

INTERSESSIONAL MEETING OF THE
WORKING GROUP ON REDUCTION OF
GHG EMISSIONS FROM SHIPS
7th session
Agenda item 2

ISWG-GHG 7/2/7
7 February 2020
ENGLISH ONLY

**FURTHER CONSIDERATION OF CONCRETE PROPOSALS TO IMPROVE THE
OPERATIONAL ENERGY EFFICIENCY OF EXISTING SHIPS, WITH A VIEW TO
DEVELOPING DRAFT AMENDMENTS TO CHAPTER 4 OF MARPOL ANNEX VI AND
ASSOCIATED GUIDELINES, AS APPROPRIATE**

**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)**

**Submitted by Greece, Japan, Norway, Panama, United Arab Emirates,
ICS, BIMCO, INTERTANKO and RINA**

SUMMARY

Executive summary: As a supplement to document ISWG-GHG 7/2/6 proposing draft amendments to MARPOL Annex VI to incorporate the goal-based energy efficiency improvement measure utilizing Energy Efficiency Existing Ship Index (EEXI), this document proposes three sets of draft guidelines to implement and enforce the EEXI. These guidelines are namely: 1) the EEXI Calculation Guidelines; 2) the EEXI Survey and Certification Guidelines; and 3) the SHaPoLi/EPL Guidelines for the EEXI.

Strategic direction, if applicable: 3

Output: 3.2

Action to be taken: Paragraph 29

Related documents: MEPC 74/7/2, MEPC 74/INF.23; MEPC 75/7/2; ISWG-GHG 6/2, ISWG-GHG 6/2/3 and ISWG-GHG 7/2/6

Introduction

1 The sixth meeting of the Intersessional Working Group on Reduction of GHG Emissions from Ships (ISWG-GHG 6) considered concrete proposals to improve the operational energy efficiency of existing ships, including a proposal for a goal-based energy

efficiency measure utilizing Energy Efficiency Existing Ship Index (EEXI) submitted by Japan and Norway (ISWG-GHG 6/2/3).

2 Following the discussion, ISWG-GHG 6 agreed that goal-based measures should be pursued and that two approaches, i.e. technical approach and operational approach, should be further developed in parallel. In this connection, ISWG-GHG 6 noted that Japan offered to informally coordinate future work on the technical approach.

3 In this context, interested Member States and non-governmental organizations formed an informal group, under informal coordination by Japan, to further develop a concrete proposal on a goal-based measure through technical approach. The informal group had participants consisting of the following Member States:

AUSTRALIA	NORWAY
CANADA	SINGAPORE
FINLAND	UNITED ARAB EMIRATES
GERMANY	UNITED KINGDOM
GREECE	UNITED STATES
JAPAN	

and the following non-governmental organizations in consultative status:

BIMCO	INTERTANKO
EUROMOT	RINA
IACS	WSC
ICS	

4 The informal group worked together to develop a concrete proposal for a goal-based measure through technical approach, using the goal-based energy efficiency measure utilizing Energy Efficiency Existing Ship Index (EEXI) submitted by Japan and Norway (ISWG-GHG 6/2/3) as the base document for further consideration.

5 Following three rounds of discussions, the informal group developed the draft legal instruments to incorporate the EEXI measure into MARPOL Annex VI as the goal-based measure through technical approach. These instruments are namely:

- .1 draft amendments to MARPOL Annex VI;
- .2 draft guidelines on method of calculation of the attained energy efficiency existing ship index (EEXI) (the "*EEXI Calculation Guidelines*" hereafter);
- .3 draft guidelines on survey and certification of the energy efficiency existing ship index (EEXI) (the "*EEXI Survey and Certification Guidelines*" hereafter); and
- .4 draft guidelines on the shaft / engine power limitation system to comply with the EEXI requirements and use of a power reserve (the "*SHaPoLi / EPL Guidelines for the EEXI*" hereafter).

6 Document ISWG-GHG 7/2/6 (Greece et al.) proposes amendments to MARPOL Annex VI to incorporate the EEXI as developed by the informal group, with a view to approval at MEPC 75 and entry into force in 2022.

7 As a supplement to document ISWG-GHG 7/2/6, this document proposes the aforementioned three sets of draft guidelines associated with the proposed amendments to MARPOL Annex VI to incorporate the EEXI. Each set of guidelines are set out in annex 1 to annex 3 of this document respectively as follows:

- .1 annex 1: the draft EEXI Calculation Guidelines;
- .2 annex 2: the draft EEXI Survey and Certification Guidelines; and
- .3 annex 3: the draft SHaPoLi / EPL Guidelines for the EEXI.

Draft EEXI Calculation Guidelines (annex 1)

8 The informal group developed the draft EEXI Calculation Guidelines in order to ensure that the attained EEXI is calculated in a consistent and transparent manner so as to ensure the smooth and uniform implementation of the EEXI requirements. Specifically, the following items were considered and discussed:

- .1 EEXI formula and correction factors (sections 2.1 and 2.2); and
- .2 ship speed V_{ref} and approximate ship speed $V_{ref,app}$ (section 2.2.2).

EEXI formula and correction factors (sections 2.1 and 2.2)

9 The informal group developed the formula to calculate the attained EEXI (the EEXI formula) as described below, following the basic structure of the EEDI formula. In this context, all correction factors (e.g. factors for ice-class ships, etc.) under the EEDI formula were incorporated into the EEXI formula in the same manner as in the EEDI.

The attained EEXI (g/t*nm) =

$$\frac{\left(\prod_{j=1}^n f_j \right) \left(\sum_{i=1}^{nME} P_{ME(i)} \cdot C_{FME(i)} \cdot SFC_{ME(i)} \right) + (P_{AE} \cdot C_{FAE} \cdot SFC_{AE}^*) + \left(\prod_{j=1}^n f_j \cdot \sum_{i=1}^{nPTI} P_{PTI(i)} - \sum_{i=1}^{neff} f_{eff(i)} \cdot P_{AEff(i)} \right) C_{FAE} \cdot SFC_{AE}}{f_i \cdot f_e \cdot f_l \cdot Capacity \cdot f_w \cdot V_{ref} \cdot f_m} - \left(\sum_{i=1}^{neff} f_{eff(i)} \cdot P_{eff(i)} \cdot C_{FME} \cdot SFC_{ME}^{**} \right)$$

Power of main engines $P_{ME(i)}$ (section 2.2.1)

10 The informal group developed the method to obtain the power of main engines P_{ME} in case of use of the Shaft/Engine Power Limitation. The members considered that P_{ME} could be obtained in a way consistent with that of EEDI for new ships, which is to use 75% of the installed power (MCR), and of the limited installed power (MCR_{lim}) in the case where the Shaft/Engine Power Limitation is installed. On the other hand, a member proposed using 87% of MCR_{lim} , noting that engine margins would be different in case of use of the Shaft/Engine Power Limitation.

11 The informal group therefore put two options (75% or 87% of MCR_{lim}) in square brackets for further consideration by the Working Group.

Ship speed V_{ref} and approximate ship speed $V_{ref,app}$ (section 2.2.2)

12 The informal group noted that some pre-EEDI ships did not have speed-power curves to calculate the ship speed V_{ref} and that some alternative method of calculation was necessary for those ships. Therefore, the following methods to obtain the ship speed V_{ref} were developed:

- .1 for EEDI-certified ships, V_{ref} should be obtained from an approved speed-power curve as defined in the 2014 EEDI Survey and Certification Guidelines; and
- .2 for pre-EEDI ships, V_{ref} should be obtained from:
 - .1 an estimated speed-power curve under the EEDI condition obtained from the tank test; or
 - .2 an alternative method of calculation based on statistical data of distribution of ship speed of existing ships obtained from the IHS Fairplay database and the ship's engine power.

