

Two-stroke

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Action code: WHEN CONVENIENT

Biofuel operation

Concerns

Owners and operators of Everllence B&W two-stroke marine combustion engines.

Types: All engines

Summary

Operational guidelines for biofuels up to B100: FAME, similar FAME-type fuels, HVO, and blends of these with distillate or residual fuel, for example B30.

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References

This Service Letter replaces SL2023-741.

SL2026-782, SL2025-776, SL2023-737, SL2022-726, SL2019-670, and SL2017-638.

More information on fuels and fuel management: "Detailed information on Preparation and Operation on fuels with maximum 0.50% sulphur" [1].



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Biofuel operation

This Service Letter gives information and guidance on operation using biofuels. It includes 100% biofuel (for example, B100) and biofuels mixed with fossil fuels (for example, B30). All current engine designs can operate on biofuel, including Tier III and use it as pilot fuel for dual-fuel engines. The types of biofuel currently accepted for Everllence B&W two-stroke engines are:

1. Fatty acid methyl ester (FAME) as defined in ISO 8127:2024, up to B100
2. Hydrotreated vegetable oil (HVO), up to B100
3. Similar FAME-type fuels¹⁾, up to B100²⁾
 - a. Marine grades of FAME
 - b. FAME distillation residue (FDR)
4. Blends of the above (1-3) with ISO 8217-compliant fossil fuels, for example, B30 and 30% biofuel.

¹⁾ Note that other names may be used for these products in the market.

²⁾ Certain conditions apply, e.g., max. acid number (AN) of 2.5 mg KOH/g.

Many guidelines and recommendations for biofuel operation are the same as those for <0.50% S VLSFO operation. These include, but are not limited to, the following:

- Avoid mixing different fuel batches.
- Use the “first in – first out” principle.
- Pay attention to the actual fuel parameters and act accordingly,
 - e.g., cold flow properties and viscosity.
- Adjust the fuel temperature to ensure a suitable viscosity at the engine inlet.

The flashpoint limit of marine fuels is a minimum of 60°C, according to the International Convention for Safety Of Life at Sea (SOLAS), unless the ship is covered by the exemptions to SOLAS Chapter II-2, regulation 2.2.2, or complies with the International Code of Safety for Ship Using Gases or Other Low-flashpoint Fuels (IGF Code).

Operation on biofuel is accepted from a technical perspective, but may involve increased operational requirements and potential impacts on component lifetime. Any such impacts remain subject to actual operating conditions and available service experience, and cannot be predicted or guaranteed. Always refer to the most recent guidelines available for your specific engine design, for example, operation manual and Service Letters (SL), recommendations for fuels, lubrication, piston rings, and cylinder condition. Service Letters are available at: [Service Letters](#)

Biofuel: definition of types and general properties

FAME, HVO, Similar FAME-type fuels, and blends of the former with ISO 8217-compliant fuels are described as “biofuel” in this document. Table 1 shows an overview of the properties of biofuels and fossil fuels. The topic of biofuels is currently growing. The umbrella term “Similar FAME-type fuels” used in SL2023-741 has been divided into the two subcategories Marine grades of FAME and FAME distillation residue, since bio-products have evolved.

Suppliers may have different naming standards. There is not yet a common international naming convention for all biofuel-types. Ask the supplier if it is unclear what type of biofuel is offered or supplied. In this SL, the convention Bxx refers to a fuel containing xx percentages of biofuel by mass or volume, without specifying the type of biofuel. For example, B100 is assumed to contain only biofuel and, likewise, B30 is assumed to contain 30% biofuel and 70% fossil fuel, such as distillate or residual fuels.

FAME – as defined in ISO 8127:2024

Fatty acid methyl esters (FAME) is commonly referred to as biodiesel. Table 1 column 1 shows the general characteristics of 100% FAME. A FAME fuel blended with an ISO 8217-compliant fossil fuel (distillate marine grade (DM) or residual marine grade (RM)) is often referred to as BX (e.g., B25, B30).

FAME, and mixtures up to 100% FAME, are included in specific grades in ISO 8217:2024 [2]. The FAME properties before blending should meet EN 14214 [3], or ASTM D6751 [4] with a few exceptions. These are sulphur, cloud point (CP), cold filter plugging point (CFPP) limits in EN 14214 and sulphur limits in ASTM D6751. The exceptions are made because the marine industry has different possibilities (temperature control) and legal requirements (sulphur-legislations) compared to automotive applications. More information about the different grades and FAME can be found in ISO 8217:2024 [2] and in CIMAC Guidelines [5, 6].

Everllence expects that fuels fulfilling EN 14214, ASTM D6751, and the ISO 8217 standard, including the fuel grades allowing up to 100% FAME inclusion, are suited for Everllence B&W two-stroke engines.

HVO

Hydrotreated vegetable oil (HVO) is covered in ISO 8217:2024 as “Hydrocarbons from synthetic or renewable sources, similar in composition to petroleum distillate fuels” [2]. HVO can also be referred to as either renewable diesel, or paraffinic diesel fuel. It consists mostly of paraffinic hydrocarbons free of oxygen, nitrogen, and aromatics.

