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REDUCTION OF GHG EMISSIONS FROM SHIPS

Consideration of the Energy Efficiency Design Index for New Ships

Minimum propulsion power to ensure safe manoeuvring in adverse conditions

Submitted by BIMCO, CESA, IACS, INTERCARGO, INTERTANKO and WSC

SUMMARY

Executive summary:	This document presents draft interim guidelines to determine whether available propulsion power is sufficient to enable safe manoeuvring in adverse conditions in the context of the EEDI framework. To facilitate an early implementation, a simplified assessment is suggested as the verification procedure in a first phase, which can be performed with the tools available today. The simplified assessment is a subset of the comprehensive assessment, which, due to its complexity, is only suggested for consideration in a later phase.
Strategic direction:	7.3
High-level action:	7.3.2
Planned output:	7.3.2.1
Action to be taken:	Paragraph 15
Related documents:	MEPC 62/INF.21; Circular letter No.3128; MEPC 61/24, MEPC 61/5/32, MEPC 61/5/3; EE-WG 1/4; MEPC 60/WP.9, MEPC 59/4/2; and resolution MSC.137(76)

Introduction

1 At MEPC 61, one of the focuses on safety implications relating to EEDI was a ship's manoeuvrability in adverse conditions. Some delegations argued that – in order to reduce installed power – ship designers may choose to lower a ship's design speed to achieve the required EEDI. To avoid negative effects on safety, such as under-powered ships, IACS's proposal to add a provision to the draft regulations text (MEPC 61/5/32) was agreed to and incorporated as regulation 21.4 (see, e.g., Circular letter No.3128):

> "*For each ship to which this regulation applies, the installed propulsion power shall not be less than the propulsion power needed to maintain the manoeuvrability of the ship under adverse conditions as defined in the guidelines to be developed by the Organization.*"

2 IACS also informed the Committee that draft guidelines would be developed and submitted to MEPC 62 for further consideration. For this purpose, IACS established a project team, which developed an interim draft and conducted a workshop with other stakeholders to discuss the impact and the practicability of the proposed guidelines. As a result, BIMCO, CESA, INTERCARGO, INTERTANKO, and WSC agreed to co-sponsor this document with support from SAJ (the Shipbuilders' Association of Japan).

3 This document presents the results of the work conducted to date.

The Challenges

4 Standards for ship manoeuvrability exist for calm environment only, as in IMO resolutions MSC.137(76) and MSC/Circ.1053, compliance with which is verified during sea trials. For manoeuvring in adverse conditions, no standards are known to exist. In particular:

.1 no standard manoeuvre(s) exists which, if being carried out successfully in adverse conditions, could demonstrate that the ship is capable of safe manoeuvring in these conditions;

.2 "adverse conditions" are not defined;

.3 model experiments with simulated adverse waves and wind are possible, but may not be practicable for routine ship design purposes, as few such facilities exist; and

.4 numerical simulation tools are not considered to be mature enough for routine ship design purposes, as recently reported by the Manoeuvring Committee to the 25th International Towing Tank Conference in 2008.

5 Due to the complexity of the issue and the lack of established practice, it is expected that work to understand and assess manoeuvrability of ships in adverse conditions will continue for some time before appropriate methods can be established and simulation tools can become available.

Proposal for guidelines and a 2-phase approach

6 Recognizing the above, the co-sponsors have developed draft interim guidelines, as set out in the annex to this document, and suggest a 2-phase approach: a simplified assessment in a first phase followed by consideration of a more comprehensive assessment at a later phase, if deemed necessary. Both approaches are described in the interim guidelines and briefly described as:

.1 the simplified assessment considers the advance of a ship only in head waves and wind and determines the required propulsion power taking into account calm water hull and appendage resistance, added resistance in waves and air drag; and

.2 the comprehensive assessment considers the full manoeuvring of a ship and includes the simplified assessment as a subset. In addition, the comprehensive assessment may be performed in two levels of sophistication: a static assessment and a time-dependent assessment.

7 The simplified assessment, further described in paragraphs 10 to 13 below, can be performed using available tools. The comprehensive assessment, further expanded in document MEPC 62/INF.21, will require more research, and, depending on whether the simplified assessment is deemed adequate after a period of trial use, could be considered as and when related tools become available.

