

Diesel Fuel Quality and Function

Marine Commercial Engines

Binder: B, D, E

Date: 02-2016

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Fuel Quality Requirements for “Marine Commercial Diesel Engines”

1. General fuel quality requirements

The fuel quality is essential for engine performance; i.e. durability, emission legislation compliance, rated power and fuel consumption.

Only fuels meeting relevant legal requirements and national and international standards must be used.

These standards are the minimum requirements for market fuels in different world regions and have, been developed in co-operation between oil industry, automotive industry and authorities.

Examples of such requirements are:

- EN590 (European standard (CEN) for automotive diesel fuel)
- ASTM D 975 1-D and 2-D (Base requirement in USA and Canada)
- JIS K 2204 (Diesel fuel standard in Japan)

NOTICE! Use of fuels or fuel blends that do not comply with the specifications given in this bulletin are not allowed and Volvo Penta will not accept warranty in case of fuel related engine damages.

2. Diesel fuel requirements

Cetane number

The cetane number is a measure of the ignitability of diesel fuels. An insufficient cetane number leads to poor startability, increased hydrocarbon and nitrogen oxide emissions and increased combustion noise.

- Requirement:** cetane number min 40 for acceptable engine function
Requirement: cetane number min 50 for good emission performance

Viscosity and density

Both viscosity and density impact engine performance; i.e. durability, emissions, power and fuel consumption. Insufficient density and viscosity will reduce the engine power and increase the fuel consumption. Excessive density and viscosity will endanger the durability and function of the fuel injection equipment.

To maintain acceptable technical and environmental performance, viscosity and density must be within the following intervals:

- Requirement:** Viscosity: 1.5-4.5 mm²/s (cSt) at 40 °C
Requirement: Density: 800-860 kg/m³ at 15 °C

Lubricity

Sufficient fuel lubricity is essential to protect the fuel injection system against excessive wear.

Requirement: max 520 µm wear scar in the HFRR test (ISO 12156).

Sulfur content

Sulfur oxides and sulfate particulate emissions increase with increasing sulfur content. Excessive sulfur levels will also give engine corrosion and wear.

Requirement: The max allowed sulfur content is 5000 ppm, with the restriction that oil of quality VDS 3 must be used for sulfur content above 3000 ppm.

Water and contaminants

The fuel must be kept free from water and contaminants.

Water will give corrosion and wear of engine parts, particularly of the fuel injection system. Water also enables microbial growth in the fuel tank, causing fuel filter clogging.

Organic contaminants (bacteria, fungi etc) can block fuel filters and inorganic contaminants (dust, sand) can cause severe damage to the fuel injection system.

Requirement: Water max 200 ppm

Requirement: Total contaminants max 30 ppm

Cold flow properties

Diesel fuel cold flow properties are determined by the cloud point (the temperature when wax crystals start to fall out) and the CFPP (cold filter plugging point). The requirements for different geographic regions and for different seasons are specified in the national fuel standards.

The oil companies are always responsible for providing fuels with the correct cold flow properties for any time of the year.

3. Marine distillate fuels

Light marine distillate fuels, such as ISO 8217 DMX, are allowed as long as they comply with the quality requirements in chapter 2.

NOTICE! Other light marine distillate fuels are approved only after agreement with Volvo Penta.

4. FAME (“biodiesel”)

FAME (Fatty Acid Methyl Ester) is a group of renewable fuels with lower energy content, higher density, higher viscosity and lower oxidation stability compared to diesel fuels. FAME is normally blended into diesel fuel.

Usage of high FAME blends will have a negative impact on engine durability and function, power, fuel consumption and nitrogen oxides; but also a substantially positive impact on other emissions.

Requirement:	Engines for emergency applications must run with diesel fuel with minimum FAME content.
Notice!	All engines can run with fuel with the same FAME content as EN 590 (at present 7% FAME that complies with EN 14214) respectively ASTM D975 (at present 5% FAME that complies with ASTM D6751).
Requirement:	Engines produced after 1 Jan 2012 are allowed to run on fuel with FAME content up to 30%, if the FAME part complies with EN 14214 and the diesel complies with EN 590, with specific service requirements as below.

NOTICE! Other FAME types and higher FAME blends are allowed only after agreement with Volvo Penta.

Specific service requirements for fuels with FAME blend up to 30%

- Oil change and oil-filter replacement intervals must be halved.
- Fuel filters shall be changed at every oil change and fuel filter housings and seals shall be changed annually.
- A fuel heater should be used due to the high viscosity of FAME at low temperature. In order to avoid starting problems FAME should not be used below -10°C.
- A fuel filter with water separator must be used since FAME is hygroscopic.
- When shifting from regular diesel fuel to higher FAME content the fuel tank must be cleaned and the fuel filter must be replaced after 50 h.
- If the engine has not been used for a period over 4 weeks the tank and fuel system must be flushed clean by running the engine on at least one full tank of regular diesel.

5. Paraffinic fuels (“Synthetic Diesel”) - HVO and GTL

Paraffinic fuels (“synthetic diesel”) have high cetane number and low density compared to diesel fuels. HVO (Hydro-treated Vegetable Oil) are renewable, and GTL (Gas-To-Liquid) are fossil, paraffinic fuels. Usage of paraffinic fuels will give lower emissions, but also marginally higher fuel consumption and lower power.

Requirement:	Volvo Penta approves usage of pure HVO and GTL that complies with EN 15940, as well as HVO and GTL blends into diesel fuels complying with the quality requirements in chapter 2.
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NOTICE! Rubber and elastomers in the low pressure fuel injection system might be impacted when shifting from diesel to paraffinic fuel. Check for possible fuel leakage and if needed contact the machine builder for support.

NOTICE! Other paraffinic fuels are allowed only after agreement with Volvo Penta.

6. Kerosene (“Jet fuel”)

Kerosene has low cetane number, low viscosity, low lubricity and high sulfur level compared to diesel fuels. Usage of kerosene will negatively impact durability, emissions, power and fuel consumption.

NOTICE! F-63 can be used, but Volvo Penta does not guarantee emission compliance.

NOTICE! F-34/JP8 and F-44/JP5 can also be used, but only with lubricity additives to ensure max 520 µm wear scar in the HFRR test (ISO 12156).

7. Additives

The oil companies shall always ensure that their fuels meet relevant requirements and are fit for their purpose. Their responsibility includes any use of additives for proper engine performance and function.

NOTICE! It is not allowed to add secondary treatment additives ("diesel boosters") into the fuel tank.

NOTICE! It is not allowed to add any kind of lubricants into the fuel tank.

NOTICE! It is not allowed to mix gasoline or alcohol into the fuel tank.