The properties of HVO are very similar to DMA, and HVO can be supplied according to the ISO 8217 DMA grade. HVOs commonly have a lower calorific value (LCV) similar to diesel, a sulphur content below 10 mg/kg (0.01%), and a viscosity around 2–3 cSt at 40°C (Table 1, column 2). It is recommended to check the lubricity on 100% HVO due to the low sulphur content and the very low viscosity.

Everllence expects that fuels fulfilling the ISO 8217 standard, including fuel grades allowing HVO up to B100, are suited for Everllence B&W two-stroke engines.

Similar FAME-type fuels

‘Similar FAME-type fuels’ is an umbrella term for fuels containing predominantly FAME, which are divided into two main categories:

1. Marine grades of FAME (Table 1, column 3a)

Marine grades of FAME products should originate from a FAME production facility and come from the product stream(s) after the transesterification or esterification process within the FAME production. The guiding values for the FAME content are minimum 90%

FAME and an acid number (AN) of maximum 2.5 mg KOH/g in the B100-product and final fuel blend. It is usually aimed for blending with a residual fuel, but could be used as a B100 product.

There is currently no international standard available; when one becomes available, it is recommended to consider using this. National standards may be available, e.g., NEN 7427-1 (Fatty acid methyl esters for marine fuel, M-FAME).

2. FAME distillation residue (FDR) (Table 1, column 3b)

The product should originate from a FAME production process where it is the bottom stream residue of the FAME distillation step after the transesterification or esterification process. These products are intended for blending with a residual fuel, but could potentially be used as a B100.

FDR products can contain varying amounts of FAME. There is no guiding value, however, acceptable service experience has been reported for a FAME content above 50% in B100 FDR-products. The guiding value for the acid number (AN) is a maximum of 2.5 mg KOH/g in the final fuel. Several other names and terms might also refer to FDR-products, e.g. (FAME) distillation bottoms, bottoms of FAME esterification, bio-heating oil.

There is currently no international standard or industry guideline available for FDR. When these become available, it is recommended to consider using these.

Both types of Similar FAME-type fuels contain varying amounts of mono-/di-/triglycerides, free fatty acids, glycerol, heavier components from the original feedstock and process, e.g., sterols and heavier molecules, such as dimerised fatty acids and FAME dimers. All of these species are combustible. FDR usually contains more of these species compared to Marine grades of FAME.

For Similar FAME-type-fuels, Everllence recommends a maximum phosphor (P) content of 20 mg/kg, and a maximum potassium (K) content of 40 mg/kg in the final blend. Increased levels can occur and still be accepted, but it should be noted that the risk for deposit buildup in the engine and turbocharger is increased. The chloride content should be as low as possible, refer to ISO 8214:2024.

The guiding value for AN is a maximum of 2.5 mg KOH/g, but should preferably be lower if the acid mainly comes from the bio-part of the fuel blend. The acid number may increase during storage due to degradation of the fuel, which can form acidic compounds, e.g., free fatty acids.

These fuel types typically contain molecules, such as waxes, with properties that strongly affect the cold-flow properties of the fuel. Wax appearance and Wax disappearance temperature analyses (WAT and WDT, ASTM D8420) can support in determining the right storage temperature and reduce the risk of filter clogging. As always, it is recommended to run these fuels through the fuel cleaning system, e.g., separator and filtering.

Table 1: Overview of some important properties for the biofuel types covered in this Service letter. Three fossil fuel types (general values) are shown for comparison. The table is not complete, as there are other properties that are equally important to analyse.

Overview of biofuel and fossil fuel properties								
Column	1	2	3a and 3b		4	5	6	7
Characteristics	FAME Fatty acid methyl esters	HVO Paraffinic hydrocarbons	Similar FAME-type		Blends Biofuel + fossil fuel (Bxx)	ULSFO DM-grade (MGO)	VLSFO RM-grade (HFO)	HSFO RM-grade (HFO)
			Marine grades of FAME	FDR				
Nitrogen [%]	~0.1	~0	~0.1	~0.1	~0.1-0.4	~0.1	~0.4	~0.4
Oxygen [%]	~10	~0	~10	~10	~0-10	~0	~0	~0
Sulphur [%]	~0	~0	~0	~0	Low ¹⁾	≤0.10	≤0.50	>0.50
LCV [MJ/kg]	~36	~43	~36	~36	37-43	42-43	39-42	39-41
Kin. viscosity [mm ² /s]	3-5 at 40°C	2-3 at 40°C	3-5 at 40°C	~10-40 at 50°C	Low ¹⁾	2-11 at 40°C	2-500 at 50°C	200-700 at 50°C
Pour point [°C]	<-6 to >+6 ²⁾	low	2)	>6 to high ²⁾	1)	ISO 8217	ISO 8217	ISO 8217
Stability	Low-high ²⁾	Very high	Low-high ²⁾	Low-high ²⁾	Medium-high	Very high	High	High
Lubricity	Analyse ³⁾	Analyse ³⁾	Analyse ³⁾	Analyse ³⁾	Analyse ³⁾	ISO 8217	ISO 8217	ISO 8217
Standard ⁴⁾	EN 14214, ASTM D6751, ISO 8217:2024	EN 15940, ISO 8217:2024	5)	5)	ISO 8217:2024	ISO 8217	ISO 8217	ISO 8217

1) Depending on the biofuel blend ratio and properties of the bio-part and the fossil fuel.

