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To relevant departments of CCS Headquarters, CCS surveyors, plan approval centers, related shipowners, ship management companies, shipyards and design units

Notice on Voluntary Applying IMO “Interim Guidelines on the Method of Calculation of the Energy Efficiency Design Index for New Ships” and “Interim Guidelines on Voluntary Verification of the Energy Efficiency Design Index”

The Marine Environment Protection Committee, at its fifth-nine session on 17 August 2009, agreed to circulate the Interim Guidelines on the Method of Calculation of the Energy Efficiency Design Index for New Ships (MEPC.1/Circ.681) and Interim Guidelines on Voluntary Verification of the Energy Efficiency Design Index (MEPC.1/Circ.682) for the purpose of test and trials. The two Guidelines in both English and Chinese languages are attached together with key points summarized as below to be taken into account for voluntory application:

1. The current EEDI formula is as follows:

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

The denominator in the formula stands for the product of ship speed (V_{ref}) and Capacity. The numerator consists of four parts: the first part is the product of main propulsion power and its fuel consumption where the ship is engaged in voyage at the speed (V_{ref}) under the design loading condition of Capacity; the second part is the product of auxiliary engine power (including necessary power for accommodation) and its fuel consumption for ensuring that the main engine operates under the condition specified in the first part; the third part is the product of the contribution to shaft power and fuel consumption of auxiliary engines where the ship is provided with shaft motor and energy saving technologies of auxiliary engine; the fourth part is the improvement of ships' energy efficiency due to fuel consumption reduction by using innovative energy saving technology.

The above formula shows that ship speed (V_{ref}), capacity and installed power P_{ME} and P_{AE} to reach the ship speed play a decisive role in EEDI for new ships. The application of innovative energy saving technologies is also a measure to optimize EEDI.

2. When applying the above formula to calculate EEDI of a ship, attention is to be paid to the following points:

(1) Ship types and propulsion systems to which EEDI is applicable: at present the EEDI formula is only applicable to 10 ship types given in the guidelines and mainly apply to the conventional propulsion system (main engine mechanical drive). It may not be able to apply to diesel-electric propulsion and gas turbine propulsion systems.

(2) **Ship speed (V_{ref})** is the ship speed in the maximum design load condition (Capacity) as defined in (3) below at 75% of the rated installed power (MCR) for main engines and assuming the weather is calm with no wind and no waves. Based on the speed estimated at design stage under fully loaded condition and the speed measured from sea-trial, it is to be corrected to the speed under fully loaded condition assuming the weather is calm with no wind and no waves in accordance with specified method.

(3) **Maximum design load condition (Capacity)** is defined by the deepest draught with its associated trim, at which the ship is allowed to operate. This condition is obtained from the stability booklet approved by the Administration. For containerships, the capacity parameter should be established at 65% of the Capacity.

(4) **Auxiliary engine power (P_{AE})** is a power calculated by means of a simplified formula, which is not the total installed auxiliary engine power. Where the simplified

P_{AE} value is significantly different from the auxiliary engine power used for EEDI calculation of ship, the P_{AE} value should be estimated by the consumed electric power (excluding propulsion) in conditions when the ship is engaged in a voyage at the speed (V_{ref}), divided by the weighted average efficiency of the generator(s). The requirements related to electric power are given in the electric power table verified and approved by the Administration/Recognized Organization; however, relevant guidelines on verification of the electric power table are still under development.

(5) $\boldsymbol{P_{eff)}}$ is 75% of the main engine power reduction due to innovative energy efficient technology.

At present innovative energy efficient technologies are not clearly defined and no relevant guidance notes are available for the selection of parameters. These innovative technologies may include wind energy (wind sail, kite), solar energy, fuel cell, alternative energy, optimization of engine, propeller, hull coating and line based on some relevant data and experiences.

(6)$\boldsymbol{P_{AEeff}}$ is the auxiliary power reduction due to innovative electrical energy efficient technology measured at P_{ME}. Based on experience, the electrical energy efficient technology at present mainly refers to waste heat recovery system of main engine.

(7) **Specific Fuel Consumption (SFC)** is the certified specific fuel consumption of the engines. The engine SFC is that recorded on the EIAPP Certificate(s) at the engine(s) corresponding MCR power or torque rating. It is to be noted that in general SFC is a correction value based on ISO standard. Where no corresponding correction value is recorded on the EIAPP Certificate(s), the measured value may be used.

(8) **Power correction factor (f_j)** is a correction factor for power to account for ship specific design elements. At present the standard f_j is only developed for ice-classed ships. For other ship types not listed in the table, f_j is taken as 1.0.

(9) **Capacity correction factor *(f_i)*** is the factor to compensate the loss of Capacity for any technical/regulatory limitation on capacity. At present the standard f_i is only developed for ice-classed ships. For other ship types not listed in the table, f_i is taken as 1.0.

(10) **Speed loss coefficient (f_w)** is a non-dimensional coefficient indicating the

decrease of speed in representative sea conditions of wave height, wave frequency and wind speed, which may be determined by conducting the ship-specific simulation or obtained from the standard f_w curve. IMO is now developing the standard f_w curve. The coefficient is determined by conducting the ship-specific simulation or using the simulation results of ships of the same or similar type.

3. At present, the verification of attained EEDI is not intended to verify whether or not the ship complies with EEDI standard, but to verify that whether or not the EEDI value is calculated in accordance with the calculation requirements in the interim guidelines on EEDI and the authenticity of attained EEDI. At the same time, it is to assist shipowners, shipyards, engine manufacturers and other relevant parties in understanding the procedure of voluntary EEDI verification and making preparations for implementating mandatory EEDI standard and verification requirements in the future.

