑ |
| | | | | | | | |
| **SE286E40** | ✓ | ☑ | ! | ! | ! | ☑ | ☑ |
| | | | | | | | |
| **SE306J38** | ✓ | ☑ | ! | ! | ! | ☑ | ☑ |

## Diesel fuel according to EN590

Climate-dependent behaviour (CFPP grades):
Summer grade (1 April to 30 September), maximum +5 °C (grade A)
Winter grade (1 October to 28 February), maximum -20 °C (grade F)
(1 March to 31 March), maximum -15 °C (grade E).

| Property Diesel EN 590 | Unit | Limits | | Test method |
|---|---|---|---|---|
| | | Minimum | Maximum | |
| Cetane number | | 51 | - | EN ISO 5165 (b)<br>EN 15195<br>EN 16144 |
| Cetane index | | 46 | - | EN ISO 4264 |
| Density at 15 °C | kg/m³ | 820 | 845 | EN ISO 3675 (c)<br>EN ISO 12185 |
| Polycyclic aromatic hydrocarbons (d) | % (m/m) | - | 8,0 | EN 12916 |
| Sulfur content | mg/kg | - | 10,0 | EN ISO 20846 (e)<br>EN ISO 20884<br>EN ISO 13032 |
| Manganese content (f)<br>until 2013–12–31<br>from 2014 to 01–01 onwards | mg/l | <br>-<br>- | <br>6,0<br>2,0 | prEN 16576 |
| Flash point | °C | Above 55,0 | - | EN ISO 2719 |
| Carbon residue (g) (on 10 % distillation residue) | % (m/m) | - | 0,30 | EN ISO 10370 |
| Ash content | % (m/m) | - | 0,01 | EN ISO 6245 |
| Water content | mg/kg | - | 200 | EN ISO 12937 |
| Total contamination | mg/kg | - | 24 | EN 12662 (h) |
| Copper strip corrosion (3 h at 50 °C) | rating | class 1 | | EN ISO 2160 |
| Fatty acid methyl ester (FAME) content (i) | % (V/V) | - | 7,0 | EN 14078 |
| Oxidation stability | g/m³<br>h | -<br>20 (j) | 25<br>- | EN ISO 12205<br>EN 15751 |
| Lubricity, corrected wear scar diameter (wsd 1,4) at 60 °C | µm | - | 460 | EN ISO 12156-1 |
| Viscosity at 40 °C | mm²/s | 2,0 | 4,5 | EN ISO 3104 |
| Distillation (k, l)<br>% (V/V) recovered at 250 °C<br>% (V/V) recovered at 350 °C<br>95 % (V/V) recovered at | <br>% (V/V)<br>% (V/V)<br>°C | <br><br>85<br> | <br>< 65<br><br>360 | <br>EN ISO 3405 (m)<br>EN ISO 3924 |

## Biofuel according to EN14214, FAME, RME

**FAME:** Fatty Acid Methyl Esters are esters of fatty acids. The physical characteristics of fatty acid esters are closer to those of fossil diesel fuels than pure vegetable oils, but properties depend on the type of vegetable oil. A mixture of different fatty acid methyl esters is commonly referred to as biodiesel, which is a renewable alternative fuel. FAME has physical properties like those of conventional diesel. It is also non-toxic and biodegradable.

**RME:** Rape Methyl Ester produced from raw rapeseed oil reacted with methanol

### Special, requirements:

- Only released in combination with the Fuel Density Kit
- Not released for long term usage or storage
- After operation the whole fuel system must be flushed sufficiently with Diesel meeting EN 590
- Installation of a fuel pre filter with a water separator is necessary
- Oil change, oil filter and fuel filter service intervals are reduced to 50% of the normal recommendation
- A reduced lifetime of sealing gaskets, fuel hoses, fuel density sensor and fuel supply pump can be expected
- After 50 hours of operation with Biodiesel EN14214, all fuel filters must be replaced. (This is done to remove the sediment which Biodiesel dissolves from the fuel system)
- Please ensure that all components of the fuel system which are used on the vessel must be released for Biofuel usage.

