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# *Implementation of Shipping MRV Regulation Monitoring*

European Sustainable Shipping Forum
Subgroup on Shipping MRV Monitoring

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# *Contents Part I: Key elements with regard to monitoring other relevant information*

1. Distance travelled
2. Total time spent at sea
3. Determination of cargo carried
   a) Passenger ships
   b) Ro-ro ships
   c) Container ships

# *1. Distance travelled*

## 1.1 International and European rules and standards

IMO Assembly Resolution A.916(22) / Annex 22 of Solas chapter V:

records must be kept so that 'a complete record of the voyage' can be restored.

EEOI guidelines:

define 'distance travelled' as 'the actual distance travelled in nautical miles (deck log-book data) for the voyage or period in question.'

## 1.2 Technological and scientific developments

Not applicable

## 1.3 Impact on the regulation

None, because distance travelled can be monitored and reported using data from ship logs.

# *1. Distance travelled*
*Questions for discussion*

- ***Are there any other relevant international and European rules and standards or technological and scientific developments to be considered?***
- ***Should the above mentioned international and European rules and standards or technological and scientific developments trigger any amendments to Annex I?***

# 2. *Total time spent at sea*

## 2.1 International and European rules and standards

IMO Assembly Resolution A.916(22) / Annex 22 of Solas chapter V:

records must be kept so that 'a complete record of the voyage' can be restored.

EEOI guidelines, definition of 'voyage':

'the period between a departure from a port to the departure from the next port'

This means that the 'total time spent at sea' is different than the voyage-time, since the time in port is not included.

## 2.3.Impact on the regulation

There may be a need to define 'port departure' and 'port arrival'.

# ***2. Total time spent at sea***
*Questions for discussion*

- ***Do you consider the above suggestion to provide definitions on 'port departure' and 'port arrival' in Annex II relevant and desirable?***
- ***Are there any other relevant international and European rules and standards or technological and scientific developments to be considered?***
- ***Should the above mentioned international and European rules and standards or technological and scientific developments trigger any amendments to Annex I?***

# *3. Amount of cargo carried – passenger ships*

## 3.1 International and European rules and standards

SOLAS Chapter III requires that all passenger ships record the number of passengers on board.

The EEOI Guidelines (MEPC.1/Circ.684) defines cargo for passenger ships as either 'number of passengers or gross tonnes of the ship'. Since the gross tonnage of a ship has no relation to the actual transport work and is monitored elsewhere, the number of passengers is an appropriate measure of the amount of cargo for passenger ships.

## 3.2 Technological and scientific developments

Not applicable

## 3.3 Impact on the regulation

None

# *3. Amount of cargo carried – passenger ships*
*Questions for discussion*

- ***Are there any other relevant international and European rules and standards or technological and scientific developments to be considered?***
- ***Should the above mentioned international and European rules and standards or technological and scientific developments trigger any amendments to Annex I?***

# *4. Amount of cargo carried – ro-ro ships*

## 4.1 International and European rules and standards

*Guidelines regarding the verified gross mass of a container carrying cargo*, (MSC.1/Circ.1475) applies to ro-ro ships if the ship has been determined by the Administration to be subject to SOLAS chapter VI .

The shipper shall inform the master of a ship about the verified gross mass of a packed container in writing and prior to loading a container.

The EEOI guidelines prescribe the use of mass of the cargo for ro-ro ships.

## 4.2 Technological and scientific developments

Not applicable

## 4.3 Impact on the regulation

Mass of cargo could be added as an option.

# *4. Amount of cargo carried – ro-ro ships*
*Questions for discussion*

- ***Should the rules for determining cargo for ro-ro vessels be amended in the light of the Guidelines regarding the verified gross mass of a container carrying cargo?***
- ***If yes, how?***
- ***Are there any other relevant international and European rules and standards or technological and scientific developments to be considered?***
- ***Should the above mentioned international and European rules and standards or technological and scientific developments trigger any amendments to Annex I?***

# *5. Amount of cargo carried – container ships*

## 5.1 International and European rules and standards

*Guidelines regarding the verified gross mass of a container carrying cargo*, (MSC.1/Circ.1475) applies to ro-ro ships if the ship has been determined by the Administration to be subject to SOLAS chapter VI .

