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DROMON BUREAU OF SHIPPING

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TECHNICAL PUBLICATION

EEDI & CII

Explanatory guidance

September 2021

REVISION HISTORY

Rev. No	Date	Amendments
Initial	September 2021	Initial issue

CONTENT

BACKGROUND

The International Maritime Organization (IMO) has agreed a set of guidelines to support mandatory measures to cut the carbon intensity of all ships. These have been approved by IMO's Marine Environment Protection Committee (MEPC) and have been adopted on the MEPC 76th session on 10-17 June, 2021.

The amendments to the MARPOL Convention require ships to combine a technical and operational approach to reduce their carbon intensity. This is in line with the ambition of the Initial IMO GHG Strategy, which aims to reduce carbon intensity of international shipping and was agreed in 2018. Two of the targets set in the Initial Strategy were:

1. reduce CO_2 emissions per transport work, as an average across international shipping, by at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008; and
2. total annual GHG emissions from international shipping should be reduced by at least 50% by 2050, compared to 2008.

The following measures have been introduced:

1. The **Energy Efficiency Existing Ship Index (EEXI)**, applicable from the first annual, intermediate or renewal IAPP survey **after 1 January 2023**. The attained Energy Efficiency Existing Ship Index (EEXI) is required to be calculated for ships of 400 GT and above, in accordance with the different values set for ship types and size categories.
2. The **enhanced Ship Energy Efficiency Management Plan (SEEMP)**, whereby an approved SEEMP needs to be kept onboard **from 1 January 2023**. The enhanced SEEMP will require companies to specify the methodology the ship will use to calculate the attained carbon intensity indicator (CII).
3. The operational **Carbon Intensity Indicator (CII)** rating scheme, taking effect **from 1 January 2023**.

The above approach aims to address both technical (how the ship is equipped and retrofitted) and operational measures (how the ship operates).

The amendments require IMO to review the effectiveness of the implementation of the CII and EEXI requirements, by 1 January 2026 at the latest, and, if necessary, develop and adopt further

amendments. IMO’s Initial GHG Strategy is to be revised by 2023.

THE ENERGY EFFICIENCY DESIGN INDEX (EEXI)

The Energy Efficiency Design Index (EEDI)[1] was made mandatory for new ships and the Ship Energy Efficiency Management Plan (SEEMP) for all ships at MEPC 62 (July 2011) with the adoption of amendments to MARPOL Annex VI (resolution MEPC.203(62)), by Parties to MARPOL Annex VI. This was the first legally binding climate change treaty to be adopted since the Kyoto Protocol.

The EEDI for new ships is the most important technical measure and aims at promoting the use of more energy efficient (less polluting) equipment and engines. The EEDI requires a minimum energy efficiency level per capacity mile (e.g. tonne mile) for different ship type and size segments. Since 1 January 2013, following an initial two-year phase zero, new ship design needs to meet the reference level for their ship type. The level is to be tightened incrementally every five years, and so the EEDI is expected to stimulate continued innovation and technical development of all the components influencing the fuel efficiency of a ship from its design phase. The EEDI is a non-prescriptive, performance-based mechanism that leaves the choice of technologies to use in a specific ship design to the industry. As long as the required energy efficiency level is attained, ship designers and builders are free to use the most cost-efficient solutions for the ship to comply with the regulations.

The EEDI provides a specific figure for an individual ship design, expressed in grams of carbon dioxide (CO2) per ship's capacity-mile (the smaller the EEDI the more energy efficient ship design) and is calculated by a formula based on the technical design parameters for a given ship.

The CO2 reduction level (grams of CO2 per tonne mile) for the first phase is set to 10% and will be tightened every five years to keep pace with technological developments of new efficiency and reduction measures. Reduction rates have been established until the period 2025 and onwards when a 30% reduction is mandated for applicable ship types calculated from a reference line representing the average efficiency for ships built between 2000 and 2010. The EEDI is developed for the largest and most energy intensive segments of the world merchant fleet and embraces emissions from new ships covering the following ship types: tankers, bulk carriers, gas carriers, general cargo ships, container ships, refrigerated cargo carriers and combination carriers. In 2014,

[1] EEDI: Energy Efficiency design index for new ship for which the building contract is placed on or after 01 January 2023.
EEXI: Energy Efficiency design index for existing ship for which the building contract is placed on or before 01 January 2023.