4. For container ships, Tank test is to be carried out under the condition of 65% Capacity during verification at design stage in order to obtain the ship speed under the condition.

Please feel free to contact Technical Management Department of CCS for any inquiry. Each branch is to actively collect problems found during verification process of EEDI and give feedback to Technical Management Department and Shanghai Rules & Research Institute. E-mail: rt@ccs.org.cn; ccscr@ccs.org.cn

This Circular is available on www.ccs.org.cn and forwarded by each branch to relevant shipowners, ship management companies, shipyards and ship design units within its business area.

Annex 1: MEPC.1/Circ.681--Interim Guidelines on the Method of Calculation of the Energy Efficiency Design Index for New Ships

Annex 2: MEPC.1/Circ.682--Interim Guidelines on Voluntary Verification of the Energy Efficiency Design Index

Should you have any question during the implementation of the Circulars, please contact: Technical Management Dept. of the Headquarters.

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MEPC.1/Circ.681
17 August 2009

INTERIM GUIDELINES ON THE METHOD OF CALCULATION OF THE ENERGY EFFICIENCY DESIGN INDEX FOR NEW SHIPS

1 The Marine Environment Protection Committee, at its fifty-ninth session (13 to 17 July 2009), recognized the need to develop an energy efficiency design index for new ships in order to stimulate innovation and technical development of all elements influencing the energy efficiency of a ship from its design phase. The Committee, being mindful that the applicability of the EEDI formula to all categories of ships and the feasibility and applicability of the technical parameters (i.e. $f_{eff(i)}$ and f_w) in the EEDI formula need to be further refined to improve the method of calculation of the EEDI; agreed to circulate the Interim Guidelines on the method of calculation of the energy efficiency design index for new ships, as set out in the annex.

2 Member Governments and observer organizations are invited to use the interim guidelines, for the purpose of test and trials on a voluntary basis:

.1 for ships with conventional propulsion systems (main engine mechanical drive); and

.2 to the extent possible, for ships with non-conventional propulsion systems (e.g., diesel-electric propulsion, turbine propulsion or hybrid propulsion systems).

3 Member Governments and observer organizations are also invited to provide the outcome and experiences in applying the interim Guidelines to future sessions of the Committee for further improvement of the method of calculation of the EEDI for new ships.

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ANNEX

INTERIM GUIDELINES ON THE METHOD OF CALCULATION OF THE ENERGY EFFICIENCY DESIGN INDEX FOR NEW SHIPS

1 Definitions

For the purpose of these Guidelines, the following definitions should apply:

.1	Passenger ship	a ship which carries more than 12 passengers as defined in SOLAS chapter 1, regulation 2
.2	Dry cargo carrier	a ship which is constructed generally with single deck, topside tanks and hopper tanks in cargo spaces, and it is intended primarily to carry dry cargo in bulk, and includes such types as ore carriers and combination carriers, as defined in SOLAS chapter IX, regulation 1
.3	Gas tanker	a gas carrier as defined in SOLAS chapter II-1, regulation 3
.4	Tanker	an oil tanker as defined in MARPOL Annex I, regulation 1 or chemical tanker and a NLS tanker as defined in MARPOL Annex II, regulation 1
.5	Containership	a ship designed exclusively for the carriage of containers in holds and on deck
.6	Ro-ro cargo ship: Vehicle carrier	A multi deck ro-ro cargo ship designed for the carriage of empty cars and trucks
.7	Ro-ro cargo ship: Volume carrier	A ro-ro cargo ship, with a deadweight per lanemetre less than 4* tons/m, designed for the carriage of cargo transportation units
.8	Ro-ro cargo ship: Weight carrier	A ro-ro cargo ship, with a deadweight per lanemetre of 4* tons/m or above, designed for the carriage of cargo transportation units
.9	General cargo ship	A ship with a multi-deck or single-deck hull designed primarily for the carriage of general cargo
.10	Ro-ro passenger ship	A passenger ship as defined in SOLAS chapter II-1, Part A, regulation 2.23

Ships falling within more than one of the ship types should be considered as being the ship type with the lower baseline.

* The value should be further investigated during the period of voluntary use of the EEDI.

2 Energy Efficiency Design Index (EEDI)

The attained new ship Energy Efficiency Design Index (EEDI) is a measure of ships CO_2 efficiency and calculated by the following formula:

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

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

Note: This formula may not be able to apply to diesel-electric propulsion, turbine propulsion or hybrid propulsion system.

Where:

.1 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 $_{MEi}$ and $_{AEi}$ refer to the main and auxiliary engine(s) respectively. C_F corresponds to the fuel used when determining *SFC* listed in the applicable EIAPP Certificate. The value of C_F is as follows:

Type of fuel	Reference	Carbon content	C_F (t-CO_2/t-Fuel)
1. Diesel/Gas Oil	ISO 8217 Grades DMX through DMC	0.875	3.206000
2. Light Fuel Oil (LFO)	ISO 8217 Grades RMA through RMD	0.86	3.151040
3. Heavy Fuel Oil (HFO)	ISO 8217 Grades RME through RMK	0.85	3.114400
4. Liquified Petroleum Gas (LPG)	Propane Butane	0.819 0.827	3.000000 3.030000
5. Liquified Natural Gas (LNG)		0.75	2.750000

.2 V_{ref} is the ship speed, measured in nautical miles per hour (knot), on deep water in the maximum design load condition (*Capacity*) as defined in paragraph 3 at the shaft power of the engine(s) as defined in paragraph 5 and assuming the weather is calm with no wind and no waves. The maximum design load condition shall be defined by the deepest draught with its associated trim, at which the ship is allowed to operate. This condition is obtained from the stability booklet approved by the Administration.