The shipper shall inform the master of a ship about the verified gross mass of a packed container in writing and prior to loading a container.

## 5.2 Technological and scientific developments

Not applicable

## 5.3 Impact on the regulation

A specific reference should be made to MSC.1/Circ.1475.

# *5. Amount of cargo carried – passenger ships*
*Questions for discussion*

- ***Should the rules for determining cargo for container ships be amended in the light of the Guidelines regarding the verified gross mass of a container carrying cargo?***
- ***If yes, would you agree to add a reference to these Guidelines or would you suggest another option?***
- ***Are there any other relevant international and European rules and standards or technological and scientific developments to be considered?***
- ***Should the above mentioned international and European rules and standards or technological and scientific developments trigger any amendments to Annex I?***

# *Contents Part II: Monitoring Methods*

1. Bunker Fuel Delivery Note (BDN) and periodic stocktakes of fuel tanks;
2. Bunker fuel tank monitoring on board;
3. Flow meters for applicable combustion processes;
4. Density values (Methods A/B/C)
5. Temperature correction (Methods A/B/C)
6. Emission factors (Methods A/B/C/D)
7. Direct emission measurements/CO2 analyzers (Method D);
8. Mass Flow calculation (Method D)

# *Contents Part II: Monitoring Methods*

Is the list complete or are there any other relevant international and European rules and standards or technological and scientific developments to be considered?

Bunker Fuel Delivery Note (BDN) and periodic stocktakes of fuel tanks;

Bunker fuel tank monitoring on board;

Flow meters for applicable combustion processes;

Density values (Methods A/B/C)

Temperature correction (Methods A/B/C)

Emission factors (Methods A/B/C/D)

Direct emission measurements/$CO_2$ analyzers (Method D);

Mass Flow calculation (Method D)

# *1 Bunker delivery notes (BDN), and regular stocktakes of fuel tanks (Method A) (1/3)*

## 1.1 International and European rules and standards

The BDN's are to be **kept on board for a period of three years** after the fuel oil has been delivered and readily available for inspection at all times (MARPOL 73/78 Annex VI Appendix V, Regulation 18 (3)).

The bunker fuel delivered to the ship should **comply with ISO 8217** which specifies the quality of the fuel and safety aspects.

The **BDN** contains the **sulphur content**, **ISO 8217** contains additional information on **water, ash and sediment content** of the fuel. This is important for corrections regarding actual fuel burnt.

For the **conversion of volume to mass** the **density** and **temperature** are required. Methods for the determination of density and temperature are discussed later.

There are also more **ISO standards** for the determination of water and sediment in petroleum products.

**Regular stocktakes of fuel tanks** are discussed under method B

**Comment:** BDNs are out of the ships boundary.

# *1 Bunker delivery notes (BDN), and regular stocktakes of fuel tanks (Method A) (2/3)*

## 2.1.2 Technological and scientific developments

Using fuel specification according to **ISO 8217 in the BDN** is under discussion (MEPC 68/3/4: Report of the Correspondence Group on Fuel Oil Quality).

**MPA Singapore** makes the use of **mass flow meters** mandatory for bunkering of fuel. This will be discussed under the flow meter section.

## 2.1.3. Impact on the regulation

No impact, there will just be more information included in the BDN in case ISO 8217 fuel specification will be used for BDNs.

# *1 Bunker delivery notes (BDN), and regular stocktakes of fuel tanks (Method A) (3/3)*

*Questions for discussion*

***1) Are there any other relevant international and European rules and standards or technological and scientific developments to be considered?***

***2) Should the above mentioned international and European rules and standards or technological and scientific developments trigger any amendments to Annex I?***

# *2 Fuel tank readings (Methods A/B) (1/3)*

## 2.1 International and European rules and standards

International **Organization of Legal Metrology** OIML R 95: Ships' tank – General requirements.