MEPC adopted amendments to the EEDI regulations to extend the scope of EEDI to: LNG carriers, ro-ro cargo ships (vehicle carriers), ro-ro cargo ships; ro-ro passenger ships and cruise passenger ships having non-conventional propulsion. These amendments mean that ship types responsible for approximately 85% of the CO2 emissions from international shipping are incorporated under the international regulatory regime.

For the calculation of EEDI ships are divided into different types based on their cargo and size as in IMO Resolution MEPC.324(75). Each ship's attained EEXI is to be below the required EEXI to comply with the EEXI requirements.

Existing table 1 - Reduction factors in Regulation 21 for the required EEDI has been amended, as shown below. The EEDI relative to the EEDI reference line and the associated footnotes have been replaced by the following:

Ship Type	Size	Phase 0 01/01/2013 – 31/12/2014	Phase 1 01/01/2015 – 31/12/2019	Phase 2 01/01/2020 – 31/03/2022	Phase 2 01/01/2020 – 31/12/2024	Phase 3 01/04/2022 and onwards	Phase 3 01/01/2022 and onwards
Bulk carrier	20,000 DWT and above	0	0-10*		0-20*		0-30*
	10,000 and above but less than 20,000 DWT	n/a	0-10*	20		30	
Gas carrier	15,000 DWT and above	0	10	20		30	
	10,000 and above but less than 15,000 DWT	0	10		20		30
	2,000 and above but less than 10,000 DWT	n/a	0-10*		0-20*		0-30*
Tanker	20,000 DWT and above	0	10		20		30
	4,000 and above but less than 20,000 DWT	n/a	0-10*		0-20*		0-30*
Containership	200,000 DWT and above	0	10	20		50	
	120,000 and above but less than 200,000 DWT	0	10	20		45	
	80,000 and above but less than 120,000 DWT	0	10	20		40	
	40,000 and above but less than 80,000 DWT	0	10	20		35	

Ship Type	Size	Phase 0 01/01/2013 – 31/12/2014	Phase 1 01/01/2015 – 31/12/2019	Phase 2 01/01/2020 – 31/03/2022	Phase 2 01/01/2020 – 31/12/2024	Phase 3 01/04/2022 and onwards	Phase 3 01/01/2022 and onwards
	15,000 and above but less than 40,000 DWT	0	10	20		30	
	10,000 and above but less than 15,000 DWT	n/a	0-10*	0-20*		15-30*	
General Cargo ships	15,000 DWT and above	0	10	15		30	
	3,000 and above but less than 15,000 DWT	n/a	0-10*	0-15*		0-30*	
Refrigerated cargo carrier	5,000 DWT and above	0	10		15		30
	3,000 and above but less than 5,000 DWT	n/a	0-10*		0-15*		0-15*
Combination carrier	20,000 DWT and above	0	10		20		30
	4,000 and above but less than 20,000 DWT	n/a	0-10*		0-20*		0-30*
LNG carrier***	10,000 DWT and above	n/a	10**	20		30	
Roro cargo ship (vehicle carrier)***	10,000 DWT and above	n/a	5**		15		30
Roro cargo ship***	2,000 DWT and above	n/a	5**		20		30
	1,000 and above but less than 2,000 DWT	n/a	0-5*,**		0-20*		0-30*
Roro passenger ship***	1,000 DWT and above	n/a	5**		20		30
	250 and above but less than 1,000 DWT	n/a	0-5*,**		0-20*		0-30*
Cruise passenger ship*** having nonconventional propulsion	85,000 GT and above	n/a	5**	20		30	
	25,000 and above but less than 85,000 GT	n/a	0-5*,**	0-20*		0-30*	

* Reduction factor to be linearly interpolated between the two values dependent upon ship size. The lower value of the reduction factor is to be applied to the smaller ship size.

** Phase 1 commences for those ships on 1 September 2015.

*** Reduction factor applies to those ships delivered on or after 1 September 2019, as defined in paragraph 43 of regulation 2.

Note: n/a means that no required EEDI applies.

Table 1 - Reduction factors

EEDI TECHNICAL FILE

As of January 1st, 2023 an **EEXI technical file** needs to exist on board for vessels satisfying the Required EEXI.

The EEXI technical file need to include the EEXI calculation with supporting documentation and must be summitted to Dromon Head Office prior the International Energy Efficiency (IEE) survey takes place or an the first scheduled annual, intermediate or renewal surveys on or after 01/01/2023.

