



IRCLASS
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GUIDELINES ON USE OF BIOFUELS ON SHIPS

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Guidelines

Use of Biofuels on Ships

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Section 1

Biofuels

1.1 Scope

1.1.1 The ongoing focus on reduction of greenhouse gas (GHG) emissions has led to search for alternative fuels and technologies. Towards this, biofuels offer an attractive option as 'drop-in' fuels for replacing conventional marine fuels, both in the short-term and the long-term. A 'drop-in' fuel is one that can blend with or fully replace an existing fuel with no modifications to fuel storage, transfer systems or end consumers required. Also, such fuels can utilize the existing/ available bunkering infrastructure and thereby provide an economical alternative to conventional fuels.

1.1.2 Due to the wide range of sources and production methods for biofuels, various types of biofuels are available such as:

(a) *FAME (fatty acid methyl ester)*: FAME is produced from vegetable oils, animal fats or waste cooking oils by transesterification, where various oils (triglycerides) are converted to methyl esters. This is the most widely available type of biodiesel in the industry and is often blended with regular marine diesel. In general, the FAME fuels are compliant with international standards such as EN 14214 or ASTM D6751.

(b) *HVO (hydrotreated vegetable oil)*: HVO or HDRD (hydrogenation- derived renewable diesel) is the product of fats or vegetable oils – alone or blended with petroleum – refined by a hydrotreating process. Diesel produced using this process is often called renewable diesel to differentiate it from FAME biodiesel. In general, HVO fuels are compliant with international standards such as ASTM D975.

(c) *BTL (biomass to liquid fuels)*: BTL is a synthetic fuel produced from biomass by means of thermo-chemical conversion. The end product can be fuels that are chemically different from conventional fuels such as gasoline or diesel but can also be used in diesel engines. In general, BTL fuels are compliant with international standards such as EN 16709 or EN 15940.

1.1.3 These Guidelines provide requirements for use of liquid biofuels on ships and offshore installations, as replacements of, or as blends with conventional petroleum derived residual (RM-grade) or distillate (DM-grade) fuel oils. Such biofuels should comply with the latest edition of ISO 8217 standard (see note below).

Note: *ISO 8217 presently covers only up to 7% volume Fatty Acid Methyl Esters (FAME) content. Currently, work is being undertaken to revise ISO 8217 standard to include FAME and paraffinic fuels, as a blend both in residual and distillate fuels of higher ratios ranging up to 100 %.*

1.1.4 These Guidelines are applicable to 'drop-in' biofuels but not to the bio-derived gaseous fuels such as biomethane or liquid methyl/ ethyl alcohol fuels which are covered by the IGF Code (IMO Resolution MSC.391(95), as may be amended).

1.1.5 The successful adoption of biofuels will also require Owners and other stakeholders to undertake their own assessments in accordance with relevant international standards, equipment manufacturers recommendations and industry best practice guidance as applicable, to ensure that the biofuel is compatible with the machinery and equipment fitted on-board, and also compliant with the applicable statutory requirements.

1.1.6 In addition to the requirements in these Guidelines, requirements of flag Administrations, Statutory / National authorities are to be complied with.

1.2 Definitions

1.2.1 Biofuel: is a fuel oil which is derived from biomass and includes, but is not limited to, processed used cooking oils, fatty-acid-methyl-esters (FAME) or fatty-acid-ethyl-esters (FAEE), straight vegetable oils (SVO), hydrotreated vegetable oils (HVO), glycerol or other biomass to liquid (BTL) type products.

1.2.2 Biofuel blends: are mixtures resulting from the blending of biofuels as defined above with a petroleum oil.

1.2.3 Biodiesel: Generic name for biomass-based fuel with properties like diesel or diesel containing bio-blends. The term is often used to describe FAME, but not exclusively.

1.2.4 Compatibility: Compatibility is the capability for different fuel types or similar batches to blend into a stable product.

1.2.5 Distillate Fuel: Fuel oil for combustion purposes with a kinematic viscosity at 40°C lower than, or equal to, 11,00 centistokes (mm²/s). DM Grade Fuel Distillate Marine grade fuels as specified in ISO 8217:2017 Table 1, i.e. DMX, DMA, DFA, DMZ, DFZ, DMB, DFB.

1.2.6 Drop-in: A liquid fuel intended as a direct replacement of, or blended with, conventional residual or distillate fuel oils and may be applied with little, or no, modification to existing fuel storage, distribution and consumer arrangements.

