INTERNATIONAL MARITIME ORGANIZATION

E

INTERSESSIONAL MEETING OF THE WORKING GROUP ON REDUCTION OF GHG EMISSION FROM SHIPS
8th session
Agenda item 2

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GUIDELINES SUPPORTING THE EEXI FRAMEWORK

Comments on draft guidelines associated with the Energy Efficiency Existing Ship Index (EEXI) in document ISWG-GHG 7/2/7

Submitted by BIMCO and RINA

SUMMARY

Executive summary:	This document proposes an alternative method to determine an accurate reference speed (V_{ref}) for EEXI, based on empirical data from in-service ship performance measurements. The alternative method and the associated result for V_{ref} should be verified by the recognized organization prior to issuing the International Energy Efficiency Certificate (IEEC). The alternative approach is a supplement to the draft guidelines on the method of calculation of the attained EEXI and draft guidelines on survey and certification of the EEXI provided in the annexes to document ISWG-GHG 7/2/7, as considered by the Correspondence Group on the Development of Technical Guidelines on Carbon Intensity Reduction.
Strategic direction, if applicable:	3
Output:	3.2
Action to be taken:	Paragraph 30
Related documents:	ISWG-GHG 7/2/7; MEPC 75/WP.3, MEPC 75/18 and MEPC 75/18/Add.1

Introduction

1 This document is submitted in accordance with document ISWG-GHG 8/1 and comments on draft guidelines associated with the Energy Efficiency Existing Ship Index (EEXI) provided in document ISWG-GHG 7/2/7 (Greece et al.).

2 Following discussion, the ISWG-GHG 6 agreed on two approaches: a technical approach and an operational approach. Both approaches were further developed in parallel, of which the informal group on the technical approach was coordinated by Japan.

3 The informal group on the technical approach worked together to develop a concrete proposal for a measure using the energy efficiency measure utilizing EEXI submitted by Japan and Norway (ISWG-GHG 6/2/3) as the base document for further consideration. The base document comprised draft guidelines on the method of calculation of the attained EEXI, including draft guidelines on survey and certification of the EEXI, in which the calculation and verification of existing ships' EEXI are to be carried out by referring to the EEDI framework.

4 ISWG-GHG 7 agreed to the urgency of finalizing the draft associated guidelines.

5 MEPC 75 approved the draft amendments to MARPOL Annex VI concerning mandatory goal-based technical (EEXI) and operational (CII) measures to reduce carbon intensity of international shipping with a view to adoption at MEPC 76.

6 MEPC 75 subsequently established the Correspondence Group on the Development of Technical Guidelines on Carbon Intensity Reduction to, inter alia, further consider and develop the draft technical guidelines supporting the EEXI framework as set out in annexes to document ISWG-GHG 7/2/7, including the draft guidelines on the method of calculating the energy efficiency existing ships index.

7 The Correspondence Group was instructed by MEPC 75 to submit a written report to MEPC 76 to be first considered by ISWG-GHG 8.[*]

8 This proposal is developed by an informal industry group consisting of representatives from ship performance consultancies, classification societies and academia, coordinated by BIMCO. The proposal has been developed in parallel to the ongoing work in the Correspondence Group. The informal group has met (online) 5 times during the period November 2020 to end of January 2021.

9 This proposal was not submitted to the Correspondence Group until round three, owing to the late start of the work.

Discussion

10 As part of the EEXI regulations, which are likely to be adopted at MEPC 76, an estimated number of 30,000 ships may have to be issued with new International Energy Efficiency Certificates (IEEC) by their first annual, intermediate or renewal survey, after 1 January 2023, whichever is first. Possibly half of these ships (15,000 ships) may require measures such as engine power limitation to comply with the EEXI requirements.

11 One of the impediments for calculating an attained EEXI value using the current draft guidelines is the determination of an accurate value for V_{ref}, defined as the ship's speed, measured in calm sea at the EEXI condition.

12 The draft guidelines currently, notwithstanding the outcome of the work which the Correspondence Group is concurrently undertaking, allow two ways to obtain the V_{ref}:

.1 obtained from an approved speed-power curve as defined in the *2014 EEDI Survey and Certification Guidelines*; or

.2 estimated speed-power curve under the EEDI condition obtained from the tank test.

[*] MEPC requested ISWG-GHG to consider guidelines and commenting papers relevant to the outputs of the Correspondence Group, even though submitted to MEPC.

13 In case such a speed-power curve does not exist, V_{ref} may alternatively be determined by using statistical data on distribution of ship speed of existing ships obtained from the IHS database, corrected for the ship's actual engine power. This method contains a conservative performance margin in the calculation method for the approximated value of V_{ref} to avoid overestimation of a ship's speed and thus efficiency.