A sample of the EEXI Technical file is included in Annex 1 of this document.

THE CALCULATION FORMULA

The calculation of the EEDI is to be performed in accordance with IMO "2018 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships, as amended".

The general formula for EEDI calculation is indicated below:

EEDI= CO_2 Emissions/Transport Work

that can be also expressed as:

EEDI= Engine Power.SFC.C_F/dwt.Speed (g CO_2/ tonmile)

where,

SPF (Specific Fuel Consumption) (g/KWH): an amount of fuel used for engines in an hour;

C_F (Carbon Factor): the amount of CO2 generated per mass fuel burned; and

DWT (DeadWeight Tonnage): the capacity of the vessel that carries full load.

The EEDI is provided by the following formula:

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

C_F is a non-dimensional conversion factor between fuel consumption measured in g and CO_2 emission also measured in g based on carbon content. The subscripts ME(i) and AE(i) refer to the main and auxiliary engine(s) respectively. CF corresponds to the fuel used when determining SFC listed in the applicable test report included in a Technical File. The value of C_F is as follows:

	Type of fuel	Reference	Lower calorific value (Kj/Kg)	Carbon content	Cf (t-CO_2/ t-Fuel)
1	Diesel/ Gas Oil	ISO 8217 Grades DMX through DMB	42.700	0.8744	0.3206
2	Light Fuel Oil (LFO)	ISO 8217 Grades RMA through RMD	41.200	0.8594	3.151
3	Heavy fuel Oil (HFO)	ISO 8217 Grades RME through RMK	40.200	0.8493	3.114
4	Liquefied Petroleum Gas	PROPANE	46.300	0.8182	3
		BUTANE	46.700	0.8264	3.03
5	Liquefied Natural Gas (LNG)		48.800	0.75	2.75
6	Methanol		19.900	0.375	1.375
7	Ethanol		26.800	0.5217	1.913

Table 2 – Conversion factor

In case the attained EEDI/EEXI meets the required EEXI, then an Energy Efficiency Certificate can be issued but in the case that the above term is not met, then energy efficiency improvement is required. At the design stage it has to be ensured that the EEDI requirements as well as the minimum required power demand for maneuverability of the ship in adverse weather conditions are fulfilled.

The energy efficiency improvement can be achieved with the below actions:

- Shaft/engine power limit (power optimization/with safety reserve);
- Fuel change and/or energy saving devices;
- Replacement with new ships; and
- Other verifiable options.

The required EEDI is the maximum allowable value of the attained EEDI as defined in table reference line values. The required EEDI is calculated for all ship types using 100% of the deadweight at summer load draft, except for passenger ships where GT is used.

The required EEDI will be reduced by X% each five years based on the initial value in phase 0 and depending on the vessel size. Below a certain size no reduction applies. Above a certain ship size,

the reduction is in general 10% for each reduction phase. In between of those sizes the reduction is linear interpolated.

$$\text{Attained EEDI} \leqq \text{Required EEDI} = (1\text{-}X/100) * \text{Reference line value}$$

where,

X= Reduction factor in percentage (table reduction rates)

The reference Line value shall be calculated as follows (table reference line values)

$$\text{Reference EEDI} = a \times b^{-c}$$

While the EEDI reference line or baseline for each ship type is defined as a curve representing an average index value fitted on a set of individual index values for a defined group of ships.

For each new and existing ship that has undergone a major conversion which is so extensive that the ship is regarded by the Administration as a newly constructed ship, the attained EEDI shall be calculated with the reduction factor applicable corresponding to the ship type and size of the converted ship at the date of the contract of the conversion, or in the absence of a contract, the commencement date of the conversion.

Ship Types	a	b	c
Bulk Carrier	961.79	DWT of the ship	0.477
Gas Carrier	1120		0.456
Tanker	1218.8		0.488
Container ship	174.22		0.201
General Cargo ship	107.48		0.216
Refrigerated Cargo Ship	227.01		0.244
Combination Carrier	1219		0.488
Ro-Ro Cargo ship (Vehicle carrier)	(DWT/GT)^(-0.7)* 780.36 where DWT/GT<0.3 1812.63 where DWT/GT≥0.3		0.471
Ro-Ro Cargo ship	1405.15		0.498
Ro-Ro passenger ship	752.16		0.381
LNG Carrier	2253.16		0.474
Cruise Passenger ship having non-conventional propulsion	170.84		0.214

Table 3 - Reference Line Values

If the design of a ship allows it to fall into more than one of the above ship type definitions, the required EEDI for the ship shall be the most stringent (the lowest) required EEDI.