.3 *Capacity* is defined as follows:

.3.1 For dry cargo carriers, tankers, gas tankers, containerships, ro-ro cargo and general cargo ships, deadweight should be used as *Capacity*.

.3.2 For passenger ships and ro-ro passenger ships, gross tonnage in accordance with the International Convention of Tonnage Measurement of Ships 1969, Annex I, regulation 3 should be used as *Capacity*.

.3.3 For containerships, the capacity parameter should be established at 65% of the deadweight.

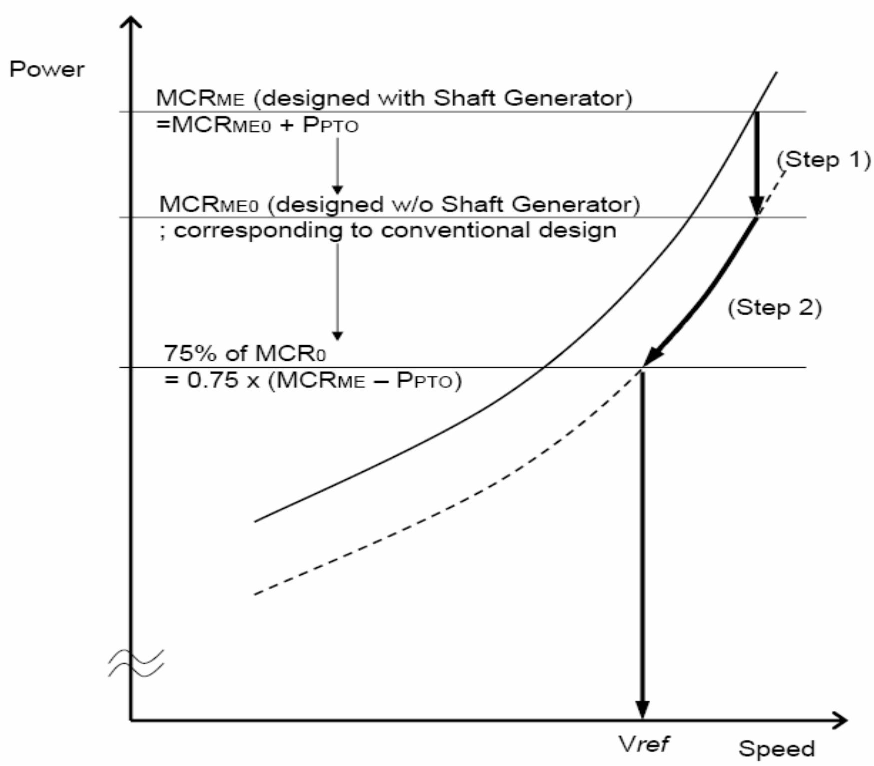
.4 *Deadweight* means the difference in tonnes between the displacement of a ship in water of relative density of 1,025 kg/m^3 at the deepest operational draught and the lightweight of the ship.

.5 *P* is the power of the main and auxiliary engines, measured in kW. The subscripts $_{ME}$ and $_{AE}$ refer to the main and auxiliary engine(s), respectively. The summation on *i* is for all engines with the number of engines (^{nME}). (See the diagram in the Appendix.)

.5.1 $P_{ME(i)}$ is 75% of the rated installed power (MCR) for each main engine (*i*) after having deducted any installed shaft generator(s):

$$P_{ME(i)} = 0.75 \times \left(MCR_{MEi} - P_{PTOi}\right)$$

The following figure gives guidance for determination of $P_{ME(i)}$:



.5.2 $P_{PTO(i)}$ is 75% output of each shaft generator installed divided by the relevant efficiency of that shaft generator.

.5.3 $P_{PTI(i)}$ is 75% of the rated power consumption of each shaft motor divided by the weighted averaged efficiency of the generator(s).

In case of combined PTI/PTO, the normal operational mode at sea will determine which of these to be used in the calculation.

Note: The shaft motor's chain efficiency may be taken into consideration to account for the energy losses in the equipment from the switchboard to the shaft motor, if the chain efficiency of the shaft motor is given in a verified document.

.5.4 $P_{eff(i)}$ is 75% of the main engine power reduction due to innovative mechanical energy efficient technology.

Mechanical recovered waste energy directly coupled to shafts need not be measured.

.5.5 $P_{AEeff\,(i)}$ is the auxiliary power reduction due to innovative electrical energy efficient technology measured at $P_{ME(i)}$.

.5.6 P_{AE} is the required auxiliary engine power to supply normal maximum sea load including necessary power for propulsion machinery/systems and accommodation, e.g., main engine pumps, navigational systems and equipment and living on board, but excluding the power not for propulsion machinery/systems, e.g., thrusters, cargo pumps, cargo gear, ballast pumps, maintaining cargo, e.g., reefers and cargo hold fans, in the condition where the ship engaged in voyage at the speed (*Vref*) under the design loading condition of *Capacity.*

.1 For cargo ships with a main engine power of 10000 kW or above, P_{AE} is defined as:

$$P_{AE(MCRME>10000KW)} = \left(0.025 \times \sum_{i=1}^{nME} MCR_{MEi}\right) + 250$$

.2 For cargo ships with a main engine power below 10000 kW, P_{AE} is defined as:

$$P_{AE(MCRME<10000KW)} = 0.05 \times \sum_{i=1}^{nME} MCR_{MEi}$$

.3 For ship types where the P_{AE} value calculated by .1 or .2 above is significantly different from the total power used at normal seagoing, e.g., in cases of passenger ships, the P_{AE} value should be estimated by the consumed electric power (excluding propulsion) in conditions when the ship is engaged in a voyage at reference speed (V_{ref}) as given in the electric power table[*], divided by the weighted average efficiency of the generator(s).