2) Depending on the feedstock used to produce FAME.

3) Most relevant for fuels with sulphur contents below 0.05% sulphur (500 mg/kg S).

4) Standards are updated from time to time. Always refer to the latest edition [2-4].

5) Standards are pending. Methods in ISO 8217:2024, Table 1, or Table 3, combined with methods in, e.g., EN 14214 can temporarily be used.

Potential use of other types of bio-components

There are other types of biofuels available on the market. This Service Letter only covers the biofuels previously outlined in this text. As it is presently unclear whether other biofuel types can be suitable as a marine fuel, we advise caution in using these. There is a risk that damage may occur to the fuel system, fuel injection system, and the engine. Operation on these biofuel types is at your own risk. If other biofuel types are to be used, it is advisable to analyse the fuel carefully, follow best practice for fuel management procedures, and, as always, to monitor the engine condition and performance carefully.

Sustainability of biofuels

To support decarbonisation, biofuels produced sustainably from sustainable feedstocks should be preferred. Proper sustainability documentation can support the decision-making process when choosing a biofuel. Information about the carbon intensity index is available in Appendix 1.

Applicable engine designs

Table 2 gives an overview of engine designs and operating modes for which biofuel-use is accepted. All current engine designs can operate on biofuel, including the Tier III equipment, and use it as pilot fuel for dual-fuel engines. The biofuel should comply with the specification or this SL and be treated according to best practice guidelines and recommendations. Compared to fuel oil operation, continuous biofuel operation has collected relatively limited service hours. There is not enough data to evaluate the expected service life of components, but it may be reduced, e.g., fuel injection equipment (see SL2022-726 and SL2026-782 Guiding overhaul intervals, latest edition applies).

Table 2: Overview of accepted biofuel use (up to B100) for different technologies, e.g., engine design, Tier III equipment, and pilot fuel in dual-fuel engines. Check technology availability for specific engine sizes.

Overview of accepted biofuel use

Technology	FAME	HVO	Similar FAME-type	Blends
Engine design: MC/MC-C, ME/ME-C, ME-B, ME-GI, ME-GIE, ME-LGIM, ME-LGIP, ME-GA and ME-LGIA	Acceptable ¹⁾	Acceptable ¹⁾	Acceptable ¹⁾	Acceptable ¹⁾
Tier III: EGR, Tier II: EcoEGR	Acceptable ¹⁾	Acceptable ¹⁾	Acceptable ¹⁾	Acceptable ¹⁾
Tier III: HPSCR ²⁾	Acceptable ¹⁾	Acceptable ¹⁾	Acceptable ¹⁾	Acceptable ¹⁾
Tier III: LPSCR ^{2) 3)}	Acceptable ¹⁾	Acceptable ¹⁾	Acceptable ¹⁾	Acceptable ¹⁾
Pilot fuel for dual-fuel engines	Acceptable ¹⁾	Acceptable ¹⁾	Acceptable ¹⁾	Acceptable ¹⁾

¹⁾ Lifetime of components may be reduced.

²⁾ Urea consumption may increase slightly due to a potential slight increase in NO_x emissions during biofuel operation. High-pressure selective catalytic reduction (HPSCR) and low-pressure selective catalytic reduction (LPSCR)

³⁾ LPSCR is only for max 0.10% S fuels.

NO_x compliance regulations

IMO MEPC 79 has adopted a unified interpretation (UI) of MARPOL Annex VI, Regulation 18.3, permitting the use of biofuels and biofuel blends without assessment of NO_x emissions, provided the engine can be operated without changes to NO_x critical components, or settings/operating values outside those given by the engine's approved Technical File.

For Everllence B&W two-stroke engines operating on the biofuels covered in this Service Letter, no changes are required to NO_x critical components, or settings/operating values outside those given by the engine's approved Technical File. As always, when changing the fuel, the operator is responsible for ensuring that the settings/operating values stated in the Technical File are fulfilled at all times.

The document (MEPC.1/Circ.795/7) [7]: *Unified Interpretations to MARPOL Annex VI and the NO_x Technical Code 2008* is available on IMO's homepage (imo.org). Always refer to the latest revision.

Biofuel sample analysis

When sending samples of biofuels for analysis, it is important to inform the laboratory of the type of biofuel or biofuel blend the fuel is composed of, as this can facilitate the selection of characteristics to measure and the methods to use. It is recommended to always analyse the type and the amount of bio-component, e.g., FAME, 30%.