Proposal for definition of adverse conditions

8 Adverse conditions corresponding to sea states 7 to 8, originally selected based on assumed reasonable probability levels were later authenticated with interviews with masters and one casualty report. The proposed range of conditions is shown in the table below.

Probability	Return period	Sea state	Sig. wave height (m)	Wave period (s)	Beaufort	Mean wind speed (knots)
2%	one week	7	7.5	7.5 to 14.5	9	44
0.5%	one month	8	9.8	8.5 to 13.5	10	51.5

9 A wave height of 8 metres and a wind force Beaufort 9 were reported to be adverse conditions for a large tanker by an experienced master interviewed by IACS. Sea states 7 to 8 were also documented in a casualty report by the Australian Transport Safety Bureau, No. 243, which reports that these conditions can be considered adverse but still permitting safe manoeuvring.

The simplified assessment in brief

10 In the simplified approach, the process of verifying a ship having sufficient installed power to enable safe manoeuvring in adverse conditions is one of submitting model test results and/or calculations to demonstrate that the required speed can be attained at the defined adverse conditions.

11 Model tests and/or calculations are to be performed to determine the speed of advance of a ship, only in head waves and wind, based on its installed propulsion power, and taking into account calm water hull resistance and appendage resistance, added resistance in waves and air drag. An example for a VLCC is provided in annex 2 to document MEPC 62/INF.21.

12 The basic assumption is that the dimensioning criterion is advance speed in waves and, implicitly, that turning and course keeping can be achieved if advance speed is maintained. This assumption is true for ships with lower design Froude Numbers, and low ratio of above-water lateral area to total lateral area, typical for bulk carriers and oil tankers, but may be questioned for other ships which are known to have reduced manoeuvring capability in strong gale force winds, such as fully loaded container ships.

13 The simplified assessment is ready for trial use once the following proposed criteria are agreed to by the Committee:

.1 suitable return period for defining the adverse conditions;

.2 required minimum advance speed; and

.3 the threshold criteria for Froude Numbers and ratios of above-water lateral area to total lateral area.

14 The proposed criteria, as given in the draft interim guidelines, are suggestions at this time. They need to be validated by different means like systematic analyses of existing ship designs, expert opinion, numerical and/or model tests, prior to a decision by the Committee being possible. It is also believed that these criteria should be investigated for existing ships with lower-than-average installed power to check if they can meet the required speed. Correspondingly, experience of masters on these ships in adverse conditions should also be sought.

Action requested of the Committee

15 The Committee is invited to note the foregoing and the latest version of the draft interim guidelines provided at annex; and the intention of the co-sponsors to develop further this text, taking account of any comments received at MEPC 62, in the intersessional period following MEPC 62 and submit an improved version to MEPC 63.

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ANNEX

DRAFT INTERIM GUIDELINES FOR DETERMINING MINIMUM PROPULSION POWER TO ENABLE SAFE MANOEUVRING IN ADVERSE CONDITIONS

Purpose

1 The purpose of these guidelines is to assist Administrations and Recognized Organizations in verifying that ships, complying with EEDI provisions set out in Regulations on Energy Efficiency for Ships, have sufficient installed propulsion power to enable safe manoeuvring in adverse weather conditions, as specified in Regulation 21.4 (Circular letter No.3128).

Definitions

2 "Safe manoeuvring" means the ship is capable of turning to a more desirable position relative to the weather, and can maintain this position without drifting over ground once the turn is completed.

3 "Adverse conditions" mean sea conditions corresponding to a [one-week] [one-month] return period with the following defined parameters:

Return period	Probability	Sea state	Sig. wave height (m)	Wave period (s)	Beaufort	Mean wind speed (knots)
[one week]	2%	7	7.5	7.5 to 14.5	9	44
[one month]	0.5%	8	9.8	8.5 to 13.5	10	51.5

Application

4 The guidelines should apply to all new ships required to comply with Regulations on Energy Efficiency for Ships.

5 The guidelines are not intended for vessels in restricted navigation; for such cases, the Administration should determine appropriate guidelines, taking the operational area and relevant restrictions into account.

Goal-based approach to manoeuvrability in adverse conditions

Goal

6 The ship should have the necessary propulsion power [and steering capability] to enable safe manoeuvring in adverse conditions.

Functional requirements

7 The vessel should have the ability to turn within a defined time period and maintain a desired course at defined minimum speed in adverse conditions.

