標題

MARPOL 条約附属書 VI の改正に伴い要求される荒天下における操船性を維持するための最低推進出力について（EEDI 関連規定）

ClassNK
テクニカル
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各位

2011 年 7 月に開催された IMO 第 62 回海洋環境保護委員会(MEPC 62)において船舶のエネルギー効率に関する規則を取り入れた MARPOL 条約附属書 VI の改正（以下、「改正附属書 VI」）が採択され、2013 年 1 月 1 日に発効いたします。
本改正につきましては、ClassNK テクニカル・インフォメーション No.TEC-0863、TEC-0872、TEC-0929 及び TEC-0930 にて関連の情報をお知らせしておりますが、本テクニカル・インフォメーションでは、エネルギー効率設計指標(EEDI: Energy Efficiency Design Index)の規制値への適合が要求される船舶に対して適用される最低推進出力要件についてご連絡いたします。

1. 背景
改正附属書 VI の第 21 規則により EEDI 規制値への適合が要求される船舶にあっては、同 21.5 規則により、荒天下における操船性を維持するため、IMO が策定するガイドラインに従って一定以上の推進出力を有することが要求されます。
2012 年 10 月に開催された IMO 第 64 回海洋環境保護委員会(MEPC 64)及び 11 月に開催された IMO 第 91 回海上安全委員会(MSC 91)において関連の審議が行われた結果、船舶が備えるべき最低推進出力を決定するための暫定ガイドライン（以下、最低出力暫定ガイドラインと呼びます）が作成されました（MSC-MEPC.2/Circ.11）。

2. 適用
最低出力暫定ガイドラインは、ばら積貨物船、タンカー、兼用船のうち、改正附属書 VI の第 21 規則により EEDI 規制値への適合が要求される船舶*にのみ適用されます（上記以外の船種に対しては、同暫定ガイドラインの規定は適用されません）。

* 20,000DWT 以上のばら積貨物船、タンカー又は兼用船のうち、2013 年 1 月 1 日以降に建造契約が結ばれる船舶（建造契約がない場合、2013 年 7 月 1 日以降に起工又は同様の建造段階にある船舶）、又は 2015 年 7 月 1 日以降に引渡しが行われる船舶

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3. 最低推進出力の要求値
上記 2.に該当する船舶につきましては、原則として下表に示す数式（載荷重量 DWT の関数）により決定される値以上の推進出力（主機関出力の合計）を搭載することが要求されます。

船 種	最低推進出力 (kW)
ばら積貨物船	0.0687 x DWT + 2924.4
タンカー及び兼用船	0.0689 x DWT + 3253.0

4. 今後の予定
最低出力暫定ガイドラインについては、今後 IMO において更に検討し、2013 年 5 月に開催予定の MEPC 65 以降の会合において必要に応じて内容を見直すことが、MEPC 64 において合意されています。今後同暫定ガイドラインの内容に変更等が生じた場合には、改めて ClassNK テクニカル・インフォメーションにてご連絡いたします。

なお、本件に関してご不明な点は、以下の部署にお問い合わせください。

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添付:

1. Interim Guidelines for Determining Minimum Propulsion Power to Maintain the Manoeuvrability of Ships in Adverse Conditions (MSC-MEPC.2/Circ.11)

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MSC-MEPC.2/Circ.11
3 December 2012

INTERIM GUIDELINES FOR DETERMINING MINIMUM PROPULSION POWER TO MAINTAIN THE MANOEUVRABILITY OF SHIPS IN ADVERSE CONDITIONS

1 The Marine Environment Protection Committee, at its sixty-fourth session, and the Maritime Safety Committee, at its ninety-first session, approved the Interim Guidelines for determining minimum propulsion power to maintain the manoeuvrability of ships in adverse conditions, as set out in the annex to this circular, which provides a guide for Administrations and recognized organizations acting on their behalf, when they consider and decide a ship in question meets the requirement of regulation 21.5 of MARPOL Annex VI.

2 Member Governments and observer organizations are invited to use the interim guidelines on an interim basis until improved guidelines becomes available.

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ANNEX

INTERIM GUIDELINES FOR DETERMINING MINIMUM PROPULSION POWER TO MAINTAIN THE MANOEUVRABILITY OF SHIPS IN ADVERSE CONDITIONS

Purpose

The purpose of these Interim Guidelines is to assist Administrations and recognized organizations in verifying that ships, complying with EEDI requirements set out in regulations on Energy Efficiency for Ships, have sufficient installed propulsion power to maintain the manoeuvrability in adverse conditions, as specified in regulation 21.5 in chapter 4 of MARPOL Annex VI.

These interim guidelines can be used until improved guidelines become available.

