



YANMAR

MARINE DIESEL ENGINES

FUTURE FUELS & HVO



PROVEN MARINE TECHNOLOGY



HVO ALTERNATIVE FUEL

YMI's Energy Transition strategy is focused on hybridization, electrification, and energy efficiency and optimization. We are exploring new technologies in terms of low carbon fuels, such as HVOs, synthetic fuels and others. We are adapting our products to be compatible with low carbon fuels. We will build solutions for sail and power boats with a minimum CO2 footprint, with a focus on using energy in a different, more efficient way.

ABOUT *HYDROTREATED VEGETABLE OIL*

What is HVO fuel?

Hydrotreated vegetable oil (HVO) is a renewable paraffinic (diesel) fuel. It is derived from used cooking oils, residue animal fats from food processing, tall oil, and non-food grade crops.

How is it made?

HVO, a new generation of bio-based diesel, has been treated with hydrogen in order to meet the European EN15940 standard for 'Paraffinic Diesel Fuel from Hydrotreatment'. This more complex process produces a cleaner fuel, without the drawbacks of traditional, or first generation, biodiesel.

What are the characteristics of paraffinic fuels and HVO?

Paraffinic diesel fuels are specified in EN15940 and have higher cetane numbers and lower density than conventional diesel fuels (EN590). HVO and Bio to Liquid (BTL) are renewable paraffinic (diesel) fuels, whereas Gas to Liquid (GTL) is an alternative fossil paraffinic (diesel) fuel. HVO is a clear, colorless, odorless liquid.

What is bacterial growth?

Over time bacterial growth can be caused by the hygroscopic properties of FAME (EN590-B7). FAME is the first generation biofuel and highly hygroscopic, explaining the short shelf life of present EN590-B7 fuel. Due to the better properties, HVO fuel can be kept longer than fuel with FAME content.

What are the benefits of HVO?

The use of renewable (HVO and BTL) fuels will give a substantial decrease (up to 90%) of fossil CO2 emissions. Featuring the low sulfur and aromatics associated with paraffinic fuels, HVO burns more cleanly than first generation biodiesel or mineral diesel.



USING HVO IN YANMAR ENGINES


Which YANMAR engines are compatible with HVO and renewable or alternative (diesel) fuels?


EN15940 HVO can be used as a direct replacement for fossil diesel in YANMAR's new and heritage marine sail and powerboat engines, either neat or blended in any proportion. YANMAR allows HVO20, HVO50 and also GTL to be blended.

The use of renewable or alternative (diesel) fuels that are in accordance with EN590 or EN15940 is permitted in the following YANMAR engine models:


 1GM Series


 YM Series

 JH Series


 4LH HTP Series

 4LH DTP Series

 4LH STP Series

 6LY Series

 6LF Series

 6LT Series

**Find a complete list of HVO-Approved engines at [yanmar.com/marine/technology](https://www.yanmar.com/marine/technology)*

Does HVO affect engine performance?

The renewable or alternative fuels that are in accordance with EN15940 have lower density and lower calorific value per volume. 6% lower output and 6% higher volumetric consumption than conventional (EN590) diesel fuels are to be anticipated.

Are there changes to engine service and warranty?

After switching to EN15940 HVO, any engine performance loss and higher fuel consumption are not covered by warranty. When renewable or alternative fuels are used that are not in accordance with EN15940, problems as fuel pump seizure or fuel injector seizure may occur due to deterioration of fuel lubricity. This will not be covered by YANMAR's Limited Warranty Coverage.

Are engine modifications required when shifting to HVO?

When shifting from conventional EN590 diesel fuel to renewable or alternative (diesel) fuels in accordance with EN590 or EN15940 for existing engines (not new engines), the fuel hoses and all (nitril) rubber seals must be replaced. Leakage due to no replacement of these parts is not covered by warranty.

Are any changes in operation, service and maintenance required?

All processes are the same for diesel and HVO.



PERFORMANCE *TESTING AND DATA*

What is the impact on emissions when using HVO?

Tests show that NOx (nitrogen oxides) emissions are similar. There is a reduction in PM (particulate matter) emissions when using HVO fuel compared to diesel and up to a 90% reduction in CO2 emissions.

What is the performance and fuel consumption difference?

Engine performance may decrease by 6% due to the lower energy density of HVO fuel. Fuel economy reduces slightly with HVO compared to using diesel and the cost may be slightly higher, but these factors could well be outweighed by the huge positives of the fuel.

AVAILABILITY AND COST *OF HVO*

Where is HVO available?

Availability of renewable biofuels and HVO is expected to improve, with new legislation to encourage the use of greener fuels. Supply is improving to regulated markets, specifically North America and Europe, and output is predicted to rise in the coming years. It is produced in significant quantities by major fuel producers globally.

What is the cost?

The cost varies between countries and whether there are special tax allowances for renewable fuels.