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[*] **Note:** The electric power table is often verified and approved by the Administration/Recognized Organization as documentation relating to SOLAS chapter II-1, Part D, regulation 40.1.1. The electric power table shows a generator load summary in kW and lists generators in service at different conditions of ship operation, e.g., "normal seagoing at full passenger load", where the ambient conditions are as follows: outside temperature is 35°C, the relative humidity is 85% and the seawater temperature is 32°C.

.6 V_{ref}, *Capacity* and *P* should be consistent with each other.

.7 *SFC* is the certified specific fuel consumption, measured in g/kWh, of the engines. The subscripts $_{ME(i)}$ and $_{AE(i)}$ refer to the main and auxiliary engine(s), respectively. For engines certified to the E2 or E3 duty cycles of the NO_x Technical Code 2008, the engine Specific Fuel Consumption ($SFC_{ME(i)}$) is that recorded on the EIAPP Certificate(s) at the engine(s) 75% of MCR power or torque rating. For engines certified to the D2 or C1 duty cycles of the NO_x Technical Code 2008, the engine Specific Fuel Consumption ($SFC_{AE(i)}$) is that recorded on the EIAPP Certificate(s) at the engine(s) 50% of MCR power or torque rating.

For ships where the P_{AE} value calculated by 2.5.6.1 and 2.5.6.2 is significantly different from the total power used at normal seagoing, e.g., conventional passenger ships, the Specific Fuel Consumption (SFC_{AE}) of the auxiliary generators is that recorded in the EIAPP Certificate(s) for the engine(s) at 75% of P_{AE} MCR power of its torque rating.

SFC_{AE} is the weighted average among $SFC_{AE(i)}$ of the respective engines *i*.

For those engines which do not have an EIAPP Certificate because its power is below 130 kW, the *SFC* specified by the manufacturer and endorsed by a competent authority should be used.

.8 f_j is a correction factor to account for ship specific design elements.

The f_j for ice-classed ships is determined by the standard f_j in Table 1.

Table 1

Correction factor for power f_j for ice-classed ships

For further information on approximate correspondence between ice classes, see HELCOM Recommendation 25/7*

Ship type	f_j	Limits depending on the ice class			
		IC	IB	IA	IA Super
Tanker	$\frac{0.516 L_{PP}^{1.87}}{\sum_{i=1}^{nME} P_{iME}}$	$\begin{cases} max\ 1.0 \\ min\ 0.72 L_{PP}^{0.06} \end{cases}$	$\begin{cases} max\ 1.0 \\ min\ 0.61 L_{PP}^{0.08} \end{cases}$	$\begin{cases} max\ 1.0 \\ min\ 0.50 L_{PP}^{0.10} \end{cases}$	$\begin{cases} max\ 1.0 \\ min\ 0.40 L_{PP}^{0.12} \end{cases}$
Dry cargo carrier	$\frac{2.150 L_{PP}^{1.58}}{\sum_{i=1}^{nME} P_{iME}}$	$\begin{cases} max\ 1.0 \\ min\ 0.89 L_{PP}^{0.02} \end{cases}$	$\begin{cases} max\ 1.0 \\ min\ 0.78 L_{PP}^{0.04} \end{cases}$	$\begin{cases} max\ 1.0 \\ min\ 0.68 L_{PP}^{0.06} \end{cases}$	$\begin{cases} max\ 1.0 \\ min\ 0.58 L_{PP}^{0.08} \end{cases}$
General cargo ship	$\frac{0.0450 \cdot L_{PP}^{2.37}}{\sum_{i=1}^{nME} P_{iME}}$	$\begin{cases} max\ 1.0 \\ min\ 0.85 L_{PP}^{0.03} \end{cases}$	$\begin{cases} max\ 1.0 \\ min\ 0.70 L_{PP}^{0.06} \end{cases}$	$\begin{cases} max\ 1.0 \\ min\ 0.54 L_{PP}^{0.10} \end{cases}$	$\begin{cases} max\ 1.0 \\ min\ 0.39 L_{PP}^{0.15} \end{cases}$

For other ship types, f_j should be taken as 1.0.

* HELCOM Recommendation 25/7 may be found at http://www.helcom.fi.

.9 f_w is a non-dimensional coefficient indicating the decrease of speed in representative sea conditions of wave height, wave frequency and wind speed (e.g., Beaufort Scale 6), and should be determined as follows:

.9.1 It can be determined by conducting the ship-specific simulation of its performance at representative sea conditions. The simulation methodology should be prescribed in the Guidelines developed by the Organization and the method and outcome for an individual ship shall be verified by the Administration or an organization recognized by the Administration.

.9.2 In case that the simulation is not conducted, f_w value should be taken from the "Standard f_w" table/curve. A "Standard f_w" table/curve, which is to be contained in the Guidelines, is given by ship type (the same ship as the "baseline" below), and expressed in a function of the parameter of *Capacity* (e.g., DWT). The "Standard f_w" table/curve is to be determined by conservative approach, i.e. based on data of actual speed reduction of as many existing ships as possible under representative sea conditions.

.9.3 f_w should be taken as one (1.0) until the Guidelines for the ship-specific simulation (paragraph .9.1) or f_w table/curve (paragraph .9.2) becomes available.

.10 $f_{eff(i)}$ is the availability factor of each innovative energy efficiency technology. $f_{eff(i)}$ for waste energy recovery system should be one (1.0).

.11 f_i is the capacity factor for any technical/regulatory limitation on capacity, and can be assumed one (1.0) if no necessity of the factor is granted.

f_i for ice-classed ships is determined by the standard f_i in Table 2.