14 Given the short time available before the entry into force of the EEXI regulation (likely 1 January 2023), the co-sponsors find it unrealistic to expect to have a high number of ships brought into compliance using the current EEXI methods (paragraphs 12.1 and 12.2 above). Both methods are very time consuming as they include either tank test or use of computational models, like Computational Fluid Dynamic (CFD) calculation.

15 The co-sponsors therefore propose amending the draft EEXI calculation guidelines by including a simplistic, though still accurate, additional alternative method to determine V_{ref}, by using empirical data from sea trial tests or the daily ship performance recordings. The result should be verified by a recognized organization as an independent third party.

Alternative methods to determine V_{ref}

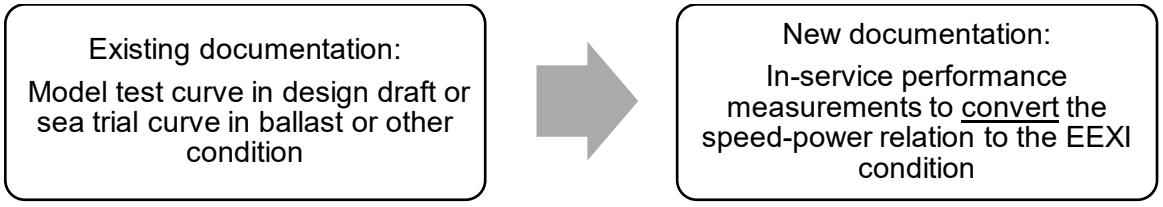
16 The proposal includes an alternative method on how to determine an accurate value for V_{ref}. The proposal is an alternative to the statistical method as described in the draft EEXI calculation guidelines and allows V_{ref} to be established from real values of a ship's speed in its actual operating conditions.

17 For pre-EEDI ships, the sea trial information from delivery and/or associated model tests (in this document: the reference condition) will be used as the basis for the speed-power curve. Since the information might not be available for the EEXI condition (draught and engine MCR), in-service performance measurements are introduced.

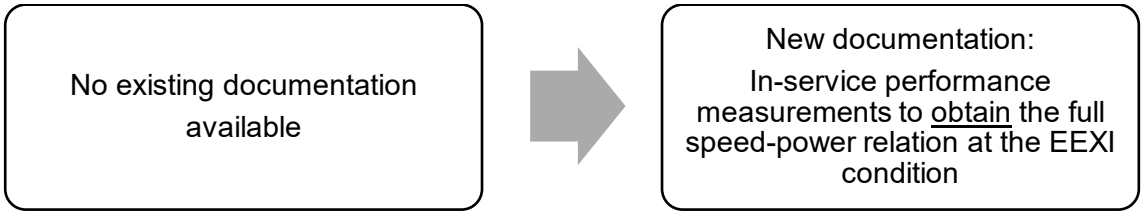
18 The in-service performance measurements are to be taken while the ship is underway and at two conditions: one at the reference condition and one at or close to the EEXI condition.

19 Two scenarios can be established depending on whether original sea trial test data are available or not:

.1 If existing sea trial test data are available:



.2 No existing sea trial test data are available:



20 The ship will have to perform a different set of in-service performance measurements depending on the scenarios illustrated in paragraphs 19.1 and 19.2.

21 The reference curve is then used to calibrate the sea trial curve at reference and at EEXI conditions (75% MCR). The V_{ref} can then be extracted from the calibrated EEXI curve.

22 If the original sea trial/model test information is not available, the V_{ref} can be extracted from in-service performance measurements alone.

23 Ship data and other information relevant for the in-service performance measurements are given in annex 3.

24 If Energy Efficiency Technologies (EETs) of category A, as defined in MEPC.1/Circ.815, are retrofitted after the delivery of the ship, the benefit to the speed-power relation needs to be well-documented. This documentation should be used both for calibration of the speed-power curve as well as for the verification.

Verification

25 The in-service performance measurements are performed underway and used to approximate the "normal" sea trial by using monitored data from normal operation, and thus not witnessed by the verifier. Procedures and documentation must therefore be described thoroughly.

26 To ensure trustworthiness of the alternative method, the in-service performance measurement protocol and the associated result for V_{ref} should be verified by the recognized organization prior to issuing the new International Energy Efficiency Certificate.

27 Prior to assessing the V_{ref} according to this alternative method, the concept, procedures and documentation relevant for the process should be agreed upon by all stakeholders involved. The purpose is to identify and describe items requiring special attention and to plan how the in-service performance measurements are handled with respect to verification.

28 Common procedures for preparing, executing and documenting the in-service performance measurements are given in annex 3 to this document together with the description and calibration of sensors for measurements. A sample template for the logging of parameters is included.

