

標題

MEPC 78 の審議結果の紹介

ClassNK

テクニカル インフォメーション

No. TEC- 1275
発行日 2022 年 8 月 19 日

各位

2022 年 6 月 6 日から 10 日に第 78 回海洋環境保護委員会 (MEPC 78) が開催されました。今般、IMO より MEPC 78 の議事録及び決議並びにサーキュラが発行されたことから、次の通り同会合の情報及び審議結果をお知らせ致します。

1. 温室効果ガス (GHG) 関連

地球温暖化対策の観点から、温室効果ガス (GHG) 排出の抑制が世界的な課題となっている中、国際海運からの GHG 抑制対策は IMO にて検討が進められています。

IMO では、現在までにエネルギー効率設計指標 (EEDI) による規制、船舶エネルギー効率管理計画書 (SEEMP) の所持、及び燃料消費実績報告制度 (DCS) を導入しています。また、2018 年 4 月に開催された MEPC 72 では、GHG 削減目標と GHG 排出削減策の候補を盛り込んだ IMO GHG 削減戦略が採択され、国際海運の脱炭素化に向けた GHG 削減手法について継続審議が行われています。

(1) GHG 排出削減のための短期対策

IMO GHG 削減戦略の短期削減目標では、2030 年までに国際海運全体の輸送効率を 2008 年比で最低 40% 改善することが明記されています。この短期目標を達成するための対策として、MEPC 76 では、EEXI 規制と、燃費実績 (CII, Carbon Intensity Indicator) 格付け制度を導入するための MARPOL 条約 附属書 VI の改正、及び関連するガイドラインが採択され、2023 年より適用開始されます。

(i) CII 燃費実績格付け制度

CII 燃費実績格付け制度は、DCS にて収集したデータを基に毎年の CO₂ 排出量の実績値となる attained CII を計算し、基準値との比較から格付け評価を行う制度となります。MEPC 76 にて設置された通信部会では、燃費実績格付け制度を実施するための、DCS と SEEMP に関する関連ガイドライン、及び船種等に対する CII の補正係数に関するガイドラインの検討作業が行われてきました。

今回の会合では、通信部会と MEPC 78 に先立ち開催された中間会合 (ISWG-GHG 12) を経て作成された関連のガイドラインが採択されました。

(添付 4-7、及び添付 10-13 参照)

なお、CII 規制の対象となる船舶については 2023 年からのデータ収集に先立ち、本船の SEEMP に CII の計算方法、今後 3 年間の CII 基準値、CII 基準値を達成するための実施計画、及び自己評価及び改善に関する手順を SEEMP Part III として作成し、確認証書 (CoC) と共に船上保管する必要があります。

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NOTES:

- ClassNK テクニカル・インフォメーションは、あくまで最新情報の提供のみを目的として発行しています。
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弊会では、SEEMP Part III の作成提出を効率よく実施いただけるよう、SEEMP Part III 作成提出機能を搭載した ClassNK MRV Portal を公開しております。SEEMP Part III の審査に関する情報につきましては、ClassNK テクニカル・インフォメーション No. TEC-1271(2022年08月03日付)を参照願います。また、CII 規制及び SEEMP Part III に関する情報を、以下の弊会ウェブサイトにてご案内しておりますので併せて参照頂けますようお願い致します。

ホーム>業務サービス>条約関連>エネルギー効率関連条約(SEEMP、IMO DCS、CII)

URL:<https://www.classnk.or.jp/hp/ja/activities/statutory/seemp/index.html>

(ii) EEXI 規制

EEXI 規制は、新造船における EEDI 規制と同等に、就航船に対して一定以上の燃費性能を要求する規制となります。

今回の会合では、運航中の海上速力試験方法や軸発電機付き船舶の EEXI 計算方法を追加した EEXI 計算ガイドライン及び EEXI 検査認証ガイドラインの改正が採択されました。また運航中の海上速力試験については、具体的な手順を示すガイダンスも承認されています。

(添付 8: 決議 MEPC.350(78)、添付 9: 決議 MEPC.351(78)、
添付 19: MEPC.1/Circ.901 参照)

(2) 船舶燃料のライフサイクル GHG 強度に関するガイドラインの策定

船舶の脱炭素化に向けて今後普及が進むことが予測される水素やアンモニア、バイオマス燃料などの低/ゼロ炭素燃料については、それら燃料の製造や流通過程において排出される CO₂ にも留意すべきことが認識されています。また、メタン(CH₄)などの CO₂ 以外の GHG についても、地球温暖化に与える影響の大きさが注目されています。このような背景から、IMO では、船舶で使用される燃料について、燃料の製造、流通、及び船上での使用を通じたライフサイクルにおける GHG 排出を総合的に評価するための、ライフサイクル GHG 強度に関するガイドラインの策定が開始されています。

今回の会合では、通信部会を設置して当該ガイドラインの内容について集中的に検討し、来年夏に開催される MEPC 80 における同ガイドラインの最終化を目指すことが合意されました。

(3) GHG 排出削減のための中・長期対策

IMO GHG 削減戦略では、中期削減目標として 2050 年までに輸送効率を 2008 年比で最低 70%改善すること、及び GHG 総排出量を同じく 2008 年比で最低 50%削減すること、並びに長期削減目標として今世紀中の出来るだけ早い時期に GHG 排出量をゼロとすることが掲げられています。

中・長期削減目標を達成するための対策の検討を進めるにあたり、2021 年に開催された MEPC 76 では、今後の作業を次の 3 つのフェーズに別けて検討を行うワークプランが合意されています。

フェーズ I (2021-2022):	具体的な対策案を各国が検討し、IMO に提案
フェーズ II (2022-2023):	検討すべき提案を選別し、優先順位付け
フェーズ III (2023-):	優先順位の高い提案について、制度案を具体化

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今回の会合では、5月に開催された中間会合(ISWG-GHG 12)にて各国から提案されていた次の対策案について、詳細な検討(フェーズII)を進めていくことが合意されました。

検討されている主な GHG 削減対策案

GFS (GHG Fuel Standard)	船舶で使用される燃料について、単位エネルギー当たりのライフサイクル GHG 排出強度を規制
IMRF (IMO 研究開発ファンド)	船舶燃料 1 トンあたり US\$2 を課金し、低・脱炭素技術の研究開発を促進するための IMO 研究開発ファンドの運用資金に充てる制度
IMSF&R	CII 格付けの情報を基に、CO2 排出量の多い船舶へ課金し、CO2 排出量の少ない船舶へ還元する制度
課金・還付 (feebate) 制度	化石燃料船への課金 (fee) し、ゼロエミ燃料船への還付 (rebate) する制度
単純課金	GHG 排出量 1 トンあたり US\$100 の課金制度。課金による収益は、UNFCCC の監督による気候変動緩和策、及び IMO の監督による脱炭素技術の研究開発に使用
ECTS (Emission Cap-and-Trade System)	排出量取引制度。各船に排出枠を設け、排出枠の余剰分や不足分を取引する制度

(4) IMO GHG 削減戦略の見直し

2018年に採択されたIMO GHG 削減戦略では、5年ごとにその内容を見直すことが規定されています。パリ協定の下で各主要国政府が2050年までにGHG 排出ゼロを目指すなど意欲的な姿勢を示している状況の中、前回のMEPC 77では、IMO GHG 削減戦略で規定している国際海運からのGHG 排出削減目標を強化する必要があるとの認識から、2023年春に開催されるMEPC 80での採択に向けてIMO GHG 削減戦略の見直し作業を開始することが合意されました。

今回の会合では、IMO GHG 削減戦略の見直し作業を進めるために、次回(MEPC 79)の前に開催される中間会合にて集中的に検討することが合意されました。

2. バラスト水管理条約

(1) 処理済み汚水、及びグレーウォータの貯蔵

特定の港湾において処理済みの汚水やグレーウォータの排出が禁止されていることから、業界よりこれらを一時的にバラストタンクに貯蔵する運用をしてよいか、との疑問が上がっています。今後、MARPOL 条約 附属書 IV やバラスト水管理条約にて、処理済みの汚水やグレーウォータの排出をどのように取り扱うべきかを検討していくことが合意されました。

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(2) 水質に問題がある場合の処理装置の利用

バラスト水処理装置(BWMS)の使用について、バラスト水処理が困難となるような水質に問題のある寄港地にてバラスト水を積み込む場合の手順を明確化すべきとの意見があり、ガイダンスの作成が検討されています。

今回の会合では、現在までに候補として挙げられているバラスト水交換と BWMS による処理を組み合わせた対応方法が閉鎖的な海域では実行できないという懸念や、想定できなかった Contingency なケースとして対応することの是非、問題になる水質の特定方法などを整理する必要があることが認識され、次回以降の会合に向け更に検討を行うことになりました。

3. 大気汚染防止

(1) バイオ燃料使用における NOx 規制

燃料の品質に関する要件を規定する MARPOL 条約 附属書 VI の第 18 規則では、石油由来の燃料油、及び石油精製以外の方法で得られる燃料油の使用について、それぞれに対する要求事項を規定しています。今回の会合では、GHG 削減対策として導入が見込まれるバイオ燃料、及び化石燃料とのブレンド油に対する同規則の適用について検討を行い、同規則に対する統一解釈が承認されました。

この統一解釈では、バイオ燃料の化石燃料油へのブレンド比率が 30%以下である場合には従来の石油由来の燃料油として扱い、追加の NOx に関連する要件が課されないことが規定されています。またバイオ燃料や、化石燃料との比率が 30%を超えるブレンド油を使用する場合であっても、原動機取扱手引書(テクニカルファイル)に規定している NOx 重要構成部品や同手引書で指定している設定値、運転値の範囲を超えるような変更無く運転できる原動機は、追加の NOx に関連する要件が課されないことが規定されています。

なお、ブレンド比率が 30%を超え、重要構成部品や設定値、運転値などに変更がある場合については、排出量の確認は NOx テクニカルコードの 6.3 に規定される簡易計測法を採用できる旨が明確化されています。

(添付 17 : MEPC.1/Circ.795/Rev.6)

(2) SOx 排出規制海域の追加

MARPOL 条約 附属書 VI の第 14 規則では、硫黄酸化物(SOx)及び粒子状物質(PM)の排出を抑制するために、2020 年より一般海域で使用する燃料油中の硫黄分濃度を 0.50%に制限しています。また、バルト海海域、北海海域、米国・カナダ沿岸 200 海里内の海域、及び米国カリブ海海域を SOx の排出規制海域(Emission Control Area: ECA)として指定しており、これらの海域で使用する燃料油の硫黄分濃度を 0.10%に制限しています。今回の会合では、欧州諸国や地中海沿岸国から、地中海海域を SOx ECA に指定すべきとの提案があり、同海域を SOx ECA に指定する MARPOL 条約 附属書 VI の改正案が承認されました。今回の会合では適用日について結論が得られなかったため、次回の MEPC 79 において再度審議を行った上で、採択される見込みです。最短で 2025 年の春より地中海を航行する船舶に、燃料油中の硫黄分濃度 0.10%規制が適用されることとなります。

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(3) 排ガス浄化装置 (EGCS)からの排水

燃料油中の硫黄分濃度規制について、MARPOL 条約 附属書 VI 第 4 規則により、適合燃料油と同等の実効性を持つ排ガス浄化装置 (EGCS) の使用に替えることが認められています。EGCS を使用する場合は、性能要件を規定する EGCS ガイドライン (決議 MEPC.259.(68)) に基づき主管庁の承認を受ける必要があり、洗浄水の排出に適合することが要求され、EGCS からの排水についても基準が設けられています。一方、EGCS にて使用した洗浄水の排出による海洋環境への悪影響を懸念する港湾では、EGCS の使用を制限する動きがあります。この状況を踏まえ、汚染防止・対応小委員会 (PPR) にて、統一的な規制を制定するための EGCS からの排水による影響評価について検討を行っていました。今回の会合では、PPR で作成された EGCS の排水が海洋環境に与える影響の評価方法を定めるガイドラインが承認されました。

(添付 18 : MEPC.1/Circ.899)

4. その他の審議事項

(1) AFS 条約

海洋生物の付着を防ぐ為の防汚塗料について、2008 年に発効した船舶の有害な防汚方法の規制に関する国際条約 (AFS 条約) では、有機スズ化合物を使用することが禁止されています。また、MEPC 76 ではシブトリンを新たに禁止物質に加える条約改正が採択されており、2023 年より規制が開始されます。

今回の会合では、新たにシブトリンを禁止物質とすることに伴う AFS サンプルングのためのガイドライン、PSC 検査のためのガイドライン、AFS の検査・認証に関するガイドラインの改正について採択されました。

(添付 14: 決議 MEPC.356(78)、添付 15 : 決議 MEPC.357(78) 、
添付 16 : 決議 MEPC.358(78)参照)

(2) 海洋プラスチックごみ

近年問題となっているプラスチックごみの海洋投棄について、2013 年に発効した MARPOL 条約 附属書 V の改正により、全ての船舶からのプラスチックごみの排出が禁止されています。しかしながら、国連の調査によると、未だ船舶に由来するプラスチックごみが排出されていることが報告されています。MEPC 77 では、現行規定の順守と 2025 年までに船舶からの海洋プラスチックごみ排出ゼロを目指すことを盛り込んだ海洋プラスチックごみに対する戦略が MEPC 決議として採択されました。