| Property Biofuel EN14214 | Units | lower limit | upper limit | Test-Method |
|---|---|---|---|---|
| Ester content | % (m/m) | 96.5 | - | EN 14103 |
| Density at 15°C | kg/m³ | 860 | 900 | EN ISO 3675 / EN ISO 12185 / EN12185. |
| Viscosity at 40°C | mm²/s | 3,5 | 5,0 | EN ISO 3104 / EN 14105 |
| Flash point | °C | > 101 | - | EN ISO 2719 / EN ISO 3679. |
| Sulfur content | mg/kg | - | 10 | - EN ISO 20846 / EN ISO 20884. |
| Cetane number | - | 51 | - | EN ISO 5165 |
| Sulfated ash content | % (m/m) | - | 0,02 | ISO 3987 |
| Water content | mg/kg | - | 500 | EN ISO 12937 |
| Total contamination | mg/kg | - | 24 | EN 12662 |
| Copper band corrosion (3 hours at 50 °C) | rating | Class 1 | Class 1 | EN ISO 2160 |
| Oxidation stability, 110°C | hours | 8 | - | EN 15751 / EN 14112 |
| Acid value | mg KOH/g | - | 0,5 | EN 14104 |
| Iodine value | - | - | 120 | EN 14111 |
| Linolenic Acid Methylester | % (m/m) | - | 12 | EN 14103 |
| Polyunsaturated (>= 4 Double bonds) Methylester | % (m/m) | - | 1 | EN 14103 |
| Methanol content | % (m/m) | - | 0,2 | EN 14110 |
| Monoglyceride content | % (m/m) | - | 0,7 | EN 14105 |
| Diglyceride content | % (m/m) | - | 0,2 | EN 14105 |
| Triglyceride content | % (m/m) | - | 0,2 | EN 14105 |
| Free Glycerine | % (m/m) | - | 0,02 | EN 14105 / EN 14106 |
| Total Glycerine | % (m/m) | - | 0,25 | EN 14105 |
| Group I metals (Na+K) | mg/kg | - | 5 | EN 14108 / EN 14109 / EN 14538 |
| Group II metals (Ca+Mg) | mg/kg | - | 5 | EN 14538 |
| Phosphorus content | mg/kg | - | 4 | EN14107 |

## ASTM D975 1-D & 2-D (S15, S500, S5000)

**Special requirements:**

- Only released in combination with the Fuel Density Kit
- **S5000**: Engine oil with higher BN (>12mg KOH/g) needed! Oil change, oil filter and fuel filter service interval reduced to 50% of the normal recommendation (e.g. Shell Rimula R6M 10W40)
- Low Lubricity leads to higher wear of fuel system components and reduced lifetime of fuel system components
- Low Cetan number (min. 40) leads to worse cold start behaviour

ASTM Specifications for Diesel Fuel Oils (D975-97)

Diesel fuel is characterized in the United States by the ASTM standard D 975. This standard identifies five grades of diesel fuel described below.

**Grade No. 1-D and Low Sulfur 1-D:** A light distillate fuel for applications requiring a higher volatility fuel for rapidly fluctuating loads and speeds as in light trucks and buses. The specification for this grade of diesel fuel overlaps with kerosene and jet fuel and all three are commonly produced from the same base stock. One major use for No. 1-D diesel fuel is to blend with No. 2-D during winter to provide improved cold flow properties. Low sulfur fuel is required for on-highway use with the sulfur level < 0.05%.

**Grade No. 2-D and Low Sulfur 2-D:** A middle distillate fuel for applications that do not require a high volatility fuel. Typical applications are high-speed engines that operate for sustained periods at high load. Low sulfur fuel is required for on-highway use with the sulfur level < 0.05%.

| Property D975 | ASTM D975-08a | | ASTM D6751-12 | | |
|---|---|---|---|---|---|
| | | | 2-B | 1-B | Test |
| Flash point, min | No 1D 38°C<br>No 2D 52°C | D93 | **93°C** | | D93 |
| Water & sediment, max | 0.05% vol | D2709 | **0.050% vol** | | D2709 |
| Water, max | | | | | |
| Total contamination, max | | | | | |
| Distillation temperature (% vol recovered) | 90%:<br>1D 288°C max<br>2D 282-338°C | D86 | **90%: 360°C max** | | D1160 |
| Kinematic viscosity | 1D 1.3-2.4 $mm^2/s$<br>2D 1.9-4.1 $mm^2/s$ | D445 | **1.9-6.0 $mm^2/s$** | | D445 |
| Density max. | 876 $Kg/m^3$ | | | | |
| Ester content | 5% vol. max | EN 14078 | | | |
| Ash, max | 0.01% wt | D482 | | | |
| Sulfated Ash, max | | | **0.020% mass** | | D874 |
| Sulfur, max (by mass) | 1D and 2D:<br>S15 15 mg/kg<br>S500 0.05%<br>S5000 0.50% | D5453<br>D2622<br>D129[2] | **Two grades:**<br>**S15 15 ppm**<br>**S500 0.05%** | | D5453 |
| Copper strip corrosion, max | No 3 | D130 | **No 3** | | D130 |
| Cetane number, min | 46* | D613 | **47** | | D613 |