Proposals

29 In light of paragraphs 16 to 28 above, the co-sponsors propose to:

.1 amend the draft guidelines on the method of calculation of the attained EEXI, as set out in annex 1 to this document; and

.2 include a new section on how to determine Vref based on in-service performance measurements, as set out in annex 3.

Actions requested of the Working Group

30 The Group is invited to consider the proposals made in paragraphs 29 and 30 and take action, as appropriate.

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ANNEX 1

Proposed amendments to the draft guidelines on the method of calculation of the attained energy efficiency existing ship index (EEXI)

New paragraph 2.2.2.5 is added as follows:

2.2.2.5 Alternative method to determine V_{ref}; Ship speed.

2.2.2.5.1 The V_{ref} approximation as described in paragraph 2.2.2.3 may not provide for a realistic estimation of a well-maintained energy efficient ship, as the V_{ref} is obtained from statistical means of distribution of ship speed and engine power. Alternatively, the V_{ref} may be determined by the use of in-service performance measurements, taken while the ship is underway. The relevant data from the in-service performance measurements can be used for producing a realistic speed-power relation at the EEXI condition.

2.2.2.5.2 If the original sea trial test data are available, the ship should perform at least two in-service performance measurements to calibrate the speed-power relation: one at a reference condition and one at the EEXI condition.

.1 The reference condition is the condition for which the ship documentation exists, e.g. a sea trial curve in ballast or a sea trial/model test curve in design conditions. The in-service performance measurement result should be calibrated towards the reference condition curve.

.2 The EEXI condition is pending on ship type and an in-service performance measurement taken in this condition. The performance measurements results are used with the same calibration factor as at the reference condition.

2.2.2.5.3 If the ship documentation for the reference condition is not available, the ship should perform at least two in-service performance measurements, conducted for the duration of 1 hour each, at power settings equivalent to the EEDI trial conditions (set out in MEPC.1/Circ.855/Rev.2, as amended). If that is not possible, then at least at power settings of 30%, 60%, 75% and 90% of MCR with a margin of +/– 5%. The in-service performance measurements should be performed at or as close as possible to the EEXI condition.

2.2.2.5.4 If the exact EEXI condition is not met, the Admiralty Law formula can be used to adjust the speed-power relation, for displacement variations of up to 2%.

2.2.2.5.5 Procedures for preparing, executing and documenting the in-service performance measurements must be thoroughly described, and should comply with annex X.*

* Note: Annex X containing draft guidelines to determine the V_{ref} based on in-service performance measurements are set out in annex 3 to this document.

2.2.2.5.6 Retrofits of Energy Efficiency Technologies (EETs)

If any retrofits of EETs of category A are installed after the delivery of the ship, the benefit to the speed-power relation should be properly documented. This documentation should be used both for calibration of the speed-power curve as well as for the verification.

2.2.2.5.7 Verification of the alternative assessment to determine the V_{ref}

.1 The alternative assessment of V_{ref} as required in paragraph 2.2.2.5.1 should be verified by the recognized organization issuing the IEE Certificate.

.2 Prior to assessing the V_{ref}, the concept, procedures and documentation relevant for the process should be agreed upon by all stakeholders involved. The purpose is to identify and describe items requiring special attention and to plan how the in-service performance measurements are handled and documented with respect to verification.

.3 The documentation to be provided to the recognized organization issuing the IEE Certificate should comprise:

a. For the reference condition:
   i. Sea trial report for the reference condition.
   ii. Model test report for the reference condition.
b. Data to be collected prior to in-service sea trials as per appendix B.
c. Data collected during the in-service sea trials as per appendix C.
d. In-service measurements containing as a minimum the data described in appendix D.
e. V_{ref} calculation and/or calibration procedure documentation.

   If CFD modelling is used in the procedure, the calculation details should also be submitted.

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ANNEX 2

Overview of methods to determine V_{ref}

Overview of ship status, data available and references to obtain V_{ref} in tables below:

1. EEDI ships

Case #	Data available	Reference to obtain V_{ref}
1		Use V_{ref} from EEDI technical file

2. EEXI ships (not in hierarchical order)

Case #	Data available	Reference to obtain V_{ref}
2	Tank test or CFD at EEDI draught*	Use V_{ref} from tank tests (1-1 paragraph 2.2.2.2), otherwise 1-1 (paragraph 2.2.2.3)
3	Tank test or CFD at design draught*	Use 1-1 (paragraph 2.2.2.3)
4	Sea trial at EEDI draught	If at P_{me} then OK, otherwise 1-1 (paragraph 2.2.2.2*bis*)
5	Sea trial close to EEDI draught	Use 1-1 (paragraph 2.2.2.3)
6	Sea trial at ballast	OK, if sea trial is corrected to EEDI condition, otherwise 1-1 (paragraph 2.2.2.3)
7	Sea trial or tank test prior to ship modification of any Energy Efficiency Technologies (EETs), hull/propeller modifications	In-service performance measurements
8	No data available	In-service performance measurements

References:

- 1-1 EEXI Calculation Guidelines
- 1-1 (para 2.2.2.3) V_{ref} approximate
- 1-1 (para 2.2.2.2bis) Power correction from ISWG-GHG 7/2/31

* Please note that CFD results may be accepted under certain circumstances, but generally still not applicable for EEDI verification as tank test results under the framework of current EEDI/EEXI guidelines.