今回の会合では、400 トン以上の国際航海船に備えることが要求されている廃物記録簿について、100 トン以上の国際航海船まで対象を拡大する MARPOL 条約 附属書 V の改正案が承認されました。この改正案は次回の MEPC 79 にて採択される予定です。

(次頁に続く)

5. 採択された強制要件

今回の会合で採択された主な強制要件は以下の通りです。

(1) 水密戸に関する要件

SOLAS に規定される水密戸に関する要件と整合させるための、MARPOL 条約 附属書 I、及び IBC Code の改正が採択されました。

発効日 : 2024 年 1 月 1 日 (MARPOL 附属書 I)

: 2024 年 7 月 1 日 (IBC Code)

(添付 1.: 決議 MEPC.343(78) / 添付 3 決議 MEPC.345(78) 参照)

(2) 有害液体物質の分類

MARPOL 条約 附属書 II の付録1に記載している有害液体物質の分類のための指針について、GESAMP ハザード評価手順の変更に伴う改正が採択されました。

発効日 : 2023 年 11 月 1 日

(添付 2.: 決議 MEPC.344(78)参照)

MEPC 78 の審議概要につきましては IMO ホームページにも掲載されていますのでご参照下さい。

<https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MEPC-default.aspx>

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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(次頁に続く)

添付:

1. 決議 MEPC.343(78): Amendments to MARPOL Annex I (Watertight Doors)
2. 決議 MEPC.344(78): Amendments to MARPOL Annex II (Abbreviated Legend to the Revised GESAMP Hazard Evaluation Procedure)
3. 決議 MEPC.345(78): Amendments to the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) (Watertight Doors)
4. 決議 MEPC.346(78): 2022 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP)
5. 決議 MEPC.347(78): Guidelines for the verification and company audits by the Administration of Part III of SEEMP
6. 決議 MEPC.348(78): 2022 Guidelines for Administration verification of ship fuel oil consumption data and operational carbon intensity
7. 決議 MEPC.349(78): 2022 Guidelines for the development and management of the IMO Ship Fuel Oil Consumption Database
8. 決議 MEPC.350(78): 2022 Guidelines on the Method of Calculation of the Attained Energy Efficiency Existing Ship Index (EEXI)
9. 決議 MEPC.351(78): 2022 Guidelines on Survey and Certification of the Attained EEXI
10. 決議 MEPC.352(78): 2022 Guidelines on Operational Carbon Intensity and the Calculation Methods (CII Guidelines, G1)
11. 決議 MEPC.353(78): 2022 Guidelines on the Reference Lines for use with Operational Carbon Intensity Indicators (CII Reference Lines Guidelines, G2)
12. 決議 MEPC.354(78): 2022 Guidelines on the Operational Carbon Intensity Rating of Ships (CII Rating Guidelines, G4)
13. 決議 MEPC.355(78): 2022 Interim Guidelines on Correction Factors and Voyage Adjustments for CII Calculations (CII Guidelines, G5)
14. 決議 MEPC.356(78): 2022 Guidelines for Brief Sampling of Anti-Fouling System on Ships
15. 決議 MEPC.357(78): 2022 Guidelines for Inspection of Anti-Fouling System on Ships
16. 決議 MEPC.358(78): 2022 Guidelines for Survey and Certification of Anti-Fouling System on Ships
17. MEPC.1/Circ.795/Rev.6: Unified Interpretations to MARPOL Annex VI
18. MEPC.1/Circ.899: 2022 Guidelines for risk and impact assessments of the discharge water from exhaust gas cleaning systems
19. MEPC.1/Circ.901 Guidance on methods, procedures and verification of in-service performance measurements

ANNEX 1

RESOLUTION MEPC.343(78)
(adopted on 10 June 2022)

**AMENDMENTS TO THE ANNEX OF THE INTERNATIONAL CONVENTION FOR THE
PREVENTION OF POLLUTION FROM SHIPS, 1973, AS MODIFIED BY THE
PROTOCOL OF 1978 RELATING THERETO**

Amendments to MARPOL Annex I

(Watertight doors)

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee conferred upon it by international conventions for the prevention and control of marine pollution from ships,

RECALLING ALSO article 16 of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL), which specifies the amendment procedure and confers upon the appropriate body of the Organization the function of considering amendments thereto for adoption by the Parties,

HAVING CONSIDERED, at its seventy-eighth session, proposed amendments to MARPOL Annex I concerning watertight doors,

1 ADOPTS, in accordance with article 16(2)(d) of MARPOL, amendments to MARPOL Annex I, the text of which is set out in the annex to the present resolution;

2 DETERMINES, in accordance with article 16(2)(f)(iii) of MARPOL, that the amendments shall be deemed to have been accepted on 1 July 2023 unless prior to that date, not less than one-third of the Parties or Parties the combined merchant fleets of which constitute not less than 50 per cent of the gross tonnage of the world's merchant fleet have communicated to the Organization their objection to the amendments;

3 INVITES the Parties to note that, in accordance with article 16(2)(g)(ii) of MARPOL, the said amendments shall enter into force on 1 January 2024 upon their acceptance in accordance with paragraph 2 above;

4 REQUESTS the Secretary-General, for the purposes of article 16(2)(e) of MARPOL, to transmit certified copies of the present resolution and the text of the amendments contained in the annex to all Parties to MARPOL;

5 ALSO REQUESTS the Secretary-General to transmit copies of the present resolution and its annex to Members of the Organization which are not Parties to MARPOL.

ANNEX

AMENDMENTS TO MARPOL ANNEX I

(Watertight doors)

CHAPTER 4 – REQUIREMENTS FOR THE CARGO AREA OF OIL TANKERS

PART A – CONSTRUCTION

Regulation 28 – Subdivision and damage stability

1 Paragraph 3.1 is replaced by the following:

- ".1 The final waterline, taking into account sinkage, heel and trim, shall be below the lower edge of any opening through which progressive flooding may take place. Such openings shall include air pipes and those which are closed by means of weathertight doors or hatch covers and may exclude those openings closed by means of watertight manhole covers and flush scuttles, small watertight cargo tank hatch covers which maintain the high integrity of the deck, remotely operated sliding watertight doors, hinged watertight access doors with open/closed indication locally and at the navigation bridge, of the quick-acting or single-action type that are normally closed at sea, hinged watertight doors that are permanently closed at sea, and sidescuttles of the non-opening type."

ANNEX 2

**RESOLUTION MEPC.344(78)
(adopted on 10 June 2022)**

**AMENDMENTS TO THE ANNEX OF THE INTERNATIONAL CONVENTION FOR THE
PREVENTION OF POLLUTION FROM SHIPS, 1973, AS MODIFIED BY THE
PROTOCOL OF 1978 RELATING THERETO**

Amendments to MARPOL Annex II

**(Abbreviated legend to the revised
GESAMP Hazard Evaluation Procedure)**

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee conferred upon it by international conventions for the prevention and control of marine pollution from ships,

RECALLING ALSO article 16 of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL), which specifies the amendment procedure and confers upon the appropriate body of the Organization the function of considering amendments thereto for adoption by the Parties,

HAVING CONSIDERED, at its seventy-eighth session, proposed amendments to appendix I of MARPOL Annex II concerning the abbreviated legend to the revised GESAMP Hazard Evaluation Procedure,

1 ADOPTS, in accordance with article 16(2)(d) of MARPOL, amendments to appendix I of MARPOL Annex II, the text of which is set out in the annex to the present resolution;

2 DETERMINES, in accordance with article 16(2)(f)(iii) of MARPOL, that the amendments shall be deemed to have been accepted on 1 May 2023 unless prior to that date, not less than one-third of the Parties or Parties the combined merchant fleets of which constitute not less than 50 per cent of the gross tonnage of the world's merchant fleet have communicated to the Organization their objection to the amendments;

3 INVITES the Parties to note that, in accordance with article 16(2)(g)(ii) of MARPOL, the said amendments shall enter into force on 1 November 2023 upon their acceptance in accordance with paragraph 2 above;

4 REQUESTS the Secretary-General, for the purposes of article 16(2)(e) of MARPOL, to transmit certified copies of the present resolution and the text of the amendments contained in the annex to all Parties to MARPOL;

5 ALSO REQUESTS the Secretary-General to transmit copies of the present resolution and its annex to Members of the Organization which are not Parties to MARPOL.

ANNEX

AMENDMENTS TO MARPOL ANNEX II

(Abbreviated legend to the revised GESAMP Hazard Evaluation Procedure)

Appendix I

Guidelines for the categorization of noxious liquid substances

The three tables under the title "Abbreviated legend to the revised GESAMP Hazard Evaluation Procedure" are replaced by the following four tables:

"

Numerical rating	A Bioaccumulation and Biodegradation		B Aquatic Toxicity	
	A1 Bioaccumulation	A2 Biodegradation	B1 Acute toxicity LC/EC/IC ₅₀ (mg/L)	B2 Chronic toxicity EC ₁₀ or NOEC (mg/L)
	A1a: log P _{ow}	A1b: BCF		
0	log <1, log > ca.7 MW > 1000	no measurable BCF	R: readily biodegradable	AT >1000 CT >1
1	1 ≤ log <2	1 ≤ BCF <10	NR: not readily biodegradable	100 < AT ≤ 1000 0.1 < CT ≤ 1
2	2 ≤ log <3	10 ≤ BCF <100		10 < AT ≤ 100 0.01 < CT ≤ 0.1
3	3 ≤ log <4	100 ≤ BCF <500		1 < AT ≤ 10 0.001 < CT ≤ 0.01
4	4 ≤ log <5	500 ≤ BCF <4000		0.1 < AT ≤ 1 CT ≤ 0.001
5	5 ≤ log < ca.7	BCF ≥ 4000		0.01 < AT ≤ 0.1
6				AT ≤ 0.01

Numerical rating	C Acute Mammalian Toxicity				
	C1 Oral toxicity	C2 Dermal toxicity	C3 Inhalation toxicity		
	LD ₅₀ /ATE (mg/kg)	LD ₅₀ /ATE (mg/kg)	C3a		C3b
			vapour/mist LC ₅₀ /ATE (mg/L)	mist only LC ₅₀ /ATE (mg/L)	vapour only LC ₅₀ /ATE (mg/L)
0	ATE >2000	ATE >2000	ATE >20	ATE >5	ATE >20
1	300 < ATE ≤ 2000	1000 < ATE ≤ 2000	10 < ATE ≤ 20	1 < ATE ≤ 5	10 < ATE ≤ 20
2	50 < ATE ≤ 300	200 < ATE ≤ 1000	2 < ATE ≤ 10	0.5 < ATE ≤ 1	2 < ATE ≤ 10
3	5 < ATE ≤ 50	50 < ATE ≤ 200	0.5 < ATE ≤ 2	0.05 < ATE ≤ 0.5	0.5 < ATE ≤ 2
4	ATE ≤ 5	ATE ≤ 50	ATE ≤ 0.5	ATE ≤ 0.05	ATE ≤ 0.5

Numerical rating	D Irritation, Corrosion and Long-term Health Effects		
	D1 Skin irritation and corrosion	D2 Eye irritation and corrosion	D3 Long-term health effects
0	not irritating	not irritating	C – Carcinogenic M – Mutagenic R – Reprotoxic Ss – Sensitizing to skin Sr – Sensitizing to respiratory system A – Aspiration hazard T – Target Organ Toxicity N – Neurotoxic I – Immunotoxic
1	mildly irritating	mildly irritating	
2	irritating	irritating	
3	severely irritating or corrosive 3A Corr. (≤4 h) 3B Corr. (≤1 h) 3C Corr. (≤3 min)	severely irritating	

E			
Interference with Other Uses of the Sea			
Numerical Rating	E1 Flammability flashpoint (°C)	E2 Physical effects on wildlife and benthic habitats	E3 Interference with coastal amenities
0	- (not flammable, does not burn)	Fp - Persistent floater F - Floater S - Sinker G - Gas E - Evaporator D - Dissolver and combinations thereof	no interference no warning
1	Fp >93		slightly objectionable warning, no closure of amenity
2	60 < Fp ≤ 93		moderately objectionable possible closure of amenity
3	23 ≤ Fp ≤ 60		highly objectionable closure of amenity
4	Fp < 23		

ANNEX 3

**RESOLUTION MEPC.345(78)
(adopted on 10 June 2022)**

**AMENDMENTS TO THE INTERNATIONAL CODE FOR THE CONSTRUCTION
AND EQUIPMENT OF SHIPS CARRYING DANGEROUS
CHEMICALS IN BULK (IBC CODE)**

(Watertight doors)

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee conferred upon it by international conventions for the prevention and control of marine pollution from ships,

RECALLING ALSO resolution MEPC.19(22), by which it adopted the *International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (the IBC Code)*, and resolution MEPC.16(22), by which the IBC Code has become mandatory under Annex II of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL),

RECALLING FURTHER article 16 of MARPOL and regulation 1.4 of MARPOL Annex II concerning the procedure for considering amendments to the IBC Code for adoption by the Parties,

HAVING CONSIDERED, at its seventy-eighth session, proposed amendments to the IBC Code concerning watertight doors,

1 ADOPTS, in accordance with article 16(2)(d) of MARPOL, amendments to the IBC Code, the text of which is set out in the annex to the present resolution;

2 DETERMINES, in accordance with article 16(2)(f)(iii) of MARPOL, that the amendments to the IBC Code shall be deemed to have been accepted on 1 January 2024 unless, prior to that date, not less than one-third of the Parties or Parties the combined merchant fleets of which constitute not less than 50 per cent of the gross tonnage of the world's merchant fleet have communicated to the Organization their objection to the amendments;

3 INVITES the Parties to note that, in accordance with article 16(2)(g)(ii) of MARPOL, the amendments to the IBC Code shall enter into force on 1 July 2024 upon their acceptance in accordance with paragraph 2 above;

4 REQUESTS the Secretary-General, in conformity with article 16(2)(e) of MARPOL, to transmit certified copies of the present resolution and the text of the amendments to the IBC Code contained in the annex to all parties to MARPOL;

5 ALSO REQUESTS the Secretary-General to transmit copies of the present resolution and its annex to the Members of the Organization which are not Parties to MARPOL.