| Property D975 | ASTM D975-08a | | ASTM D6751-12 | | |
|---|---|---|---|---|---|
| | | | 2-B | 1-B | Test |
| - cetane index | 40 min | D976-80 | | | |
| - aromaticity | 35% vol max | D1319 | | | |
| PAH, max | | | | | |
| Operability, one of:<br>- cloud point<br>- LTFT/CFPP | Report | D2500<br>D4539<br>D6371 | | | |
| Cloud point | | | **Report** | | D2500 |
| CFPP | | | | | |
| Carbon residue on 10% distillation residue, max | 1D: 0.15% wt<br>2D: 0.35% wt | D524 | **0.030*% wt[5]** | | D4530 |
| Acid number, max | | | **0.50 mg KOH/g** | | D664 |
| Oxidation stability | | | **3 hrs min** | | EN 14112 |
| Iodine value, max | | | | | |
| Linolenic acid methyl ester, max | | | | | |
| Polyunstatured methyl esters, max | | | | | |
| Alcohol control | | | **0.2% wt methanol max, or** | | EN14110 |
| | | | **130°C flash point min** | | D93 |
| Monoglycerides, diglycerides & triglycerides, max | | | | **MG**<br>**0.40% wt** | D6584 |
| Group I metals (Na + K), max | | | **5 mg/kg** | | EN 14538 |
| Group II metals (Ca + Mg), max | | | **5 mg/kg** | | EN 14538 |
| Free glycerin, max | | | **0.020% wt** | | D6584 |
| Total glycerin, max | | | **0.240% wt** | | D6584 |

| | | | | |
|---|---|---|---|---|
| Phosphorous, max | | | **0.001% wt** | D4951 |
| Lubricity, max | 520 µm | D6079 | | |

*special requirement from Steyr-Motors

## SHELL GTL GASOIL according to DIN 15940

**Special requirements:**

- Without the Fuel Density Kit a restricted engine performance has to be accepted

Product description:
Shell (Gas to Liquids) GTL Gasoil is a new innovative fuel designed to lower local emissions.
Shell GTL Gasoil is virtually free of aromatics, poly-cyclic aromatics, olefins, sulphur, nitrogen and metals. The fuel is colourless and almost odourless. GTL Gasoil predominantly contains straight chain normal paraffins and branched iso-paraffins. Due to its composition the fuel has a very high cetane number and will burn cleaner, (lower NOX, particulate matter and SOX emissions) compared to conventional diesel.

Specification:
Shell GTL Gasoil meets the following specification:
CEN TS 15940 “Automotive fuels – Paraffinic diesel from synthesis or hydrotreatment – Requirements and test methods”

Product data:
Fuel properties of GTL Gasoil will show variations due to the production process. Indicative values are shown below:

| Caracteristic GTL DIN 15940 | Unit | Test method reference | Minimum | Maximum |
|---|---|---|---|---|
| Cetan number | - | ISO 5165 | 70 | - |
| Density at 15°C | kg/m³ | ISO 3675 | 770 | 800 |
| Sulfur content | mg/kg | ISO 14596 | - | 3.0 |
| Total aromatic content | % (m(m) | EN 12916 | - | 0.5 |
| Polycyclic Aromatics content | % (m(m) | EN 12916 | - | 0.1 |
| Total Olefin content | % (m(m) | ASTM D1159 | - | 0.1 |
| Visocity at 40°C | mm²/s | ISO 3104 | 2 | 4,5 |
| Flashpiont | °C | EN 2719 | 60 | - |
| Destillation | | ISO 3405 | | |
| % (v/v) recovered at 250°C | % (v/v) | | - | 65 |
| % (v/v) recovered at 350°C | % (v/v) | | 85 | - |
| 95% (v/v) recovered at | °C | | | 360 |
| Cold filter plugging point | °C | EN 116 | - | -9(-20)** |
| ** values between brackets are valid for the Winter period | | | | |

## Neste MY renewable Diesel ™ (HVO) according to DIN 15940

**(former C.A.R.E. Diesel)**

**Special requirements:**

- Without the Fuel Density Kit a restricted engine performance has to be accepted

Neste MY Renewable Diesel™ is a high-quality synthetic diesel fuel produced entirely from renewable raw materials. Neste MY can also be referred to as HVO100 or HVO diesel fuel and meets the requirements of DIN EN 15940 for paraffinic diesel fuels.