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ANNEX 3

New draft annex to the draft guidelines on the method of calculation of the attained energy efficiency existing ship index (EEXI)

Alternative method for finding V_{ref}

When determining the V_{ref} for ships in the EEDI scheme, the speed-power information from a sea-trial combined with information from model tests is used to determine the V_{ref} at the EEDI condition.

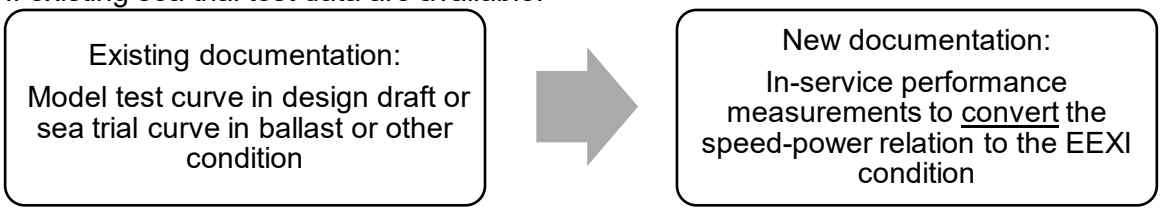
For EEXI ships, the same information might not be available. There might be sea trial information, but the documentation for the EEXI condition is unavailable.

The information on a realistic speed-power relation at the EEXI condition can be produced by introducing in-service performance measurements where the ship, while underway and in conditions close to a reference condition and to the EEXI condition, will measure speed-power relations.

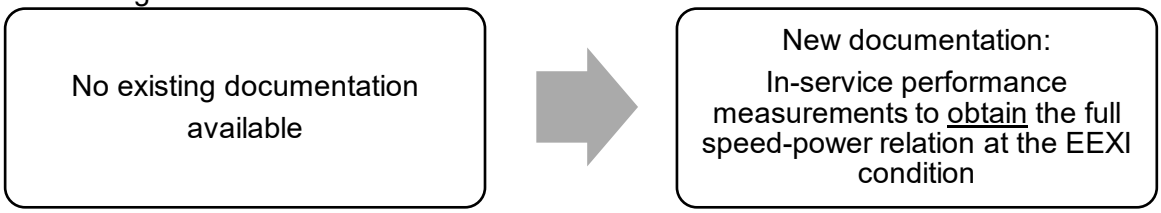
Since the in-service performance measurements are performed underway and not witnessed by the verifier, procedures and documentation must be described thoroughly. Procedures for preparing, executing and documenting the in-service performance measurements are given in appendix 3 in this document.

Two scenarios can be established depending on whether original sea trial test data are available or not:

1) If existing sea trial test data are available:



2) No existing sea trial test data are available:



The ship will have to perform a different set of in-service performance measurements depending on the scenarios illustrated above.

For scenario 1) where existing sea trial test data are available

The ships will perform at least two sets of in-service performance measurements: one at the reference condition and one at the EEXI condition.

The reference condition is the condition to where the original ship sea trial documentation exists, e.g. a sea trial curve in ballast or a sea trial curve in design conditions. The in-service performance measurements are then calibrated towards the reference curve.

The in-service performance measurements should be performed at the EEXI condition, which corresponds to even keel and either scantling or 70% DWT load condition (depending on ship type).

For scenario 2) where no existing sea trial test data are available

If the ship documentation for the reference condition is not available, the ship should perform at least two sets of in-service performance measurements, for the duration of 1 hour each, at power settings equivalent to the EEDI trial conditions (set out in MEPC.1/Circ.855/Rev.2, as amended). If that is not possible, then at least at power settings of 30%, 60%, 75% and 90% of MCR with a margin of +/– 5%.

The in-service performance measurements should be performed at or as close as possible to the EEXI condition.

General for both scenario

If the exact EEXI condition is not met, the Admiralty Law formula can be used to adjust the speed-power relation (for displacement variations of up to 2%).

If Energy Efficiency Technologies (EETs) of category A, as defined in MEPC.1/Circ.815 are retrofitted after the delivery of the ship, the benefit to the speed-power relation needs to be well-documented. This documentation should be used both for calibration of the speed-power curve as well as for the verification.