ANNEX

**AMENDMENTS TO THE INTERNATIONAL CODE FOR
THE CONSTRUCTION AND EQUIPMENT OF SHIPS CARRYING DANGEROUS
CHEMICALS IN BULK (IBC CODE)**

(Watertight doors)

CHAPTER 2

SHIP SURVIVAL CAPABILITY AND LOCATION OF CARGO TANKS

2.9 Survival requirements

1 Paragraph 2.9.2.1 is replaced by the following:

".1 the waterline, taking into account sinkage, heel and trim, shall be below the lower edge of any opening through which progressive flooding or downflooding may take place. Such openings shall include air pipes and openings which are closed by means of weathertight doors or hatch covers and may exclude those openings closed by means of watertight manhole covers and watertight flush scuttles, small watertight cargo tank hatch covers which maintain the high integrity of the deck, remotely operated sliding watertight doors, hinged watertight access doors with open/closed indication locally and at the navigation bridge, of the quick-acting or single-action type that are normally closed at sea, hinged watertight doors that are permanently closed at sea, and sidescuttles of the non-opening type;"

ANNEX 8

RESOLUTION MEPC.346(78)
(adopted on 10 June 2022)

**2022 GUIDELINES FOR THE DEVELOPMENT OF A SHIP ENERGY EFFICIENCY
MANAGEMENT PLAN (SEEMP)**

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee (the Committee) conferred upon it by international conventions for the prevention and control of marine pollution from ships,

NOTING that the Committee, at its seventy-sixth session, adopted, by resolution MEPC.328(76), the 2021 revised MARPOL Annex VI, which will enter into force on 1 November 2022,

NOTING IN PARTICULAR that the 2021 revised MARPOL Annex VI (MARPOL Annex VI) contains amendments concerning mandatory goal-based technical and operational measures to reduce the carbon intensity of international shipping,

NOTING FURTHER that regulation 26 of MARPOL Annex VI requires each ship to keep on board a Ship Energy Efficiency Management Plan (SEEMP), to be developed and reviewed, taking into account the guidelines adopted by the Organization,

RECOGNIZING that the aforementioned amendments to MARPOL Annex VI require relevant guidelines for uniform and effective implementation of the regulations and to provide sufficient lead time for industry to prepare,

NOTING that the Committee, at its seventieth session, adopted, by resolution MEPC.282(70), the *2016 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP)*,

HAVING CONSIDERED, at its seventy-eighth session, the draft *2022 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP)*,

1 ADOPTS the *2022 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP)*, as set out in the annex to the present resolution;

2 INVITES Administrations to take the annexed Guidelines into account when developing and enacting national laws which give force to and implement requirements set forth in regulation 26 of MARPOL Annex VI;

3 REQUESTS the Parties to MARPOL Annex VI and other Member Governments to bring the annexed Guidelines to the attention of masters, seafarers, shipowners, ship operators and any other interested parties;

4 AGREES to keep the Guidelines under review in light of experience gained with their implementation, also taking into consideration that in accordance with regulations 25.3 and 28.11 of MARPOL Annex VI a review of the technical and operational measures to reduce the carbon intensity of international shipping shall be completed by 1 January 2026;

5 REVOKES the *2016 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP)* adopted by resolution MEPC.282(70).

**2022 GUIDELINES FOR THE DEVELOPMENT OF
A SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP)**

CONTENTS

- 1 INTRODUCTION
 - 2 DEFINITIONS
- PART I OF THE SEEMP: SHIP MANAGEMENT PLAN TO IMPROVE ENERGY EFFICIENCY
- 3 GENERAL
 - 4 FRAMEWORK AND STRUCTURE OF PART I OF THE SEEMP
 - 5 GUIDANCE ON BEST PRACTICES FOR FUEL EFFICIENT OPERATION OF SHIPS
- PART II OF THE SEEMP: SHIP FUEL OIL CONSUMPTION DATA COLLECTION PLAN
- 6 GENERAL
 - 7 GUIDANCE ON METHODOLOGY FOR COLLECTING DATA ON FUEL OIL CONSUMPTION, DISTANCE TRAVELLED AND HOURS UNDER WAY
 - 8 DIRECT CO₂ MEASUREMENT
- PART III OF THE SEEMP: SHIP OPERATIONAL CARBON INTENSITY PLAN
- 9 GENERAL
 - 10 ATTAINED ANNUAL OPERATIONAL CII CALCULATION METHODOLOGY; DATA COLLECTION PLAN AND DATA QUALITY
 - 11 REQUIRED ANNUAL OPERATIONAL CII FOR NEXT THREE YEARS
 - 12 THREE-YEAR IMPLEMENTATION PLAN
 - 13 PROCESS FOR SELF-EVALUATION AND IMPROVEMENT
 - 14 REVIEW AND UPDATE OF PART III OF THE SEEMP
 - 15 PLAN OF CORRECTIVE ACTIONS
- APPENDIX 1 – SAMPLE FORM OF SHIP MANAGEMENT PLAN TO IMPROVE ENERGY EFFICIENCY (PART I OF THE SEEMP)
- APPENDIX 2 – SAMPLE FORM OF SHIP FUEL OIL CONSUMPTION DATA COLLECTION PLAN (PART II OF THE SEEMP)
- APPENDIX *2bis* – SAMPLE FORM OF SHIP OPERATIONAL CARBON INTENSITY PLAN (PART III OF THE SEEMP)

APPENDIX 3 – STANDARDIZED DATA REPORTING FORMAT FOR THE DATA COLLECTION SYSTEM AND OPERATIONAL CARBON INTENSITY TO THE ADMINISTRATION

APPENDIX 4 – STANDARDIZED DATA REPORTING FORMAT FOR THE PARAMETERS TO CALCULATE THE TRIAL CARBON INTENSITY INDICATORS ON A VOLUNTARY BASIS

1 INTRODUCTION

1.1 The *Guidelines for the development of a Ship Energy Efficiency Management Plan* have been developed to assist with the preparation of the Ship Energy Efficiency Management Plan (SEEMP) required by regulation 26 of MARPOL Annex VI.

1.2 Taken together, the aims of the SEEMP should assist the international shipping sector to achieve the goal of Chapter 4 of MARPOL Annex VI set out in regulation 20, which is reducing the carbon intensity of international shipping. The aims of the SEEMP are threefold:

1.2.1 To encourage companies to incorporate actions to improve the energy efficiency and carbon intensity of their ships and ship management practices.

1.2.2 To specify the methodology the ship should use to collect the data required by regulation 27.1 of MARPOL Annex VI and the processes that should be used to report the data to the ship's Administration or any organization duly authorized by it.

1.2.3 To specify the methodology the ship should use to calculate the attained annual operational carbon intensity indicator (CII) as required by regulation 28.1 of MARPOL Annex VI and the processes that should be used to report the data to the ship's Administration or any organization duly authorized by it.

1.3 There are three parts to a SEEMP:

1.3.1 Guidance for Part I of the SEEMP required by regulation 26.1 of MARPOL Annex VI, is addressed in sections 3, 4, and 5 of these Guidelines. The purpose of this part is to provide an approach to monitor ship and fleet efficiency performance over time and describe ways to improve the ship's energy efficiency performance and carbon intensity. Part I of the SEEMP applies to any ship of 400 GT and above.

1.3.2 Guidance for part II of the SEEMP required by regulation 26.2 of MARPOL Annex VI, is addressed in sections 6, 7, and 8 of these Guidelines. The purpose of this part is to provide a description of the methodologies that should be used to collect the data required pursuant to regulation 27 of MARPOL Annex VI and the processes that the ship should use to report the data to the ship's Administration or any organization duly authorized by it. Part II of the SEEMP applies to any ship of 5,000 GT and above.

1.3.3 Guidance for part III of the SEEMP required by regulations 26.3 and 28.8 of MARPOL Annex VI is addressed in sections 9, 10, 11, 12, 13, 14 and 15 of these Guidelines. The purpose of this part is to provide:

- .1 a description of the methodology that should be used to calculate the ship's attained annual operational CII required by regulation 28 of MARPOL Annex VI;
- .2 the processes that should be used to report this value to the ship's Administration or any organization duly authorized by it;
- .3 the required annual operational CII for the next three years;
- .4 an implementation plan documenting how the required annual operational CII should be achieved during the next three years;
- .5 a procedure for self-evaluation and improvement; and

- .6 for ships rated as D for three consecutive years or rated as E, a plan of corrective actions to achieve the required annual operational CII.

1.3.4 Part III of the SEEMP applies to any ship of 5,000 GT and above which falls into one or more of the categories in regulations 2.2.5, 2.2.7, 2.2.9, 2.2.11, 2.2.14 to 2.2.16, 2.2.22, and 2.2.26 to 2.2.29 of MARPOL Annex VI.

1.3.5 Sample forms of the various sections of the SEEMP are presented in appendices 1, 2, and 2*bis* for illustrative purposes. A standardized data-reporting format for the data collection system and operational carbon intensity is presented in appendix 3. A standardized data reporting format for the trial carbon intensity indicators on voluntary basis is presented in appendix 4.

2 DEFINITIONS

2.1 For the purpose of these Guidelines, the definitions in MARPOL Annex VI apply.

2.2 "Ship fuel oil consumption data" means the data required to be collected on an annual basis and reported as specified in appendix IX to MARPOL Annex VI.

2.3 "Safety management system" means a structured and documented system enabling company personnel to implement effectively the company safety and environmental protection policy, as defined in paragraph 1.1 of International Safety Management Code.

2.4 "Carbon Intensity Indicator" means a performance indicator by which it is possible to measure the carbon intensity of the ship, as defined in the guidelines developed by the Organization,¹ taking into account data listed for reporting in appendix IX to MARPOL Annex VI.

PART I OF THE SEEMP: SHIP MANAGEMENT PLAN TO IMPROVE ENERGY EFFICIENCY

3 GENERAL

3.1 Regulation 26.1 of MARPOL Annex VI requires each ship of 400 gross tonnage and above, subject to chapter 4 to keep on board a ship-specific Ship Energy Efficiency Management Plan (SEEMP).

3.2 The purpose of part I of the SEEMP is to establish a mechanism for a company and/or a ship to improve the energy efficiency and reduce the carbon intensity of a ship's operation. Preferably, this aspect of the ship-specific SEEMP is linked to a broader corporate energy management policy for the company that owns, operates or controls the ship, recognizing that no two shipping companies are the same, and that ships operate under a wide range of different conditions.

3.3 Many companies will already have an environmental management system (EMS) in place under ISO 14001 which contains procedures for selecting the best measures for particular ships and then setting objectives for the measurement of relevant parameters, along with relevant control and feedback features. Monitoring of operational environmental efficiency should therefore be treated as an integral element of broader company management systems.

¹ Refer to the *2021 Guidelines on operational carbon intensity indicators and the calculation methods (CII guidelines, G1)* (Resolution MEPC.336(76)) and the *2022 Guidelines on correction factors and voyage adjustments for CII calculations (G5)* (Resolution MEPC.XXX(78)).

3.4 In addition, many companies already develop, implement and maintain a safety management system. In such case, part I of SEEMP may form part of the ship's safety management system.

3.5 This section provides guidance for the development of part I of SEEMP that should be adjusted to the characteristics and needs of individual companies and ships. Part I of the SEEMP is intended to be a management tool to assist a company in managing the ongoing environmental performance of its ships and, as such, it is recommended that a company develop procedures for implementing the plan in a manner which limits any onboard administrative burden to the minimum necessary.

3.6 Part I of the SEEMP should be developed as a ship-specific plan by the company, and should reflect efforts to improve the energy efficiency and reduce carbon intensity of a ship through four steps: planning, implementation, monitoring, and self-evaluation and improvement. These components play a critical role in the continuous cycle to improve ship energy efficiency management and reduce its carbon intensity. With each iteration of the cycle, some elements of part I will necessarily change while others may remain as before.

3.7 At all times safety considerations should be paramount. The trade a ship is engaged in may determine the feasibility of the energy efficiency and carbon intensity reduction measures under consideration. For example, ships that perform services at sea (pipe laying, seismic survey, OSVs, dredgers, etc.) may choose different methods of improving energy efficiency when compared to conventional cargo carriers. The nature of operations and influence of prevailing weather conditions, tides and currents combined with the necessity of maintaining safe operations may require adjustment of general procedures to maintain the efficiency of the operation, for example the ships which are dynamically positioned. The length of a voyage and the need to avoid high risk areas may also be important parameters as well as trade specific safety considerations.

