

TÜRK LOYDU



SURVEY and CERTIFICATION RULES on ENERGY EFFICIENCY of SHIPS (MARPOL 73/78 ANNEX VI, CHAPTER 4)

2013

This latest edition incorporates all rule changes. The latest revisions are shown with a vertical line. The section title is framed if the section is revised completely. Changes after the publication of the rule are written in red colour.

Unless otherwise specified, these Rules apply to ships for which the date of contract for construction as defined in IACS PR No.29 is on or after 1st of October 2013. New rules or amendments entering into force after the date of contract for construction are to be applied if required by those rules. See Rule Change Notices on TL website for details.

"General Terms and Conditions" of the respective latest edition will be applicable (see Rules for Classification and Surveys).

If there is a difference between the rules in English and in Turkish, the rule in English is to be considered as valid. This publication is available in print and electronic pdf version.

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TÜRK LOYDU

Head Office Postane Mah. Tersaneler Cad. No:26 Tuzla 34944 İSTANBUL / TÜRKİYE
Tel : (90-216) 581 37 00
Fax : (90-216) 581 38 00
E-mail : info@turkloydu.org
<http://www.turkloydu.org>

Regional Offices

Ankara Eskişehir Yolu Mustafa Kemal Mah. 2159. Sokak No : 6/4 Çankaya - ANKARA / TÜRKİYE
Tel : (90-312) 219 56 34 - 219 68 25
Fax : (90-312) 219 69 72
E-mail : ankara@turkloydu.org

İzmir Atatürk Cad. No :378 K.4 D.402 Kavalalılar Apt. 35220 Alsancak - İZMİR / TÜRKİYE
Tel : (90-232) 464 29 88
Fax : (90-232) 464 87 51
E-mail : izmir@turkloydu.org

Adana Çınarlı Mah. Atatürk Cad. Aziz Naci İş Merkezi No:5 K.1 D.2 Seyhan - ADANA / TÜRKİYE
Tel : (90- 322) 363 30 12
Fax : (90- 322) 363 30 19
E-mail : adana@turkloydu.org

Marmaris Atatürk Cad. 99 Sok. No:1 Ketenbaş Apt. Kat:4 Daire 6 Marmaris - MUĞLA / TÜRKİYE
Tel : (90- 252) 412 46 55
Fax : (90- 252) 412 46 54
E-mail : marmaris@turkloydu.org

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FOREWORD

At the 62nd session of the Marine Environment Protection Committee (MEPC 62) held in July 2011; amendments to MARPOL Annex VI were adopted. The amendments that make the "Energy Efficiency Design Index (EEDI)" and the "Ship Efficiency Management Plan (SEEMP)" mandatory will come into force from 1 January 2013. "Türk Loydu Survey and Certification Guidelines on Energy Efficiency of Ships" provides detailed information for survey and certification processes related to EEDI and SEEMP.

1. DEFINITIONS OF TERMS USED IN GUIDELINES

"TL" means Türk Loydu

"New ship" means a ship:

1. For which the building contract is placed on or after 1 January 2013; or
2. In the absence of a building contract, the keel of which is laid or which is at a similar stage of construction on or after 1 July 2013; or
3. The delivery of which is on or after 1 July 2015.

(TL note: For the application of phases specified in regulation 21 (required EEDI) to "new ship", refer to Annex 2 B of these guidelines or MEPC.1/Circ 795)

"Existing ship" means a ship which is not a new ship.

"Major Conversion" means a conversion of a ship (in relation to energy efficiency) :

1. Which substantially alters the dimensions, carrying capacity or engine power of the ship; or
2. Which changes the type of the ship; or
3. The intent of which in the opinion of the Administration is substantially to prolong the life of the ship; or
4. Which otherwise so alters the ship that, if it were a new ship, it would become subject to relevant provisions of the present Convention not applicable to it as an existing ship; or
5. Which substantially alters the energy efficiency of the ship and includes any modifications that could cause the ship to exceed the applicable required EEDI.

(Additional information: Unified Interpretations for major conversion (MEPC.1/Circ 795)):

1. For regulation 2.24.1 of MARPOL Annex VI, any substantial change in hull dimensions and/or capacity (e.g. change of length between perpendiculars (LPP) or change of assigned freeboard) should be considered a major conversion. Any substantial increase of total engine power for propulsion (e.g. 5 per cent or more) should be considered a major conversion. In any case, it is the Administration's authority to evaluate and decide whether an alteration should be considered as major conversion, consistent with chapter 4 of MARPOL Annex VI.

2. Notwithstanding paragraph 1, for regulation 2.24.5 of MARPOL Annex VI, the effect on attained EEDI as a result of any change of ship's parameters, particularly any increase in total engine power for propulsion, should be investigated. In any case, it is the Administration's authority to evaluate and decide whether an alteration should be considered as major conversion, consistent with chapter 4 of MARPOL Annex VI.

3. A company may, at any time, voluntarily request re-certification of EEDI with IEEC reissuance on the basis of any new improvements to the ship efficiency that are not considered to be major conversion.

4. In regulation 2.24.4 of MARPOL Annex VI, terms "new ship" and "existing ship" should be understood as they are used in MARPOL Annex I regulation 1.9.1.4, rather than as the defined terms in regulations 2.22 and 2.23.

5. The term "a ship" referred to in regulation 5.4.2 of MARPOL Annex VI is interpreted as "new ship."

(Additional information: For application details of major conversion refer to "6. EEDI VERIFICATION FOR MAJOR CONVERSIONS" of these guidelines .)

"EEDI" is Energy Efficiency Design Index

"Attained EEDI" is the EEDI value achieved by an individual ship in accordance with regulation 20 of chapter 4 of MARPOL 73/78 Annex VI. Attained EEDI is specific to each ship and indicates the estimated performance of the ship in terms of energy efficiency. The attained EEDI shall be verified, based on the EEDI technical file, either by the Administration or by any organization duly authorized by it. TL acts as a verifier for the EEDI.

"Required EEDI" is the maximum allowable value of attained EEDI that is allowed by regulation 21 of chapter 4 of MARPOL 73/78 Annex VI for the specific ship type and size.

"EEDI Technical File" is a documentation package that contains the information necessary for the calculation of the attained EEDI and shows the process of calculation. The EEDI Technical File has to be approved by the recognized organization or a classification society on their behalf. EEDI Technical File should be written at least in English.

"Reference line" is a curve representing an average index value fitted on a set of individual index values for a defined group of ships. The reference lines were established by using existing ships index values for each ship type to which regulation 21 (Required EEDI) of MARPOL Annex VI is applicable.