Uncertainties

When evaluating the V_{ref} established by this alternative method, the following must be taken into consideration:

In-service performance conditions

The in-service performance measurement conditions are important for the outcome of the analysed V_{ref}. The procedures described in Appendix A should be followed to give the most accurate measurements and thereby the most accurate V_{ref}.

Timing in between dry dockings

In between dry dockings, the ship will be experiencing fouling of the hull and the propeller, which may influence the performance of the ship. If the ship is heavily fouled during the in-service performance measurements, the V_{ref} attained may be less than expected and this will lead to a penalty in the EEXI. It is recommended to do the in-service performance measurements when the ship has a clean hull and propeller.

Retrofits of Energy Efficiency Technologies (EETs)

The ship might have installed EETs after the delivery at newbuild. This will affect the performance and if following this alternative method, the V_{ref} may come out different to the original V_{ref} since the speed-power curves used were established before the retrofit of the EET. There are various ways in which the effect of the EET can be taken into account.

1. Model tests or CFD calculations to verify the effect of the EET; or

2. Complete sea trials after the installation of the EET.

V_{ref} preparations

When an owner has decided to have the V_{ref} evaluated by the alternative method, preparations should be made to achieve the best and most reliable result for the ship. The owner might ask an expert to handle the preparations, the formalities around the in-service performance measurements and the analysis of the performance measurements data for the derivation of the V_{ref}.

The established V_{ref} should be verified by an approved verifier. i.e. recognized organization, and all documentation, as described in the appendices to this document, shall be available to the verifier.

It is highly recommended to arrange a meeting between the owner, the consultant and the verifier before conducting the in-service performance measurements. An overview of the available information with respect to the ship's design, EET retrofits application and measuring sensors should be discussed. The plan for the period of the in-service performance measurements should be agreed upon and expectations regarding the delivery of the analysis and its format should be aligned.

Reference

- Draft guidelines associated with draft amendments to MARPOL Annex VI to incorporate the goal-based energy efficiency improvement measure utilizing Energy Efficiency Existing Ship Index (EEXI) ISWG-GHG 7/2/7 (2020).

Appendix A

In-service performance measurements

If it is not possible to perform a full sea trial, a series of in-service performance measurements can be performed. Since the in-service performance measurements need to be completed in a consistent and accurate way to be able to quantify the speed power relation, this set of guidelines has been established.

An overview of preparations and procedures are outlined in the figure below. The preparations and the processes should be discussed and agreed at the pre-meeting, see section "V_{ref} preparations".

Table 1: In-service sea trial preparations and procedures

In-service performance measurement analysis	
Step 1: Preparing sensors	• Speed log/GPS • Echosounder • Heading control • Fuel flow meter • Shaft torsion meter • Draft measurement • Gyro compass
Step 2: Pre-trial parameters	• Displacement • Forward/Aft draughts • Water depth • Air/Sea temperature • Seawater density • Anemometer height • Fuel density • Fuel LCV
Step 3: In-service performance measurement	• Sea state • Wind • Water depth • Currents
Step 4: During trial parameters	• Reported data • System prints • Equipment control • Fuel analysis
Step 5: Documentation	• Shaft RPM/Power • Heading • Ship's speed • Distance • Wind speed/direction • Current speed/direction • Wave height/period/direction

Before the in-service performance measurements

One of the most important aspects of a successful in-service performance measurement procedure is the preparation. Relevant instruments should be calibrated and their operational condition prior to the commencement of the trials be confirmed. The list below indicates the primary instruments to be used for collecting the data:

Table 2: Sensors for In-service trials

Sensor	Remarks
Shaft torque meter	The measurement system preferably should be certified for power measurements with a bias error smaller than 1%. Zero setting checked before and after test.
GPS	The GPS system should operate in the differential mode to ensure sufficient accuracy.
Anemometer	It should be clear of possible obstructions (superstructure, masts, funnel, etc.) and its height from sea level recorded.
Draft measurements	Draft measurement system (if available): Otherwise, physical observation is required.
Speed log	Preferably the sensor should have been cleaned recently.
Echo sounder	Important for checking water depth for safety and ensuring there are no effects from shallow water on the ship performance.
Course recorder	Should be checked before the trial and be able to provide a course printout following each trial run.
Fuel flow meter	Either volume flow or mass flow meters to be fitted to ships. Both should be calibrated and cleaned/maintained as per manufacturer's recommendations.
Gyro compass	Record the ship's heading during the voyage and should be calibrated prior to the trials.

Following this alternative method, it is required that the ship is equipped with a shaft torque meter, at least for the complete duration of the measurement campaign. For verification and cross checks, the detailed fuel properties information, the logged engine room conditions and the fuel oil consumption details will give an estimate of the power used at a certain fuel oil consumption value.