4 FRAMEWORK AND STRUCTURE OF PART I OF THE SEEMP

4.1 Planning

4.1.1 Planning is the most crucial stage of part I of the SEEMP, in that it primarily determines both the current status of ship energy usage and carbon intensity and the expected improvement of ship energy efficiency and reduction of carbon intensity. Therefore, it is encouraged to devote sufficient time to planning so that the most appropriate, effective and implementable plan can be developed.

Ship-specific measures

4.1.2 Recognizing that there are a variety of options to improve energy efficiency and reduce carbon intensity (e.g. speed optimization, confirming berth availability and arrival time with port of destination, weather routeing, hull maintenance, retrofitting of energy efficiency devices, and use of alternative fuels), the best package of measures for a ship to improve energy efficiency and reduce carbon intensity depends to a great extent upon ship type, cargoes, routes and other factors that should be identified in the first place. These measures should be listed as a package of measures to be implemented, thus providing the overview of the actions to be taken for that ship.

4.1.3 During the planning process, therefore, it is important to determine and understand the ship's current status of energy usage. Part I of the SEEMP should identify energy-saving and carbon intensity reducing measures that already have been undertaken, and should determine how effective these measures are in terms of improving energy efficiency and

reducing carbon intensity. Part I also should identify what measures can be adopted to further improve the energy efficiency and reduce the carbon intensity of the ship. It should be noted, however, that not all measures can be applied to all ships, or even to the same ship under different operating conditions and that some of them are mutually exclusive. Ideally, initial measures could yield energy (and cost) saving results that then can be reinvested in more difficult or expensive efficiency upgrades identified by part I.

4.1.4 Guidance on best practices for fuel-efficient operation of ships, set out in chapter 5, can be used to facilitate this part of the planning phase. Also, in the planning process, particular consideration should be given to minimize any onboard administrative burden.

Company-specific measures

4.1.5 The improvement of energy efficiency and reduction of carbon intensity of ship operation does not necessarily depend on single ship management only. Rather, it may depend on many stakeholders including ship repair yards, shipowners, operators, charterers, cargo owners, fuel suppliers, ports and traffic management services. For example, "just in time" – as explained in paragraph 5.2.4 – requires good early communication among operators, ports and traffic management services. The better the coordination among such stakeholders, the more improvement can be expected. In most cases, such coordination or total management is better made by a company rather than by a ship. In this sense, it is recommended that a company should also establish an energy efficiency and carbon intensity management plan to improve the performance of its fleet (should it not have one in place already) and make necessary coordination among stakeholders.

Human resource development

4.1.6 For effective and steady implementation of the adopted measures, raising awareness of and providing necessary training for personnel both on shore and on board are an important element. Such human resource development is encouraged and should be considered as an important component of planning as well as a critical element of implementation.

Goal setting

4.1.7 The last part of planning is goal setting.

- .1 For ships also subject to regulation 28 of MARPOL Annex VI, the goal setting should be consistent with the continuous CII improvements set out by that regulation, and should include the relevant information (see paragraph 9.7). These ships are also encouraged to consider setting ship-specific goals in addition to the applicable CII requirements that strive for additional energy efficiency improvements and carbon intensity reductions.
- .2 For ships or companies not subject to regulation 28, there are no requirements to define a goal and to communicate it to the public, or to be a subject to external inspection, surveys, or audits with respect to the SEEMP. Nevertheless, a meaningful goal should be defined to serve as a signal on a company's commitment to improve the energy efficiency and carbon intensity of the ship. The goal can be set using different indicators, including the annual fuel consumption, Annual Efficiency Ratio (AER), cgDIST, Energy

Efficiency Operational Indicator (EEOI) or other carbon intensity indicators (CIIs).² In all cases, the goal should be measurable and easy to understand.

4.2 Implementation

Establishment of implementation system

4.2.1 After a ship and a company identify the energy efficiency and carbon intensity measures to be implemented, it is essential to establish a system for their implementation. This is done by developing the procedures for energy management, defining tasks associated with those procedures, and assigning those tasks to responsible personnel. The implementation system should include procedures to ensure execution of measures and specify defined levels of authority and lines of communication. Also, it should include procedures for internal audits and management review, where relevant. In sum, part I of the SEEMP should describe how each measure should be implemented and who the responsible person or persons are. The implementation period (start and end dates) of each selected measure should be indicated. The development of such an implementation system can be considered as a part of planning, and therefore may be completed at the planning stage.

Implementation and record-keeping

4.2.2 The planned measures should be carried out in accordance with the predetermined implementation system. Record-keeping for the implementation of each measure is beneficial for self-evaluation at a later stage and should be encouraged. If any identified measure cannot be implemented for any reason, the reason or reasons should be recorded for internal use. It is recommended that events and operational conditions outside the control of the ship's crew (for example, waiting for berths, extended port dwell times, operation in severe adverse weather) which may affect the ships rating be documented.

4.3 Monitoring

Monitoring tools

4.3.1 The energy efficiency of a ship should be monitored quantitatively. This should be done by an established method, preferably by an international standard. In many cases, the monitoring tool should target the goal indicator set out in paragraph 4.1.7 (e.g. AER, cgDIST, EEOI, or other CIIs as agreed by the Organization). If a quantitative goal is not defined for a ship, a quantitative performance indicator developed by the Organization (e.g. AER, EEOI, CII) or another internationally established tool should be selected. A ship subject to regulation 28 is likely to use the CII as its monitoring tool.

4.3.2 If used, these CIIs should be calculated in accordance with the guidelines developed by the Organization,³ adjusted, as necessary, to a specific ship and trade.

4.3.3 Ships subject to regulation 28 may use other measurement tools in addition to the CII, if convenient and/or beneficial for a ship or a company. In the case where other monitoring

² Refer to the *2022 Guidelines on operational carbon intensity indicators and the calculation methods (CII guidelines, G1)* (Resolution MEPC.352(78)) and the *2022 Interim guidelines on correction factors and voyage adjustments for CII calculations (G5)* (Resolution MEPC.355(78)).

³ Refer to the *Guidelines for voluntary use of the ship energy efficiency operational indicator (EEOI)* (MEPC.1/Circ.684) and the *2022 Guidelines on operational carbon intensity indicators and the calculation methods (CII guidelines, G1)* (Resolution MEPC.352(78)) and the *2022 Interim guidelines on correction factors and voyage adjustments for CII calculations (G5)* (Resolution MEPC.355(78)).

tools are used, the reason for the use of the tool and the method of monitoring should be clarified at the planning stage.

4.3.4 It is highly advised to conduct monitoring at regular intervals for checking consistency of data and verification assistance. The ship's fuel oil consumption should be monitored using daily reporting, such as noon reports, or higher frequency data.

Establishment of monitoring system

4.3.5 It should be noted that whatever measurement tools are used, continuous and consistent and reliable data collection is the foundation of monitoring. To allow for meaningful and consistent monitoring, a monitoring system, including the procedures for collecting data and the assignment of responsible personnel, should be developed. The development of such a system can be considered as a part of planning, and therefore should be completed at the planning stage.

4.3.6 It should be noted that, in order to avoid unnecessary administrative burdens on ships' staff, monitoring should be carried out as much as possible by shore staff when the data can be automatically transferred, utilizing data obtained from existing required records such as the official and engineering logbooks and oil record books. Additional data could be obtained as appropriate.

Search and rescue

4.3.7 When a ship diverts from its scheduled passage to engage in search and rescue operations, and for which emissions are excluded pursuant to regulation 3, it is recommended that data obtained during such operations is not used in ship energy efficiency monitoring, and that such data should be recorded separately.

4.4 Self-evaluation and improvement

4.4.1 Self-evaluation and improvement is the final phase of the management cycle. This phase should produce meaningful feedback for the coming first stage, i.e. planning stage of the next improvement cycle.

4.4.2 The purpose of self-evaluation is to:

- .1 evaluate the effectiveness of the planned measures and their implementation;
- .2 deepen the understanding of the overall characteristics of the ship's operation such as what types of measures can or cannot function effectively, and how and/or why;
- .3 comprehend the trend of the efficiency improvement of that ship; and
- .4 develop the improved management plan for the next cycle through identification of further opportunities for improving energy efficiency and reducing carbon intensity.

4.4.3 For this process, procedures for self-evaluation of the ship energy efficiency management plan should be developed. Furthermore, self-evaluation should be implemented periodically by using data collected through monitoring. In addition, it is recommended that time be invested in identifying the cause and effect of the performance during the evaluated

period so lessons learned can be taken into account when revising and improving the next stage of the ship's energy efficiency management plan.

5 GUIDANCE ON BEST PRACTICES FOR FUEL-EFFICIENT OPERATION OF SHIPS

5.1 The search for energy efficiency and carbon intensity improvement across the entire transport chain takes responsibility beyond what can be delivered by the company alone. A list of all the possible stakeholders in the efficiency of a single voyage is long: obvious parties are designers, shipyards and engine manufacturers for the characteristics of the ship; and charterers, fuel suppliers, ports and vessel traffic management services, etc. for the specific voyage. All parties involved should consider the inclusion of efficiency measures in their operations both individually and collectively.

5.2 Fuel-efficient operations

Improved voyage planning

5.2.1 The optimum route and improved efficiency can be achieved through the careful planning and execution of voyages. Thorough voyage planning needs time, but a number of software tools are available to assist in voyage planning.

5.2.2 The *Guidelines for voyage planning*, adopted by resolution A.893(21), provide essential guidance for the ship's crew and voyage planners.

Weather routeing

5.2.3 Weather routeing has a high potential for efficiency savings on specific routes. It is commercially available for all types of ship and for many trade areas.

Just in time

5.2.4 Good early communication with the next port should be an aim in order to give maximum notice of berth availability and facilitate the use of optimum speed where port operational procedures support this approach.

5.2.5 Optimized port operation could involve a change in procedures involving different ship handling arrangements in ports. Port authorities should be encouraged to maximize efficiency and minimize delay.

Speed optimization

5.2.6 Speed optimization can produce significant savings. However, optimum speed means the speed at which the fuel used per tonne mile is at a minimum level for that voyage. It does not mean minimum speed; in fact, sailing at less than optimum speed will consume more fuel rather than less. Reference should be made to the engine manufacturer's power/consumption curve and the ship's propeller curve. Possible adverse consequences of slow speed operation may include increased vibration and problems with soot deposits in combustion chambers and exhaust systems. These possible consequences should be taken into account. For LNG carriers speed optimization means, quite often, a higher speed at the start of laden passages to control tanks pressure and at the end of ballast passages to use the operational LNG quantity needed for cargo tank cooling in propulsion instead of wasting in GCU or condenser steam dump. Charterers are generally aware of the improved efficiency of this speed pattern.

5.2.7 As part of the speed optimization process, due account may need to be taken of the need to coordinate arrival times with the availability of loading/discharge berths, etc. The number of ships engaged in a particular trade route may need to be taken into account when considering speed optimization.

5.2.8 A gradual increase in speed when leaving a port or estuary whilst keeping the engine load within certain limits may help to reduce fuel consumption.

5.2.9 It is recognized that under many charter parties the speed of the ships is determined by the charterer and not the operator. Efforts should be made when agreeing charter party terms to encourage the ship to operate at optimum speed in order to maximize energy efficiency.

Optimized shaft power

5.2.10 Operation at constant shaft RPM can be more efficient than continuously adjusting speed through engine power. The use of automated engine management systems to control speed rather than relying on human intervention may be beneficial.

5.2.11 When optimizing shaft power, due attention should be given to overall power system efficiency. For example, in some cases reducing load or shaft speed below the minimum necessary to operate energy recovery systems and shaft generators may increase overall emissions.

5.3 Optimized ship handling

Optimum trim

5.3.1 Most ships are designed to carry a designated amount of cargo at a certain speed for a certain fuel consumption. This implies the specification of set trim conditions. Loaded or unloaded, trim has a significant influence on the resistance of the ship through the water and optimizing trim can deliver significant fuel savings. For any given draft there is a trim condition that gives minimum resistance. In some ships, it is possible to assess optimum trim conditions for fuel efficiency continuously throughout the voyage. Design or safety factors may preclude full use of trim optimization.

Optimum ballast

5.3.2 Ballast should be adjusted taking into consideration the requirements to meet optimum trim and steering conditions and optimum ballast conditions achieved through good cargo planning.

5.3.3 When determining the optimum ballast conditions, the limits, conditions and ballast management arrangements set out in the ship's Ballast Water Management Plan are to be observed for that ship.

5.3.4 Ballast conditions have a significant impact on steering conditions and autopilot settings, and it needs to be noted that less ballast water does not necessarily mean improved energy efficiency.

Optimum propeller and propeller inflow considerations

5.3.5 Selection of the propeller is normally determined at the design and construction stage of a ship's life but new developments in propeller design have made it possible for retrofitting of later designs to deliver greater fuel economy. Whilst it is certainly for consideration, the

propeller is but one part of the propulsion train and a change of propeller in isolation may have no effect on efficiency and may even increase fuel consumption.

5.3.6 Improvements to the water inflow to the propeller using arrangements such as fins and/or nozzles could increase propulsive efficiency power and hence reduce fuel consumption.

Optimum use of rudder and heading control systems (autopilots)

5.3.7 There have been large improvements in automated heading and steering control systems technology. Whilst originally developed to make the bridge team more effective, modern autopilots can achieve much more. An integrated Navigation and Command System can achieve significant fuel savings by simply reducing the distance sailed "off track". The principle is simple: better course control through less frequent and smaller corrections will minimize losses due to rudder resistance. Retrofitting of a more efficient autopilot to existing ships could be considered.

