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PREVENTION OF AIR POLLUTION FROM SHIPS

Comments on the draft Guidelines for the Method of calculation of new ship design CO_2 Index – Proposal for definition of Vref, and corresponding draft

Submitted by Denmark and Norway

SUMMARY	
Executive summary:	The first intersessional Meeting of the Working Group on Greenhouse Gas Emissions from Ships agreed to draft guidelines on the method of calculation of the design CO_2 index for new ships. This document proposes definitions for Vref and corresponding draft conditions
Strategic direction:	7.3
High-level action:	7.3.1
Planned output:	7.3.1.1 and 7.3.1.3
Action to be taken:	Paragraph 27
Related document:	MEPC 58/4

Introduction

1 In accordance with the terms of reference set out by MEPC 57, the first intersessional meeting of the Green House Gas Working Group developed draft Guidelines for the method of calculation of the New Ship Design Index as set out in the report from the first Intersessional meeting of the Green House Gas Working Group (MEPC 58/4).

2 As described in paragraph 2.23 of document MEPC 58/4, the intersessional Working Group agreed to draft guidelines on the method of calculation of the design CO_2 index for new ships including a draft formula for consideration by MEPC 58, set out as annex 5 to the report, but agreed that the formula would need some fine tuning. The group also agreed that the values for speed, capacity and power used in the index should be consistent, and developed draft text to define these parameters

3 Paragraph 2 of the draft guidelines in annex 5 of document MEPC 58/4 reads:

> "V_{ref} is the *design 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 output of the engine(s) as defined in paragraph 5 and assuming the weather is calm with no wind and no waves."

4 The intersessional Working Group did, however, not explicitly conclude on how the terms "*design ship speed*" and "*design load condition*" should be defined. This document discusses this particular issue and proposes such definitions.

Design speed, design load and other design parameters

5 Design speed and load is commonly understood to be the typical intended (service) operating speed and load for which the ship design is optimized. Design speed and load may differ from maximum speed and load, and from the speed achieved at the sea trial (trial speed).

6 Contractual design conditions are defined in a ship building contract. Typically, this includes a minimum speed requirement at a given payload/draft condition and the corresponding maximum fuel consumption. This contracted speed may, but need not, be different from the intended operating speed of the ship. The shipbuilding contract will normally specify sea trials and acceptance tests, where the performance of the ship, as built, will be verified. Also, the contract may include corrections to the measured test values to account for wind, waves, trial draft and more as well as financial penalties in case the ship fails to meet the design specification.

Definition of speed

7 The speed definition is important, because the power requirement and hence the design CO_2 index value is very sensitive to speed. In general, due to hull friction alone, the ship propulsion power requirement increases by the third power of the speed; however, the curve can be even steeper, at higher speeds when wave generation resistance is more prominent.

8 In the discussions at the intersessional meeting, it was suggested that the "design speed" term used to calculate the CO_2 design index, could be defined as the "intended operating speed or the service speed" defined by the ship owner. That would mean an operational element is integrated into the design index. The result would be that the design index of identical ships could be different, if one ship owner assumes a lower design speed than the other. Therefore, using "design speed", as specified by the owner, undermines the fundamental purpose of the index, which is to enable fair comparison of the designs, hence this approach cannot be supported.

9 In the discussions at the intersessional meeting, it was also suggested that the design conditions defined in the shipbuilding contract could be used. This is, however, difficult as a wide range of contracts exist and there may be instances where multiple conditions are defined. Also, the situation could occur where identical ships would get different index values, because the contracts were set up differently. Therefore, this approach cannot ensure equal index for equal ships and cannot be supported.

10 Instead, the submitters of this document would argue that the design speed must be defined on the basis of the capabilities of the ship itself. Several options are available as outlined below.

11 One option is to use the speed obtained when the engine delivers 100% of the rated installed propulsion power in a well defined loading and weather condition. An advantage of this approach is that certified fuel consumption data for this load is available from the test data in engines technical file. On the other hand, this is a theoretical condition that ships cannot achieve due to the sea margin (see Figure 1). Also, the hull resistance/speed trade off at this theoretical speed will not be representative of the performance at expected operating speeds.

12 A second option is to use the speed obtained when the engine delivers 75% of the rated installed propulsion power in a well-defined loading and weather condition. An advantage of this figure is that certified fuel consumption data for this load is readily available from the test data in engines technical file. Also, this would be a realistic operating condition which could be verified at sea trial, if so desired.

13 A third option would be to use maximum speed (maximum power out-take at maximum propeller revolution at calm sea condition, i.e. maximum power of the engine less the sea margin). A disadvantage with this approach is that certified fuel consumption data may not be available for the actual load condition.