It is recommended to analyse the fuel according to ISO 8217. We recommend using the latest edition, currently ISO 8217:2024 edition 7, as this includes FAME and HVO [2].

At the time of writing, there is no international standard for analysing similar FAME-type fuels. A temporary option could be to analyse the similar FAME-type fuels using methods in ISO 8217:2024, Table 1, or Table 3, combined with methods in EN 14214, e.g., *EN 14105 Determination of free and total glycerol and mono-, di-, triglyceride content*. As similar FAME-type fuels are not part of the compositional requirements in ISO 8217, the use of similar FAME-type fuels could potentially be handled as an exception to the compositional requirement. It is recommended that the finished fuel meets all other requirements of ISO 8217.

Note that insurances, warranties, and contracts may include clauses on the usage of fuel that meets the ISO 8217 specification. A fuel can be considered to meet ISO 8217 if it adheres to the standard in its entirety. When new international standards or guidelines are issued, it is in generally advisable to consider these.

Biofuel sample analysis – considerations for each fuel type

Appropriate and relevant analyses methods should be utilised.

- 1) **HVO** – it is recommended using ISO 8217:2024, Table 1.
 - a) If the fuel contains less than 0.05% S, measure the viscosity and lubricity accurately, as these can be very low.
- 2) **FAME** – it is recommended to analyse the final fuel using ISO 8217:2024, Table 1: Distillate and bio-distillate marine fuels, or Table 3: Bio-residual marine fuels as applicable.
 - a) At the time of blending, the FAME should meet the requirements of EN 14214 or ASTM D6751, as stated in ISO 8217:2024.
- 3) **Similar FAME type fuels** – at the time of writing, there is no international standard. A temporary option is to use the methods in EN 14214 combined with methods in ISO 8217:2024. The final fuel should meet all requirements in ISO 8217, other than compositional requirements.
 - a) Analyse acid number.
 - b) Copper strip corrosion analysis should be considered. Steel strip corrosion analysis may also be available.
 - c) Wax appearance temperature (WAT) and wax disappearance temperature (WDT) (ASTM D8420) can support in establishing a suitable storage temperature for the fuels.
 - d) Elements according to IP 501, or other suitable methods.
 - i) Including phosphor (P), potassium (K), calcium (Ca), magnesium (Mg), and sodium (Na). The method chosen should be able to quantify the above elements correctly.
 - e) Lower calorific value – use the measured value (ASTM D240).

Lower calorific value – net specific energy

The lower calorific value (LCV) of the biofuel is preferably analysed according to ASTM D240, Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter.

The LCV, or the net specific energy (NSE), that is normally stated in the fuel analysis report is calculated by using the equations stated in ISO 8217:2024 (annex J: Specific Energy). These equations are not valid for biofuels, such as FAME or similar FAME-type fuels. Inputs to the equation are the properties of the fuel (density, water content, ash, and sulphur). If the equation is applied to a biofuel, the resulting NSE will be higher than the actual NSE.

NOTE: For the engine to run efficiently, it is important to adjust the engine operating parameters to the correct LCV (fuel energy content), see Appendices 2 and 3. For 100% FAME-type fuels, the difference between a correctly measured value and an incorrectly calculated value, according to ISO 8217:2024 Annex J, can be as large as 10%.

Acid number, oxidation stability

The correlation between acid number (AN, ASTM D664) and corrosive properties of marine fuels are complicated. Measuring the acid number can give an indication of the presence of acidic compounds in the fuel. Most fossil fuels have natural components with a measurable AN and the limits in ISO 8217 are based on these. Fuels with a high AN arising from acidic compounds may cause accelerated material damage, primarily found in the fuel injection equipment.

Fossil fuels made from naphthenic crude oils can have an acid number higher than 2.5 and still be acceptable for use. However, acid numbers below the limit values in ISO 8217 do not guarantee that a fuel is free from issues associated with acidic compounds. Currently, there is no recognised correlation between an acid number test result and the corrosive activity of a fossil fuel (ISO 8217:2024).

Biofuels differ from distillate and residual fuels. Acids in FAME fuels typically originate from two sources: (i) acids used in the production of the biodiesel that are not completely removed in the production process; and (ii) as a product from degradation of the FAME. Oxidation during storage and water can accelerate the formation of acids and other compounds, which can cause corrosion. Free fatty acids could cause issues with corrosion in the fuel pumps. Based on this, it is advisable to keep the acid number (AN value) of the biofuel (biofuel-part if a blend) at a low level.

The fuel must always be free from inorganic acids (strong acids), regardless of whether it is petroleum- or bio-based. Since there is a correlation between the presence of a strong acid and the corrosive activity of a fuel, the strong acid number [SAN] should be nil/0.

Lubricity

Everllence has opted to use the limits in ISO 8217 for lubricity which are most relevant for **fuels with sulphur contents lower than 0.05% S (500 ppm S)**. The lubricity limit is max. 520 μm (ISO 8217:2024) for a high-frequency reciprocating rig (HFRR) wear scar test. It might be needed to ask specifically for the lubricity to be measured at the laboratories.