1.2.7 Fuel Oil: Any fuel delivered to and intended for combustion purposes for propulsion or operation onboard a ship, including gas, distillate and residual fuels.

1.2.8 HSFO: Fuel oil with a sulphur content exceeding 0.50 per cent e.g. HSFO mainly RM.

1.2.9 Residual Fuel: Fuel oil for combustion purposes with a kinematic viscosity at 40°C greater than 11,00 centistokes (mm²/s) (IMO).

1.2.10 RM: Grade Fuel Residual Marine grade fuels as specified in ISO 8217:2017, i.e. RMA, RMB, RMD, RME, RMG, RMK.

1.2.11 Stability: A measure of the resistance of a residual fuel to break down and precipitate asphaltic sludge despite being subjected to forces, such as thermal and ageing stresses, while handled and stored under normal operating conditions.

1.2.12 ULSFO: Fuel oil as specified in ISO 8217 with a maximum of 0.10 per cent (% m/m, 1000 ppm) sulphur content, e.g. ULSFO-DM, ULSFO-RM.

1.2.13 VLSFO: Fuels Fuel oil as specified in ISO 8217 with a maximum of 0.50 per cent (% m/m, 5000 ppm) sulphur content, e.g. VLSFO-DM, VLSFO-RM.

Section 2

General Requirements

2.1 General

2.1.1 The vessel is to be classed with IRS, as a prerequisite for consideration of usage of biofuels.

2.1.2 Details of any modifications to the Internal Combustion (I.C.) engines together with any changes to fuel tank arrangements, fuel piping systems, or machinery and equipment that may be required due to the use of biofuels, or biofuel blends, together with documentation detailing the implementation plan, are to be submitted for review.

2.1.3 I.C. engines are to undergo shipboard trials to demonstrate their suitability to burn biofuels, as per an approved trial protocol. For maintenance of Classification, biofuel operation is to be satisfactorily demonstrated to the attending Surveyor.

2.2 Notations

2.2.1 Additional class notation **BIOFUEL (Description)** will be assigned to vessels that are equipped for handling, storage, and propulsion with biofuels.

The description indicates the type of biofuel and biofuel blend and the applicable machinery, for which the assessment and satisfactory trials have been completed. An example of the description in parentheses is shown below. Similar description may be used for other blends such as B30, B50 etc:

BIOFUEL (FAME (B20), Main Engine(s))

Where biofuels could also be used on other machinery such as Auxiliary Engine(s), Boiler(s), Gas Turbine(s), then the notation would be as follows (for e.g.):

BIOFUEL (FAME (B20), Main Engine(s); HVO(B100), Boiler(s))

2.2.2 Use of biofuels for trial purposes on vessels may be permitted by the relevant flag Administration in accordance with Regulation 3.2 of MARPOL Annex VI. Such vessels will be assigned notation: **BIOFUEL TRIAL (Description)**, with description in parentheses, as indicated in 2.2.1. Refer Section 5 for further details.

2.2.3 Amended Class Certificate will be issued based on compliance with requirements in these Guidelines and successful completion of the trials.

2.3 Materials

2.3.1 All materials are to be manufactured, tested and inspected in accordance with Part 2 of *the Rules and Regulations for the Construction and Classification of Steel Ships* (hereinafter referred to, as the Rules).

2.3.2 All materials, coatings, and seals in contact with the biofuel(s) are to be compatible with the range of biofuels proposed to be used during the trials/ in-service.

2.4 Plans and Documentation

2.4.1 The following plans and documentation, as relevant and applicable, are to be submitted to IRS:

- Specifications, Material Safety Data Sheets (MSDS) and analyses of the proposed range of biofuel(s) or blends;

- Details and particulars of the ship(s) on which the biofuel(s) will be used, including intended IC engines and machinery;
- Details and particulars of any proposed modifications to fuel storage arrangements, fuel systems and equipment, IC engines; boilers, gas turbines and associated machinery;
- Arrangement of the fuel oil service tanks;
- Fuel system material and coating specifications;
- Copies of OEM biofuel specifications, agreements and communications with the OEMs;
- Details of the ship specific biofuel implementation plan and associated assessments;
- Information on MARPOL compliance aspects;
- Documentation detailing any planned long-term testing and monitoring.
- Proof of sustainability as per recognised International Certification Scheme.

