Energy Efficiency Existing Ship Index (EEXI), Survey & Certification

Relevant for ship owner and managers

Refer to the Marine Environment Protection Committee (MEPC 76), 10 to 17 June 2021 (remote session), the new amendments to MARPOL Annex VI, introducing an Energy Efficiency Design Index for existing ships (EEXI), adopted and all ships of 400 GT and above engaged in international voyages are subject to The new measures to improve the energy efficiency of the shipping.

This technical information is including a general guidance to EEXI requirement, EEXI technical file review procedure, on-board inspection & issuance of related certificate (IEE certificate).

As a matter of fact, the EEXI is the CO2 emissions per cargo ton and mile. In addition, the EEXI is a design index and there is no need to refer to the on-board previous measurements. There are two defined types of EEXI which to be compared together, if needed. The first value is the "attained EEXI" and the second value is the "required EEDI". The method of calculation of the both values described at the annex I based on the IMO guideline. (Res. MEPC.333(76) (adopted on 17 June 2021)).
A brief description of the attained & required EEXI regulation specified in table 2.

The EEXI regulations do not apply to the following ships:

- Ships not propelled by mechanical means, and platforms including FPSOs, FSUs, and drilling rigs regardless of their propulsion (also not required to have the IEE certificate)
- Category A ships as defined in the Polar Code
- Ships having non-conventional propulsion such as diesel-electric propulsion, turbine propulsion, and hybrid propulsion systems (except LNG carriers and Cruise passenger ships)

Entry into force date: The ships which will be constructed on or after 01 January 2023, the EEXI to be calculated at the delivery date.

Further, the ships which has been delivered before 01 January 2023 to be fulfilled the requirement at the first IAPP periodical survey on or after 01 January 2023.

Table 1- Entry into force date

Delivery date	Entry into force date
Before 01 January 2023	The first IAPP periodical survey[1] on or after 01 January 2023.
On or after 01 January 2023	Delivery date

Major conversion

In the case of the **major conversion** after the entry into force date, the EEXI to be calculated and the EEXI technical file (as defined on the next paragraphs) to be revised and a survey (partial or general) should be conducted based on the revised EEXI technical file and background documents.
A speed trial of the ship after major conversion, to verify the attained EEXI may be needed, as required.

[1] The periodical survey defines assigned annual, intermediate or renewal survey of the international air pollution prevention surveys by the ICS.

EEXI technical file

An EEXI technical file to be prepared by the respectful owners and will be approved by the classification including the minimum information based on the IMO guidelines.

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

- Deadweight (DWT) or gross tonnage (GT) for RO-RO passenger ship and cruise passenger ship having nonconventional propulsion;
- The rated installed power (MCR) of the main and auxiliary engines;
- The limited installed power ($MCR_{lim.}$) in cases where the over ridable Shaft / Engine Power Limitation system is installed;
- the ship speed ($V_{ref.}$);
- the approximate ship speed ($V_{ref,app}$) for pre-EEDI ships in cases where the speed-power curve is not available, as specified in paragraph 2.2.3.5 of the EEXI Calculation Guidelines;
- 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 cases where regulation 22 of MARPOL Annex VI (Attained EEDI) is applied;
- an estimated speed-power curve under the EEDI condition, or under a different load draught to be calibrated to the EEDI condition, obtained from tank test and/or numerical calculations, if available;
- estimation process and methodology of the power curves, as necessary, including documentation on consistency with the defined quality standards (e.g. ITTC 7.5-03-01-02 and ITTC 7.5-03-01-04 in their latest revisions) and the verification of the numerical set-up with parent hull or the reference set of comparable ships in case of using numerical calculations;
- a sea trial report including sea trial results, which may have been calibrated by the tank test, under the sea condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines, if available;
- calculation process of $V_{ref,app}$ for pre-EEDI ships in cases where the speed-power curve is not available, as specified in paragraph 2.2.3.5 of the EEXI Calculation Guidelines;
- type of fuel;
- the specific fuel consumption (SFC) of the main and auxiliary engines, as specified in paragraph 2.2.3 of the EEXI Calculation Guidelines;
- the electric power[2] for certain ship types, as necessary, as defined in the EEDI Calculation Guidelines;
- the documented record of annual average figure of the auxiliary engine load at sea obtained prior to the date of application for a survey for verification of the ship's EEXI, as specified in paragraph 2.2.2.3 of the EEXI Calculation Guidelines, if applicable;
- calculation process of $P_{AE,app}$, as specified in paragraph 2.2.2.3 of the EEXI Calculation Guidelines, if applicable;
- 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;
- description of energy saving equipment, if available;
- 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
- for LNG carriers:
  - type and outline of propulsion systems (such as direct drive diesel, diesel electric, steam turbine);
  - LNG cargo tank capacity in m3 and BOR as defined in paragraph 2.2.5.6.3 of 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 Energy Efficiency Design Index (EEDI) (resolution MEPC.254(67), as amended by resolutions MEPC.261(68) and MEPC.309(73)); consolidated text: MEPC.1/Circ.855/Rev.2, as may be further amended).