Neste MY Renewable Diesel™ significantly exceeds the quality requirements (EN 590) for diesel fuels (with the exception of the minimum density) and is clearly superior in performance to both conventional biodiesel and fossil diesel. It has, by virtue of the very high cetane number and purest composition, a performance enhanced quality without requiring additional additives. In addition, Neste MY Renewable Diesel™ has a very slow ageing and high storage stability factor, this diesel fuel has favourable cold flow properties at very low temperatures.

| Characteristic | | Unit | Limit | Neste MY renewable Diesel™ | Test method reference |
|---|---|---|---|---|---|
| Kinematic viscosity at 40 °C (a) | | mm²/s | max.<br>min. | 2,0<br>4,0 | EN ISO 3104 |
| Density at 15 °C | | kg/m³ | min.<br>max. | 770<br>790 | EN ISO 12185 |
| Cetane number | | – | min. | 70 | EN 15195 |
| Sulfur (b) | | mg/kg | max. | 5 | EN ISO 20846 |
| Flash point | | °C | min. | 61 | EN ISO 2719 |
| Copper strip corrosion | | class | | 1 | EN ISO 2160 |
| Acid number | | mg KOH/g | max. | 0,01 | ASTM D3242 |
| Total contamination | | mg/kg | max. | 24 | EN ISO 12662 |
| Oxidation stability | | h | min. | 25 | EN ISO 12205 |
| Carbon residue: micro method on the 10 % volume distillation residue | | % (wt.) | max. | 0,3 | EN ISO 10370 |
| Distillation<br>% (V/V) recovered at 250°C<br>% (V/V) recovered at 350°<br>(V/V) recovered at | | % (V/V)<br>% (V/V)<br>°C | min. | <65<br>85<br>360 | EN ISO 3405 |
| Cloud point | | °C | max. | -22 | EN 23015 |
| CFPP | winter quality | °C | max. | reported | EN 116 |

| | | | | | |
|---|---|---|---|---|---|
| | summer quality | °C | max. | reported | |
| FAME | | vol% | – | 0,0 | |
| Water | | mg/kg | max. | 200 | EN ISO 12937 |
| Ash | | % (wt.) | max. | 0,01 | EN ISO 6245 |
| Lubricity, corrected wear scar diameter (wsd 1,4) at 60 °C (h) | | µm | max. | 400 | EN ISO 12156-1 |

*special requirement from Steyr-Motors

## Marine Distillates

**Legend:**

✓ Fuel density kit available

X Fuel density kit not available

☑ Fuel released

☒ Fuel not released

! Fuel released with special requirements (more information can be found in the description of each fuel type)

| Engine Type | Fuel Density Kit (FDK) available | DMA (MGO) ISO8217 | DMX ISO8217 | NATO F-75 | NATO F-76 |
|---|---|---|---|---|---|
| **SE144E38** | **x** | ☒ | ☒ | ☒ | ☒ |
| **SE164E40** | **x** | ☒ | ☒ | ☒ | ☒ |
| **SE126E25** | ✓ | ! | ! | ! | ! |
| **SE126E32** | ✓ | ! | ! | ! | ! |
| **SE156E26** | ✓ | ! | ! | ! | ! |
| **SE156E34** | ✓ | ! | ! | ! | ! |
| **SE186E38** | ✓ | ! | ! | ! | ! |
| **SE196E35** | ✓ | ! | ! | ! | ! |

| | | | | | |
|---|---|---|---|---|---|
| **SE236E40** | ✓ | ! | ! | ! | ! |
| | | | | | |
| **SE236S36** | ✓ | ! | ! | ! | ! |
| | | | | | |
| **SE266E40** | ✓ | ! | ! | ! | ! |
| | | | | | |
| **SE266S36** | ✓ | ! | ! | ! | ! |

| Engine Type | Fuel Density Kit (FDK) available | DMA (MGO) ISO8217 | DMX ISO8217 | NATO F-75 | NATO F-76 |
|---|---|---|---|---|---|
| **SE286E40** | ✓ | ! | ! | ! | ! |
| | | | | | |
| **SE306J38** | ✓ | ! | ! | ! | ! |