Section 3

Arrangements for Biofuels

3.1 Fuel Tanks and Fuel Systems

3.1.1 Fuel tanks and fuel systems including fuel oil pumps, pipes, fittings etc. are to be arranged in accordance with the requirements in Part 4 of the Rules, as far as they are applicable to all flammable liquid fuels used onboard.

3.1.2 Any modifications to installed fuel storage, supply systems or treatment plants required for use of the proposed biofuel(s), or installation of additional equipment, etc. are to be submitted for approval.

3.1.3 Minimum two fuel oil service tanks for each type of fuel used on board necessary for propulsion and vital systems or equivalent arrangements (Refer Fig. 4.2.4 of Part 4, Chapter 3 of the Rules for equivalent arrangements) are to be provided for propulsion and generator systems.

3.1.4 Biofuels may utilize installed service tanks arranged for HFO or MGO provided that they are suitable for the storage of the specified biofuel; the propulsion and power generation systems are capable of operating on all fuels and that they support fuel changeover without loss of propulsion or power generation capability.

3.1.5 Effective tank cleaning is required prior to use for biofuel storage due to the solvent properties of FAME biofuels, and the same is to be adequately catered for, during preparation of the changeover plan.

3.1.6 Additional service tanks may be required where the risk of incompatibility of biofuel(s) with other DM or RM grade fuels (HSFO, VLSFO, ULSFO, etc.) as may be utilized on board, or the risk of loss of propulsion or power generation capability, has been identified by the changeover plan.

3.1.7 Emergency generators, lifeboat engines, diesel driven fire pumps etc. that may store fuel in individual fuel tanks are to be kept free of FAME biofuels, due to the risk of long-term water absorption and microbial growth.

3.2 Materials and Coatings

3.2.1 A main concern of biofuel use is corrosion of certain materials due to fuel acidity. High concentration biodiesels have the largest effect, but corrosivity may also depend on feedstock, water contamination and microbial growth. Deterioration of rubber, copper, brass, lead, tin and zinc components can occur, impacting fuel system parts including gaskets, hoses, fuel filters and fuel injectors. The materials and/ or their surface treatment used for the storage and distribution of fuel oil and biofuels are to be selected such that they do not contaminate or modify the properties of the fuel. Owners should verify that all components of the applicable fuel system are compatible with their specific biodiesel blend.

3.2.2 Where it is proposed to use a corrosion-resistant lining or coating in lieu of corrosion resistant materials, then such lining and coatings are to be confirmed as being suitable for the expected operating temperatures and pressures, and the corrosive properties of the biofuel(s) or biofuel blends.

3.2.3 The seals and gaskets used are to be compatible with the proposed biofuel or biofuel blends.

3.3 Temperature and Viscosity Considerations

3.3.1 Consideration is to be given to the biofuel properties and the required fuel heating (or cooling) of the specific biofuel or biofuel blends. Consideration is also to be given to the ship's intended operating area and ambient temperatures with respect to the biofuel cloud point, pour point and cold filter plugging point. It is recommended to maintain a storage temperature of at least 10°C above the pour point.

3.3.2 Where low viscosity biofuels are used, the fuel pumps are to be arranged in accordance with Part 4, Chapter 3, Cl. 4.10.4 of the Rules.

Section 4

Operational Considerations

4.1 Biofuel Specifications

4.1.1 The biofuel specification is required to be compatible with the machinery and equipment, and in accordance with the relevant and applicable statutory requirements.

4.1.2 It is recommended that the biofuel complies with a recognized national/ international standard and that the technical and operational parameters of the biofuel or biofuel blend as supplied comply with the ISO 8217 (see note under 1.1.3), to the extent feasible.

It is further recommended that deviations from the standard (if any) are understood and form part of the finalized specification between the purchaser and fuel bunker supplier. In all cases, the biofuel should be free of harmful materials and in compliance with the clause commonly referred to as the 'workmanship clause' outlined in Clause 5 of the standard.

4.1.3 Biofuels should be certified as a sustainable fuel, as per a recognized international Certification Scheme (e.g. International Sustainability and Carbon Certification Scheme (ISCC)), meeting its sustainability criteria. Relevant proof of sustainability certificate should also be provided by the fuel bunker supplier to the ship.

4.1.4 Following are relevant:

(a) Operation on distillate biofuels containing up to 7% FAME (as complying with ISO 8217:2017) is permitted and would not require NO_x recertification or any onboard NO_x emission measurements to be undertaken for engines already certified to MARPOL Annex VI, Regulation 13.