13 In developing the alternative method of calculation for ship speed, the informal group considered that the approximation should not overestimate the ship's energy efficiency performance and that the correlation between ship speed and installed engine power should be taken into account.

14 In this context, a performance margin of ship speed was incorporated in the calculation method so that the approximated value would represent the ship's performance below the average of existing ships. Specific value of the margin was put in square brackets for further consideration by the Working Group. Besides, the average engine power was estimated from the EEDI reference line so that the ship's installed engine power in relation to the average engine power could be fairly evaluated.

15 Reflecting these points, the informal group developed the methods of calculation of $V_{ref,app}$, as follows:

In case where the speed-power curve is not available, the ship speed V_{ref} can be approximated by $V_{ref,app}$ to be obtained from statistical mean of distribution of ship speed and engine power, as defined below:

$$V_{ref,app} = (V_{ref,avg} - m) \times \left[\frac{\sum MCR_{ME}}{MCR_{avg}} \right]^{\frac{1}{3}} \quad [\text{knot}]$$

where,

$V_{ref,avg}$ is a statistical mean of distribution of ship speed in given ship type and ship size, to be calculated as follows:

$$V_{ref,avg} = A \times B^C$$

where A, B and C are the parameters given in the appendix;

m is a performance margin of a ship, which should be [5]% of $V_{ref,avg}$ or [1] [knot], whichever is lower;

MCR_{ME} is rated installed power of the main engine; and

MCR_{avg} is the average value of MCRs for main engines corresponding to the EEDI reference line.

Draft EEXI Survey and Certification Guidelines (annex 2)

16 The informal group developed the draft EEXI Survey and Certification Guidelines in order to assist verifiers in conducting survey and certification of the EEXI and to assist shipowners, shipbuilders, manufacturers and other interested parties in understanding the procedures for the survey and certification of the EEXI.

17 Reflecting the discussion on the draft amendments to MARPOL Annex VI and draft EEXI Calculation Guidelines, the following key items were incorporated in the draft EEXI Survey and Certification Guidelines:

- .1 procedure to develop the EEXI technical file, in accordance with draft amendments to MARPOL Annex VI (sections 4.2, 4.3 and appendix);
- .2 procedure to calculate the attained EEXI, in accordance with the EEXI formula and correction factors as defined in the draft EEXI Calculation Guidelines (section 4.1); and
- .3 procedure to verify the ship speed V_{ref} or the approximate ship speed $V_{ref,app}$, as defined in the draft EEXI Calculation guidelines (section 4.2).

Draft SHaPoLi / EPL Guidelines for the EEXI (annex 3)

18 The informal group developed the draft Shaft Power Limitation / Engine Power Limitation (SHaPoLi / EPL) Guidelines for the EEXI in order to provide technical and operational conditions that the SHaPoLi / EPL system should satisfy in complying with the EEXI requirements and in using a power reserve for existing ships. Specifically, following items were considered and discussed:

- .1 consolidation with relevant EEDI guidelines (section 0);
- .2 technical requirements (section 2);
- .3 use of power reserve (section 3);
- .4 Management Plan (section 4); and
- .5 demonstration of compliance (section 5).

Consolidation with relevant EEDI guidelines (section 0)

19 The informal group noted that guidelines on SHaPoLi / EPL system under EEDI framework on new ships were currently considered by the Committee. Although some requirements on the SHaPoLi / EPL system could be equally applied to both new and existing ships, appropriate consideration on circumstances and technical limitation of existing ships might be needed.

20 In light of this, the paragraph explaining potential consolidation with the relevant EEDI guidelines as appropriate was developed in the beginning (section 0) of the draft guidelines.

Technical requirements (section 2)

21 The informal group considered what function would be needed for the ShaPoLi / EPL system to limit the maximum engine power in a reliable manner without undermining the safety

of a ship. Accordingly, the informal group identified technical requirements covering both technical limiter and recording device.

Use of power reserve (section 3)

22 The informal group considered the conditions in which use of a power reserve would be allowed. Having considered consistency with relevant regulations under MARPOL Annex VI, the informal group specified such conditions by referring to regulation 3.1 and 21.5 of MARPOL Annex VI. It was also noted that ice-infested waters would fall into such conditions, as the use of power reserve might be necessary under ice-infested waters to secure the safety of a ship.

23 The informal group further considered necessary procedures to be taken during and after the use of a power reserve. Specifically, the following procedures were developed:

- .1 in case of the use of a power reserve, a ship should record relevant information and notify to the Administration or the recognized organization (RO) and port State of next destination; and
- .2 once the risks on safety are prevented, the ship should reactivate or replace the SHaPoLi / EPL system by the crew and then have confirmation by the Administration or the RO at the earliest opportunity.

Management Plan (section 4)

24 In order to identify technical description, operational procedures and management of the SHaPoLi / EPL system, the informal group developed provisions related to the Management Plan for SHaPoLi / EPL. The Management Plan is subject to verification by the Administration subsequent to a survey verifying the ship's attained EEXI. The PSC Officer may also refer to the Management Plan during inspection of the SHaPoLi / EPL system.

Demonstration of compliance (section 5)

25 The informal group developed a mechanism for demonstration of compliance of the SHaPoLi / EPL system. At the survey verifying the ship's attained EEXI, the Administration should verify compliance of the systems with the aforementioned Management Plan and the technical requirements.

26 In this context, some members raised the question whether the engine should be re-certified in accordance with regulation 13 of MARPOL Annex VI (NO_x) and the 2008 NO_x Technical Code (NTC 2008) in cases where the SHaPoLi / EPL system is applied. Having considered the current legal framework under MARPOL Annex VI and the NTC 2008, the informal group developed the following clarification to be inserted in the draft guidelines:

- .1 in cases where the SHaPoLi / EPL system is applied and no changes are made to NO_x critical settings outside what is allowed by the engine technical file as defined in the NTC 2008, engine re-certification is not needed;
- .2 in cases where the SHaPoLi / EPL system is applied and the NO_x critical settings are altered beyond what is allowed by the engine technical file as defined in the NTC 2008, the engine needs to be re-certified. In such case, for an EEDI-certified ship where the SHaPoLi / EPL system is applied at a power below that required by regulation 21.5 of MARPOL Annex VI

(minimum power requirement), the certified engine power should be at the power satisfying that requirement.

Remaining issues to be further considered

27 Although the informal group went through three rounds of discussions, the issues of i) engine power of main engines (P_{ME}) in case of the use of the Shaft / Engine Power Limitation and ii) the value of performance margin to obtain ship speed ($V_{ref,app}$) in cases where the speed-power curve is not available, were left in square brackets for further consideration by the Working Group, as described in paragraphs 10, 11, 14 and 15 of this document.

Proposal

28 The co-sponsors propose the Working Group to:

- .1 consider the remaining issue specified in paragraph 27 of this document; and
- .2 finalize the three sets of draft guidelines to implement and enforce the EEXI as set out in annex 1 to 3 of this document respectively, with a view to adoption at MEPC 76.