If an automated data acquisition system is installed on board, this should be checked for accuracy prior to the performance measurements, to ensure that the system has the required precision and measurement frequency, that can provide a trace of all the data required.

Before the start of each performance measurement run, the following should be noted in the data logging template form (example appendix D):

Table 3: In-service environment and conditions

Parameter	Remarks
Displacement	As far as practicable, speed trials should be performed at displacement and draught conditions, which are comparable to those of the delivery sea trials or model tests or assumed ballast conditions. The trim shall be maintained within very narrow limits. For the even keel condition, the trim shall be less than 0.1 % of the length between perpendiculars. For the trimmed trial condition, the fore draught shall be within ± 0.1 m of the ship's ideal condition.
Draught forward, mid and aft	
Water depth	No remarks
Air temperature	Air temperature and pressure should be measured using a calibrated thermometer and barometer.
Air pressure	
Sea water temperature	The local seawater temperature and density at the trial site need to be recorded to enable the calculation of the ship's displacement and corrections with regard to viscosity. The water temperature should be taken at the waterline level.
Sea water density	
Anemometer height	Its height from sea level should be recorded
Fuel density	The fuel's density and LCV to be obtained from a laboratory's analysis report.
Fuel LCV	

Every effort should be made to conduct runs of a duration of 1 hour, at power settings equivalent to the EEDI trial conditions (set out in MEPC.1/Circ.855/Rev.2, as amended). If that is not possible, then at least at power settings of 30%, 60%, 75% and 90% of MCR with a margin of +/– 5%.

If in-service performance measurements are performed at consecutive power settings, sufficient time in between change of settings should be considered to be sure that steady state conditions are obtained.

Prior to the in-service performance measurements, the weather forecast should be studied to ensure that favourable weather conditions will prevail during the trials (close to calm conditions).

Ensure that crew members involved in the execution are briefed about the performance measurements and are aware of their tasks and the importance of the measurements collected.

Safety of the ship is paramount and the performance measurements should be suspended should any risks to the ship and/or crew be detected. All rules and regulations as well as good seamanship are to be followed at all times.

During the in-service performance measurements

Once the in-service performance measurements have begun, variations should be minimized, as the accuracy of the ship performance measurements can be influenced greatly by fluctuations in the parameters. Thus, all control levers should remain unchanged.

An experienced helmsman or adaptive autopilot will be required to maintain heading during each run. Minimum rudder angles are to be used while maintaining a steady heading. The helm corrections should be limited to five (5) degrees or less.

The following conditions should be met if possible, in order to reduce the influence of corrections and obtain the best possible accuracy of the results of the performance measurements:

Table 4: Environmental conditions for in-service performance measurements

Parameter	Remarks
Sea state	3 or less of Douglas scale. The total wave height of local wind driven seas and swell should be equal or less than 1 m (small variations are acceptable) or conditions as specified in ISO 15016:2002
Wind speed	Less than 11 knots
Water depth	Greater than 6 times the ship's draft.
Currents	If possible, avoid areas with known high current values and variations. Ideally during the trials, the following condition should be met: $V_{GPS} - V_{STW} < 0.3\ knots$
Trials period	Trials should be conducted in daylight
Duration	Minimum suggested trial duration to be not less than 60 minutes

If any of above conditions are no longer met during in-service performance measurements, it may be necessary to abandon the run.

In case the currents are stronger than the limits specified, the in-service performance measurements can be executed as double runs. It is important that the ship is running on the same track and when the monitoring begins, the conditions are in steady state conditions, see "During the in-service performance measurements" section.

Figure 2 Sea trials with double runs

During the in-service performance measurements, accurate recordings of the required parameters are of great importance. Recording of parameters for each run should start when steady state ship conditions are met.

The following data should be collected at the beginning and end of each performance measurement run:

Main engine supply flowmeter reading
Main engine supply flowmeter temperature

Main engine return line flowmeter reading*
Main engine return line flowmeter temperature*

(*For ships fitted with flowmeter on return line)

The following data should be collected every 10 minutes during the in-service performance measurement:

Table 5: Logged parameters during in-service performance measurements

Parameter	Unit
Date	dd-mm-yyyy
Time	hh:mm:ss
Revolution counter reading	[s^{-1}]
Shaft power	[kW]
Heading	[deg]
Ship's speed (GPS and Speed Log)	[knots]
Distance ("0" should be at the beginning of each run)	[nm]
Relative wind speed	[m/s]
Relative wind direction (coming from)	[deg]
Current speed	[knots]
Relative current direction (going to)	[deg]
Observed wave height	[m]
Observed wave period	[s]
Observed wave direction (going to)	[deg]

Apart from power, rpm and consumption, average prevailing values for the following main engine parameters should be provided for each run for the following:

Scavenge air temperature
Scavenge air pressure
Blower air inlet temperature

These, as well as any other main engine data that may be required should be collected at local sensors' display and not their repeaters inside the ECR.