For each ship to which the regulation applies, the installed propulsion power shall not be less than the propulsion power needed to maintain the maneuverability of the ship under adverse conditions.

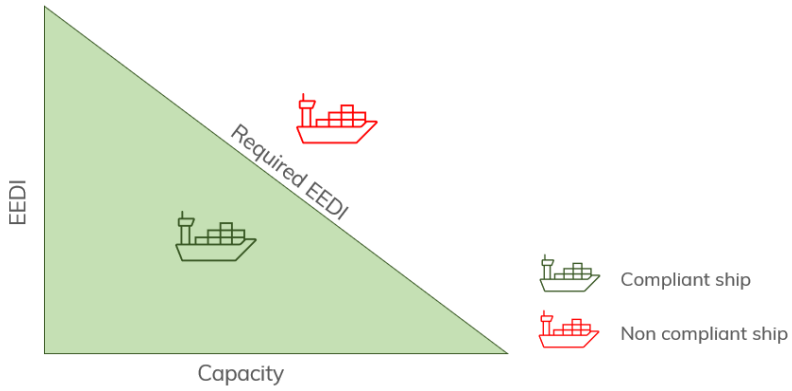


Figure 1 – Required EEDI compliance

2021 GUIDELINES ON THE SHAFT / ENGINE POWER LIMITATION SYSTEM TO COMPLY WITH THE EEXI REQUIREMENTS AND USE OF A POWER RESERVE

The purpose of the IMO Resolution MEPC.335(76) is 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.

However, noting that guidelines on the SHaPoLi / EPL system under EEDI framework on new ships are currently considered at the MEPC, the guidelines under EEXI and EEDI may be consolidated into one set of guidelines as appropriate upon consideration by the MEPC, taking into account circumstances and technical limitation of existing ships.

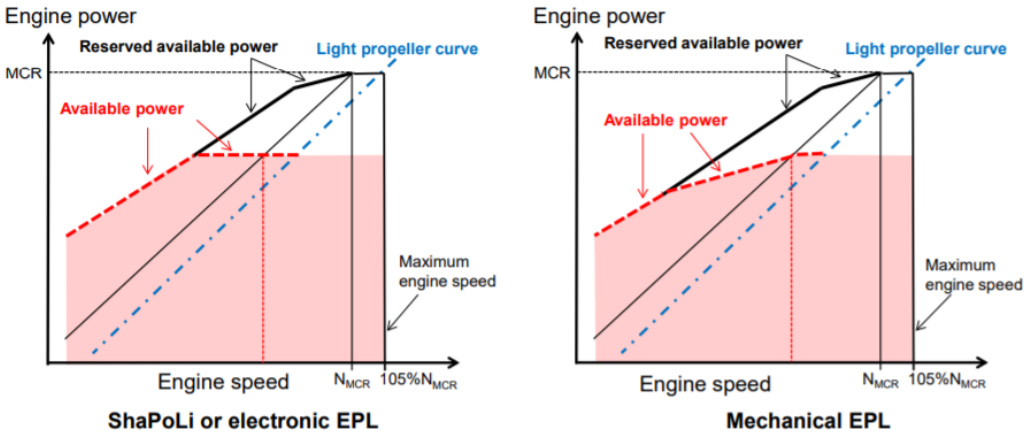


Figure 2: Engine load diagram on Shaft/Engine Power Limitation

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

1. SHaPoLi:
   - 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;
   - 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
   - a control unit for calculation and limitation of the power transmitted by the shaft to the propeller(s);
2. EPL:
   - for the mechanically controlled engine, a sealing device which can physically lock the fuel index by using a mechanical stop screw sealed by wire or an equivalent device with governor limit setting so that the ship's crew cannot release the EPL without permission from the ship's master or OICNW, as shown in figure 2; or
   - for the electronically controlled engine, fuel index limiter which can electronically lock the fuel index or direct limitation of the power in the engine's control system so that the ship's crew cannot release the EPL without permission from the ship's master or OICNW; and
   - where technically possible and feasible, the Sha/PoLi/EPL system should be controlled from the ships' bridge and not require attendance in the machinery space by ship's personnel.

