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BUNKERING GUIDE

June 2018

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Introduction 1

The loading of bunker on board a ship is a vital and critical operation. Due care must be taken to ensure safety and to mitigate the risks of oil pollution. Vessel operators should help to manage the risks involved by ensuring that all the relevant crew are familiar with the management procedures relating to bunker operations and that they have completed the appropriate training.

The purpose of this guide is to help seafarers involved in bunkering operations to act in compliance with the appropriate regulations and industry best practices to promote safe and efficient bunkering operations. The guide will also be of value to shore staff.

The guide aims to provide general information, advice and guidance. Detailed and ship specific guidelines, instructions and procedures are available in the Safety Managements System (SMS) and the Shipboard Oil Pollution Emergency Plan (SOPEP) or Ship Pollution Emergency Plan (SMPEP) as appropriate.

This guide covers the traditional bunkering of oil based fuels such as residual and distillate fuels and their various blends.

Regulation and guidance 2

IMO SOLAS – **Regulation of flash point and provision of Safety Data Sheets (SDS)**

IMO MARPOL Annex I – **Regulations for the prevention of pollution by oil**

IMO MARPOL Annex VI – **Regulation of air pollution from ships**

ISO 8217 – **Standard for marine fuels**

ISO 13739 – **Standard for bunkering procedures**

ISO 4259 – **Standard for interpretation of test analysis results**

CIMAC Guideline No. 25 **Recommendations on Heavy Fuel Treatment Plants**

Fuel types

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There are two principal types of bunker fuel oil:

Residual Fuel	Distillate Fuel
available in varying viscosities and high and low sulphur variants	marine diesel & gas oil with both high and low sulphur variants

Residual fuels are a mix of refinery residual fuel and diluents, which are often distillates blended to meet the specification requirements of a number of different grades.

Distillate fuels (which are products obtained by condensing the vapours distilled from petroleum crude oil or its products) are blends of refinery distillate streams to meet the requirements of a number of different grades, and come in two main variants:

Marine Gasoil (MGO)	Marine Diesel Oil (MDO)
a clear distillate and does not contain any residual component	may contain a small amount of residual fuel component

The majority of marine fuels are classified in accordance with the ISO 8217 standard. The sixth edition, published in March 2017 is divided into distillate marine (DM) grades, Distillate FAME (DF) grades and residual marine (RM) grades. The descriptions of which are identified as follows:

DM grades — *Distillate Marine*

DMX	special grade for lifeboat and emergency equipment engines where fuel is stored outside the machinery spaces (this fuel has a low flash point with very low ambient temperatures - it must be free from FAME)
DMA	conventional marine gas oil (MGO); max 1.00% sulphur (max 1.50% in previous edition)
DMZ	conventional marine gas oil (MGO) with an elevated minimum viscosity; max 1.00% sulphur (max 1.50% in previous edition)
DMB	conventional marine diesel oil (MDO); max 1.50% sulphur (max 2.00% in previous edition)

DF grades — *Distillate FAME*

DFA	the same as DMA but with up to 7% bio diesel content by volume
DFZ	the same as DMZ but with up to 7% bio diesel content by volume
DFB	the same as DMB but with up to 7% bio diesel content by volume

RM grades — *Residual Marine*

RMA10				
RMB30				
RMD80				
RME180				
RMG180	RMG380	RMG500	RMG700	
RMK380	RMK500	RMK700		

The letters indicate the grade specific parameters whilst the number indicates their maximum viscosity in mm^2/s (or centiStokes) at 50°C. The most significant grade differentiations are that RMK grades have a higher density limit of 1010 kg/m^3 which is too high to be used with older

designs of purifiers. When selecting the appropriate grade to be supplied to the ship, due consideration must be given to the limitations imposed by the storage, handling and treatment plant onboard the ship, the limitations of the machinery with regard to burning the fuel as well as limitations imposed by MARPOL Annex VI. Particular care must be taken with regard to the geographical area in which the ship is operating (for compliance with MARPOL Annex VI) and the associated storage and operation temperatures (for determining the cold flow characteristics of the fuel).

Low Sulphur Fuel Developments

Some of the fuels introduced in late 2014 that meet the 0.10% sulphur limit in ECAs, do not meet the ISO 8217 distillate specifications (DM). Although, some of these are closer to DM than RM grades in nature, they are typically sold under ISO 8217 RM specifications (RM grades). The key difference between these low sulphur fuels and regular RM grades tends to be that they have a higher viscosity and some need heating to remain liquid. The 0.50% sulphur limit is expected to be met with a large range of fuel blends, many of which will not meet DM specifications. Blend components may include various heavy and light refinery product streams, including residual fuels oils and middle distillates. For such fuels, the key parameters to know include their cold flow properties and viscosity to ensure appropriate storage and handling, and diligent fuel segregation to prevent problems with potential fuel incompatibility.

