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PREVENTION OF AIR POLLUTION FROM SHIPS

Comments on the CO_2 design index

Submitted by the International Association of Classification Societies (IACS)

SUMMARY	
Executive summary:	This document comments on the outcome of the recent meeting of the GHG-WG in Oslo, Norway in June. In particular, comments and proposals are provided regarding the CO_2 design index and the related verification of input parameters
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 18
Related documents:	MEPC 58/4 and GHG-WG 1/2/1

Introduction

1 This document is submitted in accordance with paragraph 4.10.5 of the Guidelines on the organization and method of work of the Committees and their subsidiary bodies (MSC-MEPC.1/Circ.2) and provides comments on MEPC 58/4.

2 MEPC 57 tasked the first Intersessional Meeting of the Working Group on GHG Emissions from Ships (GHG-WG 1) to develop a mandatory design CO_2 index for new ships with a view to approval at MEPC 58, if deemed appropriate. Based on two submissions from Denmark and Japan, the GHG-WG developed a concept for a CO_2 design index for new ships – section 2 of MEPC 58/4 refers.

Objective

3 Such a CO_2 design index should provide a fair basis for comparison, to stimulate the development of more efficient engines and ships in general, and to establish a minimum

efficiency of ships depending on ship type and ship size. Therefore, a robust methodology needs to be developed to ensure a fair comparison of future ship efficiency. This document focuses on the verification of input parameters used in the computation of a CO_2 design index.

Consistent data for power, capacity and speed and their verification

4 It is generally agreed that the main input parameters to compute the attained CO_2 design index – namely power, capacity and speed - need to be selected such that they are consistent and verifiable. It has been discussed as to whether design or maximum conditions should be selected as the appropriate basis. The building contract between owner and yard defines power, capacity and speed for certain conditions and also a verification procedure – in the form of sea trials. However, the building contract details are (usually) not accessible to an Administration and, therefore, verification of the main input parameters needs to be independent from the contract.

5 The three input parameters are not independent and, therefore, only two can be set and the third is obtained. For example, power and capacity are set to their maximum values and the speed measured is the speed under the defined conditions. It is therefore important to identify proper definitions of power and capacity.

6 The key to selecting consistent data for power, capacity and speed is to consider a realistic operating condition which is relevant for the ship designer. Consistent data that can be approved during the early design phase by an Administration – or a Recognized Organization (RO) acting on its behalf - and can be verified once the vessel is built, i.e. during sea trials. The following discussion therefore focuses on those values which could be approved at an early stage of the design process.

Main and auxiliary engines' power

7 For all internal combustion engines being installed onboard a ship, engine output power and specific fuel consumption are measured during factory acceptance tests and the results are documented in the technical file of the Engine International Air Pollution Prevention Certificate (EIAPPC). Therefore, it is recommended to use values from MARPOL Annex VI, Appendix II, as follows:

.1 Constant speed main propulsion engine: 100% engine speed, 75% power (corresponds to test cycle E2 condition with 50% weight);

.2 Constant speed auxiliary propulsion engine: 100% engine speed, 75% power (corresponds to test cycle D2 condition with 25% weight); and

.3 Propeller law operated engines: 91% engine speed, 75% power (corresponds to test cycle E3 condition with 50% weight).

8 During the early design stage, main and auxiliary engines are specified to obtain the contractually agreed performance. If standard engines are specified, data from the existing EIAPPC could be used for approving the power values. If new engine types are considered, estimates on power and specific fuel consumption need to be established jointly by the engine manufacturer and the Administration or RO with a view to subsequent confirmation, once the IAPPC has been issued.

Cargo capacity and associated draft

9 Cargo capacity is one primary design objective and it is defined at the early design stage. Once the ship lightweight and the mass of fuel, stores, crew, etc. are estimated, the ship's deadweight can be computed at the following defined waterlines:

.1 the waterline corresponding to the assigned summer freeboard;

.2 the waterline corresponding to the greatest draught permitted by the subdivision requirements (deepest subdivision load line); and

.3 the waterline corresponding to the fully loaded departure condition defined in the Stability Booklet (deepest operational draft).

10 It is recommended to use the waterline which is defined early in the design activity. It seems that the subdivision waterline is available early for approval by the Administration or RO.

11 Cargo capacity takes different units for different ship types. For those ship types with cargo capacity expressed by space-oriented units, e.g., TEU or m^3, a proper translation into a draft is needed as follows:

.1 Container vessels: one TEU is equivalent to [14][1] tons (average mass of loaded containers); and

.2 Gas tankers: the highest density of the intended cargo is used to define the mass equivalent of one m^3.

12 For those ship types with cargo capacity expressed by GT (for the purpose of the CO_2 design index), e.g., Ro-Ro-vessels, Ro-Pax-vessels and cruise ships; the deepest subdivision draft defines the deadweight. It is likely that ship designers will use an average mass for a trailer to estimate the cargo capacity for a Ro-Ro-vessel or a Ro-Pax-vessel. However, the link to GT is difficult to express. For cruise ships, cargo capacity is not a design objective. Again, a link from design parameters to GT is difficult to establish. It is questioned, therefore, whether GT is the appropriate unit for the cargo capacity of Ro-Ro-vessels, Ro-Pax-vessels and cruise ships, as used in the formula for the attained CO_2 design index.

Speed

13 If main engine power and cargo capacity are properly set according to the proposals above in paragraphs 7 and 10, the speed can be determined at defined conditions e.g., calm and deep water. At the early design stage, the speed corresponding to the deepest subdivision draft and 75% of main engine power could be determined using model tests or numerical simulations. To ensure availability of this information, a special model test condition may have to be added for the purpose of approving the attained CO_2 design index.

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1 It is assumed that the average mass of containers used in ship design varies dependent on the trade which the vessel is planned to enter. It is therefore acknowledged that this suggested value of 14 tons per TEU will need confirmation, and adjustment as necessary, based on further discussion and input from, *inter alia*, container ship designers.

14 Verification of the approved speed, corresponding to the deepest subdivision draft and 75% of main engine power, could be performed during sea trials. If the deepest draft cannot be tested, a formula needs to be established to extrapolate from the sea trial condition to the full load condition.

Correction factors

15 The correction factors are intended to account for ship particulars that require higher than average installed power. Additional class characters may be used to approve the values used in the correction formulas. This can also be done early in the design stage.

Assumptions for baseline computation

16 The baseline is computed with several assumptions and simplifications – such as a constant carbon emission factor, constant specific fuel consumptions for main and auxiliary engines and all correction factors set to One (1). These assumptions are generally supported, provided that the formula for the attained CO_2 design index provides the necessary correction factors to account for ship design characteristics, i.e. the formulas for the attained and required CO_2 design indices should only be discussed and agreed jointly.

17 The baselines suggested in document GHG WG 1/2/1 (Denmark) were computed using historic data from the period 1995 to 2004. It is recommended to re-compute the baselines using actual data, say for the period 2003-2007, and compare the resultant baselines.

Action requested of the Committee

18 The Committee is invited to consider the above comments and information when agreeing on a methodology for a CO_2 design index for new ships.

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