(b) For blends between 7-30% (inclusive) biofuel, assessment of NO_x impacts is not required under MEPC.1/ Circ. 795/ Rev.7. A fuel oil which is a blend of not more than 30% by volume of biofuel should comply with the requirements of regulation 18.3.1 of MARPOL Annex VI.

(c) For blends of more than 30% of biofuel, assessment of NO_x impacts is also not required if the biofuel can be burnt without changes to the NO_x critical components or settings in the approved NO_x Technical file.

4.1.5 As indicated in Section 5.2, the minimum flashpoint of the biofuel is to comply with SOLAS chapter II-2 and is to be documented by the fuel bunker supplier.

4.1.6 Due to the significant oxygen content of FAME and its blends, the Lower Calorific Value (or Net Specific Energy Value) cannot be calculated using the formulae as given in the Annex H to ISO 8217 but must instead be determined by testing – i.e., as per ASTM D240. However, for those biofuels such as HVO which are compositionally indistinguishable from high grade petroleum fuels the distillate formula as given in ISO 8217 can be used.

4.1.7 For FAME biofuels and biofuel blends, it is recommended that the FAME feedstock complies with standards such as

(a) EN 14214 Liquid petroleum products – Fatty acid methyl esters (FAME) for use in diesel engines and heating applications – Requirements and test methods (apart from CFPP and sulphur requirements); or

(b) ASTM D6751 Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels (apart from sulphur requirements).

4.1.8 For HVO biofuels and biofuel blends it is recommended that the fuel complies with EN 15940 Automotive fuels – Paraffinic diesel fuel from synthesis or hydrotreatment – Requirements and test methods.

4.1.9 Any other biofuel, i.e. other than FAME or HVO, supplied as 100 per cent or as a blend component should comply with a recognized standard, as far as possible, and this should be agreed for inclusion prior to supply.

4.1.10 Fuel properties critical to safe operations such as lubricity, cold flow properties, acid number and oxidation stability, etc. should be within the stipulated limits, as relevant and applicable.

4.1.11 The "Product Name", as entered onto the bunker delivery note, should be of sufficient detail to identify whether, and to what extent, a biofuel is blended into the product as supplied.

4.1.12 The bunker delivery note should be accompanied with a test report from a laboratory certified to ISO/IEC 17025 or an equivalent standard for the biofuel blend showing:

- .1 density at 15°C;
- .2 kinematic viscosity;
- .3 water content by volume;
- .4 sulphur content by mass, and
- .5 flash point as specified in ISO 8217:2017.

Additional tests such as determination of % FAME by Fame-Scan, gross and net calorific value determination (e.g. ASTM D2450), copper strip corrosion (e.g. ASTM D130) to gauge the corrosiveness of the fuel due to high FAME content, cold filter plugging point (CFPP), total acid number (TAN), oxidation stability and sediment wax precipitation point (SWPP) are recommended.

4.1.13 The bunker delivery note should be accompanied by a document stating the "*Date of manufacturing of biofuel*" used for blending and an indicated "*Shelf Life*."

4.1.14 Physical blending on board of petroleum oil and biofuels to prepare a blended mixture should not be allowed.

4.2 Biofuel Analysis

4.2.1 It is recommended that Owners may undertake a review of their onboard fuel quality monitoring procedures, (including fuel changeover procedures), for the specific biofuel types being considered.

4.2.2 Recommendations of the fuel supplier and equipment OEM are to be complied with: for stability and compatibility testing and any required fuel treatment onboard.

4.2.3 Microbial growth may be caused by longer term storage and hygroscopic effect of FAME based biofuels. Regular onboard checks and fuel testing for condition monitoring purposes are recommended on fuels intended to be stored for periods of more than the shelf life. It is however recommended that such fuels are used relatively quickly after bunkering, i.e. typically within two to three months.

4.3 Ship-specific Biofuel Implementation Plan

4.3.1 It is recommended that the Owner may consider the following aspects, whilst formulating a ship-specific implementation plan.

- a) Fuel specifications and availability/ procurement
- b) Fuel tank capacity and segregation capability (as relevant)
- c) Ship's area of operation and ambient temperatures
- d) Fuel changeover plan and training of personnel
- e) Risk assessment and mitigation
- f) Internal procedures and instructions

g) Documentation and reporting

4.3.2 A ship specific risk analysis should be carried out for the use of biofuel or blends of biofuel. Any measures required on board to address the risk as per the risk analysis should be implemented for the operational safety and emergency contingency measures.