1 Definition

1.1 "Adverse conditions" mean sea conditions with the following parameters:

Significant wave height h_s, m	Peak wave period T_P, s	Mean wind speed V_w, m/s
6.0	8.0 to 15.0	19.0

2 Applicability

2.1 These guidelines should be applied in the case of all new ships categorized in table 1 of the appendix required to comply with regulations on Energy Efficiency for Ships according to regulation 21 of MARPOL Annex VI.

2.2 These guidelines are intended for ships in unrestricted navigation; for other cases, the Administration should determine appropriate guidelines, taking the operational area and relevant restrictions into account.

3 Assessment procedure

3.1 The assessment can be carried out at two different levels as listed below:

.1 Minimum power lines assessment; and

.2 Simplified assessment.

3.2 The ship should be considered to have sufficient power to maintain the manoeuvrability in adverse conditions if it fulfils one of these assessment levels.

4 Assessment level 1 – minimum power lines assessment

4.1 If the ship under consideration has installed power not less than the power defined by the minimum power line for the specific ship type, the ship should be considered to have sufficient power to maintain the manoeuvrability in adverse conditions.

4.2 The minimum power lines for the different types of ships are provided in the appendix.

4.3 If the minimum power lines assessment is not fulfilled, then the simplified assessment may be applied.

5 Assessment level 2 – simplified assessment

5.1 The simplified assessment is applicable only to ships whose rudder area is not less than 0.9 per cent of the submerged lateral area corrected for breadth effect.

5.2 The submerged lateral area corrected for breadth effect is calculated as $LppTm(1.0+25.0(Bwl/Lpp)^2)$.

5.3 The methodology for the simplified assessment is provided in the appendix.

5.4 If the ship under consideration fulfils the requirements as defined in the simplified assessment, the ship should be considered to have sufficient power to maintain the manoeuvrability in adverse conditions.

6 Documentation

6.1 Test documentation should include at least, but not be limited to, a:

.1 description of the ship's main particulars;

.2 description of the ship's relevant manoeuvring and propulsion systems;

.3 description of the assessment level used and results; and

.4 description of the test method(s) used with references, if applicable.

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Appendix

ASSESSMENT PROCEDURES TO MAINTAIN THE MANOEUVRABILITY UNDER ADVERSE CONDITIONS, APPLICABLE DURING PHASE 0 OF THE EEDI IMPLEMENTATION

1 Scope

1.1 The procedures as described below are applicable during Phase 0 of the EEDI implementation as defined in chapter 4 of MARPOL Annex VI (see also paragraph 0 Purpose of this interim guidelines).

2 Minimum power lines

2.1 The minimum power line values, in kW, for different types of ships should be calculated as follows:

$$\text{Minimum Power Line Value} = a \times (DWT) + b$$

Where:

DWT is the deadweight of the ship in metric tons; and
a and *b* are the parameters given in Table 1.

Table 1: Parameters a and b for determination of the minimum power line values for the different ship types

Ship Type	a	b
Bulk Carriers	0.0687	2924.4
Tankers	0.0689	3253.0
Combination Carriers	see Tankers above	

3 Simplified assessment

3.1 The simplified assessment procedure is based on the principle that, if the ship has sufficient installed power to move with a certain advance speed in head waves and wind, the ship will also be able to keep course in waves and wind from any other direction. The minimum advance speed in head waves and wind is thus selected depending on ship design in such a way, that the fulfilment of the advance speed requirements means fulfilment of course-keeping requirements. For example, ships with larger rudder areas will be able to keep course even if the engine is less powerful; similarly, ships with larger lateral windage area will require more power to keep course than ships with smaller windage area.

3.2 The simplification in this procedure is that only the equation of steady motion in longitudinal direction is considered; the requirements of course-keeping in wind and waves are taken into account indirectly, by adjusting the required advance speed in head wind and waves.

3.3 The assessment procedure consists of two steps:

.1 definition of the required advance speed in head wind and waves, ensuring course-keeping in all wave and wind directions; and

.2 assessment whether the installed power is sufficient to achieve the required advance speed in head wind and waves.

Definition of required advance speed

3.4 The required advance speed in head wind and waves is set to the larger of:

.1 minimum navigational speed; or

.2 minimum course-keeping speed.

3.5 The minimum navigational speed facilitates leaving coastal area within a sufficient time to reduce navigational risk and risk of excessive motions in waves due to unfavourable heading with respect to wind and waves. The minimum navigational speed is set to 4.0 knots.