Action requested of the Working Group

29 The Group is invited to consider the proposals set out in this document and take action as appropriate.

ANNEX 1

DRAFT GUIDELINES ON THE METHOD OF CALCULATION OF THE ATTAINED ENERGY EFFICIENCY EXISTING SHIP INDEX (EEXI)

CONTENTS

- 1 Definitions
- 2 Energy Efficiency Existing Ship Index (EEXI)
 - 2.1 EEXI formula
 - 2.2 Parameters
 - 2.2.1 $P_{ME(i)}$; Power of main engines
 - 2.2.2 V_{ref} ; Ship speed
 - 2.2.3 SFC ; Certified specific fuel consumption
 - 2.2.4 C_F ; Conversion factor between fuel consumption and CO₂ emission

APPENDIX Parameters to calculate $V_{ref,app}$

1 Definitions

1.1 *MARPOL* means the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocols of 1978 and 1997 relating thereto, as amended.

1.2 For the purpose of these Guidelines, the definitions in *MARPOL* Annex VI, as amended, apply.

2 Energy Efficiency Existing Ship Index (EEXI)

2.1 EEXI formula

The attained Energy Efficiency Existing Ship Index (EEXI) is a measure of ship's energy efficiency (g/t*nm) and calculated by the following formula:

$$\frac{\left(\prod_{j=1}^n f_j \right) \left(\sum_{i=1}^{nME} P_{ME(i)} \cdot C_{FME(i)} \cdot SFC_{ME(i)} \right) + (P_{AE} \cdot C_{FAE} \cdot SFC_{AE}^*) + \left(\left(\prod_{j=1}^n f_j \cdot \sum_{i=1}^{nPTI} P_{PTI(i)} - \sum_{i=1}^{neff} f_{eff(i)} \cdot P_{AE_{eff(i)}} \right) C_{FAE} \cdot SFC_{AE} \right) - \left(\sum_{i=1}^{neff} f_{eff(i)} \cdot P_{eff(i)} \cdot C_{FME} \cdot SFC_{ME}^{**} \right)}{f_i \cdot f_c \cdot f_i \cdot Capacity \cdot f_w \cdot V_{ref} \cdot f_m}$$

* If part of the Normal Maximum Sea Load is provided by shaft generators, SFC_{ME} and C_{FME} may – for that part of the power – be used instead of SFC_{AE} and C_{FAE}

** In case of $P_{PTI(i)} > 0$, the average weighted value of $(SFC_{ME} \cdot C_{FME})$ and $(SFC_{AE} \cdot C_{FAE})$ to be used for calculation of P_{eff}

Note: This formula may not be applicable to a ship having diesel-electric propulsion, turbine propulsion or hybrid propulsion system, except for cruise passenger ships and LNG carriers.

Ships falling into the scope of EEDI requirement can use their attained EEDI calculated in accordance with the *2018 Guidelines on the method of calculation of the attained EEDI for new ships* (resolution MEPC.308(73), as amended by resolution MEPC.322(74)) as an alternative to attained EEXI without re-calculation or re-certification, unless the ship's attained EEDI does not satisfy the required EEXI.

2.2 Parameters

For calculation of EEXI by the formula in paragraph 2.1, parameters under the *2018 Guidelines on the method of calculation of the attained EEDI for new ships* (resolution MEPC.308(73), as amended by resolution MEPC.322(74)) apply, unless expressly provided otherwise. In referring to the aforementioned guidelines, the terminology "EEDI" should be read as "EEXI".

2.2.1 $P_{ME(i)}$; Power of main engines

In case where Shaft / Engine Power Limitation is installed in accordance with the *Guidelines on the shaft / engine power limit to comply with the EEXI requirements and use of a power reserve* (resolution MEPC.[...]), $P_{ME(i)}$ is [75][87]% of the limited installed power (MCR_{lim}) for each main engine (i).

2.2.2 V_{ref} ; Ship speed

2.2.2.1 For ships falling into the scope of the EEDI requirement, the ship speed V_{ref} should be obtained from an approved speed-power curve as defined in the *2014 Guidelines on survey*

and certification of the energy efficiency design index (EEDI), as amended (resolution MEPC.254(67), as amended by resolution MEPC.261(68) and resolution MEPC.309(73)).

2.2.2.2 For ships not falling into the scope of the EEDI requirement, the ship speed V_{ref} should be obtained from an estimated speed-power curve as defined in the Guidelines on survey and certification of the attained EEXI (resolution MEPC.[...]).

2.2.2.3 In case where the speed-power curve is not available, the ship speed V_{ref} can be approximated by $V_{ref,app}$ to be obtained from statistical mean of distribution of ship speed and engine power, as defined below:

$$V_{ref,app} = (V_{ref,avg} - m) \times \left[\frac{\sum MCR_{ME}}{MCR_{avg}} \right]^{\frac{1}{3}} \quad [\text{knot}]$$

where,

$V_{ref,avg}$ is a statistical mean of distribution of ship speed in given ship type and ship size, to be calculated as follows:

$$V_{ref,avg} = A \times B^C$$

where

A, B and C are the parameters given in the appendix;

m is a performance margin of a ship, which should be [5]% of $V_{ref,avg}$ or [1] [knot], whichever is lower;

MCR_{ME} is rated installed power of the main engine; and

MCR_{avg} is the average value of MCRs for main engines corresponding to the EEDI reference line, to be calculated as follows:

for $\sum MCR_{ME} \geq 10,000$ kW

$$MCR_{avg} = \frac{\text{Capacity} \times EIV_{avg} \times V_{ref,avg} - 215 \times 250}{C_F \times (190 \times 0.75 + 215 \times 0.025)}$$

for $\sum MCR_{ME} < 10,000$ kW

$$MCR_{avg} = \frac{\text{Capacity} \times EIV_{avg} \times V_{ref,avg}}{C_F \times (190 \times 0.75 + 215 \times 0.05)}$$

where EIV_{avg} is the reference line value of the required EEDI as defined in regulation 21.3 of MARPOL Annex VI.

2.2.2.4 In case where the Shaft / Engine Power Limitation is installed, the ship speed V_{ref} approximated by $V_{ref,app}$ should be calculated as follows:

$$V_{ref,app} = (V_{ref,avg} - m) \times \left[\frac{\sum MCR_{lim}}{MCR_{avg}} \right]^{\frac{1}{3}}$$

2.2.3 **SFC ; Certified specific fuel consumption**

In case where Shaft / Engine Power Limitation is installed, the *SFC* corresponding to the P_{ME} should be interpolated by using *SFCs* listed in an applicable test report included in an approved NO_x Technical File of the main engine as defined in paragraph 1.3.15 of the NO_x Technical Code.

For those engines which do not have a test report included in the NO_x Technical File, the *SFC* specified by the manufacturer with the approval of the verifier should be used.

For those engines which do not have a test report included in the NO_x Technical File and which do not have the *SFC* specified by the manufacturer, the *SFC* can be approximated by SFC_{app} defined as follows:

$$SFC_{ME,app} = 190 [g/kWh]$$

$$SFC_{AE,app} = 215 [g/kWh]$$

2.2.4 **C_F ; Conversion factor between fuel consumption and CO₂ emission**

For those engines which do not have a test report included in the NO_x Technical File and which do not have the *SFC* specified by the manufacturer, the C_F corresponding to SFC_{app} should be defined as follows:

$$C_F = 3.114 [t \cdot CO_2/t \cdot Fuel] \text{ for diesel ships (incl. HFO use in practice)}$$

Otherwise, paragraph 2.2.1 of the *2018 Guidelines on the method of calculation of the attained EEDI for new ships* (resolution MEPC.308(73), as amended by resolution MEPC.322(74)) applies.