## DMA (MGO), DMX according to ISO 8217

**Special requirements:**

- Only released in combination with the Fuel Density Kit
  Engine oil with higher BN (>12mg KOH/g) needed! (e.g. Shell Rimula R6M 10W40) Oil change, oil filter and fuel filter service interval reduced to 50% of the normal recommendation
- Installation of a fuel pre filter with a water separator is necessary
- Higher sulfur content may cause corrosion in the combustion chamber, cylinder liners, injection nozzles, valves, exhaust, turbo charger, exhaust elbow assembly
- Low Lubricity leads to higher wear of fuel system components and reduced lifetime of fuel system components e.g. fuel supply pump

| Characteristic DMX, DMA | | Unit | Limit | DMA (acc.to ISO8217) | DMX (acc.to ISO8217) | Test method reference |
|---|---|---|---|---|---|---|
| Kinematic viscosity at 40 °C (a) | | mm²/s | max. | 4,5* | 4,5* | ISO 3104 |
| | | | min. | 2,0 | 2,0* | |
| Density at 15 °C | | kg/m³ | max. | 890 | 890* | ISO 3675 or ISO 12185 |
| Cetane index | | – | min. | 40 | 45 | ISO 4264 |
| Cetane number | | – | min. | 46* | 46* | |
| Sulfur (b) | | mass % | max. | 1,0* | 1,0 | ISO 8754, ISO 14596 |
| Flash point | | °C | min. | 60 | 43 | ISO 2719 |
| Hydrogen sulfide | | mg/kg | max. | 2,0 | 2,0 | IP 570 |
| Acid number | | mg KOH/g | max. | 0,5 | 0,5 | ASTM D664 |
| Total sediment by hot filtration | | mass % | max. | – | – | ISO 10307-1 |
| Oxidation stability | | g/m³ | max. | 25 | 25 | ISO 12205 |
| Carbon residue: micro method on the 10 % volume distillation residue | | mass % | max. | 0,3 | 0,3 | ISO 10370 |
| Cloud point | | °C | max. | – | -16 | ISO 3015 |
| Pour point (upper) (c ) | winter quality | °C | max. | -6 | – | ISO 3016 |
| | summer quality | °C | max. | 0 | – | ISO 3016 |
| Appearance | | – | – | Clear and bright (h) | | |
| Water | | vol% | max. | 0,5* | 0,5* | ISO 3733 |
| Ash | | mass % | max. | 0,01 | 0,01 | ISO 6245 |
| Lubricity, corrected wear scar diameter (wsd 1,4) at 60 °C (h) | | µm | max. | 520 | 520 | ISO 12156-1 |

*special requirement from Steyr-Motors

## NATO F-75 MIL-DTL-16884M, NATO STANAG-1385

- Only released in combination with the Fuel Density Kit

| Characteristic F-75 | Unit | Limit | NATO F-75 | Test method reference |
|---|---|---|---|---|
| Kinematic viscosity at 40 °C | mm²/s | min. | 1,8 | DIN 51562 Part 1 |
| | | max. | 4,3 | |
| Density at 15 °C | kg/m³ | max. | 860 | DIN 51757 |
| Cetane number | – | min. | 46* | DIN 51773 |
| Sulfur | mass % | max. | 0,05 | DIN 51400 Part 1 and 6 |
| Flash point | °C | min. | 61 | DIN EN 22719 |
| Hydrogen sulfide | mg/kg | max. | | |
| Acid number | mg KOH/g | max. | 0,3 | D974, D664 |
| Corrosion, at 100 °C (max) | Class | | No 1 | D130 |
| Particulate Contamination | mg/liter | max. | 10 | D6217, D5452 |
| Carbon Residue on 10% bottoms | wt % | max. | 0,3* | D524, D189, D4530 |
| Total contamination | mg/kg | max. | 24* | |
| Cloud point | °C | max. | -13 | DIN EN 230515 |
| Pour point (upper) | °C | max. | -18 | DIN ISO 3016 |
| Appearance | – | – | | Clear, bright, and free of visible particulates D4176 |
| Water content | mg/kg | max. | 200* | |
| Ash | mass % | max. | 0,01 | DIN EN ISO 6245 |
| Lubricity, corrected wear scar diameter (wsd 1,4) at 60 °C | µm | max. | 460 | D6079, D7688 |

*special requirement from Steyr-Motors

## NATO F-76 MIL-DTL-16884M, NATO STANAG-1385

- Only released in combination with the Fuel Density Kit

| Characteristic F-76 | Unit | Limit | NATO F-76 | Test method reference |
|---|---|---|---|---|
| Kinematic viscosity at 40 °C | mm²/s | min. | 1,7 | IP 71 |
| | | max. | 4,3 | |
| Density at 15 °C | kg/m³ | max. | 880 | IP 160 |
| Cetane number | – | min. | 46* | ASTM D 613 |
| Sulfur | mass % | max. | 0,05 | IP 336 |
| Flash point | °C | min. | 61 | IP 34 |
| Hydrogen sulfide | mg/kg | max. | | |
| Acid number | mg KOH/g | max. | 0,3 | D974, D664 |
| Corrosion, at 100 °C (max) | Class | | No 1 | D130 |
| Particulate Contamination | mg/liter | max. | 10 | D6217, D5452 |
| Carbon Residue on 10% bottoms | wt % | max. | 0,3* | D524, D189, D4530 |
| Total contamination | mg/kg | max. | 24* | |
| Cloud point | °C | max. | -13 | IP 219 |
| Pour point (upper) | °C | max. | -18 | IP 15 |
| Appearance | – | – | | Clear, bright, and free of visible particulates D4176 |
| Water content | mg/kg | max. | 200* | D7171, D4808, D5291 |
| Ash | mass % | max. | 0,01 | IP 4 |
| Lubricity, corrected wear scar diameter (wsd 1,4) at 60 °C | µm | max. | 460 | D6079, D7688 |