"EEDI Condition" is a ship's loading condition corresponding to the maximum summer load draught in order to determine the capacity under EEDI calculations. For container ships, capacity is to set to 70 % of DWT. For ships other than container ships; capacity is to set to DWT.

"SEEMP" is Ship Energy Efficiency Management Plan. This plan shall be ship specific. The Ship Energy Efficiency Management Plan (SEEMP) is a management plan designed to improve the ship energy efficiency by implementing operational or technical measures such as but not limited to speed optimization, optimum trim, propeller polishing, and energy saving devices.

"Verifier" means an Administration or organization duly authorized by it, which conducts the survey and certification of the EEDI in accordance with regulations 5, 6, 7, 8 and 9 of MARPOL Annex VI. TL acts as a verifier for the EEDI.

“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 ship's performance), with approval of the verifier.

“IAPP Certificate” is International Air Pollution Prevention Certificate

“EIAPP Certificate” is Engine International Air Pollution Prevention Certificate

“IEEC” is International Energy Efficiency Certificate

“ITTC” is International Towing Tank Conference. The International Towing Tank Conference is a voluntary association of worldwide organizations that have responsibility for the prediction of hydrodynamic performance of ships and marine installations based on the results of physical and numerical modeling.

2. GENERAL REQUIREMENTS OF CHAPTER 4 OF MARPOL 73/78 ANNEX VI AND APPLICABILITY TO SHIPS

The amendments to MARPOL 73/78 ANNEX VI apply to all ships of 400 gross tonnage and above engaged in international voyages. In principle the regulations on “attained EEDI” and “required EEDI” shall not apply to ships mentioned hereunder:

- Which have diesel-electric propulsion, turbine propulsion or hybrid propulsion systems, or
- Which are waived by the Administration from having to comply with the requirements.

For innovative technologies other than diesel-electric propulsion, turbine propulsion or hybrid propulsion systems, MEPC.1/Circ.815 "2013 Guidance on treatment of innovative energy efficiency technologies for calculation and verification of the attained EEDI" shall be used if applicable for the system.

2.1 Attained EEDI

The attained EEDI shall be calculated for

- “1. Each new ship;
2. Each new ship which has undergone a major conversion; and
3. Each new or existing ship which has undergone a major conversion, that is so extensive that the ship is regarded by the Administration as a newly constructed ship”

That falls into one or more of the categories defined in Regulation **2.25 to 2.35** of MARPOL 73/78 ANNEX VI, attained EEDI shall be calculated in accordance with IMO Resolution MEPC.212(63) as amended by MEPC. 224(64) "2012 GUIDELINES ON THE METHOD OF CALCULATION OF THE ATTAINED ENERGY EFFICIENCY DESIGN INDEX (EEDI) FOR NEW SHIPS".

For the definition of each type of ship, please refer to Annex 1.

2.2 Required EEDI

For each:

“1. New ship;

2. New ship which has undergone a major conversion; and

3. New or existing ship which has undergone a major conversion that is so extensive that the ship is regarded by the Administration as a newly constructed ship”

That falls into one of the categories defined in Regulation **2.25 to 2.31**, of MARPOL 73/78 ANNEX VI; a ship's attained EEDI shall be on or below the required EEDI for that ship type and size.

Required EEDI is scheduled to become more stringent from Phase 0 to Phase 3 by using a reduction factor from the reference line. For the details on the required EEDI, please refer to Annex 2.

2.3 SEEMP

All ships (new and existing ships) with a gross tonnage of 400 tonnage and above engaged in international voyages shall keep on board a ship specific Ship Energy Efficiency Management Plan (SEEMP). This may form part of the ship's Safety Management System (SMS). With respect to ships required to keep on board a SEEMP, such ships exclude platforms (including FPSOs and FSUs) and drilling rigs, regardless of their propulsion.

SEEMP shall be developed according to IMO Resolution MEPC.213(63) “ 2012 GUIDELINES FOR THE DEVELOPMENT OF A SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP)”

For new ships, the verification of the requirement to have a SEEMP on board according to regulation 22 shall take place at the initial survey before a new ship is put in service and before the IEEC is issued.

For existing ships, the verification of the requirement to have a SEEMP on board according to regulation 22 shall take place at the at the initial survey before the IEEC is issued. (For existing ships, initial survey of IEEC is the first intermediate or renewal survey of the International Air Pollution Prevention Certificate (IAPP Certificate), whichever is the first, on or after 1 January 2013)

2.4 IEEC

International Energy Efficiency Certificate (IEEC), is to be issued for all ships (new and existing ships) after the requirements of the Initial Survey for any ship of 400 gross tonnage and above engaged in international voyages have been satisfied according to chapter 4 of MARPOL 73/78 ANNEX VI.

For new ships, initial survey shall be completed before a new ship is put in service.

For existing ships, initial survey date is the date of first intermediate or renewal survey of the IAPP Certificate, whichever is the first, on or after 1 January 2013.

The IEEC has no expiry date, since it will be valid throughout the life of the ship and subsequent periodical surveys are not required. The IEEC shall only cease to be valid in any of the cases listed hereunder. In cases 2 and 3 IEEC shall be rewritten or reissued.

1. If the ship is withdrawn from service; or
2. If the ship undergoes a major conversion; or
3. Upon transfer of the ship to the flag of another State

Where the Flag Administration has not ratified ANNEX VI of MARPOL 73/78 and if TL authorized by Administration, TL will carry out the relevant surveys and issue "Document of Compliance" on behalf of the Administration.

In relation to chapter 4, any port State inspection shall be limited to verifying, when appropriate, that there is a valid International Energy Efficiency Certificate on board, in accordance with article 5 of the Convention.

3. INITIAL SURVEY REQUIREMENTS OF IEEC FOR EXISTING SHIPS

For an existing ship (a ship which is not a new ship), shipowner shall develop and carry SEEMP on board. The verification of the requirement to have a SEEMP on board according to regulation 22 shall take place at the initial survey before the IEEC is issued.

For existing ships, initial survey of IEEC is the first intermediate or renewal survey of the IAPP Certificate, whichever is the first, on or after 1 January 2013. The intermediate or renewal survey mentioned here, relates solely to the timing for the verification of the SEEMP on board, i.e. these IAPP Certificate survey windows will also become the IEEC initial survey date for existing ships. The SEEMP is however a survey item solely under the new MARPOL Annex VI, chapter 4, and is not a survey item relating to IAPP Certificate surveys.