APPENDIX

PARAMETERS TO CALCULATE $V_{ref,app}$

Ship type	A	B	C
Bulk carrier	10.6585	DWT of the ship	0.02706
Gas carrier	7.4462	DWT of the ship	0.07604
Tanker	8.1358	DWT of the ship	0.05383
Containership	3.2395	DWT of the ship where DWT ≤ 80,000 80,000 where DWT > 80,000	0.18294
General cargo ship	2.4538	DWT of the ship	0.18832
Refrigerated cargo carrier	0.6726	DWT of the ship	0.36620
Combination carrier	8.1391	DWT of the ship	0.05378
LNG carrier	11.0556	DWT of the ship	0.05028
Ro-ro cargo ship (vehicle carrier)	16.6773	DWT of the ship	0.01802
Ro-ro cargo ship	8.0793	DWT of the ship	0.09123
Ro-ro passenger ship	4.1144	DWT of the ship	0.19862
Cruise passenger ship having non-conventional propulsion	4.8995	GT of the ship	0.13100

ANNEX 2

DRAFT GUIDELINES ON SURVEY AND CERTIFICATION OF THE ENERGY EFFICIENCY EXISTING SHIP INDEX (EEXI)

Table of contents

1	GENERAL
2	DEFINITIONS
3	APPLICATION
4	PROCEDURES FOR SURVEY AND CERTIFICATION
4.1	General
4.2	Verification of the attained EEXI
4.3	Verification of the attained EEXI in case of major conversion
APPENDIX	Sample of EEXI Technical File

1 GENERAL

The purpose of these guidelines is to assist verifiers of the Energy Efficiency Existing Ship Index (EEXI) of ships in conducting the survey and certification of the EEXI, in accordance with regulations 5, 6, 7, 8 and 9 of MARPOL Annex VI, and assist shipowners, shipbuilders, manufacturers and other interested parties in understanding the procedures for the survey and certification of the EEXI.

2 DEFINITIONS¹

2.1 *Verifier* means an Administration, or organization duly authorized by it, which conducts the survey and certification of the EEXI in accordance with regulations 5, 6, 7, 8 and 9 of MARPOL Annex VI and these Guidelines.

2.2 *Ship of the same type* means a ship the hull form (expressed in the lines such as sheer plan and body plan), excluding additional hull features such as fins, and principal particulars of which are identical to that of the base ship.

2.3 *Tank test* means model towing tests, model self-propulsion tests and model propeller open water tests. Numerical calculations may be accepted as equivalent to model propeller open water tests or used to complement the tank tests conducted (e.g. to evaluate the effect of additional hull features such as fins, etc. on ships' performance) with the approval of the verifier.

2.4 *MARPOL* means the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocols of 1978 and 1997 relating thereto, as amended.

2.5 For the purpose of these Guidelines, the definitions in MARPOL Annex VI, as amended, apply.

3 APPLICATION

These guidelines should be applied to ships for which an application for a survey for verification of the ship's EEXI specified in regulation 5 of MARPOL Annex VI has been submitted to a verifier.

4 PROCEDURES FOR SURVEY AND CERTIFICATION

4.1 General

4.1.1 The attained EEXI should be calculated in accordance with regulation 20A of MARPOL Annex VI and the *Guidelines on the method of calculation of the attained Energy Efficiency Existing Ship Index (EEXI)* (resolution MEPC.[...]) (EEXI Calculation Guidelines).

4.1.2 The *2013 Guidance on treatment of innovative energy efficiency technologies for calculation and verification of the attained EEDI* (MEPC.1/Circ.815) should be applied for calculation of the attained EEXI, if applicable.

4.1.3 The information used in the verification process may contain confidential information of submitters, including shipyards, which requires Intellectual Property Rights (IPR) protection.

¹ Other terms used in these guidelines have the same meaning as those defined in the *2018 Guidelines on the method of calculation of the attained EEDI for new ships* (resolution MEPC.308(73)) and the *Guidelines on the method of calculation of the attained EEXI* (resolution MEPC.[...]).

In the case where the submitter wants a non-disclosure agreement with the verifier, the additional information should be provided to the verifier upon mutually agreed terms and conditions.

4.2 Verification of the attained EEXI

4.2.1 For verification of the attained EEXI, an application for a survey and an EEXI Technical File containing the necessary information for the verification and other relevant background documents should be submitted to a verifier, unless the attained EEDI of the ship satisfies the required EEXI.

4.2.2 The EEXI Technical File should be written at least in English. The EEXI Technical File should include, but not limited to:

- .1 deadweight (DWT) or gross tonnage (GT) for cruise passenger ship having non-conventional propulsion;
- .2 the rated installed power (MCR) of the main and auxiliary engines;
- .3 the limited installed power (MCR_{lim}) in case where the Shaft / Engine Power Limitation system is installed;
- .4 the ship speed (V_{ref});
- .5 the approximate ship speed ($V_{ref,app}$) for pre-EEDI ships in case where the speed-power curve is not available, as specified in paragraph 2.2.2.3 of the EEXI Calculation Guidelines;
- .6 an approved speed-power curve under the EEDI condition as specified in paragraph 2.2 of the EEDI Calculation Guidelines, which is described in the EEDI Technical File, in case where regulation 20 of MARPOL Annex (Attained EEDI) is applied;
- .7 an estimated speed-power curve under the EEDI condition obtained from the tank test, if available;
- .8 estimation process and methodology of the power curves, as necessary;
- .9 calculation process of $V_{ref,app}$ as specified in paragraph 2.2.2.3 of the EEXI Calculation Guidelines, if applicable;
- .10 type of fuel;
- .11 the specific fuel consumption (SFC) of the main and auxiliary engines, as specified in paragraph 2.2.3 of the EEXI Calculation Guidelines;
- .12 the electric power table² for certain ship types, as necessary, as defined in the EEDI Calculation Guidelines;

² Electric power tables should be validated separately, taking into account the guidelines set out in appendix 2 of the 2014 Guidelines on Survey and Certification of the EEDI, as amended (resolution MEPC.254(67), as amended by resolution MEPC.261(68) and resolution MEPC.309(73)).

- .13 principal particulars, ship type and the relevant information to classify the ship as such a ship type, classification notations and an overview of the propulsion system and electricity supply system on board;
- .14 description of energy saving equipment;
- .15 calculated value of the attained EEXI, including the calculation summary, which should contain, at a minimum, each value of the calculation parameters and the calculation process used to determine the attained EEXI; and
- .16 for LNG carriers:
 - .1 type and outline of propulsion systems (such as direct drive diesel, diesel electric, steam turbine);
 - .2 LNG cargo tank capacity in m³ and BOR as defined in paragraph 2.2.5.6.3 of the EEDI Calculation Guidelines;
 - .3 shaft power of the propeller shaft after transmission gear at 100% of the rated output of motor (MPP_{Motor}) and $\eta_{(i)}$ for diesel electric;
 - .4 shaft power of the propeller shaft after transmission gear at the de-rated output of motor ($MPP_{Motor,lim}$) in case where the Shaft / Engine Power Limitation is installed;
 - .5 maximum continuous rated power ($MCR_{SteamTurbine}$) for steam turbine;
 - .6 limited maximum continuous rated power ($MCR_{SteamTurbine,lim}$) for steam turbine in case where the Shaft / Engine Power Limitation is installed; and
 - .7 $SFC_{SteamTurbine}$ for steam turbine, as specified in paragraph 2.2.7.2 of the EEDI Calculation Guidelines.