Health, Safety & Environment (HSE) protection 4

Fuel oil and distillates are hazardous to health. Skin contact can cause dermatitis (a form of skin irritation) and some products used to blend fuel oil have been linked to cancer. The inhalation of vapours from fuel contaminated with some organic compounds have been linked with sickness. Hydrocarbon vapours are toxic and anaesthetic and many people have been overcome by such fumes, sometimes with fatal results.

Fuel oil and distillates always pose a risk of fire and explosions. The fuel will give off flammable vapour, and if this mixes with air and meets a source of ignition there may be an explosion.

All marine fuels are pollutants and can damage the environment. They are toxic to marine life and the heavier grades are very difficult to clean up after a spill. For these reasons, stringent measures must be taken to keep fuel restricted to the designated tanks and pipelines.

In order to advise all users of these risks, oil suppliers are required to provide Safety Data Sheets (SDS) to the ship prior to loading or bunkering. This is to help shipboard personnel carry out their duties under safe conditions. The SDS can include warnings and guidance for the handling of fuel oil and vapours that may; ignite, cause dizziness and headaches, contain hydrogen sulphide which is highly poisonous, harm or cause irritation to skin or irritate the mouth and lungs. This calls for the following precautionary measures:

PRECAUTIONARY MEASURES

OILS AND VAPOURS

Never enter enclosed spaces not approved for entry.
Stand to windward when opening tank lids or sampling points.
Use goggles.
Wear suitable gloves.
Wear suitable working protective clothing.
Change out of any oil-soaked clothing as soon as possible.
Keep all doors to the accommodation areas closed during bunkering and shut off or recirculate the air conditioning system.

FIRE

Keep all bunker fuel away from naked flames, sparks or other sources of ignition.
Keep all bunker fuel away from heated surfaces.
Do not smoke on deck during bunkering operations.
Do not smoke near fuel tanks, or other locations where there may be fuel vapours.

PROTECTION MEASURES

SAFETY AND ENVIRONMENTAL

Know and use the appropriate SMS checklists and procedures for bunkering and if applicable for ship to ship operations.

Know the ship's SOPEP or SMPEP.

Ship's oil spill equipment is to be ready and available in accordance with the SOPEP/SMPEP.

Ensure proper lines and means of communication both internally and externally are established prior to bunkering.

Plug all drains on the bunker tanker and the ship.

Drain off any accumulation of oil-free water periodically.

Any spill related to a bunkering operation must be reported immediately, and in accordance with SOPEP/SMPEP and local laws and regulations to the appropriate bodies, including but not limited to:

- port authorities
- port state authorities
- owners/operators/managers
- ship's P&I club
- oil spill contractors/qualified individuals, if applicable
- ship's flag state.

Fuel handling 5

Preparations to bunker

In all cases the ship, agent and supplier should have agreed the location and delivery method before the ship arrives in port. In the case of barge delivery, the location will often be determined by the port authorities.

Prior to the bunker delivery, it is important for the ship's Master and supplier to ensure the following:

GENERAL
the fuel supplier knows exactly the type and amount of fuel required to be loaded
discuss and decide the procedures for setting up the pipelines, valves and receiving tanks
agree on the arrangements, the delivery flow rate and the manner of communication during the bunker operation
decide on the order in which the tanks will be filled
decide the pumping rate and the estimated duration of the operation
discuss and make arrangement as to how the supply line will be shut down and disconnected when the bunkering operation is finished

SAFETY
both parties take all necessary safety and antipollution measures prior to commencing the bunkering operation
both parties follow the bunkering process
both parties are aware of how to stop the bunker operation in case of an emergency

SAMPLING
agree on sampling point
discuss and decide the sampling procedures that will take place during the bunkering operation
take representative fuel samples during bunkering at an agreed location

Careful handling on board is crucial, to minimize contamination by avoiding co-mingling different fuel oils both in tanks and fuel oil lines, and to prevent the introduction of contaminants that could lead to sulphur infringements, environmental problems or safety issues. The mixing of different types of fuels that were bunkered at different times should be avoided if possible. Before bunkering, the old fuel should preferably be consolidated in tanks that ensure the "new" fuel can be bunkered into empty tanks. The "old" fuel should be used first.