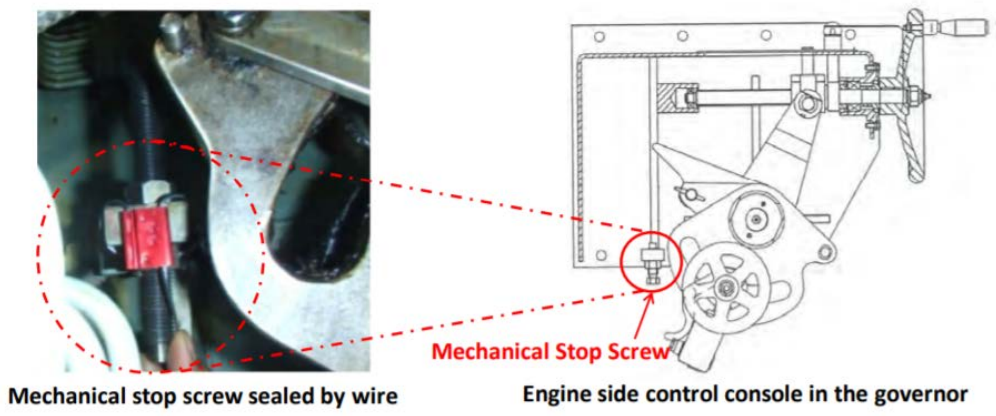


Figure 2: Sealing of mechanical stop screw

The SHaPoLi / EPL system should be non-permanent but should require the deliberate action of the ship's master or OICNW to enable the use of unlimited shaft / engine power (power reserve) of the ship. For systems that use a Password/PIN to control access to the power reserve override, attention should be paid to ensure that the necessary Password/PIN is always available when override is required.

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

For EPL for the mechanically controlled engine, the sealing device should either:

1. visibly indicate removal of the sealing when the ship's engine power exceeds the limited engine power as stated in the OMM for EPL or in any case of system malfunction; or
2. be equipped with other systems such as an alert-monitoring system which can indicate when the ship's engine power exceeds the limited engine power, as stated in the OMM for EPL or in any case of system malfunction and recording the use of unlimited mode, verified by the Administration or the RO.

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

The SHaPoLi / EPL system for the electronically controlled engine should indicate the 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 unlimiting mode; or

2. for EPL, a fuel index sealing system or power limitation system which can indicate and record the use of unlimited mode.

The procedure for SHaPoLi / EPL depends on the propulsion system and should be described in the OMM for SHaPoLi / EPL.

The use of a power reserve is only allowed for the purpose of securing the safety of a ship or saving life at sea, consistent with regulation 3.1 of MARPOL Annex VI (e.g. operating in adverse weather and ice-infested waters, participation in search and rescue operations, avoidance of pirates and engine maintenance). Use of a power reserve should not have adverse impact on the propeller, shaft and related systems. It is important that the ship master and OICNW are not restricted from exercising judgement to override the SHaPoLi / EPL when required for safety purposes. The authority for this should be clearly set out in the OMM and/or the Safety Management System manual, as appropriate.

Any use of a power reserve should be recorded in the record page of the OMM 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 and/or GT, as applicable;
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 / 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.

Where an EPL/ShaPoLi override is activated but the power reserve is not subsequently used, this event should be recorded in the bridge and engine-room logbooks.

The engine-room logbook should record power used during the period when the override was activated. The EPL/ShaPoLi should be reset as soon as possible, and details of the reset should also be recorded in the bridge and engine-room logbooks.

In case of having used a power reserve, the ship should without delay notify Dromon and the competent authority of the relevant port of destination with the information recorded.

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) by Dromon at the earliest opportunity.

ONBOARD MANAGEMENT MANUAL (OMM) FOR SHAPOLI / EPL

The SHaPoLi / EPL system should be accompanied by the OMM for SHaPoLi / EPL that should be permanently on board the ship for inspection.

The OMM for SHaPoLi / EPL should be verified by Dromon after a survey verifying the ship's attained EEXI, as required by regulation 5.4 of MARPOL Annex VI.

The OMM for SHaPoLi / EPL should, as a minimum, include:

1. SHaPoLi:
    - a technical description of the main system as specified in section 2 of these guidelines as well as relevant auxiliary systems;
    - identification of key components of the system by manufacturer, model/type, serial number and other details as necessary;
    - description of a verification procedure demonstrating that the system is in compliance with the technical description in accordance with items .1 and .2;
    - the maximum shaft power for which the unit is designed;
    - 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;

- the SHaPoLi record book for the recording of service, maintenance and calibration of the system;
- the description 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;
- the description of how the controller limits the power delivered to the propeller shaft;
- the identification of responsibilities;
- 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;
- time required for un-limiting the SHaPoLi; and
- procedures for survey of the SHaPoLi system by thew Administration/RO.