Ash and elements

Biofuels can contain various elements that can form ash after combustion, just as petroleum-based fuels. The main origin of these is the feedstock and the production process, for example, the catalyst used. Phosphor (P) and potassium (K) content, and total ash content in the biofuel should be analysed, as increased levels of these can result in deposit buildup in various places, e.g., exhaust valves and turbocharger.

Technical and operational guidelines and recommendations

Before starting biofuel operation, ensure that the engine and associated systems are in good working condition and suited for biofuel operation.

Ensure that the fuel cleaning equipment, e.g., separators and filters, can handle biofuels [6]. If there are uncertainties, it is recommended to consult the original equipment manufacturer (OEM). Biofuels, as well as conventional fuels, require careful control of the fuel cleaning and conditioning process.

It is recommended to inform and prepare the crew that a new type of fuel will be bunkered, so they can prepare accordingly.

Materials

FAME and other biofuels may not be compatible with all materials, such as different metals, or thermoplastics and elastomers used in sealing applications. The sealing materials (PTFE¹ (such as Teflon), FMK¹ (such as Viton)) used in the high-pressure fuel system on the engine have shown acceptable service experience with FAME, similar FAME-type fuels, and HVO. It is advised to have an extra set of seals available onboard if replacement is needed. Changing seals is part of regular maintenance.

It is recommended to check that seals and materials in the engine room fuel oil system are compatible with the biofuel/biofuel blend. CIMAC Guidelines on Marine Fuels Containing FAME [6] contain information on materials and equipment, such as material compatibility, storage tanks, and fuel treatment systems.

1. Both PTFE and FKM are fluorinated polymers and can hence be found on the list of PFAS (per- and polyfluoroalkyl) substances which the European Chemical Agency (ECHA) is currently proposing to restrict. EU REACH (EC No 1907/2006), PFAS restriction proposal, www.echa.europa.eu

Equipment

Biofuels with a low LCV and a low viscosity may be a risk factor for some of the fuel injector designs. If the high-pressure fuel pumps are heavily worn and the fuel has a very low viscosity, i.e., leading to a high drain leakage (SL2019-670), individual cylinder units may not be able to reach the peak load. This is especially important for MC and MC-C engines.

Since biofuels often have a low viscosity, it is important to check that the fuel system and the fuel injection system are in a good, acceptable condition (see SL2022-726). If the fuel pumps are heavily worn, or other equipment is not working acceptably, it is, as always, recommended to carry out maintenance.

Biofuels can have a significantly reduced LCV (see Table 1) and a different density (kg/m^3) compared to a normal marine distillate fuel (DF) and may therefore require a higher fuel oil supply capacity (m^3/h). An initial assessment of the needed fuel oil supply capacity can be carried out using Eq. 1 (not for design):

$$FOC_{100\% \text{ bio}} \approx FOC_{100\% \text{ DF}} \times \left[\frac{(LCV_{DF} \times \text{Density}_{DF})}{(LCV_{Bio} \times \text{Density}_{bio})} \right] \quad [\text{m}^3/\text{h}] \quad \text{Eq. 1}$$

- $FOC_{100\%, \text{ bio}}$ expected fuel oil consumption of biofuel at 100% SMCR [m^3/h]
- $FOC_{100\%, \text{ DF}}$ measured fuel oil consumption of distillate fuel at 100% SMCR [m^3/h]
- Density_{DF} distillate fuel density [kg/m^3] (from DF analysis)
- LCV_{DF} distillate fuel LCV [kJ/kg] (from DF analysis)
- Density_{bio} biofuel density [kg/m^3] (from biofuel analysis)
- LCV_{bio} biofuel LCV [kJ/kg] (from biofuel analysis)

The reference consumption should be based on distillate fuel, as its viscosity properties most closely resemble those of biofuel. This ensures that the calculation compensates for the leakage drain with the highest possible accuracy. If the installed fuel supply pump capacity is larger than the calculated value, provided the rated pump capacity is intact, it is sufficient for operation at 100% SMCR on biofuel.

As a further assessment, a measurement (if possible) of the fuel oil flow through the fuel supply overflow valve (DF @ 100% SMCR) will indicate the actual capacity of the installed fuel oil supply pump. The capacity of existing pumps may be reduced due to age and wear.

If the fuel supply system shows indications of limitations, or under-capacity, even when operating on a distillate fuel, this should also be considered during the initial assessment.

Fuel management

General good practice for fuel management processes should be implemented for biofuel. The considerations, preparations, and procedures used for biofuel are basically the same as for ULSFO and VSLFO operation.

Information about viscosity, cold-flow properties, temperature management, and how to manage fuel on-board is available in the paper "[0.50% S fuel operation 2020](#)" [1]. More useful information can also be found in CIMAC Guidelines on Marine Fuels Containing FAME [6].

It is important to check the heating and cooling capabilities of the fuel system on the ship to ensure that it can handle both high- and low-viscosity fuels. Viscosity, pour point, and other cold flow properties can vary between fuel batches. To build in a margin for safe and reliable operation and maintaining the required viscosity at the engine inlet, it may be necessary to install cooler(s) [1].