There are also a number of **ISO standards** dealing with the measurement of liquid levels for petroleum products.

The **density at 15°C** can also be derived from the **BDN**. Other methods are discussed later. Conversion to actual temperatures is required.

# *2 Fuel tank readings (Methods A/B) (2/3)*

## 2.2 Technological and scientific developments

Fuel tank readings can be carried out **manually** (sounding tapes or ullage), **mechanically** (e.g. floats or gauge glasses) or by **automatic tank gauges**.

There are a number of **automatic** (or electronic) **tank gauges** based on different technologies, which are already widely accepted for fuel tank level readings:

Bubbler gauge (famous for remote reading gauges),
Ultrasonic Level gauges,
Radar Level gauges,
Pressure Based Level Measurement,
Ultra-Sonic/Microwave Level Sensor,
Capacitive Level Sensor

## 2.3 Impact on the regulation

None

# *2 Fuel tank readings (Methods A/B) (3/3)*

*Questions for discussion*

***1) Are there any other relevant international and European rules and standards or technological and scientific developments to be considered?***

***2) Should the above mentioned international and European rules and standards or technological and scientific developments trigger any amendments to Annex I?***

***4) Is there a need to add calibration methods and intervals according to manufacturer's specification?***

# *3 Fuel flow meters (1/3)*

## 3.1 International and European rules and standards

**Directive 2004/22/EC** (Annex MI-005) on measuring instruments defines the requirements that the devices have to satisfy including maximum permissible error based on accuracy classes and associated measuring systems (temperature, density and pressure).

International Recommendation (Contained in above directive): **International Organization of Legal Metrology** (OILM) 2007: Dynamic measuring systems for liquids other than water

Meter and liquid measuring systems newly designed after 30 October 2006 will have to be submitted for **type evaluation** under the new MID Directive 2004/22/EC.

The evaluation required on these new meters and systems will result in an **EC type examination certificate** with reference to the MID directive.

Compliance with this directive is assumed when using the above OIML recommendations

Further, there are several ISO standards for measuring liquid hydrocarbons

# *3 Fuel flow meters (2/3)*

## 3.1 Technological and scientific developments

There are basically four types of flow meters:

1. **Volumetric** flow meters (also called positive displacement meters)
2. **Differential Pressure** flow meters
3. **Velocity** flow meters
4. **Mass** flow meters measure the mass of a liquid passing. They do not require temperature/density correction.

**New developments**: **Multiphase** flow meters, which can detect e.g. entrapped air in the fuel pipe.

**Info:** The **Maritime and Port Authority of Singapore** (MPA) announced that Singapore as the largest bunkering port in the world was set to be "the first port in the world to mandate the use of **mass flow meters** for bunkering".

The mandatory requirement for fuel suppliers will come into effect on January 1, 2017.

## 3.2 Impact on the regulation

None so far.

# *3 Fuel flow meters (3/3)*
*Questions for discussion*

***1) What is the expected impact of the future requirement for mass flow meters for bunkering in Singapore?***

***2) Is there a need to add calibration methods and intervals according to manufacturer's specification?***

***3) Some engines have a return flow pipe, which requires separate flow meters to calculate the fuel consumption by the difference (fuel consumed – fuel returned to fuel tank). Should this be specified in Annex I?***

***4) Are there any other relevant international and European rules and standards or technological and scientific developments to be considered?***

***5) Should the above mentioned international and European rules and standards or technological and scientific developments trigger any amendments to Annex I?***

# *4 Density values (Methods A/B/C) (1/3)*

## 4.1 International and European rules and standards

**Actual density recorded in the BDN**: MARPOL Annex VI Appendix V requires fuel suppliers to report fuel density (tested using ISO 3675:1998 or ISO 12185:1996).

**Actual On-board density** measurements are carried out according to ISO 650:1977: Relative density 60/60 degrees F (15°C) hydrometers or ISO 12185:1996: Crude petroleum and petroleum products -- Oscillating U-tube method.