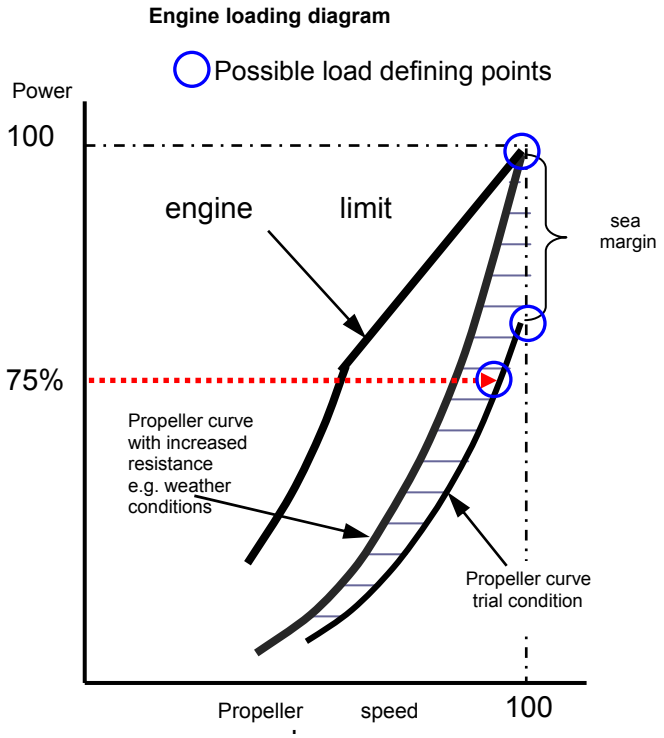

Figure 1: Engine load diagram

14 Having discussed the advantages and disadvantages of the above options, the submitters of this document propose that the speed obtained, when the engine delivers 75% engine power in a well-defined loading and weather condition, should be used to define the operating condition of the ship and that this could be implemented by changing paragraph 2 and paragraph 5 as follows:

15 Proposed amendment to paragraph 2 of the draft guidelines:

V_{ref} is the ~~design~~ 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 output of the engine(s) as defined in paragraph ~~5~~5.1.1 and assuming the weather is calm with no wind and no waves.

16 Proposed amendment to paragraph 5.1.1 of the draft guidelines:

$P_{ME(i)}$ is 75% of the rated installed power for each engine (i).

Definition of design load condition

17 The speed obtained when the engine delivers 75% of the rated installed engine power depends on the load condition, i.e. draft and trim for ships, where the capacity is the maximum deadweight, then the corresponding draft and trim is readily available from the approved stability booklet. For ships where capacity is measured in units other than deadweight (e.g., gross tonnage or cubic metres), it is necessary to establish a design draft corresponding to the capacity.

18 One option could be to use as a standard the density of the cargo; this, however, would be difficult for ships carrying different types of goods and for ships where gross tonnage is used to express capacity.

19 Another option is to use the maximum draft as defined by the summer load line. The summer load line is calculated from the Load Line Rules and depends on many factors such as length of ship, type of ship, type and number of superstructures, amount of sheer, bow height and more. However, the summer load line reflects just one limit for safe operation, and certain ships may never be this heavily laden.

20 A third option is to use the "deepest operational draft". All merchant ships are required to have an approved stability booklet on board. This booklet contains a number of loading conditions and one of them is *the fully loaded departure condition* – i.e. the condition/deepest draft to which a ship is allowed to be loaded taking all applicable requirements into consideration.

21 Normally the "deepest operational draft" will be equivalent to the summer load line. However, there might be loading conditions, where the ship is not able to make use of the full summer load line draft due to various restrictions implied by operational aspects, such as scantling, load lines, GM limit curve, stability, etc.

22 In this regard, it is important that the loading condition leading to the design index must reflect the actual operation of the ship. The latter is necessary to stimulate optimization of the ship design for its real operation and not for an artificial or ideal loading condition, which is unlikely to occur in practice due to the above-mentioned restrictions.

23 Generally, power requirements at a certain speed increase with increasing draft. It would therefore both make sense from a technical point of view and constitute a realistic worst case emission scenario to apply the approved deepest operational draft and the associated trim to define the design loading condition reflected by the design CO_2 index. Thus, it is proposed that the following definition should be inserted as new subparagraph 6.1

24 Proposed new paragraph 6.1 of the draft guidelines:

When Capacity is not defined as deadweight the design load shall be defined by the deepest operational draft with its associated trim, at which the ship is allowed to operate. This condition can be obtained from the stability booklet approved by the Administration.

25 Still, cases may exist where the "deepest operational draft" in reality always will be lower than what could be expected for a fully-laden ship.

26 To this end, it could be considered if it would be appropriate to allow such a lower design load condition. This should, however, only be allowed in special cases documented to the satisfaction of the Administration and provided that the deepest operational draft for the ship is then limited accordingly.

Action requested of the Committee

27 The Committee is invited to consider proposals above and take action as appropriate.