- shaft power of the propeller shaft after transmission gear at 100% of the rated output of motor ($M_{PPMotor}$) and $\eta_{(i)}$ for diesel electric;
- shaft power of the propeller shaft after transmission gear at the de-rated output of motor ($M_{PPMotor,\ lim}$) in cases where the over ridable Shaft / Engine Power Limitation is installed;
- maximum continuous rated power ($MCR_{SteamTurbine}$) for steam turbine;
- limited maximum continuous rated power ($MCR_{SteamTurbine,lim}$) for steam turbine in cases where the over ridable Shaft / Engine Power Limitation is installed; and
- $SFC_{SteamTurbine}$ for steam turbine, as specified in paragraph 2.2.7.2 of the EEDI Calculation Guidelines. If the calculation is not available from the manufacturer, $SFC_{SteamTurbin}$ may be calculated by the submitter.

Based on the ship types, the phase 2 or 3 of EEDI requirement to be fulfilled. For bulk carriers, tankers, RO-RO cargo ships the phase 2 will be applied and for container ships, LNG carries & Gas Carriers the phase 3 will be mandatory. (just for EEDI liable vessels)
This means the ships which pass the phase 2 or 3 of EEDI requirement will pass the new EEXI requirement, too.

When a ship doesn't meet the EEXI requirement, the proper measures to improve the efficiency are required. (Engine power limitation, fuel conversion to a low-carbon fuel, installing energy saving equipment, etc.)

A helpful flow chart of the systematic EEXI confirmation demonstrate in chart I.

EEXI Regulation:
On the basis of draft Reg. 23 of MARPOL Annex VI, all ships of 400 GT and above sailing in international voyages are subject to attained EEXI calculation. EEXI can be calculated by the same way with attained EEDI and the 2021 Guidelines on the method of calculation of the attained Energy Efficiency Existing Ship Index (EEXI) (resolution MEPC.333(76)).

For EEDI ships both attained EEDI & attained EEXI must be calculated and if attained EEDI <= attained EEXI the attained EEDI can be replaced with the attained EEXI, as an alternative.
So, 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.

The attained EEXI of the above mentioned vessels, should be less than the required EEXI. The required EEXI is equivalent to required EEDI in 2023 although for some ship types there is a little relaxation in 2023.

If the attained EEXI calculated more than required EEXI, the proper actions to improve the energy efficiency must be conducted. Some practicable measures which may be planned by owners listed below (just for reference):

- EPL (Engine Power Limitation)
- Installation or modification of energy-saving devices
- Fuel conversion to a low-carbon fuel

To conduct the first item above, the EPL to be performed based on the "2021 GUIDELINES ON THE SHAFT /ENGINE POWER LIMITATION SYSTEM TO COMPLY WITH THE EEXI REQUIREMENTS AND USE OF A POWER RESERVE" (IMO Resolution MEPC.334(76), as amended).

To verify 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 the classification, unless the attained EEDI of the ship satisfies the required EEXI.

Background document:

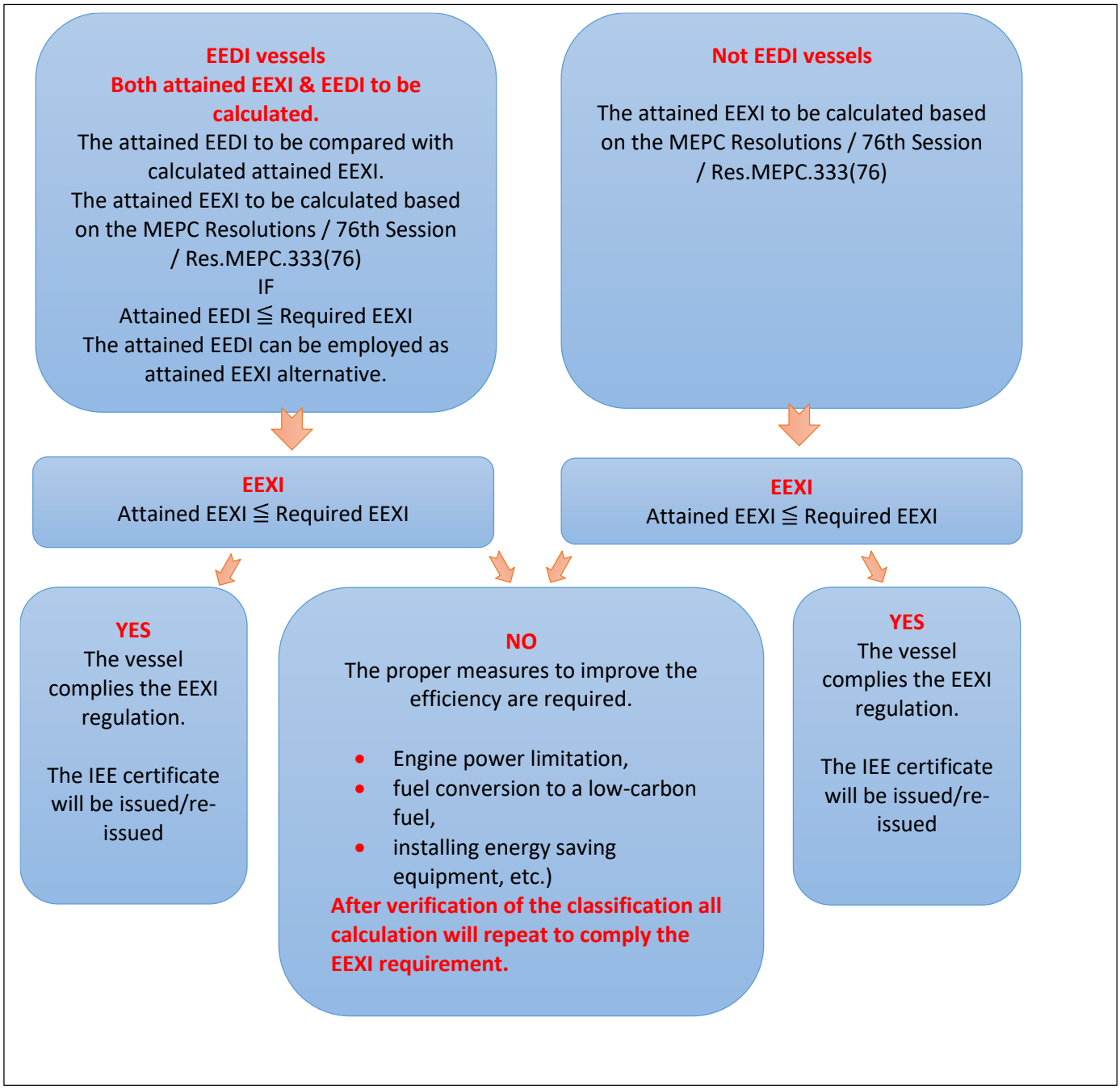
The background documents should include as a minimum, but are not limited to:

- details of the conversion;
- EEXI parameters changed after the conversion and the technical justifications for each respective parameter;
- reasons for other changes made in the EEXI Technical File, if any; and
- 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.