A sample of an EEXI Technical File is provided in appendix.

4.2.3 The *SFC* should be corrected to the value corresponding to the ISO standard reference conditions using the standard lower calorific value of the fuel oil, referring to ISO 15550:2002 and ISO 3046-1:2002. For the confirmation of the *SFC*, a copy of the approved NO_x Technical File and documented summary of the correction calculations should be submitted to the verifier.

4.2.4 For ships equipped with dual-fuel engine(s) using LNG and fuel oil, the C_F -factor for gas (LNG) and the specific fuel consumption (*SFC*) of gas fuel should be used by applying the criteria specified in paragraph 4.2.3 of the *2014 Guidelines on survey and certification of the energy efficiency design index (EEDI)*, as amended³, as a basis for the guidance of the Administration.

4.2.5 Notwithstanding paragraphs 4.2.3 and 4.2.4, in case where Shaft / Engine Power Limitation is installed, or in case where engines do not have a test report included in the NO_x

³ Resolution MEPC.254(67), as amended by resolution MEPC.261(68) and resolution MEPC.309(73)

Technical File, *SFC* should be calculated in accordance with paragraph 2.2.3 of the EEXI Calculation Guidelines.

4.2.6 The verifier may request further information from the submitter, as specified in paragraph 4.2.7 of the EEDI Survey and Certification Guidelines, in addition to that contained in the EEXI Technical File, as necessary, to examine the calculation process of the attained EEXI.

4.2.7 The estimated speed-power curve obtained from the tank test should be reviewed on the basis of the relevant documents in accordance with the EEDI Survey and Certification Guidelines.

4.2.8 In case where the Shaft / Engine Power Limitation system is installed, the verifier should confirm that the system is appropriately installed and sealed in accordance with the *Guidelines on the Shaft / Engine Power Limitation system to comply with the EEXI requirements and use of a power reserve* (resolution MEPC.[..]) and that a verified Management Plan for Shaft / Engine Power Limitation is on board the ship.

4.3 Verification of the attained EEXI in case of major conversion

4.3.1 In cases of a major conversion of a ship, the shipowner should submit to a verifier an application for a general or partial survey with the EEXI Technical File duly revised, based on the conversion made and other relevant background documents.

4.3.2 The background documents should include as a minimum, but are not limited to:

- .1 details of the conversion;
- .2 EEXI parameters changed after the conversion and the technical justifications for each respective parameter;
- .3 reasons for other changes made in the EEXI Technical File, if any; and
- .4 calculated value of the attained EEXI with the calculation summary, which should contain, as a minimum, each value of the calculation parameters and the calculation process used to determine the attained EEXI after the conversion.

4.3.3 The verifier should review the revised EEXI Technical File and other documents submitted and verify the calculation process of the attained EEXI to ensure that it is technically sound and reasonable and follows regulation 20A of MARPOL Annex VI and the EEXI Calculation Guidelines.

4.3.4 For verification of the attained EEXI after the major conversion, speed trials of the ship are required, as necessary.

APPENDIX

SAMPLE OF EEXI TECHNICAL FILE

1 Data

1.1 General information

Shipowner	XXX Shipping Line
Shipbuilder	XXX Shipbuilding Company
Hull no.	12345
IMO no.	94112XX
Ship type	Bulk carrier

1.2 Principal particulars

Length overall	250.0 m
Length between perpendiculars	240.0 m
Breadth, moulded	40.0 m
Depth, moulded	20.0 m
Summer load line draught, moulded	14.0 m
Deadweight at summer load line draught	150,000 tons

1.3 Main engine

Manufacturer	XXX Industries
Type	6J70A
Maximum continuous rating (MCR_{ME})	15,000 kW x 80 rpm
Limited maximum continuous rating with the Engine Power Limitation installed ($MCR_{ME,lim}$)	11,000 kW x 72 rpm
SFC at 75% of P_{ME}	166.5 g/kWh
Number of sets	1
Fuel type	Diesel Oil

1.4 Auxiliary engine

Manufacturer	XXX Industries
Type	5J-200
Maximum continuous rating (MCR_{AE})	600 kW x 900 rpm
SFC at 50% MCR_{AE}	220.0 g/kWh
Number of sets	3
Fuel type	Diesel Oil

1.5 Ship speed

Ship speed (V_{ref}) (with the Engine Power Limitation installed)	13.20 knots
---	-------------

2 Power curve

(Example 1; case of the EEDI ship)

The approved speed-power curve contained in the EEDI Technical File is shown in figure 2.1.

(Example 2; case of the pre-EEDI ship)

The estimated speed-power curve obtained from the tank test is shown in figure 2.1.