5.3.8 During approaches to ports and pilot stations the autopilot cannot always be used efficiently as the rudder has to respond quickly to given commands. Furthermore, at certain stages of the voyage it may have to be deactivated or very carefully adjusted, i.e. during heavy weather and approaches to ports.

5.3.9 Consideration may be given to the retrofitting of improved rudder blade design (e.g. "twist-flow" rudder).

Hull maintenance

5.3.10 Docking intervals should be integrated with the company's ongoing assessment of ship performance. Hull resistance can be optimized by new technology-coating systems, possibly in combination with cleaning intervals. Regular in-water inspection of the condition of the hull is recommended.

5.3.11 Propeller cleaning and polishing or even appropriate coating may significantly increase fuel efficiency. The need for ships to maintain efficiency through in-water hull cleaning should be recognized and facilitated by port States.

5.3.12 Consideration may be given to the possibility of timely full removal and replacement of underwater paint systems to avoid the increased hull roughness caused by repeated spot blasting and repairs over multiple dockings.

5.3.13 Generally, the smoother the hull, the better the fuel efficiency.

Propulsion system

5.3.14 Marine diesel engines have a very high thermal efficiency (~50%). This excellent performance is only exceeded by fuel cell technology with an average thermal efficiency of 60%. This is due to the systematic minimization of heat and mechanical loss. In particular, the new breed of electronic controlled engines can provide efficiency gains. However, specific training for relevant staff may need to be considered to maximize the benefits.

Propulsion system maintenance

5.3.15 Maintenance in accordance with manufacturers' instructions in the company's planned maintenance schedule will also maintain efficiency. The use of engine condition monitoring can be a useful tool to maintain high efficiency.

5.3.16 Additional means to improve engine efficiency might include use of fuel additives, adjustment of cylinder lubrication oil consumption, valve improvements, torque analysis, and automated engine monitoring systems.

5.4 Waste heat recovery

5.4.1 Waste heat recovery systems use thermal heat losses from the exhaust gas for either electricity generation, heating or additional propulsion with a shaft power take in.

5.4.2 It may not be possible to retrofit such systems into existing ships. However, they may be a beneficial option for new ships. Shipbuilders should be encouraged to incorporate new technology into their designs.

5.5 Improved fleet management

5.5.1 Better utilization of fleet capacity can often be achieved by improvements in fleet planning. For example, it may be possible to avoid or reduce long ballast voyages through improved fleet planning. There is opportunity here for charterers to promote efficiency. This can be closely related to the concept of "just in time" arrivals.

5.5.2 Efficiency, reliability and maintenance-oriented data sharing within a company can be used to promote best practice among ships within a company and should be actively encouraged.

5.6 Improved cargo handling

Cargo handling is in most cases under the control of the port or terminal operators and optimum solutions matched to ship and port or terminal requirements should be explored. However, in cases where ships use their own cargo handling equipment (e.g. cargo cranes, self-unloading booms, cargo pumps (tankers)), procedures should be in place to efficiently utilize the energy produced from any additional generators required to operate the equipment.

5.7 Energy management

5.7.1 A review of electrical services on board can reveal the potential for unexpected efficiency gains. However, care should be taken to avoid the creation of new safety hazards when turning off electrical services (e.g. lighting). Thermal insulation is an obvious means of saving energy. Also see comment below on shore power.

5.7.2 Optimization of reefer container stowage locations may be beneficial in reducing the effect of heat transfer from compressor units. This might be combined as appropriate with cargo tank heating, ventilation, etc. The use of water-cooled reefer plant with lower energy consumption might also be considered.

5.8 Fuel type

The use of emerging alternative fuels may be considered as a CO₂ reduction method, but availability will often determine the applicability.

5.9 Other measures

5.9.1 Development of computer software for the calculation of current fuel consumption, for the establishment of an emissions "footprint," to optimize operations, and the establishment of goals for improvement and tracking of progress may be considered.

5.9.2 Renewable energy sources, such as solar (or photovoltaic) cell technology, have improved enormously in recent years and should be considered for onboard application.

5.9.3 In some ports shore power may be available for some ships but this is generally aimed at improving air quality in the port area. If the shore-based power source is carbon efficient, there may be a net efficiency benefit. Ships may consider using onshore power if available.

5.9.4 Even wind-assisted propulsion may be worthy of consideration. Various systems are available for retrofit, including Flettner rotors, wing sails and aerofoil kites.

5.9.5 Efforts could be made to source fuel of improved quality in order to minimize the amount of fuel required to provide a given power output.

5.10 Compatibility of measures

5.10.1 These Guidelines indicate a wide variety of possibilities for energy efficiency improvements for the existing fleet. While there are many options available, they are not necessarily cumulative, are often area and trade dependent and likely to require the agreement and support of a number of different stakeholders if they are to be utilized most effectively.

Age and operational service life of a ship

5.10.2 All measures identified in this document as applied to part I of the SEEMP are potentially cost-effective in case of high oil prices. The financial feasibility of a specific energy efficiency enhancement can be evaluated by various means. One way would be to estimate the return on investment (ROI) time. However, while measures with lower ROI may have the lowest cost, this does not guarantee the best results in energy efficiency performance improvement. Clearly, this equation is heavily influenced by the remaining service life of a ship and the cost of fuel.

Trade and sailing area

5.10.3 The feasibility of many of the measures described in this guidance will be dependent on the trade and sailing area of the ship. Sometimes ships will change their trade areas as a result of a change in chartering requirements, but this cannot be taken as a general assumption. For example, certain types of wind-enhanced power sources might not be feasible for short sea shipping as these ships generally sail in areas with high traffic densities or in restricted waterways. Air draft limitations may also affect the feasibility of wind assistance technology and certain other emission reduction measures. Another aspect is that the world's oceans and seas each have characteristic conditions and so ships designed for specific routes and trades may not obtain the same energy efficiency benefits by adopting the same measures or combination of measures as other ships that operate in different areas. It is also likely that some measures will have a greater or lesser effect in different sailing areas.

5.10.4 The trade a ship is engaged in may also determine the feasibility of the efficiency measures under consideration. For example, ships that perform services at sea (pipe laying, seismic survey, OSVs, dredgers, etc.) may choose different methods of improving energy efficiency when compared to conventional cargo carriers. The length of voyage may also be an important parameter as may trade specific safety considerations. The pathway to the most efficient combination of measures will be unique to each vessel within each shipping company.

5.10.5 Environmental conditions and the nature of cargo carried also varies between regions. For example, some routes may carry greater volumes of goods requiring careful temperature conditioning, or some transit regions may be subject to frequent severe adverse weather conditions. This may lead to an increase of emissions of ships serving those routes and regions.

PART II OF THE SEEMP: SHIP FUEL OIL CONSUMPTION DATA COLLECTION PLAN

6 GENERAL

6.1 Regulation 26.2 of MARPOL Annex VI specifies that, "in the case of a ship of 5,000 gross tonnage and above, the SEEMP shall include a description of the methodology that will be used to collect the data required by regulation 27.1 of this Annex and the processes that will be used to report the data to the ship's Administration". Part II of the SEEMP, the Ship Fuel Oil Consumption Data Collection Plan (hereinafter referred to as "Data Collection Plan") contains such methodology and processes.

6.2 With respect to Part II of the SEEMP, these Guidelines provide guidance for developing a ship-specific method to collect, aggregate and report ship data with regard to annual fuel oil consumption, distance travelled, hours under way and other data required by regulation 27 of MARPOL Annex VI to be reported to the Administration.

6.3 Pursuant to regulation 5.4.5 of MARPOL Annex VI, the Administration should ensure that each covered ship's SEEMP complies with regulation 26.2 of MARPOL Annex VI prior to collecting any data.

7 GUIDANCE ON METHODOLOGY FOR COLLECTING DATA ON FUEL OIL CONSUMPTION, DISTANCE TRAVELLED AND HOURS UNDER WAY

Fuel oil⁴ consumption

7.1 Fuel oil consumption should include all the fuel oil consumed on board including but not limited to the fuel oil consumed by the main engines, auxiliary engines, gas turbines, boilers and inert gas generator, for each type of fuel oil consumed, regardless of whether a ship is under way or not. Methods for collecting data on annual fuel oil consumption in metric tonnes include (in no particular order):

- .1 method using bunker delivery notes (BDNs):

This method determines the annual total amount of fuel oil used based on BDNs, which are required for fuel oil for combustion purposes delivered to and used on board a ship in accordance with regulation 18 of MARPOL Annex VI; BDNs are required to be retained on board for three years after the fuel oil has been delivered. The Data Collection Plan should set out how the ship will operationalize the summation of BDN information and conduct tank readings. The main components of this approach are as follows:

⁴ Regulation 2.1.14 of MARPOL Annex VI defines "fuel oil" as "fuel oil means any fuel delivered to and intended for combustion purposes for propulsion or operation on board a ship, including gas, distillate and residual fuels."

- .1 annual fuel oil consumption would be the total mass of fuel oil used on board the vessel as reflected in the BDNs. In this method, the BDN fuel oil quantities would be used to determine the annual total mass of fuel oil consumption, plus the amount of fuel oil left over from the last calendar year period and less the amount of fuel oil carried over to the next calendar year period;
 - .2 to determine the difference between the amount of remaining tank oil before and after the period, the tank reading should be carried out at the beginning and the end of the period;
 - .3 in the case of a voyage that extends across the data reporting period, the tank reading should occur by tank monitoring at the ports of departure and arrival of the voyage and by statistical methods such as rolling average using voyage days;
 - .4 fuel oil tank readings should be carried out by appropriate methods such as automated systems, soundings and dip tapes. The method for tank readings should be specified in the Data Collection Plan;
 - .5 the amount of any fuel oil offloaded should be subtracted from the fuel oil consumption of that reporting period. This amount should be based on the records of the ship's oil record book; and
 - .6 any supplemental data used for closing identified difference in bunker quantity should be supported with documentary evidence;
- .2 method using flow meters:

This method determines the annual total amount of fuel oil consumption by measuring fuel oil flows on board by using flow meters. In case of the breakdown of flow meters, manual tank readings or other alternative methods will be conducted instead. The Data Collection Plan should set out information about the ship's flow meters and how the data will be collected and summarized, as well as how necessary tank readings should be conducted:

- .1 annual fuel oil consumption may be the sum of daily fuel oil consumption data of all relevant fuel oil consuming processes on board measured by flow meters;
- .2 the flow meters applied to monitoring should be located so as to measure all fuel oil consumption on board. The flow meters and their link to specific fuel oil consumers should be described in the Data Collection Plan;
- .3 note that it should not be necessary to correct this fuel oil measurement method for sludge if the flow meter is installed after the daily tank as sludge will be removed from the fuel oil prior to the daily tank;

- .4 the flow meters applied to monitoring fuel oil flow should be identified in the Data Collection Plan. Any consumer not monitored with a flow meter should be clearly identified, and an alternative fuel oil consumption measurement method should be included; and
- .5 calibration of the flow meters should be specified. Calibration and maintenance records should be available on board;
- .3 method using bunker fuel oil tank monitoring on board:
 - .1 to determine the annual fuel oil consumption, the amount of daily fuel oil consumption data measured by tank readings which are carried out by appropriate methods such as automated systems, soundings and dip tapes will be aggregated. The tank readings will normally occur daily when the ship is at sea and each time the ship is bunkering or de-bunkering; and
 - .2 the summary of monitoring data containing records of measured fuel oil consumption should be available on board;
- .4 method using LNG cargo tank monitoring on board:

LNG ships use the Custody Transfer Monitoring System (CTMS) to monitor/record the cargo volumes inside the tanks. When calculating the consumption:

 - .1 the LNG liquid volume consumed is converted to mass using the methane density of 422 kg/m³. This is because LNG is transported at methane boiling point, while other heavier hydrocarbons have a higher boiling point and remain at liquid state; and
 - .2 nitrogen mass content is subtracted for each laden voyage from LNG consumption as it does not contribute to CO₂ emissions;
- .5 method using cargo tank monitoring on board for ships using cargo other than LNG as a fuel:
 - .1 to determine the annual fuel oil consumption, the amount of daily fuel oil consumption data measured by tank readings which are carried out by appropriate methods to the cargo used as a fuel. The method for tank readings should be specified in the SEEMP Data Collection Plan; and
 - .2 the tank readings will normally occur daily when the ship is at sea and each time the ship is loading or discharging cargo; and the summary of monitoring data containing records of measured fuel oil consumption should be available on board.

7.2 Any corrections, e.g. density, temperature, nitrogen content for LNG, if applied, should be documented.⁵

Conversion factor CF

7.3 If fuel oils are used that do not fall into one of the categories as described in the *2018 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships* (resolution MEPC.308(73)), as amended, and have no CF-factor assigned (e.g. some "hybrid fuel oils"), the fuel oil supplier should provide a CF-factor for the respective product supported by documentary evidence.

Distance travelled

7.4 Appendix IX of MARPOL Annex VI specifies that distance travelled should be submitted to the Administration and:

- .1 distance travelled over ground in nautical miles should be recorded in the logbook in accordance with SOLAS regulation V/28.1;⁶
- .2 the distance travelled while the ship is under way under its own propulsion should be included in the aggregated data of distance travelled for the calendar year; and
- .3 other methods to measure distance travelled accepted by the Administration may be applied. In any case, the method applied should be described in detail in the Data Collection Plan.