During initial survey of IEEC, TL surveyor shall verify that:

- The ship specific SEEMP is provided onboard. (SEEMP does not to be approved by the Administration or Classification Society under the revised MARPOL ANNEX VI)
- The SEEMP is established in a working language or languages understood by ship's personnel
- The SEEMP is developed taking into account IMO Resolution MEPC.213(63) "2012

GUIDELINES FOR THE DEVELOPMENT OF A SHIP ENERGY EFFICIENCY

MANAGEMENT PLAN (SEEMP)"

In detail, TL surveyor shall also verify that SEEMP includes items listed hereunder:

- Energy efficiency improvement measures (representative examples of the measures are presented in chapter 5 of MEPC.213(63), e.g. weather routing, speed optimization, etc.)

- Monitoring methods for energy efficiency
- Measurable goals for energy efficiency
- Procedures of evaluation

After completion of verification of SEEMP, IEEC will be issued by TL.

Where the Flag Administration has not ratified ANNEX VI of MARPOL 73/78 and if TL authorized by Administration, TL will carry out the relevant surveys and issue "Document of Compliance" on behalf of the Administration.

The validity of the IAPP Certificate is not impacted by the lack of a SEEMP as the SEEMP is a survey item solely under the new MARPOL Annex VI, chapter 4, and not under the IAPPC surveys.

4. INITIAL SURVEY REQUIREMENTS OF IEEC FOR NEW SHIPS

New ships required to carry IEEC after completion of initial survey of IEEC. (**TL note:** Refer to "1. DEFINITIONS OF TERMS USED IN GUIDELINES" for "new ship" definition in guidelines)

Briefly; during initial survey of IEEC for new ships, TL surveyor shall verify that:

- Ship's attained EEDI is in accordance with the requirements in chapter 4 of ANNEX VI of MARPOL 73/78
- Ship has an approved EEDI Technical File
- The technical equipment listed in the EEDI Technical File is available on board (engine, shaft, generator)
- The ship specific SEEMP is provided onboard. (SEEMP does not to be approved by the Administration or Classification Society under the revised MARPOL ANNEX VI)
- The SEEMP is established in a working language or languages understood by ship's personnel
- The SEEMP is developed taking into account IMO Resolution MEPC.213(63) "2012

GUIDELINES FOR THE DEVELOPMENT OF A SHIP ENERGY EFFICIENCY

MANAGEMENT PLAN (SEEMP)"

In detail, TL surveyor shall also verify that SEEMP includes items listed hereunder:

- Energy efficiency improvement measures (representative examples of the measures are presented in chapter 5 of MEPC.213(63), e.g. weather routing, speed optimization, etc.)
- Monitoring methods for energy efficiency

- Measurable goals for energy efficiency
- Procedures of evaluation

5. EEDI VERIFICATION PROCESS OF NEW SHIPS FROM DESIGN STAGE TO FINAL VERIFICATION

The attained EEDI shall be calculated for

“1 Each new ship;

2. Each new ship which has undergone a major conversion; and

3. Each new or existing ship which has undergone a major conversion, that is so extensive that the ship is regarded by the Administration as a newly constructed ship”

That falls into one or more of the categories defined in Regulation **2.25 to 2.35** of MARPOL 73/78 ANNEX VI. Attained EEDI shall be calculated in accordance with IMO Resolution MEPC.212(63) as amended by MEPC. 224(64) "2012 GUIDELINES ON THE METHOD OF CALCULATION OF THE ATTAINED ENERGY EFFICIENCY DESIGN INDEX (EEDI) FOR NEW SHIPS".

For the definition of each type of ship, please refer to Annex 1.

Before the design stage designer/owner/shipbuilder should assess by taking into account ship type, DWT, construction date etc.; the situation of the ship, whether:

- The the ship has to comply with required EEDI according to regulation 21 of chapter 4 of MARPOL 73/78 Annex VI (refer to Annex 2 of guidelines)
- Which phase is applicable for the ship (refer to Annex 2 of guidelines)

(Additional information: In determining a ship’s attained Energy Efficiency Design Index (EEDI) as per resolution MEPC.212(63), a lower threshold for the minimum installed propulsion power for bulk carriers, oil and chemical tankers and combination carriers is needed. The method for determining this lower minimum threshold is contained in **MEPC 232 (65), “2013 Interim Guidelines for determining minimum propulsion power to maintain the manoeuvrability of ships in adverse conditions”**)

EEDI verification is conducted in accordance with MEPC.214(63) “2012 GUIDELINES ON SURVEY AND CERTIFICATION OF THE ENERGY EFFICIENCY DESIGN INDEX (EEDI)” **as amended by MEPC 234(65) and IACS PR 38.**

EEDI verification is conducted through 2 steps:

- Preliminary verification at the design stage
- Final verification during sea trials

For ships to which regulation 21 (required EEDI) of MARPOL Annex VI applies, the power curves used for the preliminary verification at the design stage should be based on reliable results of tank test.

For ensuring the quality of tank tests, ITTC quality system should be taken into account. If TL has no recent experience with the tank test facility and the tank test organization quality system is not ISO 9001 certified; description of the tank test facility and tank test organisation quality manual shall be submitted as documented information listed hereunder:

- Descriptions of the tank test facility; this should include the name of the facility, the particulars of tanks and towing equipment, and the records of calibration of each monitoring equipment.
- Quality manual containing at least the information listed in the ITTC Sample quality manual (2002 issue)
Records of measuring equipment calibration.
- Standard model-ship extrapolation and correlation method (applied method and tests description).

TL will audit the quality management system of the towing tank if previous experience is insufficiently demonstrated.