**Laboratory density** is measured according to ISO 3675:1998: Crude petroleum and liquid petroleum products -- Hydrometer method. Another lab method is carried out with pyknometers (ISO 3838:1984).

**Standard density** values are given in Petroleum measurement tables (ISO 91-1 and 91-2:1991).

# *4 Density values (Methods A/B/C) (2/3)*

## 4.1 Technological and scientific developments

Several **manual** and **electronic test kits** are on the market for off-line sample analysis. Claimed accuracy is 0.1%.

When fuel **oil quality** changes, the **standard density tables** require revision.

Density could be measured in **fuel test laboratories** for all three fuel monitoring methods (A/B/C).

## 4.2 Impact on the regulation

Annex 1, 2. Method B, paragraph (c) allows a third method for the determination of density:

"(c) the density measured in a test analysis conducted in an accredited fuel test laboratory, where available."

**Suggestion:** This option should be included into Methods A and C.

# *4 Density values (Methods A/B/C) (3/3)*
*Questions for discussion*

***1) Do you consider the above suggestion on density measurement relevant and desirable?***

***2) Are there any other relevant international and European rules and standards or technological and scientific developments to be considered?***

***3) Should the above mentioned international and European rules and standards or technological and scientific developments trigger any amendments to Annex I?***

# *5 Temperature correction (Methods A/B/C) (1/2)*

## 5.1 International and European rules and standards

There are **standard petroleum measurement tables** for reference temperatures of 15 °C and 20°C:

ISO 91-1:1992: Petroleum measurement tables -- Part 1: Tables based on reference temperatures of **15 degrees C** and 60 degrees F.

ISO 91-2:1991: Petroleum measurement tables -- Part 2: Tables based on a reference temperature of **20 degrees C**.

ISO 4268:2000: Petroleum and liquid petroleum products -- Temperature measurements -- **Manual methods**.

API, Manual of Petroleum Measurement Standards Chapter 7

## 5.2 Technological and scientific developments

None. Mass flow meters do not require temperature correction.

## 5.3 Impact on the regulation

None

# *5 Temperature correction (Methods A/B/C) (2/2)*

*Questions for discussion*

***1) Are there any other relevant international and European rules and standards or technological and scientific developments to be considered?***

***2) Should the above mentioned international and European rules and standards or technological and scientific developments trigger any amendments to Annex I?***

# *6 Emission factors (Methods A/B/C/D) (1/3)*

## 6.1 International and European rules and standards

**Default values**

2006 **IPCC Guidelines for National Greenhouse Gas Inventories**: Default, upper and lower (uncertainty) emission factors in kg CO2/TJ.

**Commission Regulation** (EU) No°601/2012 Annex VI **refers to IPCC** 2006. This also includes biofuels.

**IMO MEPC**.1/Circ. 681: Interim Guidelines on the Method of **Calculation of the EEDI** for New Ships. Carbon content of fuels and CO2 emission per ton fuel in t CO2/t-fuel.

EN 16258:2012: Methodology for calculation and declaration of **energy consumption and GHG emissions of transport services**.

American Petroleum Institute (API) 2009 Table 4-3 page 150

**Comment:**

Data from IPCC 2006 contain fuel emission factors in tons $CO_2$ per Tera Joule [t $CO_2$/TJ] and net calorific values per mass of fuel [TJ/Gg]. 1 Gg = 1000 t

Emission factors are not given for biofuels.

# *6 Emission factors (Methods A/B/C/D) (2/3)*

## 6.1 Technological and scientific developments

**IPCC Emission Factor Database** currently contains default emission factors of the 2006 IPCC Guidelines.

New data are expected to be provided by the global scientific and inventory society and lead to **permanent updates**.

## 6.2 Impact on the regulation

None as Annex 1, chapter A, paragraph 6 of the adopted MRV already refers to the IPCC Guidelines.

**Alternatively**, the use of established **IMO emission factors** for heavy fuel oil, light fuel oil and marine diesel and gas oil should be allowed.

The advantage would be that **no conversion** from net calorific values (TJ) per mass of fuel (Gg) to tons CO2 per net calorific value (TJ) would have to take place.