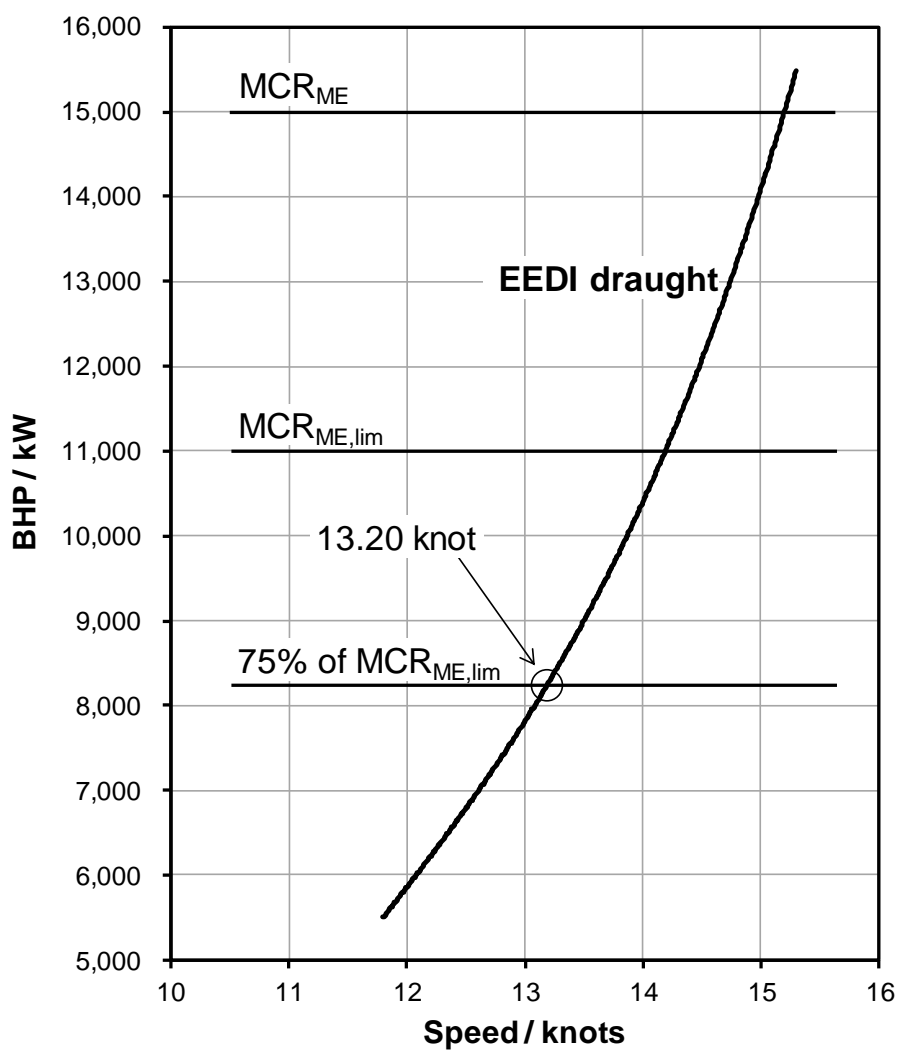


Figure 2.1: Power curve

3 Overview of propulsion system and electric power supply system

3.1 Propulsion system

3.1.1 Main engine
Refer to paragraph 1.3 of this appendix.

3.1.2 Propeller

Type	Fixed pitch propeller
Diameter	7.0 m
Number of blades	4
Number of sets	1

3.2 Electric power supply system

3.2.1 Auxiliary engines
Refer to paragraph 1.4 of this appendix.

3.2.2 Main generators

Manufacturer	XXX Electric
Rated output	560 kW (700 kVA) x 900 rpm
Voltage	AC 450 V
Number of sets	3

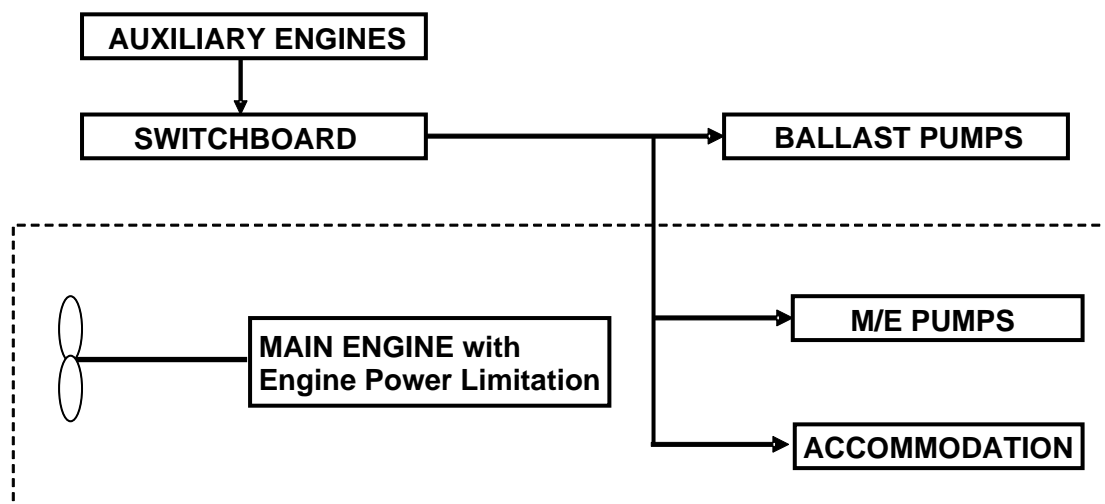


Figure 3.1: Schematic figure of propulsion and electric power supply system

4 Estimation process of speed-power curve

(Example; case of pre-EEDI ship)

Speed-power curve is estimated based on model test results. The flow of the estimation process is shown below.

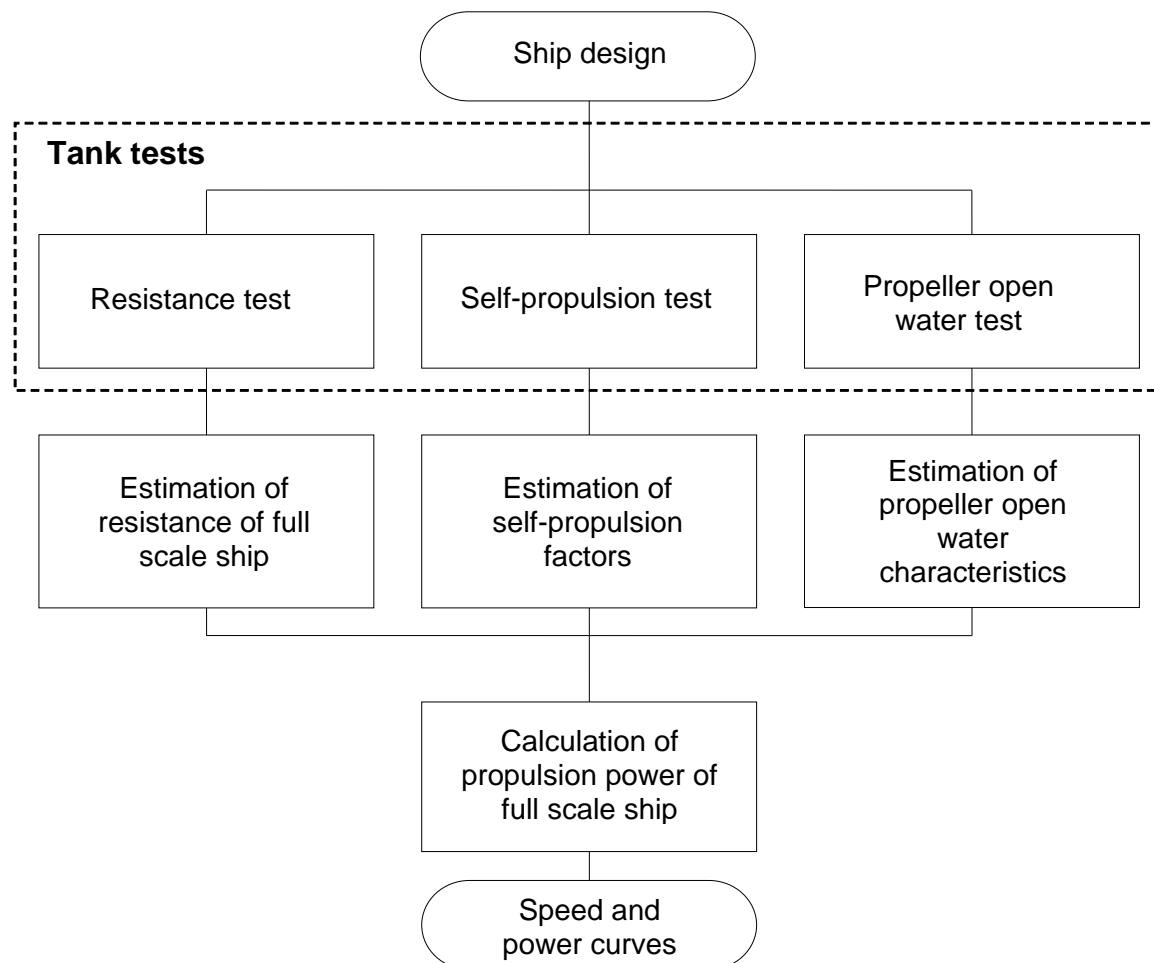


Figure 4.1: Flow-chart of process for estimating speed-power curve

5 Description of energy saving equipment

5.1 Energy saving equipment the effects of which are expressed as $P_{AEff(i)}$ and/or $P_{eff(i)}$ in the EEXI calculation formula

N/A

5.2 Other energy saving equipment

(Example)

5.2.1 Rudder fins

5.2.2 Rudder bulb

.....