Hours under way

7.5 Appendix IX of MARPOL Annex VI specifies that hours under way should be submitted to the Administration. Hours under way should be an aggregated duration while the ship is under way under its own propulsion.

Data quality

7.6 The Data Collection Plan should include data quality control measures which should be incorporated into the existing safety management system. Additional measures to be considered could include:

- .1 the procedure for identification of data gaps and correction thereof; and
- .2 the procedure to address data gaps if monitoring data is missing, for example, flow meter malfunctions.

A standardized data reporting format

7.7 Regulation 27.3 of MARPOL Annex VI states that the data specified in appendix IX of the Annex are to be communicated electronically using a standardized form developed by the

⁵ For example, ISO 8217 provides a method for liquid fuel.

⁶ Distance travelled measured using satellite data is distance travelled over the ground.

Organization. The collected data should be reported to the Administration in the standardized format shown in appendix 3.

8 DIRECT CO₂ EMISSIONS MEASUREMENT

8.1 Direct CO₂ emission measurement is not required by regulation 27 of MARPOL Annex VI.

8.2 Direct CO₂ emissions measurement, if used, should be carried out as follows:

- .1 this method is based on the determination of CO₂ emission flows in exhaust gas stacks by multiplying the CO₂ concentration of the exhaust gas with the exhaust gas flow. In case of the absence or/and breakdown of direct CO₂ emissions measurement equipment, manual tank readings will be conducted instead;
- .2 the direct CO₂ emissions measurement equipment applied to monitoring is located so as to measure all CO₂ emissions from the ship. The locations of all equipment applied are described in the monitoring plan; and
- .3 calibration of the CO₂ emissions measurement equipment should be specified. Calibration and maintenance records should be available on board.

PART III OF THE SEEMP: SHIP OPERATIONAL CARBON INTENSITY PLAN

9 GENERAL

9.1 Regulation 26.3.1 of MARPOL Annex VI specifies that, for certain categories of ships of 5,000 GT and above, on or before 1 January 2023, the SEEMP shall include:

- .1 a description of the methodology that will be used to calculate the ship's attained annual operational CII required by regulation 28 of MARPOL Annex VI and the processes that will be used to report this value to the ship's Administration;
- .2 the required annual operational CIIs, as specified in regulation 28 of MARPOL Annex VI, for the next three years;
- .3 an implementation plan documenting how the required annual operational CIIs will be achieved during the next three years; and
- .4 a procedure for self-evaluation and improvement.

9.2 Sections 9 to 15 of these Guidelines provide guidance for ships to which regulation 26.3 of MARPOL Annex VI applies for the following purposes:

- .1 to assist them in developing part III of the ship's SEEMP, including guidance on developing a ship-specific method to collect necessary data;
- .2 to describe the methodology that will be used to calculate the ship's attained annual operational CII value and report this to the ship's Administration;

- .3 to determine the ship's required annual operational CII for the next three years;
- .4 to develop and apply an implementation plan documenting how the required annual operational CIIs will be achieved during the next three years;
- .5 to define a procedure for self-evaluation and improvement; and
- .6 to develop corrective actions, as applicable.

9.3 The required annual operational CII is to be calculated in accordance with regulation 28 and taking into account the guidelines developed by the Organization.⁷

9.4 In addition, pursuant to regulation 28 of MARPOL Annex VI, part III of the SEEMP is further to include calculation methodologies and a plan of corrective actions for ships that are rated D for three consecutive years or rated as E.

9.5 The ship's attained annual operational carbon intensity is to be calculated taking into account the guidelines developed by the Organization.⁸

9.6 Ships of 5,000 gross tonnage and above that are subject to regulations 26.3 and 28 of MARPOL Annex VI are strongly encouraged to review part I of their SEEMP to revise it as needed to reflect the actions taken to achieve the ship's CII requirements.

9.7 The goal setting, as referred to in paragraph 4.1.7 in part I, should be consistent with the requirements of regulation 28 of MARPOL Annex VI and should include the ship's required annual operational CII for the next three years following the updating of the SEEMP.

9.8 In addition, while ships subject to regulation 28 of MARPOL Annex VI may rely on the CII requirements when defining goals under part I of the SEEMP, they are encouraged to consider setting additional ship-specific goals that go beyond the applicable CII requirements and strive for energy efficiency improvements and carbon intensity reductions beyond such requirements.

9.9 Ships subject to regulation 28 of MARPOL Annex VI may consider voluntarily using one or more of the trial CIIs (EEPI, cbDIST, cDIST or EEOI), where applicable, for the purpose of providing supporting data for decision-making to support the review clause set out in regulation 28.11 of MARPOL Annex VI. A standardized data reporting format for the parameters to calculate the trial carbon intensity indicators on a voluntary basis is presented in appendix 4. A description of the methodology that should be used to calculate the trial CII should be included in the SEEMP.

9.10 Part III of the ship's SEEMP should be updated in case of voluntary modifications or necessary corrective actions are involved (every three years).

⁷ Refer to the *2022 Guidelines on the reference lines for use with operational carbon intensity indicators (CII reference lines guidelines, G2)* (Resolution MEPC.353(78)) and the *2021 Guidelines on the operational carbon intensity reduction factors relative to reference lines (CII reduction factors guidelines, G3)* (Resolution MEPC.338(76)).

⁸ Refer to the *2022 Guidelines on operational carbon intensity indicators and calculation methods (CII Guidelines, G1)* (Resolution MEPC.352(78)) and the *2022 Interim guidelines on correction factors and voyage adjustments for CII calculations (G5)* (Resolution MEPC.355(78)).

10 ATTAINED ANNUAL OPERATIONAL CII CALCULATION METHODOLOGY; DATA COLLECTION PLAN AND DATA QUALITY

10.1 Taking into account the guidelines developed by the Organization,⁹ part III of the SEEMP provides detailed information on how the ship's attained annual operational CII should be calculated. Regulation 28 of MARPOL Annex VI states that the attained annual operational CII shall be calculated, using the data collected in accordance with regulation 27 (Fuel Oil Data Collection System).

10.2 In describing the calculation methodology, part III of the SEEMP should include a detailed description of the data required for the calculation of the attained annual operational CII. The data collection should follow the relevant methodology and requirements on the Fuel Oil Data Collection System pursuant to regulation 27 of MARPOL Annex VI (see part II of these Guidelines).

10.3 In case of transfer of the ship from one company to another according to regulation 27.5 or 27.6 of MARPOL Annex VI, all relevant data necessary for the calculation of the attained annual operational CII should be submitted by the former company to the receiving company within one month after the date of transfer. The data should have been verified by the Administration or any organization duly authorized by it according to regulation 6.7 of MARPOL Annex VI before they are transferred to the receiving company. The format of the transfer should be consistent with appendix 3 and such that the receiving company can use it in the calculations of the attained annual operational CII for the whole year in which the transfer takes place.

10.4 In case the former company does not transfer the required data, the Administration may make relevant data submitted to the IMO Fuel Oil Consumption Database available to the receiving company. In case of a transfer of both company and Administration concurrently, the incoming Administration may make a request to the Organization for access to the data according to regulation 27.11. If no such data is available, the attained annual operational CII can be calculated and verified using the available data covering a period of the preceding calendar year as long as practically possible.

10.5 In case of transfer of a ship from one Administration to another according to regulation 27.4 of MARPOL Annex VI the data needed for calculating the annual attained CII is already in the possession of the relevant company and no further exchange of data is needed.

11 REQUIRED ANNUAL OPERATIONAL CII FOR NEXT THREE YEARS

11.1 Part III of the SEEMP describes the required annual operational CII values for the ship for each of the next three years, calculated in accordance with regulation 28 of MARPOL Annex VI and taking into account the guidelines developed by the Organization,¹⁰ as the basis for those calculations.

⁹ Refer to the *2022 Guidelines on operational carbon intensity indicators and calculation methods (CII Guidelines, G1)* (Resolution MEPC.352(78)) and the *2022 Interim guidelines on correction factors and voyage adjustments for CII calculations (G5)* (Resolution MEPC.355(78)).

¹⁰ Refer to the *2022 Guidelines on the reference lines for use with operational carbon intensity indicators (CII reference lines guidelines, G2)* (Resolution MEPC.353(78)) and the *2021 Guidelines on the operational carbon intensity reduction factors relative to reference lines (CII reduction factors guidelines, G3)* (Resolution MEPC.338(76)).

12 THREE-YEAR IMPLEMENTATION PLAN

12.1 The three-year implementation plan describes the measures the ship plans to take to continue to achieve the required annual operational CII over the next three-year period. These may include, but are not limited to, measures as outlined in section 5 of these Guidelines.

12.2 The three-year implementation plan is ship-specific.

12.3 The three-year implementation plan should be SMART (Specific, Measurable, Achievable, Realistic, and Time-bound) to the extent envisaged and feasible. It should include:

- .1 a list of measures that improve the energy efficiency and reduce the carbon intensity of the ship, with time and method of implementation necessary for achieving the required operational CII;
- .2 a description of how, when the listed measures are implemented, the required operational CII will be achieved, taking into consideration the combined effect of the measures on operational carbon intensity;
- .3 the company personnel responsible for the three-year implementation plan, and for monitoring and recording performance throughout the year for the reviewing of the effectiveness of the three-year implementation plan; and
- .4 identification of possible impediments to the effectiveness of the measures for improving the energy efficiency and reducing the carbon intensity of the ship, including possible contingency measures put in place to overcome these impediments.

12.4 The three-year implementation plan should be monitored and adjusted when necessary, and the data to be monitored, identified.

13 PROCESS FOR SELF-EVALUATION AND IMPROVEMENT (IN ADDITION TO SECTION 4.4. OF THESE GUIDELINES)

13.1 The purpose of self-evaluation is to evaluate the effectiveness of the planned measures and their implementation, to deepen the understanding of the overall characteristics of the ship's operation, such as what types of measures can function effectively, and how or why, to comprehend the trend of the efficiency improvement of that ship, to understand trends in the ship's utilization in terms of cargo carried and areas of operation, and to develop an improved action plan for the next cycle. This evaluation should produce meaningful feedback based on experience in the previous period, to enhance performance in the next period.

13.2 Procedures for self-evaluation of the ship's energy usage and carbon intensity should be developed and included in this section of the SEEMP. Self-evaluation should be carried out periodically based on data collected through monitoring. It is recommended that the cause and effect of the ship's performance in the evaluated period be identified in order to identify measures for improving performance during the next period.

13.3 The process of self-evaluation and improvement could consist of the following elements:

- .1 regular internal shipboard and company audits to verify implementation and the effectiveness of the system;

- .2 improvement, i.e. implementing preventive or modifying measures (responsible personnel within the company should evaluate such audit reports and implement corrective actions including preventive or modifying measures); and
- .3 periodical review of the SEEMP and associated documents, to update the SEEMP in a manner which minimizes any administrative and unnecessary burdens on company's personnel and ship's staff.

13.4 The content of the self-evaluation and improvement could include the following elements:

- .1 criteria for evaluation, including elements to evaluate, such as quality of monitoring, record-keeping, effectiveness of implemented measures (including cause and effect) and achievement of the goal;
- .2 the evaluation of the effectiveness of the different measures taken, in terms of energy efficiency and carbon intensity;
- .3 which measures contribute the most and how much, which measures do not contribute and are therefore not efficient, which ship and/or company-specific elements adversely affect the CII and how these could be improved;
- .4 timeline for starting the review process ahead of the end of the compliance period and for implementation of new measures in the subsequent year;
- .5 measures identified to address deficiencies and discrepancies including correction of data gaps and system weaknesses, new measures to improve implementation (e.g. training) as well as new carbon intensity improvement measures as needed;
- .6 where relevant, actions that will be taken to bring the ship into better CII ratings including estimated quantification of the additional expected reduction in carbon intensity;
- .7 where applicable, if a plan of corrective actions is required, the plan should include items listed under 15.4.5 to bring the ship out of inferior performance; and
- .8 where relevant, identification of critical factors that contributed to missing the CII target.

14 REVIEW AND UPDATE OF PART III OF THE SEEMP

14.1 Regulation 26.1 of MARPOL Annex VI provides: "Each ship shall keep on board a ship-specific Ship Energy Efficiency Management Plan (SEEMP). This may form part of the ship's safety management system. The SEEMP shall be developed and reviewed, taking into account guidelines adopted by the Organization". Regulation 26.3.2 of MARPOL Annex VI provides: "For ships rated as D for three consecutive years or rated as E, in accordance with regulation 28 of this Annex, the SEEMP shall be reviewed in accordance with regulation 28.8 of this Annex to include a plan of corrective actions to achieve the required annual operational CII".

14.2 The company should ensure that the SEEMP is reviewed and updated when necessary, as per paragraph 9.10.

14.3 The SEEMP should include a log for when it has been reviewed and updated and identify which parts have been changed.

15 PLAN OF CORRECTIVE ACTIONS

15.1 A plan of corrective actions is not required to be included in the SEEMP unless a ship has been rated D for three consecutive years or E for one year.

15.2 For a ship that is required to develop a plan of corrective actions in accordance with regulation 28.7 of MARPOL Annex VI, a revised SEEMP including the corrective actions for CII reduction shall be submitted to the Administration or any organization duly authorized by it for verification in accordance regulation 28.8 of MARPOL Annex VI. The revised SEEMP should be submitted together with, but in no case later than one month after reporting the attained annual operational CII in accordance with regulation 28.2.