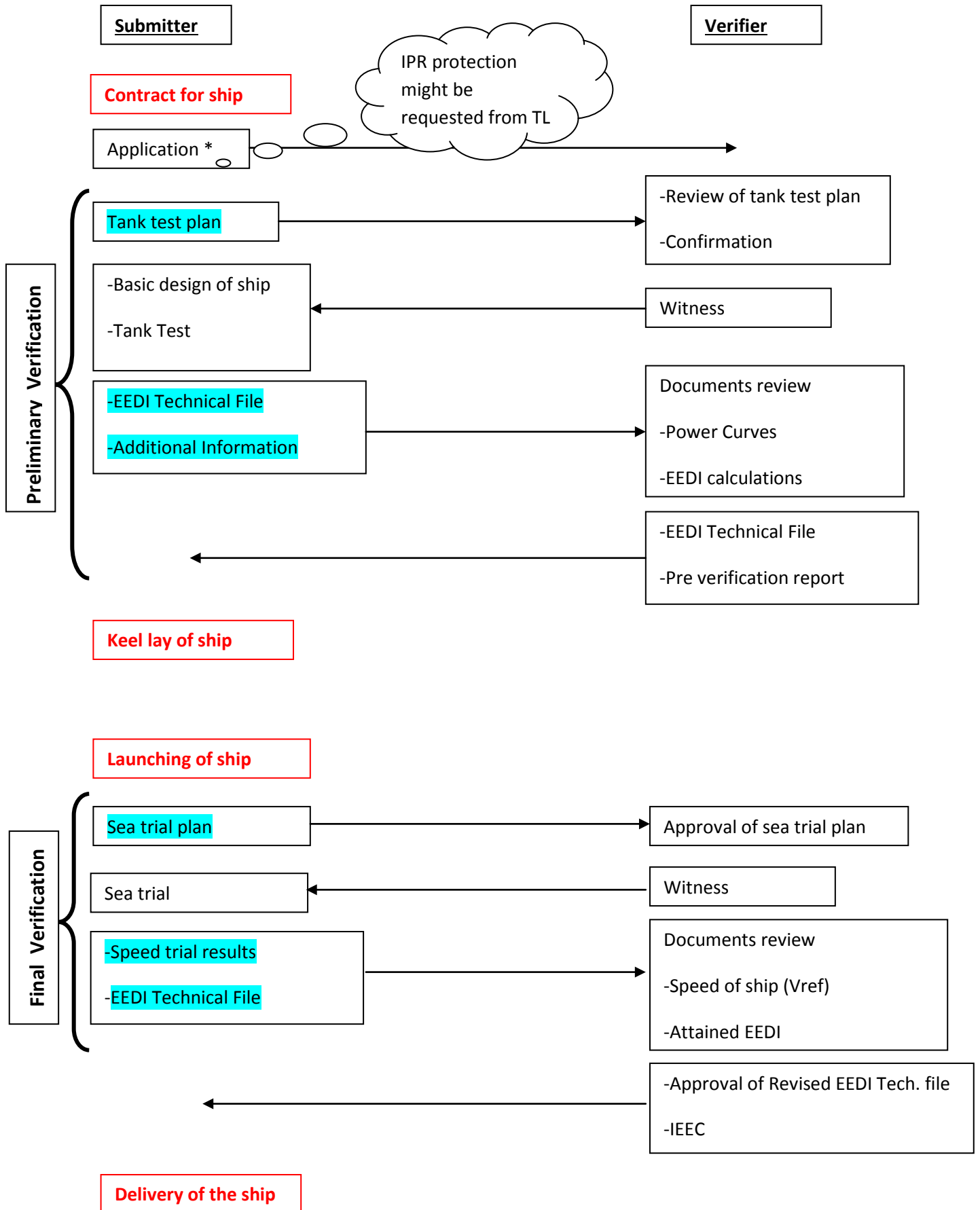
Model tank test should be witnessed by the TL.

A tank test for an individual ship may be omitted in the following cases:

- The results of tank tests for ships of the same type are available
- Speed trials will be carried under the EEDI condition upon agreement of the shipowner and shipbuilder and with approval of the TL.
- Required EEDI is not applied
- Other cases based on technical justifications

In line with the MEPC.214(63) "2012 GUIDELINES ON SURVEY AND CERTIFICATION OF THE ENERGY EFFICIENCY DESIGN INDEX (EEDI)" as amended by MEPC 234(65) (4.1.2), it is recognized that the documents submitted for verification may contain confidential information of submitters, which requires Intellectual Property Rights (IPR) protection. In the case where the submitter wants a non-disclosure agreement with the TL, the additional information should be provided to TL upon mutually agreed terms and conditions.

Basic Flow of Survey and Certification Process



Documents to be submitted for preliminary verification at the design stage

For preliminary verification stage submitter shall submit documents listed hereunder to TL:

- If necessary, documented information about tank test facility.
- Tank tests plan (min. 3 copies)
- EEDI Technical File (min. 3 copies)
- EIAPP certificates and NOx technical files of engines or technical files of engine manufacturers (min. 3 copies)
- Additional information (min. 3 copies)
 - Preliminary trim and stability booklet,
 - Documentation for innovative technologies if necessary for calculation of EEDI,
 - Model test results,
 - Lines plan of model ship and actual ship,
 - Detailed calculation process for determining the ships speed which includes the way to estimate the power curves etc.

Data for preliminary EEDI technical file

Parameter	Description	Unit
C_F	The conversion factor of the fuel type used for EIAPP cert. in NO _x Tech. File of all main and auxiliary engines (MEPC.212(63) as amended by MEPC.224(64))	g CO ₂ /g fuel
Δ	The displacement should be taken from the loading manual / preliminary trim and stability booklet.	t
DWT	The deadweight should be taken from the loading manual / preliminary trim and stability booklet, alternatively a freeboard calculation.	t
$f_{eff(i)}$	The availability factor for each innovative energy efficiency technology shall be based on comprehensive documentation of the determination for each innovative energy efficiency technology For waste heat recovery systems $f_{eff(i)}$ shall be set to one.	
f_i	For ice-classed ships f_i is determined by the standard given in MEPC. 212(63) as amended by MEPC.224(64) Documentation on intended ice class	
f_j	For ships with planned ice class f_j is given in MEPC.212(63) as amended by MEPC.224(64) Documentation on intended ice class	
f_w	Refer to MEPC.1/Circ. 796	