(Specifications, schematic figures and/or photos, etc., for each piece of equipment or device should be indicated. Alternatively, attachment of a commercial catalogue may be acceptable.)

6 Calculated value of attained EEXI

6.1 Basic data

Type of ship	Capacity DWT	Speed V_{ref} (knots)
Bulk carrier	150,000	13.20

6.2 Main engine

MCR_{ME} (kW)	$MCR_{ME,lim}$ (kW)	P_{ME} (kW)	Type of fuel	C_{FME}	SFC_{ME} (g/kWh)
15,000	11,000	8,250	Diesel oil	3.206	166.5

6.3 Auxiliary engines

P_{AE} (kW)	Type of fuel	C_{FAE}	SFC_{AE} (g/kWh)
625	Diesel oil	3.206	220.0

6.4 Ice class

N/A

6.5 Innovative electrical energy efficient technology

N/A

6.6 Innovative mechanical energy efficient technology

N/A

6.7 Cubic capacity correction factor

N/A

6.8 Calculated value of attained EEXI

$$\begin{aligned}
 EEXI &= \frac{(\prod_{j=1}^M f_j)(\sum_{i=1}^{n_{ME}} P_{ME(i)} \cdot C_{FME(i)} \cdot SFC_{ME(i)}) + (P_{AE} \cdot C_{FAE} \cdot SFC_{AE})}{f_i \cdot f_c \cdot f_l \cdot Capacity \cdot f_w \cdot V_{ref} \cdot f_m} \\
 &+ \frac{\{(\prod_{j=1}^M f_j \cdot \sum_{i=1}^{n_{PTI}} P_{PTI(i)} - \sum_{i=1}^{n_{eff}} f_{eff(i)} \cdot P_{AEeff(i)}) \cdot C_{FAE} \cdot SFC_{AE}\}}{f_i \cdot f_c \cdot f_l \cdot Capacity \cdot f_w \cdot V_{ref} \cdot f_m} \\
 &- \frac{(\sum_{i=1}^{n_{eff}} f_{eff(i)} \cdot P_{eff(i)} \cdot C_{FME} \cdot SFC_{ME})}{f_i \cdot f_c \cdot f_l \cdot Capacity \cdot f_w \cdot V_{ref} \cdot f_m} \\
 &= \frac{1 \times (8250 \times 3.206 \times 166.5) + (625 \times 3.206 \times 220.0) + 0 - 0}{1 \times 1 \times 1 \times 150000 \times 1 \times 13.20 \times 1} \\
 &= 2.41 \text{ (g - CO}_2\text{/ton \cdot mile)}
 \end{aligned}$$

attained EEXI: 2.41 g-CO₂/ton mile

ANNEX 3

DRAFT GUIDELINES ON THE SHAFT / ENGINE POWER LIMITATION SYSTEM TO COMPLY WITH THE EEXI REQUIREMENTS AND USE OF A POWER RESERVE

Table of contents

0	General
1	Definitions
2	Technical requirements for SHaPoLi / EPL system
3	Use of a power reserve by un-limiting the shaft / engine power
4	Management Plan for SHaPoLi / EPL
5	Demonstration of compliance of the SHaPoLi / EPL system

0 General

The purpose of these guidelines is to provide technical and operational conditions that SHaPoLi / EPL system should satisfy in complying with the EEXI requirements and in using a power reserve for existing ships. However, noting that guidelines on SHaPoLi / EPL system under EEDI framework for new ships are currently considered by the Committee, these guidelines under EEXI and EEDI may be consolidated into one set of guidelines as appropriate upon consideration by the Committee, taking into account circumstances and technical limitation of existing ships.

1 Definitions

1.1 *Shaft power* means the mechanical power transmitted by the propeller shaft to the propeller hub. It is the product of the shaft torque and the shaft rotational speed. In case of multiple propeller shafts, the shaft power means the sum of the power transmitted to all propeller shafts.

1.2 *Engine power* means the mechanical power transmitted from the engine to the propeller shaft. In case of multiple engines, the engine power means the sum of the power transmitted from the engines to the propeller shafts.

1.3 *Shaft Power Limitation (SHaPoLi) system* means a verified and approved system for the limitation of the maximum shaft power by technical means.

1.4 *Engine Power Limitation (EPL) system* means a verified and approved system for the limitation of the maximum engine power by technical means.

1.5 *Power reserve* means shaft / engine power above the limited power which cannot be used in normal operation unless in the case when SHaPoLi / EPL is unlimited for the purpose of securing the ship safety.

1.6 *MARPOL* means the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocols of 1978 and 1997 relating thereto, as amended.

1.7 For the purpose of these Guidelines, the definitions in MARPOL Annex VI, as amended, apply.

2 Technical requirements for SHaPoLi / EPL system

2.1 Required main systems

The SHaPoLi / EPL system should consist of the following main arrangements:

- .1 SHaPoLi:
 - .1 sensors for measuring the torque and rotational speed delivered to the propeller(s) of the ship. The system includes the amplifier and the analogue to the digital converter;
 - .2 a data recording and processing device for tracking and calculation of the data as given in paragraph 2.2.5.1 of these guidelines; and
 - .3 a control unit for calculation and limitation of the power transmitted by the shaft to the propeller(s);

- .2 EPL:
- .1 for the mechanically controlled engine, a sealing device which can physically lock the fuel index by using a mechanical stop screw sealed by wire so that the ship's crew cannot release the EPL without permission, as shown in Figure 1; or
 - .2 for the electronically controlled engine, a password-locked fuel index limiter which can electronically lock the fuel index so that the ship's crew cannot release the EPL without permission.

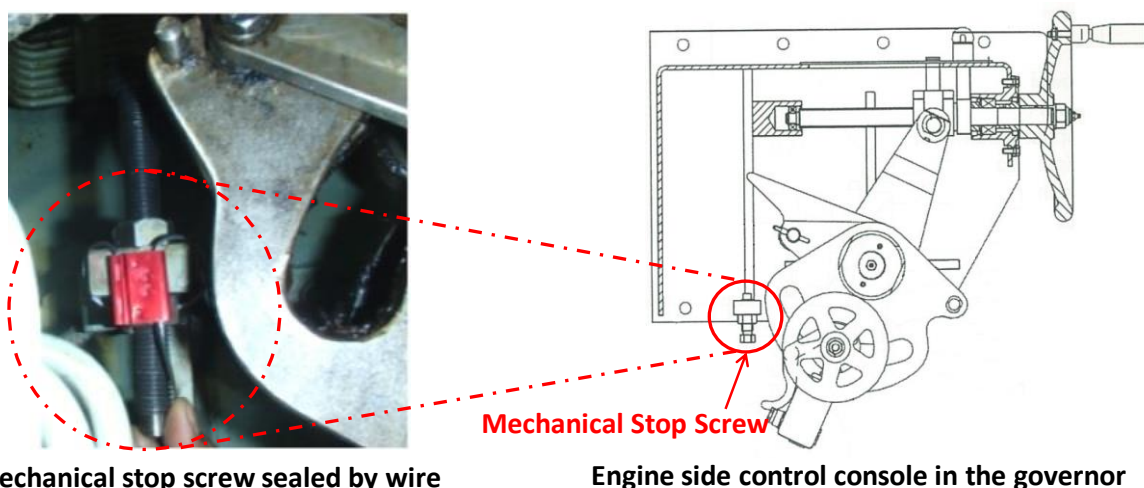


Figure 1: Sealing of mechanical stop screw

2.2 General system requirements

2.2.1 The SHaPoLi / EPL system should be non-permanent but should require the deliberate action of the ship's master to enable the use of unlimited shaft / engine power (power reserve) of the ship.