Table 2

Capacity correction factor f_i for ice-classed ships

For further information on approximate correspondence between ice classes, see HELCOM Recommendation 25/7*

Ship type	f_i	Limits depending on the ice class			
		IC	IB	IA	IA Super
Tanker	$\frac{0.00115 Lpp^{3.36}}{capacity}$	$\begin{cases} max\, 1.31 Lpp^{-0.05} \\ min\, 1.0 \end{cases}$	$\begin{cases} max\, 1.54 Lpp^{-0.07} \\ min\, 1.0 \end{cases}$	$\begin{cases} max\, 1.80 Lpp^{-0.09} \\ min\, 1.0 \end{cases}$	$\begin{cases} max\, 2.10 Lpp^{-0.11} \\ min\, 1.0 \end{cases}$
Dry cargo carrier	$\frac{0{,}000665 \cdot Lpp^{3.44}}{capacity}$	$\begin{cases} max\, 1.31 Lpp^{-0.05} \\ min\, 1.0 \end{cases}$	$\begin{cases} max\, 1.54 Lpp^{-0.07} \\ min\, 1.0 \end{cases}$	$\begin{cases} max\, 1.80 Lpp^{-0.09} \\ min\, 1.0 \end{cases}$	$\begin{cases} max\, 2.10 Lpp^{-0.11} \\ min\, 1.0 \end{cases}$
General cargo ship	$\frac{0{,}000676 \cdot Lpp^{3.44}}{capacity}$	1.0	$\begin{cases} max\, 1.08 \\ min\, 1.0 \end{cases}$	$\begin{cases} max\, 1.12 \\ min\, 1.0 \end{cases}$	$\begin{cases} max\, 1.25 \\ min\, 1.0 \end{cases}$
Containership	$\frac{0.1749 \cdot Lpp^{2.29}}{capacity}$	1.0	$\begin{cases} max\, 1.25 Lpp^{-0.04} \\ min\, 1.0 \end{cases}$	$\begin{cases} max\, 1.60 Lpp^{-0.08} \\ min\, 1.0 \end{cases}$	$\begin{cases} max\, 2.10 Lpp^{-0.12} \\ min\, 1.0 \end{cases}$
Gas tanker	$\frac{0.1749 \cdot Lpp^{2.33}}{capacity}$	$\begin{cases} max\, 1.25 Lpp^{-0.04} \\ min\, 1.0 \end{cases}$	$\begin{cases} max\, 1.60 Lpp^{-0.08} \\ min\, 1.0 \end{cases}$	$\begin{cases} max\, 2.10 Lpp^{-0.12} \\ min\, 1.0 \end{cases}$	1.0

For other ship types, f_i should be taken as 1.0.

.12 *Length between perpendiculars*, *Lpp* means 96 per cent of the total length on a waterline at 85 per cent of the least moulded depth measured from the top of the keel, or the length from the foreside of the stem to the axis of the rudder stock on that waterline, if that were greater. In ships designed with a rake of keel the waterline on which this length is measured shall be parallel to the designed waterline. The length between perpendiculars (L_{pp}) shall be measured in metres.

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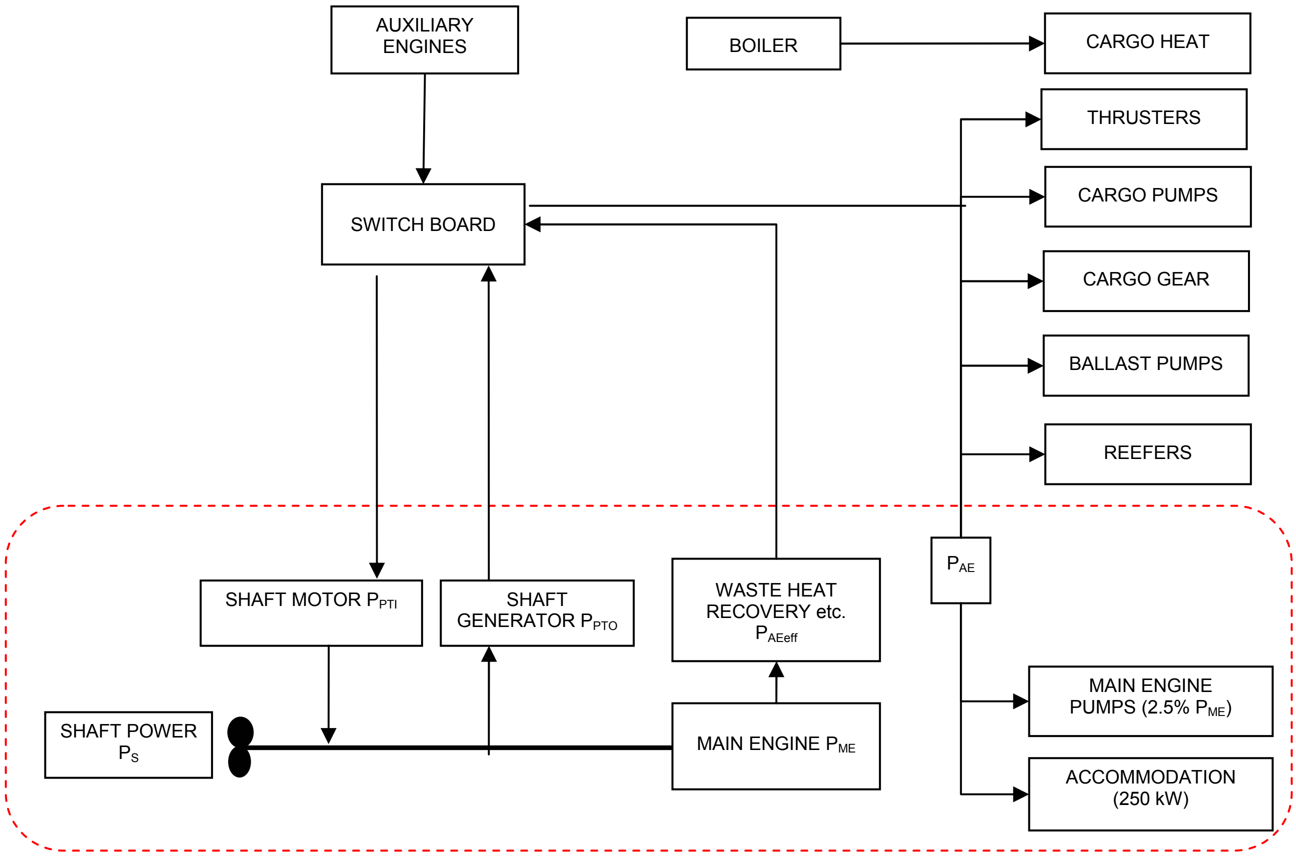
* HELCOM Recommendation 25/7 may be found at http://www.helcom.fi.