Data for preliminary EEDI technical file

Parameter	Description	Unit
GT	GT shall be calculated acc. to the International Convention of Tonnage Measurements of ships 1969, corresponding documentation shall be submitted	
Lightweight	The lightweight shall be taken from the loading manual / preliminary trim and stability booklet.	t
P _{AE}	<ul style="list-style-type: none"> - If $\sum MCR_{ME(i)} > 10,000$ Kw, P_{AE} shall be calculated as: $P_{AE} = 0.025 \cdot (MCR_{ME} + 250)$ - If $\sum P_{ME(i)} < 10,000$ Kw, P_{AE} shall be: $P_{AE} = 0.05 \cdot MCR_{ME}$ 	kW
P _{Aeff(i)}	Manufacturer's documentation acc. to existing IEC and ISO standards incl. factory acceptance test data for auxiliary power reduction with innovative mechanical energy efficient technology.	kW
P _{eff(i)}	Manufacturer's documentation acc. to existing IEC and ISO standards incl. factory acceptance test data for power output of each innovative mechanical energy efficient technology.	kW
P _{ME(i)}	EIAPP certificate to document MCR of main engine(s). Manufacturer's documentation is required if an EIAPP certificate is not available at the design stage.	kW
P _{PTI(i)}	Manufacturer's documentation acc. to existing IEC and ISO standards incl. factory acceptance test data for power take-in devices (e.g. shaft motor). If a shaft motor is installed also the weighted average efficiency of the generators shall be documented.	kW
P _{PTO(i)}	Manufacturer's documentation acc. to existing IEC and ISO standards incl. factory acceptance test data for power take-off devices (e.g. shaft generator) and their efficiency. Alternatively a fixed value of 0.9 could be used as efficiency.	kW
SFC _{AE}	EIAPP certificate and NO _x Technical File acc. NO _x Technical Code to document specific fuel oil consumption at 50% of MCR power of auxiliary engine(s). Manufacturer's documentation is required if an EIAPP certificate is not available at the design stage. If no EIAPP Certificate for an engine is available because its power is below 130 kW, the SFC specified by the manufacturer and endorsed by a competent authority should be used	g/kWh
SFC _{ME(i)}	EIAPP certificate and Technical File acc. NO _x Technical Code to document specific fuel oil consumption at 75% of MCR power of main engine(s) Manufacturer's documentation is required if an EIAPP certificate is not available at the design stage.	g/kWh
V _{ref}	A speed-power curve from towing tank test (or equivalent) for a) EEDI conditions, and b) Ballast conditions at sea trial The documents shall include the name and particulars of the towing tank facility where the towing tank tests were conducted and the details of the calculation method.	kn

Sub Steps for preliminary verification

1. Review of the tank test plan
2. Witnessing of the tank tests

TL shall verify:

- Quality control of the tank test facility
 - Ship model: Manufacturing accuracy
 - Propeller Model: Manufacturing accuracy
 - Calibration records of measuring equipment
 - Draught at the resistance test and self-propulsion test
 - Measurement items of resistance test, self-propulsion test and propeller open water test
3. Document review

TL will check that the work done by the tank test organisation is consistent with the present IMO Guidelines. In particular, TL will review that the power curves at full scale are determined in a consistent way between sea trials and EEDI loading conditions, applying the same calculation process of the power curves and considering justifiable differences of experience based parameters between the two conditions, in order to verify the results for the design stage based on the EEDI Technical File and Additional Information.

4. Issuance of preliminary verification report

After the completion of the preliminary verification of EEDI at design stage, a preliminary verification report will be issued by TL.

Documents to be submitted for final verification during sea trials

- Sea trial plan (min. 3 copies)
- Results of speed trial (min. 3 copies) (Documentation shall include description of measuring and sea trial procedure observed and measured environmental conditions, draft and trim of the ship, uncorrected measured data, and the calibration records of the measuring equipment used. The sea trial report shall include the speed-power curves.)
- EEDI Technical File (Final) (min. 3 copies)
- NOx Technical File (for confirmation of specific fuel consumption of the main and auxiliary engines) (min. 3 copies)

- Additional information (min. 3 copies)
 - Results of inclining test /Lightweight survey (for confirmation of deadweight)
 - Final trim and stability booklet
 - Documentation of measured main and auxiliary power reduction with innovative mechanical energy efficient technology and method used
 - Documentation of reference speed calculation

Data for final EEDI technical file after sea trial

Parameter	Description	Unit
f_w	Refer to MEPC.1/Circ. 796	
GT	International Tonnage Certificate	
Lightweight	Derived lightweight determined in inclining test. Alternatively, a lightweight survey documentation	t
P_{AE}	Only if the P_{AE} value calculated by the standard method is significantly different from the total power used at normal seagoing, documentation of consumed electric power (excluding propulsion) in EEDI condition at reference speed (V_{ref}), according to guidelines.	kW
$P_{Aeff(i)}$	Documentation of measured auxiliary power reduction with innovative mechanical energy efficient technology and method used	kW
$P_{eff(i)}$	Documentation of measured power of each innovative mechanical energy efficient technology and method used	kW
$P_{ME(i)}$	EIAPP certificate for the main engine(s) Documentation of measured shaft power and method used at sea trial, and the calibration records of the measuring equipment used.	kW
$P_{PTI(i)}$	Documentation of measured power taken-in and method used Manufacturer's documentation on efficiency of the installed generators	kW
$P_{PTO(i)}$	Documentation of measured power taken-off and method used Manufacturer's documentation on efficiency	kW
SFC_{AE}	- EIAPP certificate for the main engine's and the technical file acc. NO _x Technical Code - If no NO _x Technical File for an engine is available because its power is below 130 kW, the SFC specified by the manufacturer and endorsed by a competent authority should be used	g/kWh
$SFC_{ME(i)}$	EIAPP certificate for the main engine(s) and the technical file acc. NO _x Technical Code.	g/kWh
V_{ref}	Measured speed acc. ISO 15016 and ISO 19019 at sea trials for EEDI condition or for ballast draft corresponding to the towing tank tests (or equivalent) speed calculation, documentation of the calculation procedure used to determine V_{ref} . Documentation of sea trial with measurement protocol incl. list of measurement equipment, measuring method, and speed-power curves.	kn

Data for final EEDI technical file after sea trial

Parameter	Description	Unit
C_F	The conversion factor of the fuel type used for EIAPP cert. in NO _x Tech. File	g CO ₂ /g fuel
Δ	Displacement tables as given in the final stability booklet or from the results of the inclining test	t
DWT	The deadweight of summer load draft as outlined in the final stability booklet.	t
$F_{eff(i)}$	If applicable, documentation on measured availability for each innovative energy efficiency technology and method used	
f_i	Class certificate including ice class notation	
f_j	Class certificate including ice class notation	

Sub Steps for final verification

1. Review of the sea trial procedure (TL shall examine the programme of the sea trial to check that the test procedure and in particular that the number of speed measurement points comply with the requirements of the IMO Verification Guidelines)
2. Witnessing of the sea trial (TL shall take notes the main parameters to be used for the final calculation of the EEDI, as given under 4.3.3 of the IMO Verification Guidelines)

TL shall verify:

- Propulsion and power supply system, particulars of the engines, and other relevant items described in the EEDI Technical File;
- Speed trial conditions, including weather conditions, sea conditions, draught, trim and displacement; and
- Ship speed and output of the main engine.