After the in-service performance measurements

All information collected should be checked and any errors/typos should be noted in supplementary documentation, including any corrected/replaced values clearly marked in the form. Data which is continually recorded should be provided "as is" and non-variable data should be noted at the beginning and the end of the in-service performance measurements in order to confirm that any changes are set to a minimum.

For each run the following should be submitted:

1 One filled-in soft copy of the "In-service performance monitoring reporting form" (appendix D)

2 Printouts and/or soft copies from the performance monitoring system output

3 Printouts and/or soft copies from the loading computer calculations representing the loading condition at which the run took place

4 Printouts and/or soft copies from the course recorder for the period covering the run.

Also, a copy of the fuel oil analysis for the fuel used during the in-service performance measurements should be submitted.

Any comments about the in-service performance measurements, including any large variations in environmental conditions, should be noted.

A summary of the required information to be submitted for verification can be found in appendices B, C and D.

Appendix B

Information to be submitted prior to conducting the in-service performance measurements.

The following information needs to be submitted prior to conducting the performance measurements.

Document	Mandatory	Optional
Hydrostatics	☐	☒
Shop tests of main engine	☒	☐
Sea trials (machinery and hull part)	☒	☐
Model tests	☐	☒
Propeller characteristics and structural drawings	☐	☒
GA drawing	☒	☐
Details of appendages and rudder	☐	☒
Fuel oil piping diagram	☐	☒

Ship's main particulars

IMO number:	
Date delivered:	
Ship's email address(s):	
Date ship was launched (when did ship enter the water):	
Ship's name:	
Owner:	
Managing company:	
Ship type:	
Ship capacity:	
Yard:	
Length overall (m):	
Length between perpendiculars (m):	
Breadth moulded (m):	
Depth to upper deck (m):	
Design draft (m):	
Design displacement (mt):	
Scantling draft (m):	

Displacement at scantling draft (mt):	
Lightship weight (mt):	
Design speed (knots):	

Dry-docking history (within the last 5 years):			
Date	Yard	Coating specs	Hull treatment
		Please attach	Please attach

Hull cleaning and propeller polishing history since last dry-dock:			
Date	Place	Brief description of works	Propeller polishing standard*

*only for propeller polishing events

Main engine(s)	
Maker:	
Type:	
Number:	
Type of fuel:	
MCR (kW):	
SMCR (kW) x RPM:	

Main engine modifications/upgrades		
	Yes	No
Derating	☐	☐
T/C cut offs	☐	☐
Part load tuning	☐	☐
Low load tuning	☐	☐
Retrofit (please provide details)	☐	☐
Other modifications (please provide details)	☐	☐

Propeller(s) including modifications/upgrades	
Type: (FP or CPP)	
Diameter (m)	
Pitch (m)	
Number	

	Yes	No
Trimmed	☐	☐
Other (please state)	☐	☐

Propulsion improvement devices		
	Yes	No
Ducts	☐	☐
Fins	☐	☐
Other (please provide details)	☐	☐

Power measurements		
	Yes	No
By torsion meter	☐	☐
(Details of torsion meter including last calibration)		
By indicator diagrams	☐	☐
Other method (please provide details)		

Performance monitoring systems		
	Yes	No
PMS	☐	☐
please provide details of type and maker		

Fuel measurements		
	Yes	No
By volume flowmeter	☐	☐
(Details of flowmeter including last calibration)		
By mass flowmeter	☐	☐
(Details of flowmeter including last calibration)		
Soundings	☐	☐

Other instruments & gauges used for data collection	
	Dates of Calibration
Speed log	
DGPS	
Anemometer Provide height of anemometer in metres:	
Other (please provide details)	

Additional information		
	Yes	No
Reduction gear	☐	☐
(please provide details)		
Shaft motor	☐	☐
(please provide details)		
Shaft generator	☐	☐
(please provide details)		

Person to be contacted for further info:	

Appendix C

Information to be submitted for verification after conduction of the in-service performance measurements.

The following information needs to be submitted after conducting the in-service performance measurements.