Appendix

A generic and simplified marine power plant



Note 1: Mechanical recovered waste energy directly coupled to shafts need not be measured.

Note 2: In case of combined PTI/PTO, the normal operational mode at sea will determine which of these to be used in the calculation.

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MEPC.1/Circ.682
17 August 2009

INTERIM GUIDELINES FOR VOLUNTARY VERIFICATION OF THE ENERGY EFFICIENCY DESIGN INDEX

1 The Marine Environment Protection Committee, at its fifty-ninth session (13 to 17 July 2009), recognizing the need to develop a method for voluntary verification of the energy efficiency design index for new ships in order to promote uniform use of the Interim Guidelines on the method of calculation of the energy efficiency design index for new ships (MEPC.1/Circ.681), agreed to circulate the Interim Guidelines on voluntary verification of the energy efficiency design index, as set out in the annex.

2 Member Governments are invited to use the annexed Interim Guidelines for the purpose of tests and trials on a voluntary basis.

3 Member Governments and observer organizations are also invited to provide the outcome and experiences in applying the Interim Guidelines to future sessions of the Committee for further improvement of the Interim Guidelines.

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ANNEX

INTERIM GUIDELINES FOR VOLUNTARY VERIFICATION OF THE ENERGY EFFICIENCY DESIGN INDEX

1 GENERAL

The purpose of these Guidelines is to assist verifiers of Energy Efficiency Design Index (EEDI) of ships in conducting the verification, on a voluntary basis, of the EEDI which should be calculated in accordance with the Interim Guidelines on the Method of Calculation of the EEDI for New Ships ("EEDI Guidelines", hereafter), and assist shipowners, shipbuilders and manufacturers being related to the energy efficiency of a ship and other interested parties in understanding the procedures of the voluntary EEDI verification.

2 DEFINITIONS[1]

2.1 *Verifier* means an organization which conducts the voluntary EEDI verification in accordance with these Guidelines, including Administrations, classification societies and other organizations which possess technical expertise necessary for conducting the EEDI verification.

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

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

2.4 *Tank test* means model towing tests, model self-propulsion tests and model propeller open water tests. Numerical tests may be accepted as equivalent to model tests if they are performed under documented conditions agreed by the shipbuilder and shipowner.

3 APPLICATION

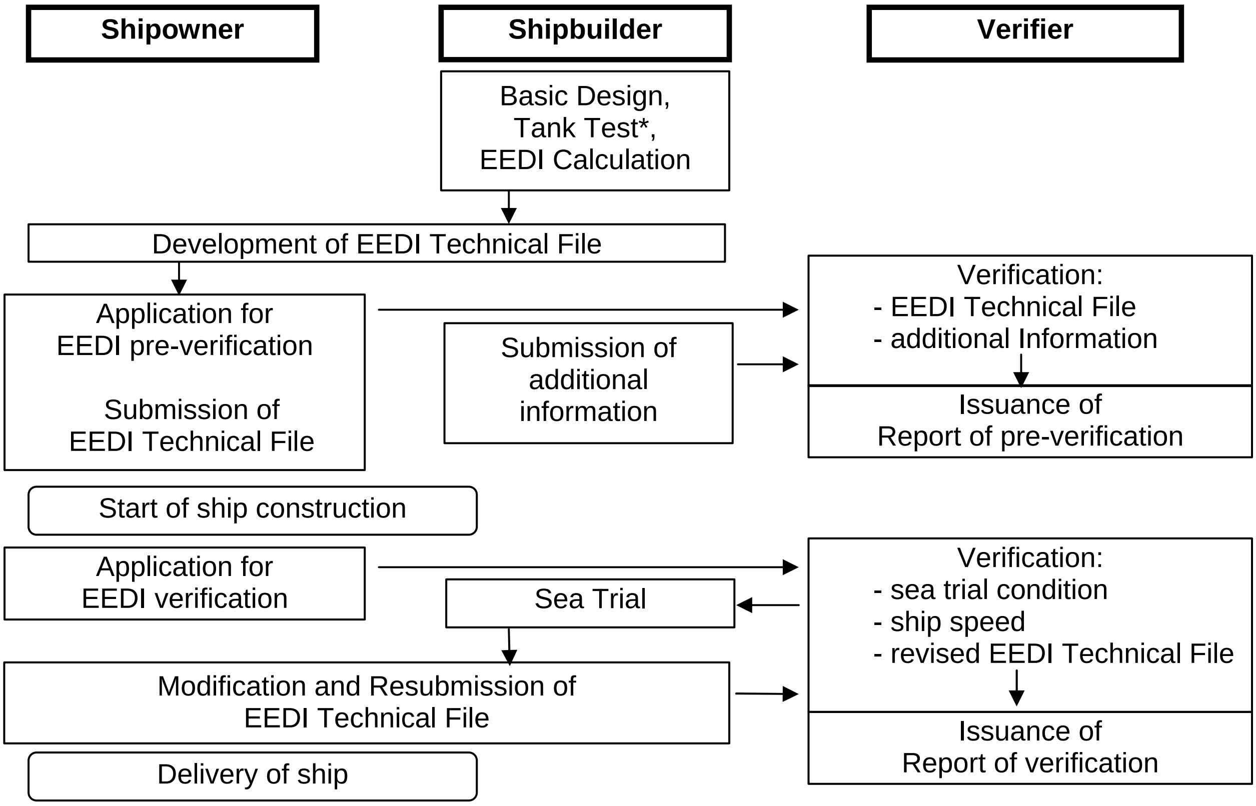
These Guidelines should be applied on a voluntary basis to new ships for which an application for an EEDI verification has been submitted to a verifier.