2. EPL:
   - rated installed power (MCR) or motor output (MPP) and engine speed (NMCR);
   - limited installed power (MCRlim) or motor output (MPPlim) and engine speed (NMCR,lim);
   - technical description of the EPL system;
   - method for sealing the EPL (mechanically controlled engine);
   - method for locking and monitoring the EPL (electronically controlled engine);
   - procedures and methods for releasing the EPL;
   - time required for unlimiting the EPL;
   - procedures for survey of the EPL system by the Administration/RO;
   - procedure for the report on release of the EPL; and
   - administrator of the EPL system.

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

In cases where the SHaPoLi / EPL system is applied and the NOX critical settings and/or components are altered beyond what is allowed by the engine technical file as defined in NTC 2008, the engine needs to be re-certified. In such a case, for an EEDI-certified ship where the SHaPoLi / EPL system is applied at a power below that required by regulation 24.5 of MARPOL Annex VI (minimum power requirement), the certified engine power should be at the power satisfying that requirement.

ENHANCED SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP)

There are two parts to a Ship Energy Efficiency Management Plan (SEEMP). Part I provides a possible approach for monitoring ship and fleet efficiency performance over time and some options to be considered when seeking to optimize the performance of the ship. Part II provides the methodologies ships of 5,000 gross tonnage and above should use to collect the data required pursuant to regulation 22A of MARPOL Annex VI and the processes that the ship should use to report the data to the ship's Administration.

SEEMP Part I is required by Regulation 22 of Annex VI to MARPOL 73/78 and is applicable to all ships above 400 GT. The plan has been implemented on board as of January 1, 2013.

A SEEMP Part I provides a possible approach for monitoring ship and fleet efficiency performance over time and some options to be considered when seeking to optimize the performance of the ship.

The purpose of Part I of a SEEMP is to establish a mechanism for a company and/or a ship to improve the energy efficiency of a ship's operation. Preferably, the ship-specific SEEMP is linked to a broader corporate energy management policy for the company that owns, operates or controls the ship, recognizing that no two shipping companies are the same, and that ships operate under a wide range of different conditions.

The enhanced SEEMP shall be applicable for cargo, cruise and ro-pax ships above 5,000 GT. By January 01, 2023, this shall additionally include:

- A description of the methodology that will be used to calculate a ship’s attained annual operational CII and the process to be used to report this value to the ship’s flag Administration;
- The required annual operational CII for the next three (3) years;
- An implementation plan documenting how the required annual operational CII will be achieved during the next three (3) years; and
- A procedure for self-evaluation and improvement.

Additional guidelines will be considered during the MEPC 77.

CII REDUCTION FACTOR (CII)

Under the MARPOL amendments, ships of 5,000 GT and above have to determine their required annual operational carbon intensity indicator (CII). The ship's CII determines the annual reduction factor needed to ensure continuous improvement of the ship's operational carbon intensity within a specific rating level.

The actual annual operational CII achieved (attained annual operational CII) would be required to be documented and verified against the required annual operational CII. This would enable the operational carbon intensity rating to be determined.

These ships will be required to determine their required annual operational CII and will then get a rating of their energy efficiency (A, B, C, D, E - where A is the best), which will be incorporated in their mandatory Statement of Compliance to be issued by Dromon on an annual basis.

The draft 2021 Guidelines on the operational Carbon Intensity rating of ships set the method to determine the rating boundaries. These are:

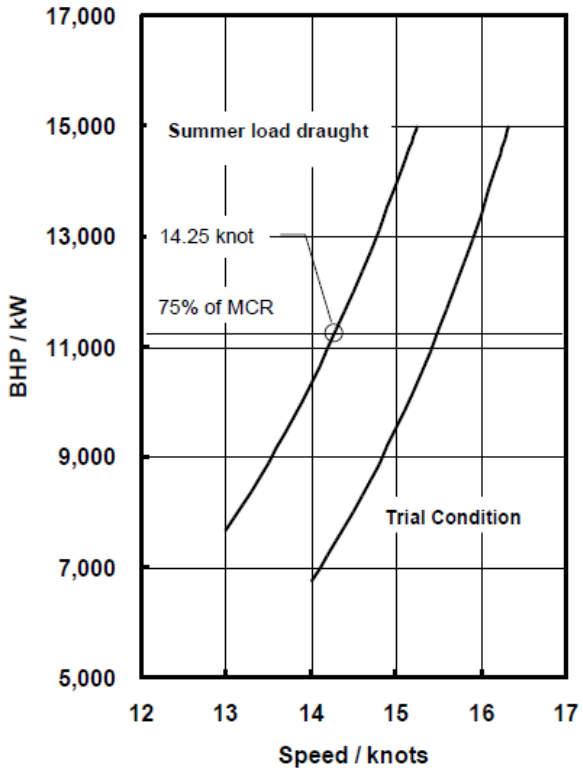
- Calculation Guidelines (G1);
- Reference line guidelines (G2);
- Reduction factor guidelines (G3);
- Rating guidelines (G4); and
- New correction factor guidelines (G5) – to be further discussed in MEPC 78.

The rating would be given on a scale - operational carbon intensity rating A, B, C, D or E - indicating a major superior, minor superior, moderate, minor inferior, or inferior performance level. The performance level would be recorded in the ship's Ship Energy Efficiency Management Plan (SEEMP).

Under the MARPOL amendments, cargo, ro-pax and cruise ships above 5000 GT shall need every year from 2023 to annually calculate and report CII and their rating A to E. A ship rated C or D or E for three consecutive years would have to submit a corrective action plan, to show how the required index (C or above) would be achieved. This need to be included and submitted within one (1) month after reporting the CII.

ANNEX 1- SAMPLE OF EEDI TECHNICAL FILE

1	**Data**	
1.1	General Information	
	Shipbuilder:	JAPAN Shipbuilding Company
	Hull No.:	12345
	IMO No.:	94111XX
	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:	JAPAN Heavy Industries Ltd.
	Type:	6J70A
	Maximum continuous rating (MCR):	15,000 kW x 80 rpm
	SFC at 75% MCR:	165.0 g/kWh
	Number of sets:	1
	Fuel type:	Diesel Oil
1.4	Auxiliary engine:	
	Manufacturer:	JAPAN Diesel Ltd.
	Type:	5J-200
	Maximum continuous rating (MCR):	600 kW x 900 rpm
	SFC at 50% MCR:	220.0 g/kWh
	Number of sets:	3
	Fuel type:	Diesel Oil
1.5	Ship speed	
	Ship speed in deep water at summer load line draught at 75% of MCR:	14.25 knots
2	**Power curves**	

	The power curves estimated at the design stage and modified after the speed trials are shown in figure 2.1.	
	 **Figure 2.1: Power curves**	
3	**Overview of propulsion system and electric power supply system**	
3.1	Propulsion system	
3.1.1	Main engine	
	Refer to paragraph 1.3	
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	
3.2.2	Main generators	
	Manufacturer	JAPAN Electric
	Rated output	560 kW (700 kVA) x 900 rpm
	Voltage	AC 450 V
	Number of sets	3

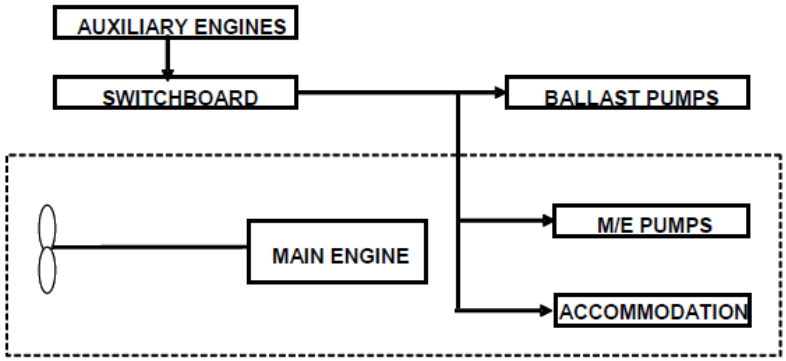


Figure 3.1: Schematic figure of propulsion and electric power supply system

4 Estimation process of power curves at design stage

Power curves are estimated based on model test results. The flow of the estimation process is shown below.