3.6 The minimum course-keeping speed in the simplified assessment, $V_{ck,}$ is selected to facilitate course-keeping in waves and wind from all directions. This speed is defined on the basis of the reference course-keeping speed V_{ref}, related to ships with the rudder area A_R equal to 0.9 per cent of the submerged lateral area corrected for breadth effect, and a reduction factor taking into account the actual rudder area:

$$V_{ck} = V_{ref} - 10.0 \times (A_R\% - 0.9\%)$$

where V_{ck} is the required advance speed, knots, in head wind and waves to facilitate course-keeping in all wind and wave directions, V_{ref}, knots, is the reference advance speed, and A_R% is the actual rudder area as percentage of the submerged lateral area corrected for breadth effect.

3.7 The reference advance speed V_{ref} is defined, depending on the block coefficient C_B and the ratio A_F/A_L of the frontal windage area to the lateral windage area, as follows:

.1 for ships with the block coefficient $C_B \leq 0.74$: 16.0 and 9.0 knots for the ratio of the frontal windage area to lateral windage area, A_F/A_L=0.1 and 0.4, respectively;

.2 for ships with the block coefficient $C_B \geq 0.84$: 9.0 and 4.0 knots for the ratio of the frontal windage area to lateral windage area, A_F/A_L=0.1 and 0.40, respectively; and

.3 linearly interpolated for intermediate values of C_B and A_F/A_L.

The above is summarized in table 2.

Table 2: Definition of reference minimum required course-keeping speed at minimum rudder area in knots

C_B	A_F/A_L=0.1	A_F/A_L=0.4
less than or equal to 0.74	16.0	9.0
more than or equal to 0.84	9.0	4.0

Procedure of assessment of installed power

3.8 The assessment is to be performed in maximum draught condition at the required advance speed defined above. The principle of the assessment is that the required propeller thrust, T, defined from the sum of bare hull resistance in calm water R_{cw}, resistance due to

appendages R_{app}, aerodynamic resistance R_{air}, and added resistance in waves R_{aw}, can be provided by the ship's propulsion system, taking into account the thrust deduction factor t:

$$T = (R_{cw} + R_{air} + R_{aw} + R_{app})/(1-t) \quad (1)$$

3.9 The calm-water resistance can be calculated neglecting the wave resistance as $R_{cw} = (1+k)C_F \frac{1}{2}\rho S V_s^2$, where k is the form factor, $C_F = \frac{0.075}{(\log_{10}\mathrm{Re} - 2)^2}$ is the frictional resistance coefficient, $\mathrm{Re} = V_s L_{pp}/\nu$ is the Reynolds number, ρ is water density, kg/m^3, S is the wetted area of the bare hull, m^2, V_s is the ship speed, m/s, and ν is the kinematic viscosity of water, m^2/s.

3.10 The form factor k can be obtained either from model tests or empirical formula below:

$$k = -0.095 + 25.6\frac{C_B}{(L_{pp}/B_{wl})^2\sqrt{B_{wl}/T_m}}$$

3.11 Aerodynamic resistance can be calculated as $R_{air} = C_{air}\frac{1}{2}\rho_a A_F V_w^2$, where C_{air} is the aerodynamic resistance coefficient, ρ_a is the density of air, kg/m^3, A_F is the frontal windage area of the hull, m^2, and V_w is the relative wind speed, m/s, defined by the adverse conditions in paragraph 1.1 of the interim guidelines plus the ship advance speed. The coefficient C_{air} can be obtained from model tests or empirical data. If none of the above is available, the value 1.0 is to be assumed.

3.12 The added resistance in waves, defined by the adverse conditions in paragraph 1.1 of the interim guidelines, R_{aw}, can be derived from model test. The model test should be added resistance test in regular waves at the required advance speed as per ITTC procedure 7.5-02 07-02.1.

3.13 The thrust deduction factor t can be obtained either from model tests or empirical formula. Default conservative estimate is t=0.7w, where w is the wake fraction defined below.

3.14 In order to check whether the required thrust can be provided by the engine, the required advance ratio of the propeller J is found from the equation:

$$T = \rho u_a^2 D_P^2 K_T(J)/J^2 \quad (2)$$

where $K_T(J)$ is the thrust coefficient curve, and $u_a = V_s(1-w)$. Wake fraction w can be obtained from model tests or empirical formula; default conservative estimates are given in table 3.

Table 3: Recommended values for wake fraction *w*

Block coefficient	One propeller	Two propellers
0.5	0.14	0.15
0.6	0.23	0.17
0.7	0.29	0.19
0.8	0.35	0.23

3.15 The required rotation speed of the propeller is found from the relation:

$$n = u_a / (J D_P) \quad (3)$$

3.16 The required power is then defined from the relation

$$P_D = 2\pi\rho n^3 D_P^5 K_Q(J) \quad (4)$$

3.17 For diesel engines, the available power is limited because of the torque-speed limitation of the engine $Q \le Q_{max}(n)$. Therefore, an additional requirement shall be evaluated as:

$$Q = P_D / (2\pi n) \le Q_{max}(n). \quad (5)$$