4.3.3 The risk assessment should take into account properties listed below as may be relevant, while considering the storage, handling and use of the biofuels or blends of biofuel:

- a) Stability in storage;
- b) Viscosity;
- c) Sulphur content;
- d) Cloud point;
- e) Pour point;
- f) Carbon residue and ash;
- g) Water content
- h) Acid number
- i) Oxidation stability;
- j) Microbiological degradation;
- k) Material compatibility; and
- l) Flash point.

4.3.4 The ship-specific biofuel implementation plan is to be forwarded for review by IRS, as applicable.

4.4 Operation and Maintenance Considerations

4.4.1 Shipboard operational procedures should be provided which may be part of the Safety Management System manual and should include procedures for risk assessment, emergency contingency measures, procurement, storage and use of biofuels or its blends, inspection, maintenance and monitoring of fuel tanks, engine components, equipment and fittings in fuel oil system as may be required by the manufacturers.

4.4.2 Shipboard procedures should also include logging/monitoring of all relevant engine parameters, maintenance, and checks in consultation with the equipment manufacturer.

4.4.3 Any incident pertaining to use of biofuels or blends of biofuel should be reported to IRS/ the Flag Administration and a record maintained.

4.4.4 The crew should be familiarized with the safety in handling the biofuels or blends of biofuel including the shipboard procedures and contingency measures regarding the use of such fuel and records maintained.

4.4.5 The blend ratio and the carbon conversion factor for the biofuel blend is to be reported to the Administration while reporting ship fuel oil consumption data as per regulation 27 of MARPOL Annex VI.

4.4.6 The operational biofuel compatibility and stability checks, as applicable to the range of fuels used on board, together with detailed fuel changeover procedures appropriate for all the installed machinery and equipment that may use biofuels and any specific instructions for Master, Chief Engineer, or crew, are to be provided on board.

4.4.7 The availability of such procedures will be verified by the attending Surveyor.

Section 5

Regulatory Requirements for Biofuel Trials

5.1 General

5.1.1 Requirements in this Section are applicable to vessels where use of biofuels has been permitted by the flag Administration on a trial basis in accordance with the MARPOL Annex VI, Reg. 3.2.

5.1.2 Owners are to take due cognizance of the safety and environmental aspects contained in the Regulations to facilitate smooth trials of biofuels. This Section provides guidance on various aspects (including Regulations) to be considered, whilst undertaking biofuel trials.

5.2 Safety

Flashpoint

5.2.1 In accordance with the requirements of SOLAS II-2, Part B, Regulation 4.2.1.1, the flash point for all oil fuel used onboard (except in emergency generators, emergency fire pumps and other similar equipment, and with additional defined requirements) is to be greater than 60°C, as determined by a closed cup test in accordance with ISO 2719:2016.

This test method is suitable for determining the flashpoint of combustible liquids, including biofuels, that tend to form a surface film in the temperature range of 40°C to 370°C. Procedure A of ISO 2719 is applicable to distillate fuels (including biodiesel blends), Procedure B is applicable to residual fuel oils and Procedure C is applicable to FAME biofuels complying with EN 14214 or ASTM D6751 standards, respectively.

5.2.2 Biofuel compliance with the flash point requirements of SOLAS II-2/4.2.1.1 is not expected to be a concern (for e.g., the EN 14214 standard specifies a minimum flash point of 101°C for FAME fuels) however, it is recommended that this is verified in the agreed biofuel specification and documented by the fuel bunker supplier.

Material Safety Data Sheets

5.2.3 SOLAS chapter VI, Regulation 5-1 requires that ships carrying oil or oil fuel are to be provided with MSDS prior to the loading of such cargo in bulk or the bunkering of oil fuel. MSDS' are to be based on the format in resolution MSC.286(86), as may be amended. Accordingly, bunkered biofuels or biofuel blends would also be required to be delivered with MSDS that comply with the recommended IMO format.

Safety Management System

5.2.4 Introduction of a new fuel for use onboard is required to be considered under the ISM Code with respect to implications on the ship, its crew and the environment and; the Safety Management Systems may need to be updated, as relevant and applicable.