*special requirement from Steyr-Motors

# Jet Fuels

**Special requirements:**

- Released in combination with the Fuel Density Kit
- Without the Fuel Density Kit a restricted engine performance has to be accepted
- Low Lubricity can lead to higher wear of fuel system components and the reduced lifetime of fuel system components e.g. fuel supply pump
- High viscosity can lead to higer stresses on the fuel system components and reduced the lifetime of fuel system components e.g. fuel supply pump

**Legend:**

✓ Fuel density kit available

X Fuel density kit not available

☑ Fuel released

☒ Fuel not released

! Fuel released with special requirements (more information can be found in the description of each fuel type)

| Engine Type | Fuel Density Kit (FDK) available | Jet A | Jet A-1 | MIL JP-5 | MIL JP-8 | NATO F-34 | NATO F-35 | NATO F-44 | NATO F-63 | NATO F-65 |
|---|---|---|---|---|---|---|---|---|---|---|
| SE144E38 | x | ! | ! | ! | ! | ! | ! | ! | ! | ! |
| SE164E40 | x | ! | ! | ! | ! | ! | ! | ! | ! | ! |
| SE126E25 | ✓ | ! | ! | ! | ! | ! | ! | ! | ! | ! |
| SE126E32 | ✓ | ! | ! | ! | ! | ! | ! | ! | ! | ! |
| SE156E26 | ✓ | ! | ! | ! | ! | ! | ! | ! | ! | ! |
| SE156E34 | ✓ | ! | ! | ! | ! | ! | ! | ! | ! | ! |
| SE186E38 | ✓ | ! | ! | ! | ! | ! | ! | ! | ! | ! |
| SE196E35 | ✓ | ! | ! | ! | ! | ! | ! | ! | ! | ! |

| Engine Type | Fuel Density Kit (FDK) available | Jet A | Jet A-1 | MIL JP-5 | MIL JP-8 | NATO F-34 | NATO F-35 | NATO F-44 | NATO F-63 | NATO F-65 |
|---|---|---|---|---|---|---|---|---|---|---|
| SE236E40 | ✓ | ! | ! | ! | ! | ! | ! | ! | ! | ! |
| SE236S36 | ✓ | ! | ! | ! | ! | ! | ! | ! | ! | ! |
| SE266E40 | ✓ | ! | ! | ! | ! | ! | ! | ! | ! | ! |
| SE266S36 | ✓ | ! | ! | ! | ! | ! | ! | ! | ! | ! |
| SE286E40 | ✓ | ! | ! | ! | ! | ! | ! | ! | ! | ! |
| SE306J38 | ✓ | ! | ! | ! | ! | ! | ! | ! | ! | ! |

## Jet A

Industry standard is used only by U.S. commercial airlines when operating within the U.S.
– ASTM D1655
– Freeze Point: ≤ -40ºC (- 40ºF)
– Density @15ºC: 0.775 to 0.840 kg/L
– Flash Point: ≥ 38ºC (100ºF)

## Jet A-1

Industry “standard” used worldwide by all commercial airlines. Has slightly lower freeze point requirement than Jet A (-47° vs. -40°C), interchanged under NATO code **number F-35**.
– ASTM specification D1655, DEF STAN 91-91
– Freeze Point: ≤ -47ºC (- 53ºF)
– Density @15ºC: 0.775 to 0.840 kg/L
– Flash Point: ≥ 38ºC (100ºF)