3. Confirmation of attained EEDI

The relevant data measured during the speed trials is to be confirmed and the correction process for the attained EEDI is to be verified. Specifically, it is to be confirmed that the reference ship speed (V_{ref}), normally the ship speed at 75% MCR power under EEDI Condition, is determined based on the power curves developed by the results of speed trial and speed correction.

4. Approval of EEDI Technical File

The final EEDI Technical File is to be confirmed and approved by TL. (SAMPLE OF EEDI TECHNICAL FILE template in Appendix 1 of IMO Verification Guidelines shall be used)

6. EEDI VERIFICATION FOR MAJOR CONVERSIONS*

As per regulation 20 (attained EEDI) of chapter 4 of MARPOL 73/78 Annex VI, the attained EEDI shall be calculated for each new ship which has undergone a major conversion; and each new or existing ship which has undergone a major conversion, that is so extensive that the ship is regarded by the Administration as a newly constructed ship which falls into one or more of the categories in regulations 2.25 to 2.35. (Refer to Annex 1 for definition of ship types)

As per regulation 21 (required EEDI) of chapter 4 of MARPOL 73/78 Annex VI, for each new ship which has undergone a major conversion; and new or existing ship which has undergone a major conversion that is so extensive that the ship is regarded by the Administration as a newly constructed ship that falls into one of the categories defined in Regulation 2.25 to 2.31, of MARPOL 73/78 ANNEX VI; a ship's attained EEDI shall be on or below the required EEDI for that ship type and size. **

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 and meet the requirement of paragraph 21.1 of chapter 4 of MARPOL 73/78 Annex VI 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.

According to regulation 5 of chapter 2 of MARPOL 73/78 Annex VI, ships to which chapter 4 applies shall also be subject to the surveys specified below, taking into account MEPC. 214(63) "Guidelines on Survey and Certification of the Energy Efficiency Design Index" as amended by MEPC 234(65) adopted by the Organization:

- A general or partial survey, according to the circumstances, after a major conversion of a ship to which this regulation applies. The survey shall ensure that the attained EEDI is recalculated as necessary and meets the requirement of regulation 21, with the reduction factor applicable to the ship type and size of the converted ship in the phase corresponding to the date of contract or keel laying or delivery determined for the original ship in accordance with regulation 2.23 (new ship definition) of chapter 1 of MARPOL 73/78 Annex VI;
- In cases where the major conversion of a new or existing ship is so extensive that the ship is regarded by the Administration as a newly constructed ship, the Administration shall determine the necessity of an initial survey on attained EEDI. Such a survey, if determined necessary, shall ensure that the attained EEDI is calculated and meets the requirement of regulation 21, 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.

An IEEC issued shall cease to be valid in if a new certificate is issued following major conversion of the ship.

*For definition of major conversion and UIs on major conversion, refer to 1. DEFINITIONS OF TERMS USED IN GUIDELINES

** Refer to Annex 1 for definition of ship types

Annex 1

Definition of each type of ship according to MARPOL 73/78 Annex VI.

Chapter 1, Regulation 2:

.25 "Bulk carrier" means 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.

.26 "Gas carrier" means a cargo ship constructed or adapted and used for the carriage in bulk of any liquefied gas.

.27 "Tanker" in relation to chapter 4 means 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. (**Additional information:** Fruit Juice carriers shall be categorized as "Refrigerated cargo carriers" as agreed by MEPC 64, refer to MEPC.1/Circ 795)

.28 "Container ship" means a ship designed exclusively for the carriage of containers in holds and on deck.

.29 "General cargo ship" means 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 carrier, barge carrier, heavy load carrier, yacht carrier, nuclear fuel carrier.

.30 "Refrigerated cargo carrier" means a ship designed exclusively for the carriage of refrigerated cargoes in holds.

.31 "Combination carrier" means a ship designed to load 100% deadweight with both liquid and dry cargo in bulk.

.32 "Passenger ship" means a ship which carries more than 12 passengers.

.33 "Ro-ro cargo ship (vehicle carrier)" means a multi deck roll-on-roll-off cargo ship designed for the carriage of empty cars and trucks.

.34 "Ro-ro cargo ship" means a ship designed for the carriage of roll-on-roll-off cargo transportation units.

.35 "Ro-ro passenger ship" means a passenger ship with roll-on-roll-off cargo spaces."

Annex 2

A- Summary information on the calculation of required EEDI according to regulation 21 of chapter 4 of MARPOL 73/78

Annex VI:

Attained EEDI \leq Required EEDI = $(1-X/100) \times$ Reference line value

Reference line value = $a \times b^{-c}$

Parameters for Determination of Reference Line Values for the Different Ship Types

Ship Type	Reference line
Bulk carrier	$961.79 \times \text{DWT}^{-0.477}$
Gas carrier	$1120.00 \times \text{DWT}^{-0.456}$
Tanker	$1218.80 \times \text{DWT}^{-0.488}$
Container ship	$174.22 \times \text{DWT}^{-0.201}$
General cargo ship	$107.48 \times \text{DWT}^{-0.216}$
Refrigerated cargo carrier	$227.01 \times \text{DWT}^{-0.244}$
Combination carrier	$1219.00 \times \text{DWT}^{-0.488}$

Reduction factors (in percentage) for the EEDI relative to the EEDI Reference line

Ship Type	Size (DWT)	EEDI Reduction factor (X)			
		Phase 0	Phase 1	Phase 2	Phase 3
		1 Jan. 2013- 31 Dec. 2014	1 Jan 2015- 31 Dec. 2019	1 Jan. 2020- 31 Dec. 2024	1 Jan. 2025 -
Bulk carrier	20,000 -	0 %	10 %	20 %	30 %
	10,000 – 20,000	n/a	0 - 10 %	0 - 20 %	0 - 30 %
Gas carrier	10,000 -	0 %	10 %	20 %	30 %
	2,000 – 10,000	n/a	0 - 10 %	0 - 20 %	0 - 30 %
Tanker	20,000 -	0 %	10 %	20 %	30 %
	4,000 – 20,000	n/a	0 - 10 %	0 - 20 %	0 - 30 %
Container ship	15,000 -	0 %	10 %	20 %	30 %
	10,000 – 15,000	n/a	0 - 10 %	0 - 20 %	0 - 30 %
General cargo ship	15,000 -	0 %	10 %	15 %	30 %
	3,000 – 15,000	n/a	0 - 10 %	0 - 15 %	0 - 30 %
Refrigerated cargo carrier	5,000 -	0 %	10 %	15 %	30 %
	3,000 – 5,000	n/a	0 - 10 %	0 - 15 %	0 - 30 %
Combination carrier	20,000 -	0 %	10 %	20 %	30 %
	4,000 – 20,000	n/a	0 - 10 %	0 - 20 %	0 - 30 %