5.3 Environment

MARPOL Annex I

5.3.1 The discharge of oil or oily mixtures from ships is prohibited by MARPOL Annex 1, except when complying with defined criteria where discharges are to be processed by oil filtering equipment and discharge monitoring equipment complying with the requirements and associated guideline specifications. Discharges are not to exceed an oil content of 15 ppm and be provided with monitoring equipment that provides alarm and shutdown capability.

5.3.2 The Oily Water Separator (OWS) is to be compatible with the biofuels being used.

MARPOL Annex VI

5.3.3 *Regulation 3.2*: specifies the process for permitting trials for research in ship emission reduction and control technologies. This regulation provides a means for Owners and flag Administrations to gather NO_x (and other) emissions data from the use of biofuels in those engines installed onboard the ships undergoing trials. In such cases, the flag Administration may issue a permit for trials which allows exemption from specific provisions of MARPOL Annex VI or the NO_x Technical Code (NTC) to cover the emission reduction trials. Permits are to be issued to the 'minimum number of ships necessary' and are not to exceed 18 months for marine diesel engines with a per cylinder displacement up to 30 litres (if additional time is required, the Administration may permit a renewal for one additional 18 month period) and five years for marine diesel engines with a per cylinder displacement at or above 30 litres (with progress review by the Administration at each intermediate survey, and a renewal for an additional time period not exceeding five years).

5.3.4 *Regulation 4*: provides requirements for ships applying 'equivalents' to the Annex VI regulations. It is noted that Regulation 4.1 does allow '*alternative fuel oils*' to be used on board as an equivalent. Regulation 4.4 does however require that the flag Administration approving such equivalents is to '*... endeavour not to impair or damage its environment ...*', which implies that emissions measurements or trials may be required.

5.3.5 It is understood that ship trials in various areas have applied either Regulation 3.2 or Regulation 4 as the basis for undertaking trials of biofuels in accordance with instructions from the flag Administration.

5.3.6 *Regulation 13*: does not have direct requirements for the use of biofuels, however some limitations with respect to the NO_x implications of using fuels derived by methods other than petroleum refining under regulation 18.3.2 are provided, which are clarified as follows:

- Fuel oil which is a blend of not more than 30% by volume of biofuel and which do not require changes to its NO_x critical components or settings/operating values outside those as given by that engine's approved Technical File, will be considered falling under regulation 18.3.1 of MARPOL Annex VI and there is no change in IAPP certificate or supplement necessary.
- Fuel oil which is a blend of more than 30% by volume of biofuel and which does not require changes to its NO_x affecting components or settings/operating values outside those as given by that engine's approved technical file, such blends may be allowed to be used onboard without having to undertake the assessment as given in the Regulation 18.3.2.2.
- Fuel oil which is a blend of more than 30% by volume of biofuel and which require changes to its NO_x affecting components or settings/operating values outside those as given by that engine's approved technical file: The NO_x assessment required by Regulation 18.3.2.2 may be undertaken using the on-board simplified measurement method in accordance with 6.3 of the NTC or using the direct measurement and monitoring method in accordance with 6.4 of the NTC.

5.3.7 *Regulation 14*: regulates the sulphur content of fuel oils used on board ships. From Regulation 2.9, it is noted that the definition of 'fuel oil' covers all fuel delivered to and intended for propulsion or operation on board a ship, including gaseous fuels, as well as the conventional distillate and residual marine fuels. This broad definition is therefore understood to include biofuels and biofuel blends. Biofuels are inherently low in or contain negligible sulphur, but the actual sulphur content will depend on the biofuel specification and blend which, in any case, is to be indicated in the Bunker Delivery Note (BDN). Where ships are using separate fuel oils to meet the global and ECA limits, they are to carry a written procedure showing how the fuel changeover procedure is to be done (Refer Regulation 14.6). Such a procedure is to ensure sufficient time for flushing of fuel oils before entry into an ECA. The Regulation also requires the recording of relevant parameters, including fuel tank volumes, date, time, and position of the ship during the fuel changeover to be recorded in an appropriate logbook as prescribed by the Administration. Such changeover procedures should be included in the ship-specific implementation plan (Refer Section 4.3).

5.3.8 It is recommended that the Owner agrees to the application of UI MEPC.1/Circ.795/Rev.7 and/or Regulation 3.2 or Regulation 4 of Annex VI, with the flag Administration specifically for each biofuel(s) and each ship. Where it is not apparent that biofuel can be used without changes to the approved NOx Technical File, NOx critical components or settings/ operating values, obtaining concurrence from the engine OEM is recommended.