Table 2 - required and attained EEXI based on the ship types & sizes

Ship Type	Definition	Calculation of Attained EEXI	Conformity Required EEXI
Bulk carrier	A ship which is intended primarily to carry dry cargo in bulk, including such types as ore carriers as defined in SOLAS chapter XII, regulation 1, but excluding combination carriers.	400 GT and above	10,000 DWT and above
Gas carrier	A cargo ship, other than an LNG carrier as defined in paragraph 2.16 of this regulation, constructed or adapted and used for the carriage in bulk of any liquefied gas.	400 GT and above	2,000 DWT and above
Tanker	An oil tanker as defined in MARPOL Annex I, regulation 1 or a chemical tanker or an NLS tanker as defined in MARPOL Annex II, regulation 1.	400 GT and above	4,000 DWT and above
Containership	A ship designed exclusively for the carriage of containers in holds and on deck.	400 GT and above	10,000 DWT and above
General cargo ship	A ship with a multi-deck or single deck hull designed primarily for the carriage of general cargo. This definition excludes specialized dry cargo ships, which are not included in the calculation of reference lines for general cargo ships, namely livestock carriers, barge carriers, heavy load carriers, yacht carriers, and nuclear fuel carriers.	400 GT and above	3,000 DWT and above
Refrigerated cargo carrier	A ship designed exclusively for the carriage of refrigerated cargoes in holds.	400 GT and above	3,000 DWT and above
Combination carrier	A ship designed to load 100% deadweight with both liquid and dry cargo in bulk.	400 GT and above	4,000 DWT and above
Ro-ro cargo ship (vehicle carrier)	A multi-deck roll-on-roll-off cargo ship designed for the carriage of empty cars and trucks.	400 GT and above	10,000 DWT and above
Ro-ro cargo ship	A ship designed for the carriage of roll-on-roll-off cargo transportation units.	400 GT and above	1,000 DWT and above
Ro-ro passenger ship	A passenger ship with roll-on-roll-off cargo spaces.	400 GT and above	250 DWT and above
LNG carrier	A cargo ship constructed or adapted and used for the carriage in bulk of liquefied natural gas (LNG).	400 GT and above	10,000 DWT and above
Cruise passenger ship (having non-conventional propulsion)	A passenger ship not having a cargo deck, designed exclusively for commercial transportation of passengers in overnight accommodations on a sea voyage.	400 GT and above	25,000 GT and above

Chart I - Flow chart of EEXI regulation



Annex I – Calculation Method of Attained & Required EEXI

Attained EEXI formula

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

*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}·C_{FME}) and (SFC_{AE}·C_{FAE}) to be used for calculation of P_{eff}

Required EEXI formula

Required EEXI = $\left(1 - \frac{X}{100}\right) EEDI\ Reference\ Line\ Value$

= $\left(1 - \frac{X}{100}\right) a \times DWT^{-C}$

X: EEXI Reduction Factor (%) relative to the EEDI Reference Line

Table 3 - Parameters for Determination of Reference Line Values for Each Ship Type

Type of ship		Reference Line
Bulk carrier	DWT ≤ 279,000	$961.79 \times DWT^{-0.477}$
	DWT > 279,000	$961.79 \times 279{,}000^{-0.477}$
Gas carrier		$1120.00 \times DWT^{-0.456}$
Tanker		$1218.80 \times DWT^{-0.488}$
Containership		$174.22 \times DWT^{-0.201}$
General cargo ship		$107.48 \times DWT^{-0.216}$
Refrigerated cargo carrier		$227.01 \times DWT^{-0.244}$
Combination carrier		$1219.00 \times DWT^{-0.488}$
Ro-ro cargo ship (vehicle carrier)	DWT/GT < 0.3	$(DWT/GT)^{-0.7} \times 780.36 \times DWT^{-0.471}$
	DWT/GT ≥ 0.3	$1812.63 \times DWT^{-0.471}$
Ro-ro cargo ship	DWT ≤ 17,000	$1686.17 \times DWT^{-0.498}$
	DWT > 17,000	$1686.17 \times 17{,}000^{-0.498}$
Ro-ro passenger ship	DWT ≤ 10,000	$902.59 \times DWT^{-0.381}$
	DWT > 10,000	$902.59 \times 10{,}000^{-0.381}$
LNG carrier		$2253.7 \times DWT^{-0.474}$
Cruise passenger ship having non-conventional propulsion		$170.84 \times GT^{-0.214}$

Table 4 - X: EEXI Reduction Factor (%) relative to the EEDI Reference Line

Type of ship	Size	Reduction factor（X）%
Bulk carrier	200,000 DWT and above	15
	20,000 - 200,000 DWT	20
	10,000 - 20,000 DWT	0 - 20 *
Gas carrier	15,000 DWT and above	30
	10,000 - 15,000 DWT	20
	2,000 - 10,000 DWT	0 - 20 *
Tanker	200,000 DWT and above	15
	20,000 - 200,000 DWT	20
	4,000 - 20,000 DWT	0 - 20 *
Containership	200,000 DWT and above	50
	120,000 - 200,000 DWT	45
	80,000 - 120,000 DWT	35
	40,000 - 80,000 DWT	30
	15,000 - 40,000 DWT	20
	10,000 - 15,000 DWT	0 - 20*

* Reduction factor to be linearly interpolated between the two values dependent upon ship size.