| COMPOSITION Jet A/A1 | | Jet A /A1-1 Kerosine (1) | Test Method ASTM |
|---|---|---|---|
| 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 |
| Sulphur, Mercaptan (wt %) | Max. | 0.003 | D3227 |
| or Doctor Test | | Negative | D4952 |
| **VOLATILITY** | | | |
| Distillation Temperature: | | | D86, D2887 (3) |
| 10% Recovery (°C) | Max. | 205 (185) | |
| 50% Recovery (°C) | Max. | Report | |
| 90% Recovery (°C) | Max. | Report | |
| Final BP (°C) | Max. | 300 (340) | |
| 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 | D2386, D4305 (6) |
| Freezing Point (°C) | Max. | -47 Jet A-1 | D5901, D5972 (7) |
| Viscosity @ -20°C (cst) | Max. | 8.0 | 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 (8) | D3241 |
| Tube Deposit Rating (Visual) | Max. | <3 (9) | |
| **CONTAMINANTS** | | | |
| Existent Gum (mg/100mL) | Max. | 7 | D381 |
| Water Reaction Interface | Max. | 1b | D1094 |
| MSEP Rating | Min. | 85 (10) | |
| **OTHER** | | | |
| Conductivity (pS/m) | | 50-450 (11) | D2624 |
| **ADDITIVES** | | | |
| Anti-icing (vol %) | | Agreement (12) | |
| Antioxidant | | Option | |
| Corrosion Inhibitor | | Agreement | |

**NOTES Jet A/A1**

(1) Jet A-1 is similar to Jet A in all proberties 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 limit in parentheses.
(4) Results obtained by method D3828 may be up to 2°C lower than those optained by method D56.
(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.

**JP-5 MIL-DTL-5624's** Grade JP-5 interchanged under NATO code **number F-44**; contains only kerosene fractions; not considered volatile.
– MIL-DTL-5624, DEF STAN 91-86
– Freeze Point: ≤ -46ºC (-50.8ºF)
– Density @15ºC: 0.788 to 0.845 kg/L
– Flash Point: ≥ 60ºC (140ºF)

| Property JP-5 | GRADE JP-5 | ASTM or IP Test Method |
|---|---|---|
| Color, Saybolt | Report | D156 or D6045 |
| Total acid number, mg KOH/g, max | 0.015 | D3242 |
| Aromatics, vol percent, max | 25.0 | D1319 |
| Sulfur, Mercaptan, mass percent, max | 0.002 | D3227 |
| or | | |
| Doctor test | Negative | D4952 |
| Sulfur, total, mass percent, max | 0.20 | D129, D1266,D2622, D3120,D4294 or D5453 |
| Distillation temperature, ° C | | D86 or D2887 |
| Initial boiling point | Report | |
| 10 percent recovered, temp | 205, max | |
| 20 percent recovered, temp | Report | |
| 50 percent recovered, temp | Report | |
| 90 percent recovered, temp | Report | |
| End point, max temp | 300, max | |
| Residue, vol %, max (for D86) | 1,5 | |
| Loss, vol %, max (for D86) | 1,5 | |
| Flash point, ° C, min | 60.0 | D56, D93, or D3828 |
| Density, at 15° C | | D1298, D4052 or D7777 |
| kg/L, min (API max) | 0.788 | |
| kg/L, max (API min) | 0.845 | |
| Freezing point, ° C, max | -46 | D2386, D5972 D7153, or D7154 |
| Viscosity, at -20° C, max, mm2/s | 8,5 | D445 |
| Net Heat of combustion, MJ/kg, min | 42.6 | D3338, D4529, or D4809 |

| Property JP-5 | GRADE JP-5 | ASTM or IP Test Method |
|---|---|---|
| Hydrogen content, mass percent, min | 13,4 | D3701 or D7171 |
| Copper strip corrosion, 2 hr at | No. 1 | D130 |
| 100° C, max | | |
| Fuel system icing inhibitor | | D5006 |
| volume percent min | 0.10 | |
| volume percent max | 0.15 | |
| Lubricity, µm, max | 760* | D5001 |

*special requirement from Steyr-Motors

**JP-8 MIL-DTL-83133** interchanged under NATO code **number F-34**; contains only kerosene fractions; not considered volatile. Identical to ASTM D 1655 Jet A-1, except Jet A-1 does not include fuel system icing inhibitor, corrosion inhibitor, or static dissipator additive, which are all mandatory under MIL-DTL-83133.

– MIL-DTL-83133, DEF STAN 91-87
– Freeze Point: ≤ -47ºC (-52.6ºF)
– Density @15ºC: 0.775 to 0.840 kg/L
– Flash Point: ≥ 38ºC (100.4ºF)