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

B- Applicability of Phases specified in table 1 of regulation 21 (required EEDI) of MARPOL Annex VI to new ships according to MEPC.1/Circ 795

Summary table for applicability of phases to new ships

Contract / Delivery	Before 1 Jan. 2013	1 Jan. 2013 - 31 Dec. 2014	1 Jan. 2015 - 31 Dec. 2019	1 Jan. 2020 - 31 Dec. 2024	1 Jan. 2025 -
Before 1 July 2015	n/a	Phase 0	Phase 1	-	-
1 July 2015 – 31 Dec. 2018	Phase 0	Phase 0	Phase 1	-	-
1 Jan. 2019 – 31 Dec. 2023	Phase 1	Phase 1	Phase 1	Phase 2	-
1 Jan. 2024 – 31 Dec. 2028	Phase 2	Phase 2	Phase 2	Phase 2	Phase 3
1 Jan. 2029 -	Phase 3	Phase 3	Phase 3	Phase 3	Phase 3

(In the absence of a building contract)

Keel-lay / Delivery	Before 1 July 2013	1 July 2013 - 30 June 2015	1 July 2015 - 30 June 2020	1 July 2020 - 30 June 2025	1 July 2025 -
Before 1 July 2015	n/a	Phase 0	-	-	-
1 July 2015 – 31 Dec. 2018	Phase 0	Phase 0	Phase 1	-	-
1 Jan. 2019 – 31 Dec. 2023	Phase 1	Phase 1	Phase 1	Phase 2	-
1 Jan. 2024 – 31 Dec. 2028	Phase 2	Phase 2	Phase 2	Phase 2	Phase 3
1 Jan. 2029 -	Phase 3	Phase 3	Phase 3	Phase 3	Phase 3

The required EEDI of Phase 0 is applied to the following new ship:

	Before 1 Jan. 2013	Phase 0 1 Jan. 2013 – 31 Dec. 2014	Phase 1 1 Jan. 2015 – 31 Dec. 2019	Phase 2 1 Jan. 2020 – 31 Dec. 2024	Phase 3 1 Jan. 2025 –
Case 1		Contract	Delivery		
Case 2	Contract		Delivery		
Case 3		Keel-lay	Delivery		
Case 4	Keel-lay		Delivery		
	Before 1 July 2013	1 July 2013 – 30 June 2015 30 months	1 July 2015 – 31 Dec. 2018		

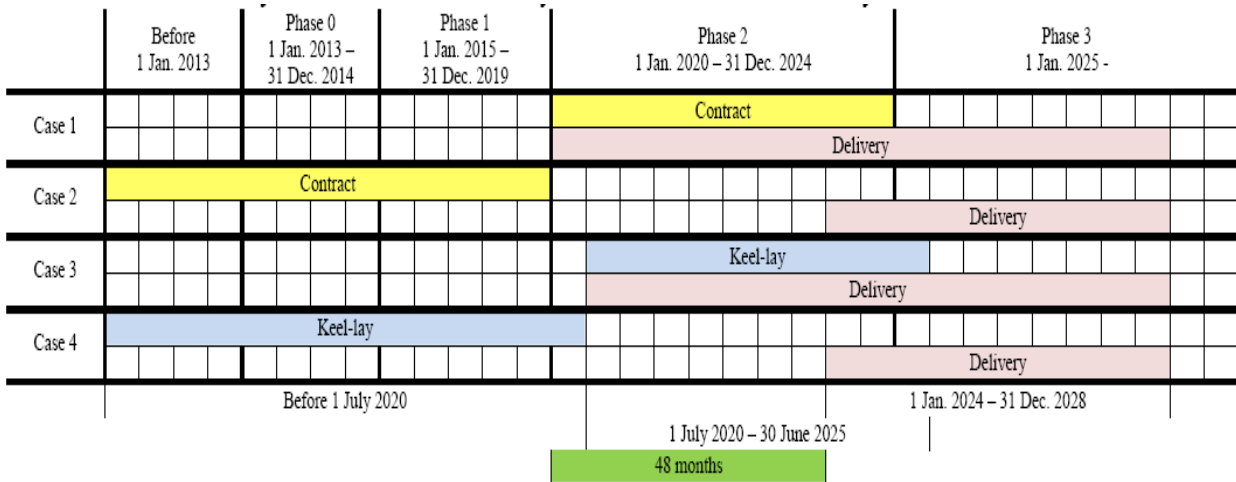
The required EEDI of Phase 1 is applied to the following new ship:

	Before 1 Jan. 2013	Phase 0 1 Jan. 2013 – 31 Dec. 2014	Phase 1 1 Jan. 2015 – 31 Dec. 2019	Phase 2 1 Jan. 2020 – 31 Dec. 2024	Phase 3 1 Jan. 2025 –
Case 1			Contract	Delivery	
Case 2	Contract			Delivery	
Case 3			Keel-lay	Delivery	
Case 4	Keel-lay			Delivery	
	Before 1 July 2015		1 July 2015 – 30 June 2020 48 months	1 Jan. 2019 – 31 Dec. 2023	

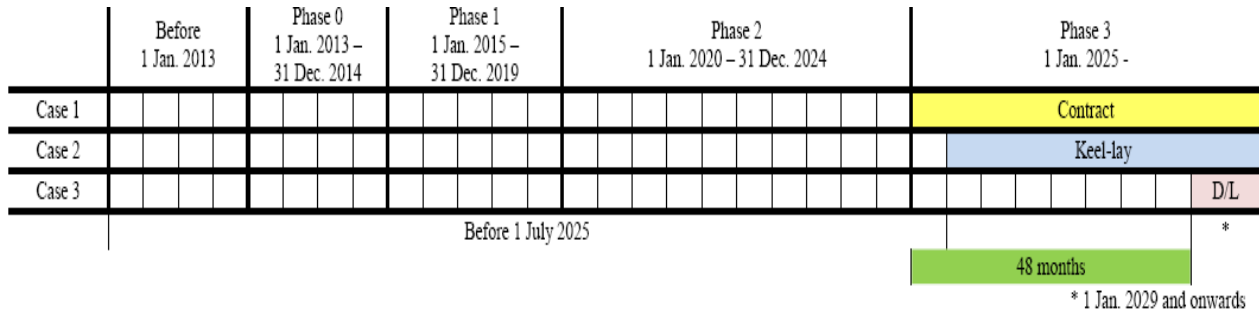
Türk Loydu Survey and Certification Rules on Energy Efficiency of Ships
(MARPOL 73/78 Annex VI, Chapter 4)