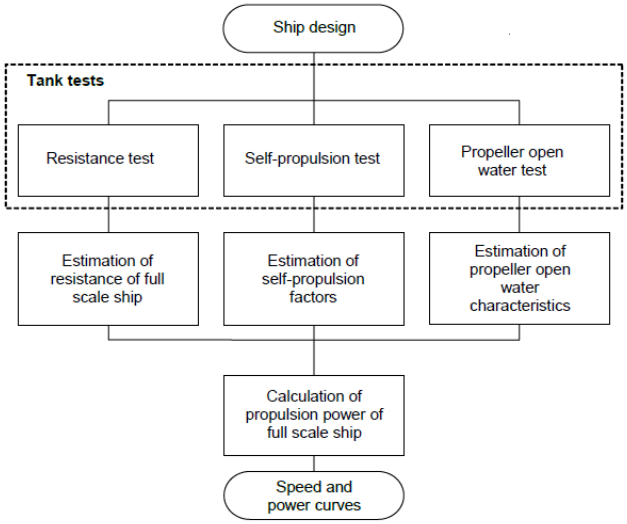


Figure 4.1: Flow-chart of process for estimating power curves

5 Description of energy saving equipment

5.1 Energy saving equipment the effects of which are expressed as PAEeff(i) and/or Peff(i) in the EEDI calculation formula

N/A

5.2 Other energy saving equipment

(Example)

5.2.1 Rudder fins

5.2.2 Propeller boss cap fins

(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 EEDI

6.1 Basic data

Type of ship	Capacity DWT	Speed V_{ref} (knots)
Bulk Carrier	150,000	14.25

6.2 Main engine

	MCR_{ME} (kW)	Shaft gen.	P_{ME} (kW)	Type of fuel	C_{FME}	SFC_{ME} (g/kWh)
	15,000	N/A	11,250	Diesel Oil	3.206	165.0
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 EEDI					

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

$$= \frac{1 \times (11250 \times 3.206 \times 165.0) + (625 \times 3.206 \times 220.0) + 0 - 0}{1 \cdot 1 \cdot 150000 \cdot 1 \cdot 14.25}$$

$$= 2.99 \quad (\mathrm{g - CO_2/ton \cdot mile})$$

attained EEDI: 2.99 g-CO_2/ton mile

7	**Calculated value of attained $EEDI_{weather}$**					
7.1	Representative sea conditions					
		Mean wind speed	Mean wind direction	Significant wave height	Mean wave period	Mean wave direction
	BF6	12.6 (m/s)	0 (deg.)*	3.0 (m)	6.7 (s)	0 (deg.)*
	* Heading direction of wind/wave in relation to the ship's heading, i.e. 0 (deg.) means the ship is heading directly into the wind.					
7.2	Calculated weather factor, f_w					
	f_w	0.900				
7.3	Calculated value of attained $EEDI_{weather}$					

attained EEDIweather: 3.32 g-CO_2/ton mile

REFERENCES

1. International Maritime Organization (IMO) (www.imo.org)
2. MARPOL Annex VI Chapter 4
3. IMO Resolution MEPC.214(63), Guidelines On Survey And Certification Of The Energy Efficiency Design Index (EEDI).
4. IMO Resolution MEPC.212(63), 2012 Guidelines On The Method Of Calculation Of The Attained Energy Efficiency Design Index (EEDI) For New Ships
5. IMO Resolution MEPC.254(67), Guidelines On Survey And Certification Of The Energy Efficiency Design Index (EEDI).
6. IMO Resolution MEPC.245(66), 2014 Guidelines On The Method Of Calculation Of The Attained Energy Efficiency Design Index (EEDI) For New Ships
7. IMO Resolution MEPC.308(73), 2018 Guidelines On The Method Of Calculation Of The Attained Energy Efficiency Design Index (EEDI) For New Ships
8. IMO Resolution MEPC.322(74), Amendments To The 2018 Guidelines On The Method Of Calculation Of The Attained Energy Efficiency Design Index (EEDI) For New Ships
9. IMO Resolution MEPC.324(75), Procedures For Sampling And Verification Of The Sulphur Content Of Fuel Oil And The Energy Efficiency Design Index (EEDI)
10. IMO Resolution MEPC.335(76), 2021 Guidelines On The Shaft / Engine Power Limitation System To Comply With The EEXI Requirements And Use Of A Power Reserve
11. IMO Resolution MEPC.1/Circ.855/Rev.2, 2014 Guidelines On Survey And Certification Of The Energy Efficiency Design Index (EEDI).

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