Tanks and pipe systems

The following recommendations should be followed when bunkering and operating on biofuels:

- 1) Empty tanks completely before bunkering biofuel. Only the unpumpable heel should be left.
 - a) This is to avoid any compatibility issues.
 - b) Some biofuels can have a cleaning effect on the system. This means that the new fuel dissolves the residues in the system and brings it forward. At the beginning of use, it can result in increased sludge in filters and separators.
 - c) Cleaning/stripping of the tank can be recommended if excessive amounts of sludge are present.
- 2) Avoid mixing fuels
 - a) If fuels are mixed – ensure that the fuels are compatible.
- 3) The fuel temperature should be adjusted to a level suitable for the biofuel.
 - a) Check the viscosity and cold-flow properties and adjust the system accordingly.
 - b) The fuel temperature should be kept minimum 10°C above the pour point.
 - i) Some biofuels might require higher temperatures to avoid wax-formation.
- 4) Water contained in the biofuel should be settled and drained.
 - a) Removing water decreases the risk of microbial growth (see the next section) and the risk of fuel instability.
- 5) Monitoring the fuel filters and the fuel filter flow is important as filters may become blocked. The aim is to obtain a stable and normal flow.
- 6) Fuel cleaning should be carried out according to best practice. For more information, see SL2017-638 and reference [6].

Microbial growth in the fuel – “diesel pest”

Many biofuels are prone to attracting water, which also increases the risk of microbial growth and corrosion. Removing the water from the fuel will decrease this risk. If microbial growth is detected, it should be taken care of as soon as possible. It will not disappear by itself.

Microbial growth causes sludge and slime in tanks and pipes and may cause filters to clog. The microbes can produce acids, which can cause corrosion. They can also produce carbon dioxide and, in the worst case, the highly toxic gas hydrogen sulphide (H₂S), which may accumulate if not properly vented.

Water can be removed by a properly designed fuel system. It is important that the separators are operated and maintained. If free water is appearing in the fuel tanks, it is important to drain off this water.

A planned process for dealing with microbial growth should be carried out if detected. An example is given below:

1. Isolate the tanks and drain excess water
2. Seek expert guidance on following steps
3. Draw samples from the water-fuel interface in the tanks and from the sludge
4. Drain tanks to remove the water

Everllence does not recommend that ships carry their own biocide chemicals, unless this is part of a planned treatment program.

Cylinder lubrication

The currently used cylinder oil and feed rate can be kept as a starting point when starting biofuel operation, provided that the cylinder condition is acceptable during normal VLSFO and ULSFO operation. Subsequent adjustments in cylinder oil type and feed rate may be necessary based on scavenge drain oil analyses and scavenge port inspections. Liner temperatures could potentially increase slightly because of the longer injection duration. Careful drain oil monitoring is recommended to avoid potential issues. It is recommended to carry out scavenge port inspections before and after biofuel usage, or when required by the operating conditions. Refer to the latest lubrication guidelines, currently SL2025-776 and SL2023-737.

Recommended fuel viscosity at the engine inlet

The recommended viscosity range at the engine inlet for Everllence B&W two-stroke engines is the same for biofuels as for distillate and residual fuels. Always refer to the latest specification for the specific engine type. A suitable fuel injection temperature and viscosity need to be established. It may not be the same as for an equivalent fossil fuel.

Table 3: Recommended viscosity at the engine inlet

Range	Viscosity at engine inlet
Minimum	2 cSt
Normal (DM grades, HVO, B100-FAME, Bxx with DM grade)	3 cSt or higher
Normal (RM grades, Bxx with RM-grade)	3-18 cSt
Maximum	20 cSt

Engine control system and performance

B100 of FAME or similar FAME-type fuels usually have LCV values in the range of 36–38 MJ/kg. This means that more fuel is needed to achieve the same power output as with a regular petroleum fuel. Adjustments may be necessary in the engine control system (ECS) to correctly compensate for the change in injection quantity at a given load.

ME/ME-C and all dual-fuel engines

For ME/ME-C and all dual-fuel engines operating on a primary fuel (single fuel mode), the ECS has two options for automatically adjusting engine performance to compensate for changes in the fuel calorific value. Engines are configured with either '**PMI Autotuning**' or '**ACCo**' (**Adaptive Cylinder Control**) and each option has its own user interface for handling adjustments to the fuel quality.

If incorrect values of LCV (for PMI autotuning) or Manual Index calibration (for ACCo) are keyed into the ECS, this can, in the worst case, affect the engine's starting performance. Care must be taken to keep the performance parameters as stated in the Technical File.

Appendices 1 and 2 contain instructions for making these adjustments when running on fuel types with large changes in LCV, such as FAME or similar FAME-type fuels (B100). For dual-fuel engines operating in second fuel mode, e.g., on gas or methanol, no adjustments to the pilot-fuel injection are necessary.