Acceptance criteria[1]

8 The ability to turn, or "turning ability", is defined as:

.1 time to complete a 180 degree turn is less than [15][30] minutes; and

.2 the displacement in the wave direction is less than f * 5L, with f = [1.2][1.5].

9 The ability to maintain a desired course at defined speed, or "course keeping and advance ability", is defined as:

.1 achieving a minimum advance speed of [2][4] knots through water; and

.2 the average deviation from the course is less than ± [5][10] degrees.

Verification procedures[2]

10 Verification may be achieved by model tests and/or numerical simulations. Two verification procedures are defined with different levels of sophistication as follows.

Simplified approach

11 This approach is applicable only to ships whose dynamic coupling of motions in waves and manoeuvring (e.g., due to broaching) is not considered significant, and whose:

.1 design Froude number is below [0.2][0.3]; and

.2 ratio of the above-water lateral area to the total lateral area including the rudder area is smaller than [0.65][0.75], taking the ship's loading condition resulting in the largest ratio.

12 The safe manoeuvring goal may be deemed to be met if the ship can achieve the minimum advance speed set out in paragraph 9 in adverse conditions and in the following defined conditions:

.1 the ship at deepest draught (maximum summer load line);

.2 maximum propulsion power is applied;

.3 the rudder in neutral position;

.4 head wind and wave (co-aligned); and

.5 irregular short-crested or long-crested waves with maximum significant wave height and zero up-crossing periods varied as [7.5,] 8.5, 9.5, 10.5, 11.5, 12.5, 13.5 [,14.5] s.

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1 The numeral criteria in square brackets are interim suggestions. They will require validation by different means, like systematic analyses of existing ship designs, expert opinion, numerical simulation and/or model tests.

2 The numeral criteria in square brackets are interim suggestions. They will require validation by different means, like systematic analyses of existing ship designs, expert opinion, numerical simulation and/or model tests.

13 The verification may be achieved by means of model test programs or by calculations. An example of the verification procedures using calculations is provided in document MEPC 62/INF.21.

Comprehensive approach

14 This approach, if deemed necessary, would be applicable to all ships. Verification of compliance with criteria set out in paragraphs 8 and 9 may be achieved by model test programs and/or by numerical simulations.

15 To verify compliance with the criteria of "turning ability" and "course keeping and advance ability", the test programs should be performed in adverse conditions and in the following defined conditions:

	Turning ability	**Course keeping and advance ability**
Loading condition	2 representative conditions: deepest draught (maximum summer load line) and largest projected lateral area of the part of the ship and deck cargoes above the water line	
Propulsion power	Maximum – as supplied to propellers	
Rudder angle	Maximum	As necessary to achieve desired course
Wind direction	3 directions: aligned with wave direction and ±30 degrees from wave direction	
Wave direction	If test programs performed with 360-degree turning circle: one direction only If test programs performed with 180-degree turning circle: 0-180 degrees in steps of 15 degrees	0-180 degrees in steps of 15 degrees
Wave conditions	Irregular short-crested or long-crested waves with maximum significant wave height and zero up-crossing periods varied as [7.5], 8.5, 9.5, 10.5, 11.5, 12.5, 13.5, [14.5] s	

16 A number of runs should be performed at each wave condition to demonstrate the repeatability of the results to within satisfactory engineering accuracy [95% fulfilment].

Phased implementation of verification procedures

17 A 2-phase approach is recommended. In the initial phase (Phase 1), only the simplified approach need be applied. In Phase 2, the Organization would determine whether a more comprehensive approach is necessary based on experience gained in Phase 1 and the availability and practicability of relevant tools.

Documentation

18 Model tests programs, calculations, or numerical calculations should be documented. These should include but not be limited to the following:

.1 description of the vessel's main particulars;

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

.3 description of test program and test results; and

.4 description of applied test method with references.

References

MSC.137(76) (2002) Standards for ship manoeuvrability.

MSC/Circ.1053 (2002) Explanatory notes to the Standards for ship manoeuvrability.

MSC/Circ.707 (1995) Guidance to the master for avoiding dangerous situations in following and quartering seas.

IACS (2001) recommendation 34 – standard wave data.

The manoeuvring committee (2008) Final report and recommendations to the 25th ITTC.

Australian Transport Safety Bureau, June 2007, Marine occurrence investigation No. 243.