In case the use of IMO emission factors shall be allowed, the following text could be added: "**Alternatively, IMO emission factors (MEPC.1/Circ.681, 2009) can be applied**"

# *6 Emission factors (Methods A/B/C/D) (3/3)*

*Questions for discussion*

***1) Do you consider the above suggestion on emission factors relevant and desirable?***

***2) Are there any other relevant international and European rules and standards or technological and scientific developments to be considered?***

***3) Should the above mentioned international and European rules and standards or technological and scientific developments trigger any amendments to Annex I?***

# *7 Direct emission measurements/CO2 analyzers (Method D) (1/3)*

## 7.1 International and European rules and standards

**MARPOL Annex VI** Resolution 2 Appendix 3: Specification for analysers to be used in the determination of gaseous components of diesel engine emissions.

CO2 analysis shall be carried out with **Non-Dispersive InfaRed** (NDIR) absorption type.

**Other analyzers** may, subject to **approval by the Administration**, be accepted if they yield equivalent results to that of NDIR absorption.

**Calibration methods**: MARPOL Annex VI Resolution 2 Appendix 4: Calibration of the analytical instruments.

## 7.2 Technological and scientific developments

IMO: The delegation of Japan informed in PPR 1/9/2 that a technology for undertaking **measurement of CO2 on a wet** basis is now available and so should be appropriately reflected in the guidelines.

Proposed draft amendments were agreed at PPR.

# *7 Direct emission measurements/CO2 analyzers (Method D) (2/3)*

## 2.7.3. Impact on the regulation

A specification of CO2 analyzers (Non-Dispersive InfaRed (NDIR) absorption type) or equivalent CO2 analyzers in terms of accuracy could be added to Annex I.

**Note:** CO2 is measured as gas volume concentration in the exhaust gas volume: ppm (V/V). Conversion to mass is required.

# *7 Direct emission measurements/CO2 analyzers (Method D) (3/3)*

*Questions for discussion*

***1) Do you consider the above suggestion on a specification of CO2 analyzers relevant and desirable?***

***2) Are there any other relevant international and European rules and standards or technological and scientific developments to be considered?***

***3) Should the above mentioned international and European rules and standards or technological and scientific developments trigger any amendments to Annex I?***

# *8 Mass Flow calculation (Method D) (1/3)*

## 8.1 International and European rules and standards

CO2 analyzers measure Volume CO2 in a Volume of gas. This requires conversion to mass.

MARPOL Annex VI, **NOx Technical Code**, Chapter 5

- 5.5.1: **Direct measurement method**. Direct measurement of exhaust gas flow by flow nozzles or equivalent metering systems.
- 5.5.2: **Air and fuel measurement method**
- 5.5.3: **Calculation** of the exhaust gas mass flow (carbon-balance method)

**The latter two methods include fuel consumption data.**

In case the exhaust flow is measured directly by e.g. **nozzles** in the exhaust gas system (5.5.1), the NOx Technical Code requires the instrument to be **approved** according to a recognized international standard.

In a Note it says that "Precautions shall be taken to avoid measurement errors which will result in emission value errors."

**Directive 2004/22/EC** (Annex MI-010) on measuring instruments: Defines the requirements that the devices have to satisfy.

# *8 Mass Flow calculation (Method D) (2/3)*

## 8.1 Technological and scientific developments

Normally the air/fuel ratio serves as basis for the mass flow calculation.

## 8.2 Impact on the regulation

As two of the three mass flow measurement or calculation methods **require fuel consumption data**, there will be a link to the other methods on measurement of fuel consumption.

This way method D will fall back in most cases to methods A/B/C. This could be mentioned in Annex I.

# *8 Mass Flow calculation (Method D) (3/3)*

*Questions for discussion*

***1) Do you consider the above suggestion on a reference to methods A/ B/ C relevant and desirable?***

***2) Are there any other relevant international and European rules and standards or technological and scientific developments to be considered?***

***3) Should the above mentioned international and European rules and standards or technological and scientific developments trigger any amendments to Annex I?***