2.2.2 For SHaPoLi / EPL system for the electronically controlled engine, the control unit should inform the ship's master clearly and conspicuously when the ship's shaft / engine power exceeds the limited shaft / engine power as stated in the Management Plan for SHaPoLi / EPL or in any case of system malfunction.

2.2.3 For EPL for the mechanically controlled engine, the sealing device should visibly indicate removal of the sealing when the ship's engine power exceeds the limited engine power as stated in the Management Plan for EPL or in any case of system malfunction.

2.2.4 The SHaPoLi / EPL system (or each sub system) should be tamper-proof.

2.2.5 The SHaPoLi / EPL system for the electronically controlled engine should indicate following data during operation:

- .1 for SHaPoLi, shaft rotational speed, shaft torque and shaft power (and total shaft power in case of multiple shaft arrangements) to be recorded constantly in un-limiting mode; or
- .2 for EPL, a fuel index sealing system which can indicate and record the use of un-limited mode.

2.2.6 The procedure for SHaPoLi / EPL depends on the propulsion system and should be described in the Management Plan for SHaPoLi / EPL in accordance with section 4 of these guidelines.

3 Use of a power reserve by un-limiting the shaft / engine power

3.1 The use of a power reserve is only allowed as described in regulations 3.1 and 21.5 of MARPOL Annex VI including avoidance of occasions that may endanger safety (e.g. hurricanes, pirates) and sailing in ice-infested waters requiring the use of more than the limited power for safe operation. The use of a power reserve should not have adverse impact on the propeller, shaft and related systems.

3.2 Any use of a power reserve should be recorded in the record page of the Management Plan for SHaPoLi / EPL, signed by the master, and should be kept on board. The record should include:

- .1 ship type;
- .2 IMO number;
- .3 ship size in DWT;
- .4 ship's limited shaft / engine power and ship's maximum unlimited shaft / engine power;
- .5 position of the ship and timestamp when the power reserve was used;
- .6 reason for using the power reserve;
- .7 Beaufort number and wave height or ice condition in case of using the power reserve under adverse weather condition;
- .8 supporting evidence (e.g. expected weather condition) in case of using the power reserve for avoidance action;
- .9 records from the SHaPoLi system / EPL system for the electronically controlled engine during the power reserve was used; and
- .10 position of the ship and timestamp when the power limit was reactivated or replaced.

3.3 In case of having used a power reserve, the ship should without delay notify its Administration or recognized organization responsible for issuing the relevant certificate, and the competent authority of the relevant port of destination, with the information recorded in accordance with paragraph 3.2.

3.4 Once the risks have been mitigated, the ship should be operated below the certified level of engine power under the SHaPoLi / EPL. The SHaPoLi / EPL system should be reactivated or replaced by the crew immediately after the risks have been prevented and the ship can be safely operated with the limited shaft / engine power. The reactivation or replacement of the SHaPoLi / EPL system should be confirmed (e.g. validation of mechanical sealing) with supporting evidence (e.g. engine power log, photo taken at the occasion of resetting the mechanical sealing) in the presence of the Administration or the RO at the earliest opportunity.

3.5 Any defect of the SHaPoLi / EPL system should be reported to the Administration or recognized organization responsible for issuing the relevant certificate in accordance with regulation 5.6 of MARPOL Annex VI.

3.6 The port State control officers should inspect whether the SHaPoLi / EPL system has been properly installed and used in accordance with the IEE Certificate and the Management Plan as described in section 4 of these guidelines. If overriding of the SHaPoLi / EPL without proper notification in accordance with paragraph 3.2 of these guidelines has been detected, the reactivation or replacement of the SHaPoLi / EPL should be immediately conducted in the presence of the Administration or the RO at the port.

4 Management Plan for SHaPoLi / EPL

4.1 The SHaPoLi / EPL system should be accompanied by a Management Plan for SHaPoLi / EPL that should be permanently on board the ship for inspection.

4.2 The Management Plan for SHaPoLi / EPL should be verified by the Administration or the RO subsequent to a survey verifying the ship's attained EEXI, as required by regulation 5.4 of MARPOL Annex VI.

4.3 The Management Plan for SHaPoLi / EPL should, as a minimum, include:

.1 SHaPoLi:

- .1 a technical description of the main system as specified in section 2 of these guidelines as well as relevant auxiliary systems;
- .2 identification of key components of the system by manufacturer, model/type, serial number and other details as necessary;
- .3 description of a verification procedure demonstrating that the system is in compliance with the technical description in accordance with items 1 and 2 of this list;
- .4 the maximum shaft power for which the unit is designed;
- .5 service, maintenance and calibration requirements of sensors according to sensor manufacturer and a description how to monitor the appropriateness of the calibration intervals, if applicable;
- .6 the SHaPoLi record book for the recording of service, maintenance and calibration of the system;
- .7 the description of how the shaft power can be limited and unlimited and how this is displayed by the control unit as required by paragraph 2.2.5 of these guidelines;
- .8 the description of how the controller limits the power delivered to the propeller shaft;
- .9 the identification of responsibilities;

- .10 procedures for notification of the use of power reserve and the detections of malfunctions of the system in accordance with paragraphs 3.4 and 3.5 of these guidelines; and
- .11 procedures for survey of the SHaPoLi system by the Administration/RO.
- .2 EPL:
 - .1 rated installed power (MCR) and engine speed (N_{MCR});
 - .2 limited installed power (MCR_{lim}) and engine speed ($N_{MCR,lim}$);
 - .3 technical description of the EPL system;
 - .4 method for sealing the EPL (mechanically controlled engine);
 - .5 method for locking and monitoring the EPL (electronically controlled engine);
 - .6 procedures and methods for releasing the EPL;
 - .7 procedures for survey of the EPL system by the Administration/RO;
 - .8 procedure for the report on release of the EPL; and
 - .9 administrator of the EPL system.

5 Demonstration of compliance of the SHaPoLi / EPL system

5.1 The demonstration of compliance of the SHaPoLi / EPL system should be verified by an appropriate survey in accordance with regulation 5.4 of MARPOL Annex VI for the verification of the ship's EEXI according to regulation 20A. The survey should include the verification and validation of the system by addressing the following items:

- .1 the verification of compliance of the system with the Management Plan for SHaPoLi / EPL;
- .2 the verification of compliance of the system with the specifications set out in section 2 of these guidelines; and
- .3 the verification of the Management Plan for SHaPoLi / EPL that the Management Plan for SHaPoLi / EPL is in compliance with the specifications set out in section 4 of these guidelines.

5.2 In cases where the SHaPoLi / EPL system is applied and no changes are made to NO_x critical settings outside what is allowed by the engine technical file as defined in the 2008 NO_x Technical Code (NTC 2008), engine re-certification is not needed.

5.3 in cases where the SHaPoLi / EPL system is applied and the NO_x critical settings are altered beyond what is allowed by the engine technical file as defined in the NTC 2008, the engine needs to be re-certified. In such case, for an EEDI-certified ship where the SHaPoLi / EPL system is applied at a power below that required by regulation 21.5 of MARPOL Annex VI (minimum power requirement), the certified engine power should be at the power satisfying that requirement.