20/24

The required EEDI of Phase 2 is applied to the following new ship:



The required EEDI of Phase 3 is applied to the following new ship:



USEFUL REFERENCE DOCUMENTS

IMO DOCUMENTS

RESOLUTION MEPC.203(62): AMENDMENTS TO THE ANNEX OF THE PROTOCOL OF 1997 TO AMEND THE INTERNATIONAL CONVENTION FOR THE PREVENTION OF POLLUTION FROM SHIPS, 1973, AS MODIFIED BY THE PROTOCOL OF 1978 RELATING THERETO (Inclusion of regulations on energy efficiency for ships in MARPOL Annex VI)

RESOLUTION MEPC.212(63) AS AMENDED BY RESOLUTION MEPC.224(64): 2012 GUIDELINES ON THE METHOD OF CALCULATION OF THE ATTAINED ENERGY EFFICIENCY DESIGN INDEX (EEDI) FOR NEW SHIPS

RESOLUTION MEPC.213(63): 2012 GUIDELINES FOR THE DEVELOPMENT OF A SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP)

RESOLUTION MEPC.214(63) AS AMENDED BY MEPC 234(65): 2012 GUIDELINES ON SURVEY AND CERTIFICATION OF THE ENERGY EFFICIENCY DESIGN INDEX (EEDI)

RESOLUTION MEPC.215(63): GUIDELINES FOR CALCULATION OF REFERENCE LINES FOR USE WITH THE ENERGY EFFICIENCY DESIGN INDEX (EEDI)

MEPC.1/Circ.684: GUIDELINES FOR VOLUNTARY USE OF THE SHIP ENERGY EFFICIENCY OPERATIONAL INDICATOR (EEOI)

MEPC.1/Circ 795: UNIFIED INTERPRETATIONS TO MARPOL ANNEX VI

MEPC 64/INF.22: FIRST VERSION OF INDUSTRY GUIDELINES ON CALCULATION AND VERIFICATION OF THE ENERGY EFFICIENCY DESIGN INDEX (EEDI) (Submitted by BIMCO, CESA, IACS, ICS, INTERCARGO, INTERTANKO, ITTC, OCIMF and WSC)

MSC-MEPC.2/Circ.11: INTERIM GUIDELINES FOR DETERMINING MINIMUM PROPULSION POWER TO MAINTAIN THE MANOEVRABILITY OF SHIPS IN ADVERSE CONDITIONS

MEPC.1/Circ.796: INTERIM GUIDELINES FOR THE CALCULATION OF THE COEFFICIENT f_w FOR DECREASE IN SHIP SPEED IN A REPRESENTATIVE SEACONDITION FOR TRIAL USE

MEPC 64/INF.6: SPEED/POWER TRIALS, PART 2, ANALYSIS OF SPEED/POWER TRIAL DATA

MEPC 232(65): 2013 INTERIM GUIDELINES FOR DETERMINING MINIMUM PROPULSION POWER TO MAINTAIN THE MANOEVRABILITY OF SHIPS IN ADVERSE CONDITIONS.

MEPC.1/Circ.815: 2013 GUIDANCE ON TREATMENT OF INNOVATIVE ENERGY EFFICIENCY TECHNOLOGIES FOR CALCULATION AND VERIFICATION OF THE ATTAINED EEDI

IACS PR38: PROCEDURE FOR CALCULATION AND VERIFICATION OF THE ENERGY EFFICIENCY DESIGN INDEX (EEDI).

ITTC (INTERNATIONAL TOWING TANK CONFERENCE) DOCUMENTS

ITTC- Sample Quality Manual (2002)

ITTC Guidelines about CFD analysis:

7.5-03		CFD
7.5-03-01		General
<u>7.5-03-01-01</u>	P	<u>Uncertainty Analysis in CFD, Verification and Validation Methodology and Procedures</u>
<u>7.5-03-01-02</u>	G C	<u>Uncertainty Analysis in CFD, Guidelines for RANS Codes</u>
<u>7.5-03-01-03</u>	P	<u>CFD User's Guide</u>
<u>7.5-03-01-04</u>	P	<u>CFD Verification</u>

ITTC Guidelines about calibration:

7.6		CONTROL OF INSPECTION, MEASURING AND TEST EQUIPMENT
7.6-01		Measuring Equipment
<u>7.6-01-01</u>		<u>Control of Inspection, Measuring and Test Equipment</u>

ITTC Guidelines about ship models & manufacture accuracy and propeller model:

7.5		PROCESS CONTROL
7.5-01		Test Preparation
7.5-01-01		Ship Models
<u>7.5-01-01-01</u>	P	<u>Ship Models</u>

ITTC Guidelines about resistance test:

7.5-02-02		Resistance
<u>7.5-02-02-02</u>	P	<u>Resistance Tests</u>
<u>7.5-02-02-02</u>	P	<u>Uncertainty Analysis Guidelines for Resistance Towing Tank Tests</u>

ITTC Guidelines about propulsion test and propeller model accuracy

7.5-02-03		Propulsion
7.5-02-03-01		Performance
7.5-02-03-01.1	P	<u>Propulsion / Bollard pull Test</u>
<u>7.5-02-03-01.2</u>	P	<u>Uncertainty Analysis: Example for Propulsion Test</u>

ITTC Guidelines about propeller open water test

7.5-02-03-02		Propulsor
<u>7.5-02-03-02.1</u>	P	<u>Open Water Test</u>
<u>7.5-02-03-02.2</u>	P	<u>Uncertainty Analysis: Ewample for Open Water Test</u>

ITTC Guidelines about speed trial prediction calculation

7.5-02-03-01.4	P	<u>1978 ITTC Performance Prediction Method</u>
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ITTC Guidelines about final verification on sea trial

7.5-04		Full Scale Measurements
7.5-04-01		Speed and Power Trials
<u>7.5-04-01-01.1</u>	P	<u>Preparation and Conduct of Speed/Power Trials</u>
<u>7.5-04-01-01.2</u>	P	<u>Uncertainty Analysis, Example for Open Water Test</u>

STANDARDS

ISO 15016:2002: Ships and marine technology – Guidelines for the assessment of speed and power performance by analysis of speed trial data

ISO 19019:2005: Sea-going vessels and marine technology — Instructions for planning, carrying out and reporting sea trials

BSRA Standard method of speed trials analysis – BSRA report 486 / 1976