15.3 Regulation 28.9 of MARPOL Annex VI further provides that "A ship rated as D for three consecutive years or rated as E shall duly undertake the planned corrective actions in accordance with the revised SEEMP."

15.4 Developing the plan of corrective actions

15.4.1 The purpose of the plan of corrective actions is to set out what actions a ship that was rated D for three consecutive years or E for one year should take to achieve at least a C rating for the calendar year following the adoption of the plan of corrective actions and ultimately the required annual operational CII.

15.4.2 The plan of corrective actions is ship-specific.

15.4.3 Many of the approaches described in section 5 of these guidelines or any other suitable measure may be applied to a ship to improve its fuel efficiency and thus its CII rating.

15.4.4 The plan for corrective action should describe the actions that the ship plans to take, the timeline in which those actions will be applied, and the expected impact their application will have on the ship's CII rating. It should be demonstrated how the corrective actions will contribute to achieving the required annual operational CII, so as to ascertain the effectiveness of the corrective actions. Experience gained from previously taken corrective actions and their degree of effectiveness should be taken into account when selecting the proper corrective actions.

15.4.5 The plan of corrective actions should be SMART (Specific, Measurable, Achievable, Realistic, and Time-bound). It should include:

- .1 an analysis of the cause of the inferior CII rating;
- .2 an analysis of the performance of implemented measures;
- .3 a list of additional measures and revised measures to be added to the implementation plan with time and method of implementation necessary for achieving the required operational CII;

- .4 designation of a company person to be responsible for the added and revised measures in the implementation plan, monitoring and recording performance throughout and reviewing of the effectiveness of the corrective actions; and
- .5 identification of possible impediments to the effectiveness of the measures for improving the energy efficiency and reducing the carbon intensity of the ship, including possible additional contingency measures put in place to overcome and how these impediments will be overcome.

15.4.6 The implementation of the plan of corrective actions should be monitored and adjusted when necessary. Additional measures should be taken to strengthen corrective actions in case of insufficient intermediate results.

15.4.7 The company should ensure that it is in a position to perform the actions set out in the plan of corrective actions and confirm that it is able to do so when submitting its updated SEEMP.

APPENDIX 1

**SAMPLE FORM OF SHIP MANAGEMENT PLAN TO
IMPROVE ENERGY EFFICIENCY
(PART I OF THE SEEMP)**

Name of ship:		Gross tonnage:	
Ship type:		Capacity:	
IMO number:			

Date of development:		Developed by:	
Implementation period:	From: Until:	Implemented by:	
Planned date of next evaluation:			

Review and update log

Date/timeline	Updated parts	Developed by	Implemented by

1 MEASURES

Energy efficiency measures	Implementation (including the starting date)	Responsible personnel

2 MONITORING

Description of monitoring tools

3 GOAL

Measurable goals

4 EVALUATION

Procedures of evaluation

APPENDIX 2

**SAMPLE FORM OF SHIP FUEL OIL CONSUMPTION DATA COLLECTION PLAN
(PART II OF THE SEEMP)**

1 Review and update log

Date/timeline	Updated parts	Developed by	Implemented by

2 Ship particulars

Name of ship	
IMO number	
Company	
Flag	
Year of delivery	
Ship type	
Gross tonnage	
NT	
DWT	
Attained EEDI (if applicable)	
Attained EEXI (if applicable)	
Ice class	

3 Record of revision of Fuel Oil Consumption Data Collection Plan

Date of revision	Revised provision

4 Ship engines and other fuel oil consumers and fuel oil types used

	Engines or other fuel oil consumers	Power	Fuel oil types
1	Type/model of main engine	(kW)	
2	Type/model of auxiliary engine	(kW)	
3	Boiler	(...)	
4	Inert gas generator	(...)	

5 Emission factor

C_F is a non-dimensional conversion factor between fuel oil consumption and CO₂ emission in the 2018 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships (resolution MEPC.308(73)), as amended. The annual total amount of CO₂ is calculated by multiplying annual fuel oil consumption and C_F for the type of fuel.

Fuel oil type	C_F (t-CO ₂ / t-Fuel)
Diesel/Gas oil (e.g. ISO 8217 grades DMX through DMB)	3.206
Light fuel oil (LFO) (e.g. ISO 8217 grades RMA through RMD)	3.151
Heavy fuel oil (HFO) (e.g. ISO 8217 grades RME through RMK)	3.114
Liquefied petroleum gas (LPG) (Propane)	3.000
Liquefied petroleum gas (LPG) (Butane)	3.030
Liquefied natural gas (LNG)	2.750
Methanol	1.375
Ethanol	1.913
Other (.....)	

6 Method to measure fuel oil consumption

The applied method for measurement for this ship is given below. The description explains the procedure for measuring data and calculating annual values, measurement equipment involved, etc.

Method	Description

7 Method to measure distance travelled

Description

8 Method to measure hours under way

Description

9 Processes that will be used to report the data to the Administration

Description

10 Data quality

Description

APPENDIX 2bis

**SAMPLE FORM OF SHIP OPERATIONAL CARBON INTENSITY PLAN
(PART III OF THE SEEMP)**

1 Review and update log

Date/timeline	Updated parts	Developed by	Implemented by
<1 st time>			
<2 nd time>			
Etc.			

2 Required CII over the next three years, attained CII and rating over three consecutive years

Name of the ship		IMO number		
Company		Year of delivery		
Flag		Ship type		
Gross tonnage		DWT		
Applicable CII		<input type="checkbox"/> AER ; <input type="checkbox"/> cgDIST		
Year	Required annual operational CII	Attained annual operational CII (before any correction)	Attained annual operational CII	Operational carbon intensity rating (A, B, C, D or E):
<year -1>				
<year -2>				
<year -3>				
	Required annual operational CII			
<year>:				
<year + 1>				
<year + 2>				

3 Calculation methodology of the ship's attained annual CII, including required data and how to obtain these data as far as not addressed in part II

Description

4 Three-year implementation plan

Description

Company personnel to be responsible for the three-year implementation plan, monitoring and recording performance

List of measures to be considered and implemented

Measure	Impact on CII	Time and method of implementation and responsible personnel			Impediments and contingency measures	
		Milestone	Due	Responsible	Impediment	Contingencies

Calculation showing the combined effect of the measures and that the required operational CII will be achieved

Year	Required annual operational CII	Targeted operational annual CII	Targeted rating
<year>:			
<year + 1>			
<year + 2>			

5 Self-evaluation and improvement

Description

6 Plan of corrective actions (if applicable)

Analysis of causes for inferior CII rating

Cause	Analysis of effect	Actions

Analysis of measures in the implementation plan

Measure	Analysis of effect	Actions

List of additional measures and revised measures to be added to the implementation plan

Measure	Impact on CII	Time and method of implementation and responsible personnel			Impediments and contingency measures	
		Milestone	Due	Responsible	Impediments	Contingencies

APPENDIX 3

STANDARDIZED DATA REPORTING FORMAT FOR THE DATA COLLECTION SYSTEM
AND OPERATIONAL CARBON INTENSITY TO THE ADMINISTRATION

Name of the ship		IMO number	
Company		Year of delivery	
Flag		Ship type	
Gross tonnage		DWT	
Applicable CII		<input type="checkbox"/> AER ; <input type="checkbox"/> cgDIST	
Operational carbon intensity rating		<input type="checkbox"/> A ; <input type="checkbox"/> B ; <input type="checkbox"/> C ; <input type="checkbox"/> D ; <input type="checkbox"/> E	
CII for trial purpose (none, one or more on voluntary basis)		<input type="checkbox"/> EEPI ; <input type="checkbox"/> cbDIST ; <input type="checkbox"/> clDIST ; <input type="checkbox"/> EEOI	
Attained annual operational CII before any correction (AER in g CO ₂ /dwt.nm or cgDIST in g CO ₂ /gt.nm)			
Attained annual operational CII (AER in g CO ₂ /dwt.nm or cgDIST in g CO ₂ /gt.nm)			
End date for annual CII (dd/mm/yy)*			
Start date for annual CII (dd/mm/yy)*			
Attained EEDI (if applicable)			
Attained EEXI (if applicable)			
EEPI (gCO ₂ /dwt.nm)			
cbDIST (gCO ₂ /berth.nm)			
clDIST (gCO ₂ /m.nm)			
EEOI (gCO ₂ /t.nm or others)			
.....			
.....			
IMO number			
End date for DCS (dd/mm/yy)			
Start date for DCS (dd/mm/yy)			

APPENDIX 4

STANDARDIZED DATA REPORTING FORMAT FOR THE PARAMETERS TO CALCULATE
THE TRIAL CARBON INTENSITY INDICATORS ON VOLUNTARY BASIS*

Attained annual EEOI	
Metric of Cargo Mass Carried or Work Done in EEOI calculation (gCO ₂ /t.nm or others)*****	
Transport work*****	
Attained annual EEPI (gCO ₂ /dwt.nm)	
Laden distance travelled (n.m)	
Attained annual cIDIST (gCO ₂ /m.nm) ****	
Length of lanes (metre) ****	
Attained annual cbDIST(gCO ₂ /berth.nm) ***	
Available lower berths***	
End date for trial CII (dd/mm/yy)**	
Start date for trial CII (dd/mm/yy)**	
IMO number**	
End date for DCS (dd/mm/yy)**	
Start date for DCS (dd/mm/yy)**	

- * For reporting a trial CII, the data should be reported as applicable taking into account the information already provided in appendix 3.
- ** Consistent with appendix 3.
- *** Only applicable to cruise passenger ships.
- **** Only applicable to ro-ro ships.
- ***** As defined in section 3 of *Guidelines for voluntary use of the ship energy efficiency operational indicator (EEOI)* circulated by MEPC.1/Circ.684. The distance travelled shall be determined from berth of the port of departure to berth of the port of arrival and shall be expressed in nautical miles.

ANNEX 9

RESOLUTION MEPC.347(78) (adopted on 10 June 2022)

GUIDELINES FOR THE VERIFICATION AND COMPANY AUDITS BY THE ADMINISTRATION OF PART III OF THE SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP)

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee (the Committee) conferred upon it by international conventions for the prevention and control of marine pollution from ships,

NOTING that the Committee adopted, at its seventy-sixth session, by resolution MEPC.328(76), the *2021 Revised MARPOL Annex VI* which will enter into force on 1 November 2022,

NOTING IN PARTICULAR that the *2021 Revised MARPOL Annex VI* (MARPOL Annex VI) contains amendments concerning mandatory goal-based technical and operational measures to reduce carbon intensity of international shipping,

NOTING FURTHER that regulation 26 of MARPOL Annex VI requires each ship to keep on board a Ship Energy Efficiency Management Plan (SEEMP), to be developed and reviewed, taking into account the guidelines adopted by the Organization,

RECOGNIZING that the aforementioned amendments to MARPOL Annex VI require relevant guidelines for uniform and effective implementation of the regulations and to provide sufficient lead time for industry to prepare,

HAVING CONSIDERED, at its seventy-eighth session, draft *Guidelines for the verification and company audits by the Administration of part III of the Ship Energy Efficiency Management Plan (SEEMP)*,

1 ADOPTS the *Guidelines for the verification and company audits by the Administration of part III of the Ship Energy Efficiency Management Plan (SEEMP)*, as set out in the annex to the present resolution;

2 INVITES Administrations to take the annexed Guidelines into account when developing and enacting national laws which give force to and implement requirements set forth in regulation 26 of MARPOL Annex VI;

3 REQUESTS the Parties to MARPOL Annex VI and other Member Governments to bring the annexed Guidelines to the attention of masters, seafarers, shipowners, ship operators and any other interested parties;

4 AGREES to keep the Guidelines under review in light of experience gained with their implementation, also taking into consideration that, in accordance with regulations 25.3 and 28.11 of MARPOL Annex VI, a review of the technical and operational measures to reduce carbon intensity of international shipping shall be completed by 1 January 2026.

ANNEX

**GUIDELINES FOR THE VERIFICATION AND COMPANY AUDITS BY THE
ADMINISTRATION OF PART III OF THE SHIP ENERGY EFFICIENCY MANAGEMENT
PLAN (SEEMP)**

CONTENTS

- 1 INTRODUCTION
- 2 DEFINITIONS
- 3 RESPONSIBILITIES
- 4 VERIFICATION OF THE SEEMP AND DOCUMENTATION
- 5 INITIAL, PERIODICAL, ADDITIONAL VERIFICATIONS AND COMPANY AUDITS
- 6 ELEMENTS OF VERIFICATION
- 7 COMBINATION WITH ISM

ANNEX – SAMPLE FORMAT FOR CONFIRMATION OF COMPLIANCE

1 INTRODUCTION

1.1 The *Guidelines for the verification and company audits by the Administration of part III of the Ship Energy Efficiency Management Plan (SEEMP)* have been developed to assist Administrations with carrying out the verifications and company audits required by regulation 26.3.3 of MARPOL Annex VI.

1.2 The aim of these Guidelines is to:

- .1 provide guidance to Administrations to effectively and efficiently carry out verifications of, and company audits related to, the Ship Energy Efficiency Management Plan (SEEMP) to ensure compliance with regulation 26.3 and with regulation 28 of MARPOL Annex VI; and
- .2 ensure that the SEEMP includes the relevant elements in accordance with regulation 26.3 of MARPOL Annex VI, as applicable, and that the SEEMP is reliable, while minimizing the costs and associated burdens to the ship and the Administration.