Before the start of bunkering the barge supplier crew and a representative from the ship will check the measurements of the barge's tanks. It is usual for the bunker supplier to get a document signed by the receiving ship, called a "master's requisition", confirming the quantity, quality and often the order of grades to be pumped and the pumping rate required. It will be at this point the ship can expect to receive a quality certificate if available.

Bunkering operation

As with all shipboard operations, monitoring of the operation and watch keeping is to be carried out in accordance with the SMS, SOPEP or SMPEP and good seamanship, whilst taking into account the prevailing conditions on board and in the vicinity of the ship. There should be a minimum of one deck watchman and one engine-room watchman on duty, but this should not preclude the use of new technology such as closed-circuit cameras, always monitoring the:

- **safe access between ship to shore or ship to ship**
- **bunker transfer connection**

- **bunker transfer process (transfer rate in order to avoid overfills, bunkers received compared to capacity and agreed quantity, estimated time of completion, etc.)**

- **sampling.**

During the bunkering, all events and operations are to be carefully entered in both the deck and engine log books respectively and checks made that the appropriate entries in the engine room oil record book are also completed.

The actual bunkering starts slowly in order to check that there are no leaks and that oil is going in the assigned tanks. The pumping rate will then increase to the agreed transfer speed before slowing down at the end. Throughout the operation both ship and the supplier will monitor their tanks to ensure that the oil is coming from the correct supplier tanks and ends up in the correct tanks of the ship. It will often be necessary to reduce the pumping rate when the receiving ship is changing tanks.

Once the tank has been shut off from the supply line, the tank level should be rechecked to ensure the inflow of fuel has been stopped.

Measurements and quantity

When fuel is supplied it is important to ensure that the quantities supplied are correctly recorded on the Bunker Delivery Note (BDN). Whilst the receiving vessel will make its own checks and calculations, in almost all cases the commercial contract will base the quantities on the measurements at the supplier's facility (terminal, road tanker or barge). The contract will contain a provision for the representative of the buyer to witness these measurements. A prudent bunker buyer should consider appointing a third-party bunker surveyor, who should be present before, during and after bunkering in order

to assist the receiving vessel with the correct received volumes.

In order to calculate the quantity, the key measurements required are the liquid level in the tank and the temperature of the product in the tank. The liquid level may be determined either by a sounding (depth of the liquid) or ullage (distance from the liquid to the tank top). When witnessing barge measurements, the witness should take care to ensure that there is no pumping or product transfer taking place at that time. All barge tanks should be measured, even those not involved in the supply, all tank temperatures need to be measured and the temperature reading given time to stabilize before it is recorded. The initial measurements must be taken before the start of supply and the final measurements taken after the supply is complete and the pipe and hose contents allowed to drain back to the barge prior that measurement.

The depth of liquid determines the observed volume of product and by using the Volume Correction Factor (VCF) this can then be converted to give the standard volume of the product. The supplier should supply the standard density of the product which allows the mass in vacuum to be determined. The application of the Weight Correction Factor permits the conversion to mass in air (sometimes called weight). In the case of a barge delivery, the trim of the barge is needed to correct the tank level measurement. The conversion of level measurement to volume is made by reference to the tank calibration tables, and if on a barge, these tables also provide the trim corrections.

If volumetric flow metering is used, the meter reading should be taken before the start and again at the end of delivery. If a volume meter is used for residual fuels, check to see if it has automatic temperature compensation.

The procedures for Mass Flow Metering (MFM) are different. The witnessing involves verification of the meter system sealing arrangements before and after supply, the resetting of the resettable totalizer before commencement and the reading of that totalizer at the end of supply. As the MFM provides a quantity in mass, there is no need to make calculations of the volume or mass. The MFM will provide a computed standard volume and a computed average standard density.

Vessels should be aware that different countries use different standard temperatures, different volume units and some use different mass measurements (mass in vacuo instead of mass in air).

The contract is almost always based on the supplier's measurements. The vessel staff needs to ensure that they have witnessed the barge measurements, verified the BDN data and calculations and, if appropriate submitted a "note of protest" to the supplier's representative if there is a significant difference between the suppliers delivered quantity and the quantity on board the receiving ship.

Sampling, including MARPOL sampling

The taking of samples is vital in establishing the actual quality of fuel supplied. It may be used in evidence in both commercial and criminal courts, so adherence to a strict sampling procedure is vital to protect the interests of all parties involved.