5.3.9 Operation within the approved range of NOx critical components or settings/operating values may be verified during the shipboard trials.

Chapter 4 Carbon Intensity Indicator

5.3.11 Reporting of the annual fuel consumption data is according to the methodology included in the approved Ship Energy Efficiency Management Plan (SEEMP Part II) that is required to be carried onboard each ship by MARPOL Annex VI Regulation 26. The use of biofuels may therefore require a change to the SEEMP Part II, and any required amendments should be considered in the ship-specific biofuel implementation plan.

5.3.12 MEPC.1/Circ. 905 provides interim guidance on the use of biofuels under regulations 26, 27 and 28 of MARPOL Annex VI. The Circular gives an interim simplified method until a more comprehensive method is developed to calculate a fuel's Emission Conversion Factor, pending further development of the methodology according to the LCA Guidelines. The Circular specifies that biofuels that have been certified by an international certification scheme, meeting its sustainability criteria, and that provide a well-to-wake GHG emissions reduction of at least 65% compared to the well-to-wake emissions of fossil MGO may be assigned a carbon emission factor 'C_f' value corresponding to the well-to-wake GHG emissions of the fuel and its LCV. For blends, the C_f should be based on the weighted average of the C_f for the respective amount of fuels by energy. Regarding the certification scheme, the guidance refers to ICAO's Approved Sustainability Certification Schemes and the CORSIA Sustainability Criteria (Chapter 2) for CORSIA Eligible Fuels. The interim guidance is effective from 01 Oct 2023.

Note: For e.g. In case, it is declared in the Proof of Sustainability certificate under one of the approved schemes mentioned above, that the Well-to-Wake emissions of the Biofuel is 14 gCO_{2e}/MJ and has a lower calorific value of 40000 J/g,

Then the 'C_f' factor for the biofuel component would be $14 \times 40000 / 1000000 = 0.56$.

If the above biofuel is used in a B30 blend with diesel oil, then 'C_f' based on weighted average would be $((0.7 \times 3.206) + (0.3 \times 0.56)) = 2.4122$

Section 6

Biofuel Trials

6.1 Verification by IRS

6.1.1 The following documentation will be reviewed by IRS towards vessels undertaking trials/ plying on biofuels:

- Ship-specific biofuel implementation plan
- Plans/ documentation regarding any changes to fuel systems/ engines.
- Procedures for collection/verification of data during trials. (Review of proposal for use of Biofuel on board).
- Safety management system procedures incorporating the requirements as mentioned in the document.
- NOx Measurement procedure (for engines having NOx technical file and for engines without NOx certification), as applicable.
- Sea trials procedure and subsequent review of sea trial reports.
- Reports of NOx measurement of Main Engines and Auxiliary Engines, as relevant and applicable.

6.1.2 Following would be carried out by IRS Surveyor on-board, as and when decided for such an attendance by IRS on case-to-case basis:

- Verification of changes to fuel systems or engines having been completed in accordance with approved plans (as relevant and applicable).
- Familiarity of the crew with the fuels being used and any required fuel changeover procedures (i.e. Ship-specific biofuel implementation plan) are available and implemented.
- Measurement of NOx and other gases during initial trial, as applicable.
- Vibration measurements at various load points.
- Stripping down of engines to be offered for examination (preferably after 3 months of trials)

6.2 Shipboard Trials

6.2.1 Emission Measurements may be carried out in any of the following cases:

- (a) Supporting trial use of biofuels in accordance with MARPOL Annex VI, Reg. 3.2
- (b) Demonstration of equivalency in accordance with MARPOL Annex VI, Reg. 4
- (c) Confirmation (where required) that the biofuels will not cause the engine to exceed the applicable NOx limit (Reg. 13 and as referred to be Reg. 18.3.2.2)

6.2.2 Engines are to undergo shipboard trials as indicated in Part 4, Chapter 4, Sec. 4.12 of the Rules. These trials may be carried out simultaneously with any other testing required by the flag Administration for reasons of safety or environmental considerations.

6.2.3 A sample of the biofuel is to be drawn for subsequent analysis to verify the relevant parameters and properties of the biofuel are consistent with the specifications and complying with the OEM and/ or other statutory requirements.

6.2.4 The Surveyor is to verify the availability of the relevant documentation and procedures including the fuel changeover procedures and any other specific instruction to the ship's crew.