Document	Mandatory	Optional
Calibration certificate of torquemeter	☒	☐
Calibration certificate of flowmeters	☐	☒
Calibration certificate of anemometer	☐	☒
Calibration certificate of speed log	☐	☒
Calibration certificate of GPS	☐	☒
Calibration certificate of echosounder	☐	☒
Calibration certificate of gyro compass	☐	☒
Fuel oil analysis	☒	☐

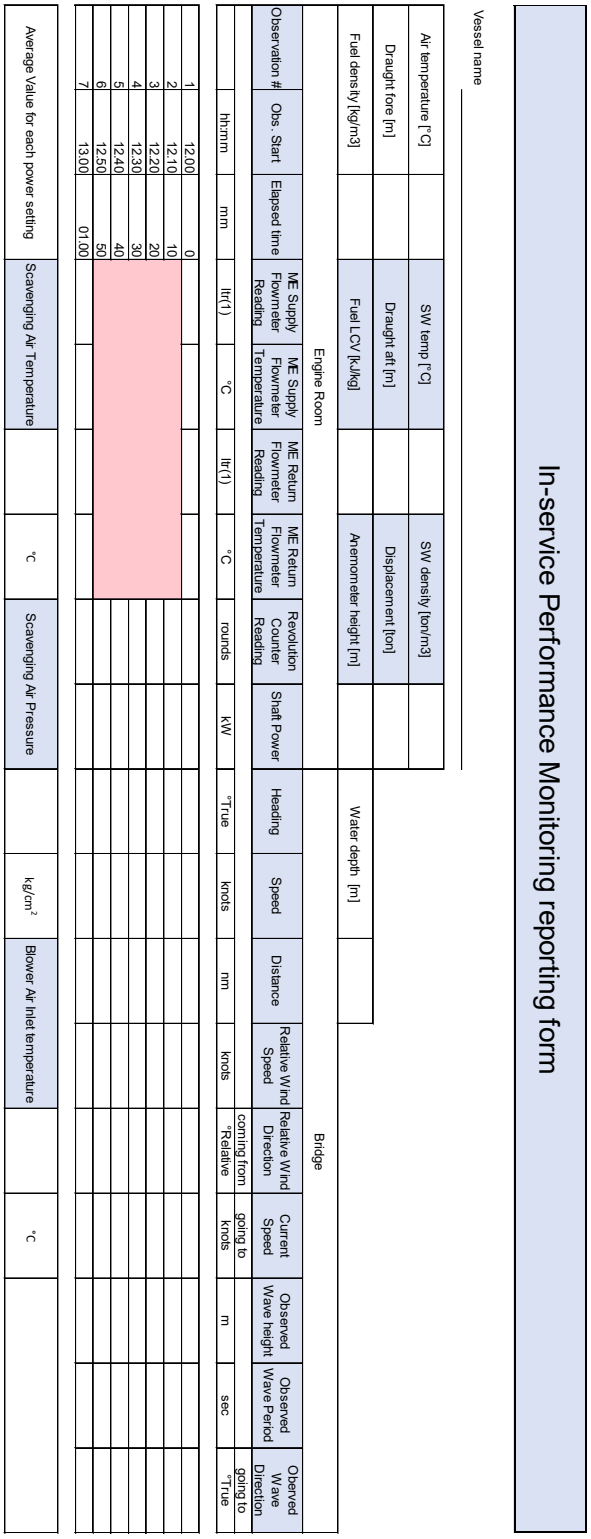
Furthermore, for each run, the following needs to be submitted:

Document	Mandatory	Optional
Sea trial reporting form	☒	☐
A printout of course recorder	☐	☒
A printout of ME load indicator (depicting the loading condition of the ship during the trials)	☐	☒
A printout/soft copy of the anemometer output (if the anemometer is digital)	☐	☒

Appendix D

Example of the in-service performance measurements reporting form

The form below is for a 1-hour average measurement.



In-service Performance Monitoring reporting form

Vessel name _____

Air temperature [°C]		SW temp [°C]		SW density [ton/m3]	
Draught fore [m]		Draught aft [m]		Displacement [ton]	
Fuel density [kg/m3]		Fuel LCV [kJ/kg]		Anemometer height [m]	

	Engine Room								Bridge											
Observation #	Obs. Start	Elapsed time	ME Supply Flowmeter Reading	ME Supply Flowmeter Temperature	ME Return Flowmeter Reading	ME Return Flowmeter Temperature	Revolution Counter Reading	Shaft Power	Heading	Speed	Distance	Relative Wind Speed	Relative Wind Direction	Current Speed	Observed Wave height	Observed Wave Period	Oberved Wave Direction
	hh:mm	mm	ltr(1)	°C	ltr(1)	°C	rounds	kW	°True	knots	nm	knots	coming from °Relative	going to knots	m	sec	going to °True
1	12.00	0															
2	12.10	10															
3	12.20	20															
4	12.30	30															
5	12.40	40															
6	12.50	50															
7	13.00	01.00															

Average Value for each power setting	Scavenging Air Temperature	°C	Scavenging Air Pressure	kg/cm^2	Blower Air Inlet temperature	°C	

Please note that a log sheet should be created for each run. For example, if five runs are performed, five logs sheets should be filled out.