The most cost effective and reliable method of sampling is accepted to be the use of a manual continuous drip sampler mounted on the delivery line. The location of the sampler is the subject of much debate. Most supplier's term of sale and some jurisdictions specify sampling on the barge, while the IMO guidelines for the MARPOL sample in Resolution MEPC.182(59) advise sampling at

the intake flange of the receiving vessel, the ISO 13739 standard, meanwhile, allows for the use of either end of the bunker supply hose subject to mutual agreement.

The objective is to gather a sample that matches the quality of the actual product supplied as closely as possible. The usual sample quantity collected will be between 4 and 5 litres and it must be collected over the whole of the delivery period. The rate of collection is adjusted by a small needle valve and the supervisor of the sampling should check the rate of sampling throughout the entire operation, adjusting the flow as required. If the bunker operation requires the use of two barges pumping product consecutively, then each barge delivery should be subject to a separate sample collection. The collected sample must be decanted into the required number of separate sample containers in accordance with the appropriate procedure. This will usually require agitation of the bulk container, decanting of sample into each sample bottle in turn filling each by one third capacity before resealing the bulk container, and repeating the process (agitation then decanting) two more times. The sample bottles should all then be sealed with individually numbered seals and labelled. The seal numbers must be recorded on the BDN. Vessel staff should understand that the "commercial" samples which are proof of quality delivered against the nominated specification and the "MARPOL" sample for regulatory control are separate. They may be taken from the same bulk sample collection container but they are not interchangeable once sealed. The MARPOL sample given to the receiving ship must be retained under the ship's control (generally on board the ship) for at least 12 months or until consumed, whichever is longer.

While a fuel oil purchaser/user may choose to use ISO 13739 or some other sampling procedure, it should

be remembered that MARPOL Annex VI sets out the procedures for compliance and enforcement. If a specific sampling method is desired, it can be specified in the fuel oil purchase contract. However, that contract will not override the requirement of MARPOL Annex VI in respect to compliance with mandatory standards or enforcement brought about by a flag, port or coastal state.

Bunker Delivery Notes

The BDN is the official receipt acknowledging the apparent grade and quantity of bunker fuel supplied to the receiving vessel. In addition to its commercial function it has to fulfil certain requirements of MARPOL Annex VI for regulatory and compliance purposes. The requirements are laid out in regulation 18.5 of Annex VI and Appendix V of Annex VI stipulates the information to be included in the BDN. Appendix V has been amended to allow for supply of fuel oils exceeding the limit values of the regulation to ships using abatement technology (equivalent means) to comply. The amendments enter into force on 1 January 2019, which is reflected in the following overview of information to be included in the BDN and accordance with the MARPOL regulation:

- **name and IMO number of receiving ship**
- **port**
- **date of commencement of delivery**
- **name, address and telephone number of the marine fuel oil supplier**
- **products name**
- **quantity in metric tonnes**

- **density at 15°C (kg/m^3)**
- **sulphur content (% m/m)**
- **Up to 31 December 2018: a declaration signed and certified by the fuel oil supplier's representative that the fuel supplied is in conformity with regulation 18.3 and the applicable subparagraph of regulation 14.1 (global limit) or 14.4 (ECA limit) of MARPOL Annex VI.**
- **After 1 January 2019: a declaration signed and certified by the fuel oil supplier's representative that the fuel supplied is in conformity with regulation 18.3 and that the sulphur content of the fuel oil supplied does not exceed the limit value given by regulation 14.1 or 14.4 of MARPOL Annex VI, or the purchaser's specified sulphur limit value (in % m/m). The latter is to be completed by the fuel oil supplier's representative based on the purchaser's notification that the fuel oil is intended to be used either in combination with an equivalent means of compliance in accordance with regulation 4 of Annex VI, or that the ship is subject to a relevant exemption to conduct trails for sulphur oxides emissions reduction and control technology research in accordance with regulation 3.2 of MARPOL Annex VI.**

Additional details may be included according to local requirements and the commercial requirements of the seller. The BDN must be signed by both the supplier's representative and the receiving vessel. For MARPOL compliance, the BDN must be kept available for inspection on board the receiving ship for a period of three years.

Testing

A prudent owner will have a sample of delivered fuel tested by an independent accredited testing laboratory and will try to ensure that he has the results of the analysis

available before the fuel has to be used.

Fuel testing is not required for MARPOL compliance or to meet the minimal requirements of ISM procedures certified by IACS members. It is however, a major help in avoiding issues with the use and handling of a fuel on board.

The first requirement is a representative sample of the delivered fuel. This then needs the prompt transportation to the testing laboratory, a speedy programme of fuel testing and an accurate and realistic assessment of the fuel quality parameters.