6.2.5 In the long term, monitoring of aspects identified under Section 2.4.1 or emission testing under MARPOL Annex VI Reg. 3.2 may be required. It is recommended that such trials are included in the ship-specific biofuel implementation plan.

6.3 On-board Monitoring and Best Practices

6.3.1 Frequency of cleaning of fuel filters: Some contaminants in biofuels have relatively low solubility in diesel fuel and can precipitate from fuel blends leading to formation of larger agglomerates. These can settle in the bottom of storage tanks and clog filters. The frequency of filter cleaning is to be noted and reported.

6.3.2 Storage tanks, transfer lines and associated piping and fittings are to be inspected at regular intervals.

6.3.3 Following engine parameters are to be monitored and reported at the interval of one hour for at least first 100 hours of running on biofuel and at the interval of 2 hours until the first engine strip down is carried out:

- Engine power/ torque - Engine speed
- Fuel index
- Exhaust gas temperature before turbine
- Charge air temperature
- Charge air pressure
- Turbocharger speed
- All other engine parameters that are required for control and monitoring for the intended use.

6.3.4 In addition, the following best practices may be followed:

- Ensure tanks are arranged and cleaned for the range of fuels intended to be used.
- Take all necessary precautions and actions to remove cat fines from the fuels to the OEM recommended level.
- Use cylinder lubrication oil which is recommended/approved by the OEM for the specific engine type/ model and fuels being used.
- Evaluate drain oil samples of every cylinder as recommended by the OEM. In general, samples should be taken at regular intervals of 14 days or monthly, or more frequently if suspected wear issues are detected.
- Test the total content of iron (Fe) and residual base number in the cylinder oil drain samples. Laboratory testing according to ASTM D5185-09 is the most appropriate measuring method. But the base number is to be tested in accordance with ISO 3771:2011(E) procedure. Onboard analysis kits should be used to compare results with the laboratory analysis.
- Cylinder oil base number levels in drain oil samples may vary depending on the engine and oil type. Generally, the remaining BN should not be lower than 25% of the new cylinder oil.

- Optimize the correct cylinder oil lubrication feed rate, following the procedure developed and provided by the OEM.
- Regularly check the piston ring and the cylinder liner conditions through scavenge port inspections.
- Follow OEM guidance on piston and piston ring specifications, consider replacing the installed pistons and/or piston rings with the OEM recommended ceramic coated piston rings at an appropriate maintenance point.
- Optimize cylinder liners with the engine temperature profiles, and in accordance with OEM recommendations to prevent cold corrosion.

References:

- MEPC.107(49), Revised Guidelines and Specifications for Pollution Prevention Equipment for Machinery Space Bilges of Ships, as amended by MEPC.285(70)
- MEPC.108(49), Revised Guidelines and Specifications for Oil Discharge Monitoring and Control Systems for Oil Tankers, as amended by MEPC.240(65)
- MSC-MEPC.2/Circ.17, Guidelines for the Carriage of Blends of Biofuels and MARPOL Annex I Cargoes
- MEPC.1/Circ. 879, Guidelines for the Carriage of Energy-Rich Fuels and their Blends
- MEPC.1/Circ. 795, Rev 7, Unified Interpretations to MARPOL Annex VI
- MEPC.1/Circ. 905, Interim Guidance on the use of Biofuels under Regulations 26, 27 and 28 of MARPOL Annex VI (DCS and CII).
- DGS (Government of India) MS Notice No. 14 of 2023 - Use of Biofuel and its blends on Indian Ships-reg
- IRS Technical Circular 58/2022 dated 26th September 2022
- ISO 8217:2017 - Petroleum products - Fuels (class F) - Specifications of marine fuels
- ISO 2719:2016/Amd 1 2021 - Determination of flash point — Pensky-Martens closed cup method
- EN 14214 - Liquid petroleum products - Fatty acid methyl esters (FAME) for use in diesel engines and heating applications - Requirements and test methods (includes Amendment :2019)
- EN 15940 - Automotive fuels. Paraffinic diesel fuel from synthesis or hydrotreatment. Requirements and test methods (includes Amendment:2019)
- EN 590:2022 - Automotive fuels. Diesel. Requirements and test methods
- ASTM D6751:2023 - Standard Specification for Biodiesel Fuel Blendstock (B100) for Middle Distillate Fuels
- ASTM D975:2022 - Standard Specification for Diesel Fuel

End of Guidelines