Biofuel blends, for example B30, give a smaller difference in LCV. The same effects are still valid, but the impact will be significantly smaller for these blends compared to B100. In general, the engine control system can automatically adjust the intended injection quantity at a given engine load.

MC and MC-C engines

1. If the LCV is low, it may be necessary to adjust the limiters in the governor. The governor compensates for the lower LCV by increasing the fuel index (injection duration) to maintain the requested RPM. A larger amount of fuel will then be injected.
2. Verify the maximum operating load and smoke emissions when operating on a biofuel.
3. If the Everllence engine power limitation (EPL) is installed, the maximum power may be reduced when a fuel with a low calorific value is used. This can result in starting failures.

Managing potentially increased ash and element amounts

Biofuels can contain various levels of elements that can cause deposit buildup, just as other fuels. To ensure a good performance of the engine, it is, as always, important to monitor the turbocharger (TC) performance and to have a suitable cleaning frequency.

It is good practice to monitor the exhaust gas temperature after the TC and the scavenge air pressure. Indications of ash deposits accumulating in the TC include: If the temperature suddenly increases unexpectedly or steadily moves upwards, seemingly without reason; or if the scavenge air pressure drops or gradually decreases.

Deposit buildup can be counteracted by cleaning the turbocharger. In some cases, increasing the cleaning frequency can further help remove the deposits. Different turbocharger suppliers have different cleaning strategies. Please refer to the OEM specific guidance.

There is a protective grating (protection grid, gas grid) placed in the exhaust receiver directly in front of the turbocharger to prevent ash and debris from entering the turbine. This grating can also require cleaning if deposits are building up and the exhaust flow is obstructed. Refer to *Operation manual, 6645-0100-xxxx Checks during standstill periods, section 2.5 Exhaust receiver*.

Nevertheless, it remains the responsibility of the owner/operator of an engine to ensure that suitable fuels and lubes are conditioned and used to prevent damage to the engine and other equipment on board.

Yours sincerely,



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Appendix 1: Accounting for biofuels in the carbon intensity index

In 2023, IMO MEPC 80 adopted interim guidance on how to account for biofuels in the carbon intensity index (CII), which was implemented on 1 October 2023. The guidance is available on IMO's website as MEPC.1/Circ.905 [8].

Biofuels with a GHG emission reduction of minimum 65%, compared to a fossil MGO reference of 94 g_{CO₂eq}/MJ on a well-to-wake basis and which have been certified by a certification scheme recognised by the ICAO, may be assigned a Cf equal to the value of well-to-wake GHG emissions of the fuel, according to the certificate (expressed in g_{CO₂eq}/MJ) multiplied by its LCV (expressed in MJ/kg). For blends, Cf should be based on a weighted average (by energy) of Cf of the respective number of fuels.

Abbreviations:

GHG = Greenhouse gas

Fossil MGO = MGO equal to ISO 8217 DMA grade and part of ULSFO-DM grade

ICAO = International Civil Aviation Organization

Cf = carbon factor

LCV = lower calorific value

This interim guidance will be withdrawn when IMO Life Cycle Assessment (LCA) Guidelines have been further developed and agreed on at the IMO.

Appendix 2: Index calibration on engines with PMI autotuning

1. Key in the correct LCV (NSE) in the “Lower Calorific Value (MJ/kg)” box in the Index Calibration menu under Process Adjustments in the engine control system (ECS) (Fig. 1). Use a measured LCV value. The measurement standard ASTM D240 is recommended.
 - a) **Note! Remember to reset this value when biofuel operation ends.**
2. Add the “Fuel Oil Calculated Correction” value given by the MOP screen to the “Manual Fuel Oil Index Calibration” box, see example in Fig 1.
3. Verify the ECS internal load estimation by measuring the actual power with a torquemeter or by using the estimated load from the PMI system.
4. If necessary, adjust the applied “Manual Fuel Oil Index Calibration” value until the ECS load matches the measured load.

Note – these procedures are identical for both normal fuels and biofuels.