Most analysis programmes will provide a test report assessing the fuel against the nearest ISO 8217 grade and giving a narrative account of any non-compliant parameters of the fuel together with suggested remediation.

The analysis will be part of any evidence in the event of a quality claim against the supplier, therefore, the quality of the samples taken is critical. If this sample is taken at delivery and witnessed by both parties then it is likely to carry considerable weight. Samples taken after delivery and outside of the purview of the supplier are going to struggle to be accepted as evidence.

It is also critical to note that the sample analysis must be compared against the grade actually ordered. The original nomination messages and the agreed terms of sale are crucial in assessing if the correct fuel was supplied.

Analysis

The quality and usefulness of the report depends on how well the samples were taken, how promptly the laboratory receives the samples and how well the laboratory staff assessing the fuel are informed about the treatment plant on the receiving ship. Vessel staff receiving the report need to understand that whilst a report may indicate that one or more parameters may exceed the limits in the ordered specification, this does not automatically render the fuel unfit for use. Many defects, if proven, may justify commercial compensation even though the fuel remains suitable for use; however, in some cases the defects may mean that the fuel needs special treatment, remediation or in extreme cases, removal from the vessel. If a supplied fuel is reported to exceed the parameter limits of the ordered specification, the vessel should seek guidance from the vessel operator, who in turn may need to take external expert advice. The actual test results need to be viewed in light of the provisions of ISO 8217 and ISO 4259 (which is referenced in ISO 8217). There is excellent guidance on interpreting the results in a document published by the International Council on Combustion Engines (CIMAC) (see section on "Useful Links")

Disputes 6

It is important that the vessel representative does not sign the BDN unless they are satisfied that the details on the note are correct, within the limits of the information available to them. In cases where there is some dispute as to the details, this should be recorded in a "note of protest", given to the supplier's representative and once a copy has been signed by the supplier's representative (for receipts only), then the BDN can be signed.

BIMCO's Bunkering Operations and Sampling Clause 7

BIMCO has initiated a suite of standard bunker clauses for use in time charter parties. The rationale behind developing the suite is to address the increasing importance of bunker issues in time charter parties and to minimise the risk of bunker disputes, by using clearly worded clauses that reflect legislative developments. The suite provides clauses to cover matters relating to the delivery/redelivery of bunkers; bunkering operations; sampling; fuel testing programmes; and ECA trading, all of which are matters that are frequently absent from or insufficient in many standard time charter parties. Many older time charter forms contain bunker clauses covering the fundamental principles under the charter, but do not take into account today's situation where vessels are required to carry and use several grades of fuel and where sampling and testing regimes are an integral part of the process. However, like any charter party clause, they can be modified by mutual consent by the charterer and owner.

Useful links

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www.bimco.org – **BIMCO homepage and access to the Suite of BIMCO standard bunker clauses.**

www.ibia.net – **International Bunker Industry Association homepage gives information and news on bunkering issues.**

www.cimac.com – **The International Council on Combustion Engines (CIMAC) which promotes the exchange of scientific and technical information between engine manufacturers and owners.**

www.imo.org – **International Maritime Organization is the United Nations specialized agency with responsibility for the safety and security of shipping and the prevention of marine pollution by ships.**

www.iso.org – **International Organization for Standardization homepage giving access to ISO standards.**

www.mpa.gov.sg – **Maritime and Port Authority of Singapore homepage gives information on the quality of supplies and services to all parties within the bunker supply chain in Singapore as well as the effective, safe and secure bunker delivery operations.**

Conclusion 9

It's the hope of BIMCO and IBIA that this pamphlet will be used on board ships as guidance in bunker operations to ensure safe and secure handling of bunker fuel in compliance with applicable regulations, and to help shore based staff to avoid the most common pitfalls.

BIMCO

BIMCO is the world's largest international shipping association, with around 2,000 members in over 120 countries. Our global membership includes shipowners, operators, managers, brokers and agents.

Our vision is to be the chosen partner trusted to provide leadership to the global industry. Our mission is to provide expert knowledge and practical advice to safeguard and add value to our members' businesses.

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IBIA

The International Bunker Industry Association (IBIA) is the voice for the global bunker industry across all sectors and the entire industry value chain. The Association represents stakeholders in discussions and negotiations with other industry associations, national and international policy makers and legislators, including IMO where IBIA has consultative NGO status. IBIA promotes the common good of the industry through education, fostering professional conduct and developing standards.

For more information, contact the IBIA at:

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BIMCO and IBIA gratefully acknowledge the co-operation and assistance provided by Nigel Draffin, M.I. Mar.E.S.T. in the production of this publication.

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