4 PROCEDURES FOR VERIFICATION

4.1 General

Attained EEDI should be calculated in accordance with the EEDI Guidelines. Voluntary EEDI verification should be conducted on two stages: preliminary verification at the design stage, and final verification at the sea trial. The basic flow of the verification process is presented in Figure 1.

[1] Other terms used in these guidelines have the same meaning as those defined in the EEDI Guidelines.



* To be conducted by a test organization or a shipbuilder itself.

Figure 1 – Basic Flow of Verification Process

4.2 Preliminary verification at the design stage

4.2.1 For the preliminary verification at the design stage, a shipowner should submit to a verifier an application for the verification and an EEDI Technical File containing the necessary information for the verification and other relevant background documents.

4.2.2 EEDI Technical File, which is to be developed by either a shipowner or a shipbuilder, should include at least but not limited to:

.1 deadweight (DWT) or gross tonnage (GT) for passenger and ro-ro passenger ships, the shaft power of the main and auxiliary engines, the ship speed on deep water in the maximum design loaded conditions at the 75% of the maximum continuous rate (MCR) for the main engine, the specific fuel consumption (SFC) of the main engine at the 75% of MCR power, the SFC of the auxiliary engines at the 50% MCR power, and the electric power table for certain ship types, as necessary, as defined in the EEDI Guidelines;

.2 power curves (kW – knot) estimated at design stage under fully loaded condition and sea trial condition;

.3 principal particulars and the overview of propulsion system and electricity supply system on board;

.4 estimation process and methodology of the power curves at design stage;

.5 description of energy saving equipment; and

.6 calculated value of the Attained EEDI.

4.2.3 Sea trial conditions should be set in fully loaded condition, if possible – e.g., in case of tankers.

4.2.4 The SFC of the main and auxiliary engines should be quoted from the approved NO_x Technical File. For the confirmation of the SFC, a copy of the approved NO_x Technical File should be submitted to the verifier. In case NO_x Technical File has not been approved at the time of the application for preliminary verification, the test reports provided by manufacturers should be used. In this case, at the time of the sea trial verification, a copy of the approved NO_x Technical File should be submitted to the verifier.

Note: SFC in the NO_x Technical File are the values of a parent engine, and the use of such value of SFC for the EEDI calculation for member engines may have the following technical problems for further consideration:

- The definition of "member engines" given in NO_x Technical File is broad and specification of engines belonging to the same family group may vary; and

- The rate of NO_x emission of the parent engine is the highest in the group/family – i.e. CO_2 emission, which is in the trade-off relationship with NO_x emission, can be lower than the other engines in the group/family.

Thus, for member engines of which specifications are different from the parent engine, how to determine SFC should be considered further. For instance, measured values of SFC at test bed of manufacturers could be used.

4.2.5 The power curves used for the preliminary verification at the design stage should be based on reliable results of tank test. A tank test for an individual ship may be omitted based on technical justifications such as availability of the results of tank tests for ships of the same/similar type.

4.2.6 The verifier may request the shipbuilder for additional information on top of those contained in Technical File, as necessary, to examine the calculation process of the Attained EEDI. The estimation of the ship speed at the design stage much depends on each shipbuilder's experiences, and it may not be practicable for any person/organization other than the shipbuilder to fully examine the technical aspects of experience-based parameters such as the roughness coefficient and wake coefficient. Therefore, the preliminary verification should focus on the calculation process of the Attained EEDI that should follow the EEDI Guidelines.

Note: A possible way forward for more robust verification is to establish a standard methodology of deriving the ship speed from the outcomes of tank test, by setting standard values for experience-based correction factors such as roughness coefficient and wake coefficient. In this way, ship-by-ship performance comparison could be made more objectively by excluding the possibility of arbitrary setting of experience-based parameters. If such standardization is sought, this would have an implication on how the ship speed adjustment based on sea trial results should be conducted in accordance with paragraph 4.3.8 of these Guidelines.

Note: For ensuring the quality of tank tests, it would be desirable in the future that an organization conducting a tank test be authorized by the Administration or an organization recognized by it in accordance with the guidelines developed by the Organization.

4.2.7 Additional information that the verifier should request the shipbuilder to provide directly to it (i.e. not to be contained in Technical File) includes but not limited to:

.1 descriptions of a 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;

.2 lines of a model ship and an actual ship for the verification of the appropriateness of the tank test; the lines (sheer plan, body plan and half-breadth plan) should be detailed enough to demonstrate the similarity between the model ship and the actual ship;

.3 lightweight of the ship and displacement table for the verification of the deadweight;

.4 detailed report on the method and results of the tank test; this should include at least the tank test results at sea trial condition and at fully loaded condition;

.5 detailed calculation process of the ship speed, which should include the estimation basis of experience-based parameters such as roughness coefficient, wake coefficient; and

.6 reasons for exempting a tank test, if applicable; this should include lines and tank test results of the ships of same/similar type, and the comparison of the principal particulars of such ships and the ship in question. Appropriate technical justification should be provided for regarding the tank test unnecessary.