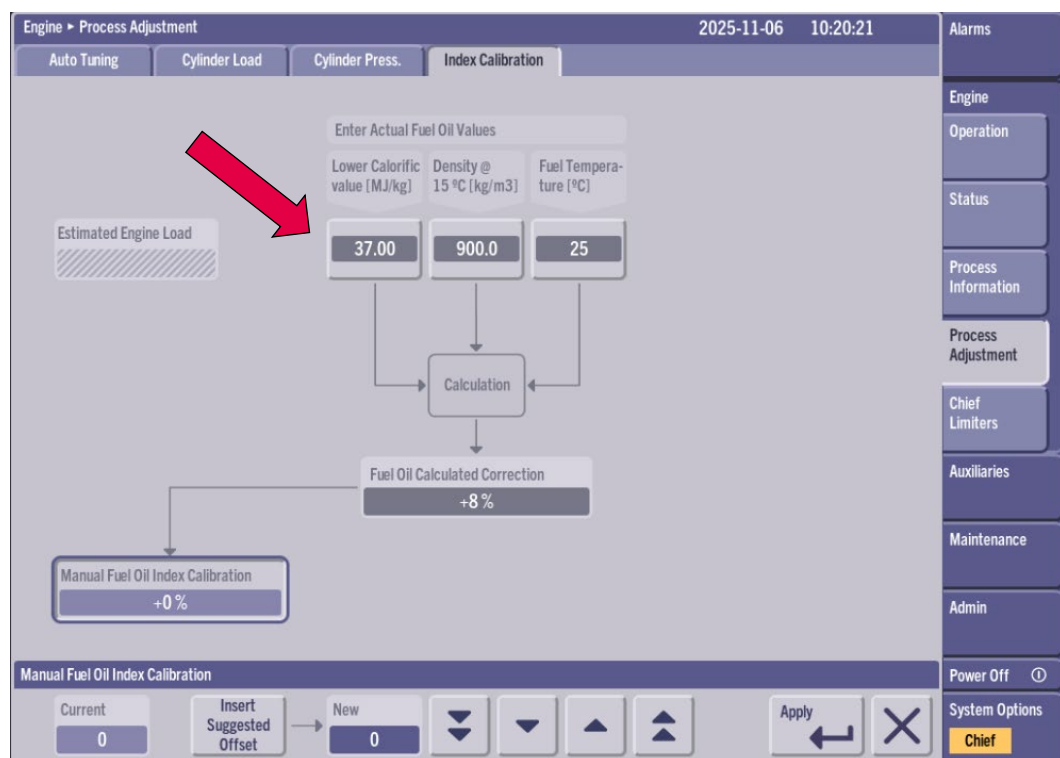


Fig. 1: Key in the correct LCV (NSE) in “Lower Calorific Value (MJ/kg)” in the ECS, as marked with a red arrow. In this example, the LCV for biofuel is set to 37 MJ/kg.

Appendix 3: Index calibration on engines configured with ACCo

Adaptive cylinder control (ACCo) is the newest collection of autotuning control features in the ECS. The wider adjustment band of the ACCo accommodates changes in the LCV. ACCo is therefore favourable for biofuel operation, especially for biofuel blends such as B30, as this can in many cases be done without any manual adjustments. When operating on 100% biofuel (B100) with an LCV in the range of 36–38 MJ/kg, a manual adjustment must be made using the following steps.

1. Calculate the “Manual Index Calibration” with Eq. 2.

$$\text{Manual Index Calibration} = 100 \times \left[\left(\frac{LCV_{DO}}{LCV_{bio}} \right) - 1 \right] \quad [\%] \quad \text{Eq. 2}$$

- LCV_{DO} is the LCV of the distillate fuel [MJ/kg] (reference value 42.7 MJ/kg)
- LCV_{bio} is the LCV for the biofuel or the biofuel blend [MJ/kg] (from fuel analysis)

Eq. 2 assumes that the two fuels are similar apart from the difference in LCV. Significantly large differences in, for example, density, can also be corrected for in the same way.

2. Key in the result in the ECS in the “Manual Index Calibration” box on the Running mode tab under process adjustments, as highlighted with a red arrow in Fig. 2. An ACCO alarm for “Manual Index Calibration” will be raised. This can be turned off.

Note! Remember to reset the “Manual Index Calibration” and the alarm when biofuel operation ends.

Example: Adjustment of the “Manual Index Calibration”

$LCV_{DO} = 43 \text{ MJ/kg}$ $LCV_{bio} = 37 \text{ MJ/kg}$

$$\text{Manual Index Calibration} = 100 \times \left[\left(\frac{43}{37} \right) - 1 \right] = 16\%$$

The screenshot displays the ECS interface with the following components:

- Header:** Engine ▶ Process Information, 2025-11-06 09:26:54, Alarms
- Navigation:** Running Mode, Speed Control, Cyl. Monitoring
- Engine Mode:** Economy
- Running Mode:** 1
- Fuel Index:** 100 %
- Estimated Engine Load:** 100 %
- Online Index Calibration (FO):** 0 %
- Online Index Calibration (SF):** 0 %
- Manual Index Calibration:** +0 % (highlighted with a red arrow)
- Parameter Table:**

Value	Set Point	Actual
Speed [RPM]	184.0	183.5
Hydraulic Oil [Bar]	300	300
Maximum Pressure [Bar]	123	---
Compression Pressure [Bar]	98	---
Pcomp/Pscav [-]	36.9	---
Pscav [Bar]		1.69
Variable EGB [%]	100	100
- Manual Index Calibration Section:**

Current	New
0	0

Warning: Manual Index Calibration should only be applied if Cylinder Process is controlled manually.

Buttons: Apply, X
- Right Sidebar:** Alarms, Engine, Operation, Status, Process Information, Process Adjustment, Chief Limiters, Auxiliaries, Maintenance, Admin, Power Off, System Options, Chief

Fig. 2: Illustrative example of the ECS screen. Key in the result from Eq. 2 in the ECS in the "Manual Index Calibration", as marked with a red arrow.