| COMPOSITION JP-8 | | JP-8 Kerosine | Test Method ASTM |
|---|---|---|---|
| Appearance | | C & B (2) | |
| Acidity, Total (mg KOH/g) | Max. | 0.015 | D3242 |
| Aromatics (vol %) | Max. | 25 | D1319 |
| Sulphur, Total (wt %) | Max. | 0.30 | D4294 (3) |
| Sulphur, Mercaptan (wt %) | Max. | 0.002 | D3227 |
| or Doctor Test | | Negative | D4952 |
| Colour, Saybolt | | Report | D156, D6045 |
| **VOLATILITY** | | | |
| Distillation Temperature: | | | D86, D2887 |
| Initial BP (°C) | Min. | Report | |
| 10% Recovery (°C) | Max. | 205 (186) max. | |
| 20% Recovery (°C) | Min. | Report | |
| 50% Recovery (°C) | | Report | |
| 90% Recovery (°C) | Max. | Report | |
| Final BP (°C) | Max. | 300 (330) | |
| Distillation Residue (vol %) | Max. | 1.5 | |
| Distillation Loss (vol %) | Max. | 1.5 | |
| Flash Point (°C) | Min. | 38 | D56, D3828 |
| Density @ 15°C (kg/L) | | 0.775-0.840 | D1298, D93, D4052 |
| or Gravity, API @ 60°F | | 51.0-37.0 | D1298 |
| **FLUIDITY** | | | |
| Freezing Point (°C) | Max. | -47 | D2386, D5901, D5972, D445 |
| Viscosity @ -20°C (cst) | Max. | 8.0 | D445 |
| **COMBUSTION** | | | |
| Net Heat of Comb. (MJ/kg) | Min. | 42.8 | D3338, D4809 |
| Cetane Index (calculated) | | Report | D976 |
| Smoke Point (mm) | Min. | 25 | D1322 |
| or Smoke Point (mm) | Min. | 19 | D1322 |
| and Naphthalenes (vol %) | Max. | 3.0 | D1840 |
| Hydrogen Content (wt %) | Min. | 13.4 | D3701, D3343 (6) |
| **CORROSION** | | | |
| Copper Strip (2h @ 100°C) | Max. | 1 | D130 |

| COMPOSITION JP-8 | | JP-8 Kerosine | Test Method ASTM |
|---|---|---|---|
| **THERMAL STABILITY** | | | |
| JFTOT ΔP @260°C (mm Hg) | Max. | 25 | D3241 (7) |
| Tube Deposit Rating (Visual) | Max. | <3 Visual (8) | |
| **CONTAMINANTS** | | | |
| Existent Gum (mg/100mL) | Max. | 7 | D381 |
| Particulates (mg/L) | Max. | 1.0 | D2276, D5452 |
| Filtration Time (min) | Max. | 15 | -11 |
| Water Reaction Interface | Max. | 1b | D1094 |
| MSEP Rating | Min. | 90 (12) | D3948 |
| **OTHER** | | | |
| Conductivity (ps/m) | | (13) | D2624 |
| **ADDITIVES** | | | |
| Anti-icing (vol %) | | 0.10-0.15 (14) | D5006 |
| Antioxidant (ppm) | | Required (15) | |
| Corrosion Inhibitor (ppm) | | Required (16) | |
| Metal Deactivator | | Agreement | |
| Static Dissipator | | Required | |

**NOTES**

(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-8 (which also accepts D129 and D5453).

(6) May use calculation (D3343) or measurement method (D3701).

(7) Test conditions for JP-8 fuel at 260°C for 2.5h.

(8) No peacock or abnormal colours allowed.

(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 additivers 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 additve shall be added to JP-7 fuel. Corrosion inhibitor conforming to MIL-PREF-25017 shall be added to F-34 fuel, but is optional for F-35.

**F-44** is a kerosine grade of aviation fuel suitable for most turbine-engined aircraft.
This military fuel grade is intended specifically for use on naval aircraft carriers, where a fuel with a higher flash point than standard Jet A-1/JP-8 is required for on-board safety reasons.

**F-54** (Diesel fuel) middle distillate fuel used for automotive diesel and gas turbine engines.
– ASTM D975
– Density @15ºC: ~ 0.820 to 0.840 kg/L
– Flash Point: ≥ 52ºC (125.6ºF)

**F-63** same as F-35 (Jet A-1) incl. wear and ignition improver additive.

**F-65** mixture from F-54, F-34 and F-35

## Warranty:

Compliance with the fuel specification document is an integral part of the warranty conditions.

The fuel supplies are responsible for the worldwide consistent quality of the above products.

STEYR-MOTORS accept no liability for improper or non-specified use of the released fuels.

In case of warranty, the claimed fuel components must be forwarded inclusive of a fuel sample from the fuel tank (at least 1 litre) and the fuel filter(s).

For the examination of any warranty claim, we need the following as a minimum requirement:

- Customer name, telephone number, E-mail details and postal address
- Engine type
- Engine number
- Running time of the claimed components
- Fuel samples (at least 1 litre of each) and fuel filter(s)
- Description of the warranty claim