4.2.8 Such additional information may contain shipbuilders' confidential information. Therefore, after the verification, the verifier should return all or part of such information to the shipbuilder at its request.

4.3 Final verification of the Attained EEDI at sea trial

4.3.1 Prior to the sea trial, a shipowner should submit the application for the verification of EEDI together with the final displacement table and the measured lightweight, or a copy of the survey report of deadweight, as well as a copy of NO_x Technical File as necessary.

4.3.2 The verifier should attend the sea trial and confirm:

.1 propulsion and power supply system, particulars of the engines, and other relevant items described in the EEDI Technical File;

.2 draft and trim;

.3 sea conditions;

.4 ship speed; and

.5 shaft power of the main engine.

4.3.3 Draft and trim should be confirmed by the draft measurements taken prior to the sea trial. The draft and trim should be as close as practical to those at the assumed conditions used for estimating the power curves.

4.3.4 Sea conditions should be measured in accordance with ISO15016:2002 or the equivalent.

4.3.5 Ship speed should be measured in accordance with ISO15016:2002 or the equivalent and at more than two points of which range includes the 75% of MCR power.

4.3.6 The shaft power of the main engine should be measured by shaft power meter or estimated by fuel rack. Otherwise, it should be measured by a method which the engine manufacturer recommends and the verifier approves.

4.3.7 The shipbuilder should develop power curves based on the measured ship speed and the measured shaft power of the main engine at sea trial. For the development of the power curves, the shipbuilder should calibrate the measured ship speed, if necessary, by taking into account the effects of wind, tide and waves in accordance with ISO15016:2002 or the equivalent.

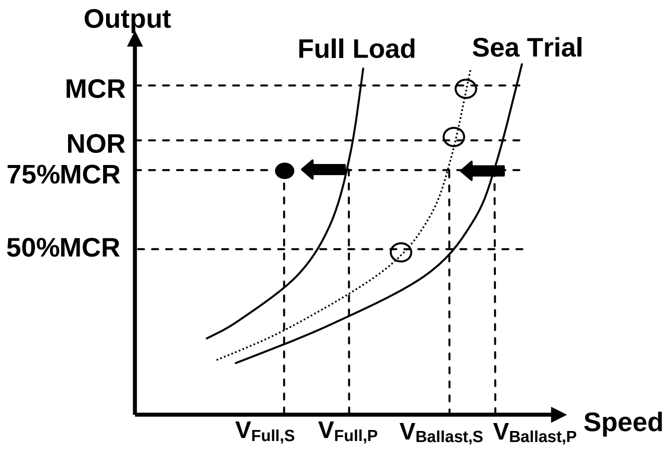
4.3.8 The shipbuilder should compare the power curves obtained as a result of the sea trial and the estimated power curves at the design stage. In case differences are observed, the Attained EEDI should be recalculated, as necessary, in accordance with the following:

.1 for ships for which sea trial is conducted in fully loaded condition (e.g., tankers): the Attained EEDI should be recalculated using the measured ship speed at sea trial at 75% of MCR power; and

.2 for ships for which sea trial cannot be conducted in fully loaded condition (e.g., dry bulkers): if the measured ship speed at 75% of MCR power of the main engine at the sea trial conditions is different from the expected ship speed on the power curve at the corresponding condition, the shipbuilder should recalculate the Attained EEDI by adjusting ship speed in fully loaded condition by an appropriate correction method that is agreed by the verifier.

An example of possible methods of the speed adjustment is given in Figure 2:

Note: Further consideration would be necessary for speed adjustment methodology in 4.3.8.2. One of concerns relates to a possible situation where the power curve for sea trial condition is estimated in excessively conservative manner (i.e. power curve is shifted in a leftward direction) with the intention to get an upward adjustment of the ship speed by making the measured ship speed at sea trial easily exceed the lower-estimated speed for sea trial condition at design stage.



$$V_{Full,S} = V_{Full,P} \text{ X } (V_{Ballast,S}/V_{Ballast,P})$$

$V_{Ballast,P}$:estimated ship speed at sea trial conditions on the power curve estimated at design stage
$V_{Ballast,S}$:ship speed obtained as a result of the sea trial
$F_{Full,S}$: adjusted ship speed by the results of sea trial, in fully loaded condition
$F_{Full,P}$:estimated ship speed in fully loaded condition at design stage.

Figure 2 – An Example of Possible Ship Speed Adjustment

4.3.9 In case where the Attained EEDI is calculated at the preliminary verification by using SFC based on the manufacturer's test report due to the non-availability at that time of the approved NO_x Technical File, the shipowner or the shipbuilder should recalculate the Attained EEDI by using SFC in the approved NO_x Technical File.

4.3.10 The shipowner or the shipbuilder should revise an EEDI Technical File, as necessary, by taking into account the results of sea trial. Such revision should include, as applicable, the adjusted power curve based on the results of sea trial (namely, modified ship speed at 75% of MCR power of the main engine at full-loaded condition) and SFC described in the approved NO_x Technical File, and the recalculated Attained EEDI based on these modifications.

4.3.11 The EEDI Technical File, if revised, should be submitted to the verifier for the confirmation that the (revised) Attained EEDI is calculated in accordance with the EEDI Guidelines.

5 ISSUANCE OF THE EEDI VERIFICATION REPORT

5.1 The verifier should issue the Report on the Preliminary Verification of EEDI after it verified the Attained EEDI at design stage in accordance with Sections 4.1 and 4.2 of these Guidelines.

5.2 The verifier should issue the report on the Verification of EEDI after it verified the Attained EEDI after the sea trial in accordance with Sections 4.1 and 4.3 of these Guidelines.

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