1.3 The verification of and the company audits related to the SEEMP may be carried out by the Administration or an organization recognized by it.¹

1.4 It should be noted that the Organization has adopted separate *2022 Guidelines for Administration verification of ship fuel oil consumption data and operational carbon intensity* (resolution MEPC.348(78), adopted 10 June 2022).

2 DEFINITIONS

For the purpose of these Guidelines, the definitions in MARPOL Annex VI apply.

3 RESPONSIBILITIES

3.1 The responsibilities of Administrations and ships are set out in MARPOL Annex VI. These Guidelines do not change those responsibilities or create any new obligations.

3.2 An Administration may authorize an organization to carry out verifications of, and company audits related to, the SEEMP, and issue the Confirmation of Compliance, submit the data to the Organization and perform other actions authorized by the Administration. In every case, the Administration assumes full responsibility for all tasks conducted by the Administration, or any organization duly authorized by it (hereinafter referred to as "the Administration").

3.3 Verification of, and company audits related to, the SEEMP do not relieve the company, management, those undertaking delegated SEEMP tasks, officers or seafarers of their obligations as to compliance with those requirements in regulation 28 of MARPOL Annex VI.

3.4 The company is responsible for:

- .1 informing relevant personnel and those undertaking the delegated SEEMP tasks about the content of the SEEMP;

¹ Refer to the *Code for Recognized Organizations (RO Code)*, as adopted by the Organization by resolution MEPC.237(65), as may be amended by the Organization.

- .2 appointing responsible members of staff to accompany the verifier; and
- .3 providing access and evidential materials as requested by the verifier.

4 VERIFICATION OF THE SEEMP AND DOCUMENTATION

4.1 To facilitate the verification, the Administration should indicate what documentation, if any, the company should submit along with its SEEMP.

5 INITIAL, PERIODICAL, ADDITIONAL VERIFICATIONS AND COMPANY AUDITS

5.1 The verification and audit process for the SEEMP according to regulation 26.3.3 of MARPOL Annex VI should normally involve the following:

- .1 initial verification;
- .2 periodical verifications;
- .3 additional verifications; and
- .4 company audits.

5.2 The initial, periodical, additional verifications and company audits should be based on documentary evidence.

Initial verification (regulation 5.4.6 of MARPOL Annex VI)

5.3 The Administration should perform an initial verification to ensure that for each ship to which regulation 26.3 of MARPOL Annex VI applies, the SEEMP complies with regulation 26.3.1 of MARPOL Annex VI. In accordance with regulation 5.4.6 of MARPOL Annex VI, this process must be done prior to 1 January 2023 for existing ships or before a new ship is put in service.

5.4 On satisfactory assessment of the SEEMP part III, the Administration can issue the Confirmation of Compliance (sample format in the annex to this document).

Periodical verification (regulation 5.4.6 of MARPOL Annex VI)

5.5 If any of the elements in regulation 26.3.1 is updated, and in any case every three years, the Administration should perform a periodical verification to ensure the SEEMP complies with regulation 26.3.1 of MARPOL Annex VI in accordance with regulation 5.4.6 of MARPOL Annex VI.

5.6 On satisfactory assessment of SEEMP part III, the Administration should issue the Confirmation of Compliance (sample format in the annex to this document).

Additional verifications (regulation 6.8 of MARPOL Annex VI)

5.7 The Administration should, in the case of a ship rated as D for three consecutive years or a ship rated as E, perform an additional verification to ensure that a plan of corrective actions has been established in accordance with regulations 28.7 and 28.8.

5.8 On satisfactory verification of the plan of corrective actions, the Administration can issue the Statement of Compliance according to regulation 6.8.

Company audits

5.9 The Administration should, in accordance with regulation 26.3.3, perform periodical company audits to:

- .1 verify that the SEEMP for which the Confirmation of Compliance has previously been issued complies with regulation 26.3.1 and, in the case of non-compliance, require remedial action;
- .2 confirm that the ship is being operated in accordance with SEEMP part III, regardless of its rating;
- .3 verify the progress made in the (corrective) actions to be taken in the execution of the three-year implementation plan and the plan of corrective actions;
- .4 verify self-assessment and improvement of actions taken; and
- .5 verify the assignment of responsibilities related to the implementation and monitoring of measures.

5.10 The periodical company audits may include annual audits of the company (company audits) and verifications on board the ship (shipboard audits).

5.11 These additional shipboard verifications and company audits, if undertaken, should be six months after the issuance of the Statement of Compliance at the latest.

6 ELEMENTS OF VERIFICATION

6.1 Verification could consist of, but not be limited to, the following elements:

- .1 verification of the method of calculations of the CII and that there is a proper description of the method to report ship data to the Administration;
- .2 assessment of the effectiveness (of the combination) of measures, so that when implemented the ship will with reasonable assurance achieve the required annual operational CII, including the goal as set in accordance with paragraph 4.1.7 and 9.7 of the SEEMP Guidelines; and
- .3 robustness of the three-year implementation plan and, where applicable, the plan of corrective actions, including whether realistic timelines for implementation of actions have been included.

7 COMBINATION WITH ISM AUDITS

7.1 Verification of implementation aspects of the SEEMP on board (monitoring, self-evaluation and improvements, etc.) could be combined with the ISM audits.

7.2 The verifications may be carried out in accordance with guidelines on implementation of the ISM Code referred to in Chapter 15 of the ISM Code.

ANNEX

SAMPLE FORMAT FOR CONFIRMATION OF COMPLIANCE

CONFIRMATION OF COMPLIANCE – SEEMP PART III

Issued under the provisions of the Protocol of 1997, as amended, to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 related thereto (hereinafter referred to as "the Convention") under the authority of the Government of:

.....

(full designation of the Country)

by

(full designation of the competent person or organization authorized under the provisions of the Convention)

Particulars of ship*

Name of ship

Distinctive number or letters.

IMO number†.

Port of registry

Gross tonnage.

SEEMP part III date of revision, as applicable

THIS IS TO CONFIRM:

Taking into account the *2022 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP)* adopted by resolution MEPC.346(78), the ship's SEEMP has been developed and complies with regulation 26.3.1 of Annex VI of the Convention.

Issued at:

(place of issue of the Confirmation)

Date (dd/mm/yyyy)

(date of issue)

.....
(signature of duly authorized official
issuing the Confirmation)

(seal or stamp of the authority, as appropriate)

* Alternatively, the particulars of the ship may be placed horizontally in boxes.

† In accordance with the IMO Ship Identification Number Scheme, adopted by the Organization by resolution A.1117(30).

ANNEX 10

RESOLUTION MEPC.348(78)
(adopted on 10 June 2022)

**2022 GUIDELINES FOR ADMINISTRATION VERIFICATION OF SHIP FUEL OIL
CONSUMPTION DATA AND OPERATIONAL CARBON INTENSITY**

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee (the Committee) conferred upon it by international conventions for the prevention and control of marine pollution from ships,

NOTING that the Committee adopted, by resolution MEPC.328(76), the *2021 Revised MARPOL Annex VI*, which will enter into force on 1 November 2022,

NOTING IN PARTICULAR that the *2021 Revised MARPOL Annex VI* (MARPOL Annex VI) contains amendments concerning mandatory goal-based technical and operational measures to reduce carbon intensity of international shipping,

NOTING ALSO that regulation 27.7 of MARPOL Annex VI requires that ship fuel oil consumption data be verified according to procedures established by the Administration, taking into account guidelines developed by the Organization,

NOTING FURTHER that regulation 28.6 of MARPOL Annex VI specifies that the attained annual operational CII shall be documented and verified against the required annual operational CII to determine operational carbon intensity rating, taking into account the guidelines developed by the Organization,

RECOGNIZING that the aforementioned amendments to MARPOL Annex VI require relevant guidelines for uniform and effective implementation of the regulations and to provide sufficient lead time for industry to prepare,

NOTING that the Committee, at its seventy-first session, adopted, by resolution MEPC.292(71), the *2017 Guidelines for Administration verification of ship fuel oil consumption data*,

HAVING CONSIDERED, at its seventy-eighth session, draft *2022 Guidelines for Administration verification of ship fuel oil consumption data and operational carbon intensity*,

1 ADOPTS the *2022 Guidelines for Administration verification of ship fuel oil consumption data and operational carbon intensity*, as set out in the annex to the present resolution;

2 INVITES Administrations to take the annexed Guidelines into account when developing and enacting national laws which give force to and implement requirements set forth in regulation 27 of MARPOL Annex VI;

3 REQUESTS the Parties to MARPOL Annex VI and other Member Governments to bring the annexed Guidelines to the attention of masters, seafarers, shipowners, ship operators and any other interested parties;

4 AGREES to keep the Guidelines under review in light of experience gained with their implementation, also taking into consideration that in accordance with regulations 25.3 and 28.11 of MARPOL Annex VI a review of the technical and operational measures to reduce carbon intensity of international shipping shall be completed by 1 January 2026;

5 REVOKES the *2017 Guidelines for Administration verification of ship fuel oil consumption data* adopted by resolution MEPC.292(71).

ANNEX

2022 GUIDELINES FOR ADMINISTRATION VERIFICATION OF SHIP FUEL OIL CONSUMPTION DATA AND OPERATIONAL CARBON INTENSITY

1 INTRODUCTION

1.1 Regulation 27 of MARPOL Annex VI establishes the IMO Ship Fuel Oil Consumption Database, to be administered by the Organization, to which each Administrations will submit relevant data for their registered ships of 5,000 gross tonnage (GT) and above. Regulation 27.7 specifies that "the data shall be verified according to procedures established by the Administration, taking into account guidelines developed by the Organization".

1.2 Regulation 28 of MARPOL Annex VI establishes the operational carbon intensity rating mechanism. Regulation 28.6 specifies that the attained annual operational CII shall be documented and verified against the required annual operational CII to determine operational carbon intensity rating A, B, C, D or E, either by the Administration or by any organization duly authorized by it, taking into account the guidelines developed by the Organization.

1.3 This document contains the Guidelines referred to in regulations 27.7 and 28.6 and is intended to assist Administrations in developing their own verification programme.

1.4 A verification procedure should ensure the reliability of the collected data and the correctness of the attained annual operational CII, while minimizing the costs and associated burdens to the ship and the Administration.

2 DEFINITIONS

For the purpose of these Guidelines, the definitions in MARPOL Annex VI apply.

3 RESPONSIBILITIES

3.1 The responsibilities of Administrations and ships are set out in MARPOL Annex VI. These Guidelines do not change those or create any new obligations.

3.2 Under the data collection system for fuel oil consumption and the operational carbon intensity rating of ships, as specified in MARPOL Annex VI, an Administration may authorize an organization¹ to receive the data from a ship, verify the data for compliance with the requirements, verify the attained annual operational CII against the required annual operational CII, determine the operational carbon intensity rating, issue the Statement of Compliance, and submit the data to the Organization. In every case, the Administration assumes full responsibility for all tasks conducted by the Administration or any organization duly authorized by it (hereinafter referred to as "the Administration").

4 VERIFICATION OF THE REPORTED DATA

4.1 To facilitate data verification, the Administration should indicate what additional documentation a ship should submit along with its annual data report. Specification of this

¹ Refer to the *Guidelines for the authorization of organizations acting on behalf of the Administration*, adopted by the Organization by resolution A.739(18), as amended by resolution MSC.208(81), and the *Specifications on the survey and certification functions of recognized organizations acting on behalf of the Administration*, adopted by the Organization by resolution A.789(19), as may be amended by the Organization.

documentation can be done on a ship basis, as part of the assessment of the Data Collection Plan,² or it may be done as a general policy statement or through such other policy instruments as the Administration deems appropriate. Additional documentation to facilitate data verification may include the following, as well as other documentation that the Administration deems relevant:

- .1 a copy of the verified ship's Data Collection Plan (SEEMP Part II);
- .2 summaries of bunker delivery notes (BDNs), in sufficient detail to show that all fuel oil consumed by the ship is accounted for (see sample form of BDN summary set out in appendix 1);
- .3 summaries of disaggregated data of fuel oil consumption, distance travelled and hours under way, in a format specified by the Administration (see sample form of data summary set out in appendix 2);
- .4 information to demonstrate that the ship followed the Data Collection Plan set out in its SEEMP, including information on data gaps and how they were filled as well as how the event that caused the data gap was resolved;
- .5 copies of documents containing information on the amount of fuel oil consumption, distance travelled and hours under way for the ship's voyages during the reporting period (e.g. the ship's official logbook, oil record book, BDNs, arrival/noon/departure reports, and from auto-log data files); and
- .6 supported by documentary evidence, copies of the fuel oil mass to CO₂ mass conversion factor provided by fuel supplier in case the type of fuel is not covered by the guidelines developed by the Organization.³

4.2 In addition to the documentation described in paragraph 4.1, the Administration may request a ship to submit such documentation needed to perform a comprehensive review of a ship's annual fuel oil consumption, distance travelled, and hours under way. The Administration may request that this documentation be submitted by all ships or a subset of the ships under its jurisdiction. This documentation may be used by the Administration to verify whether the ship followed the methodology specified in its Data Collection Plan, with a view to confirming:

- .1 consistency of reported data and calculated values, including with previous reporting periods (if applicable), through recalculating the annual reported values using the underlying data, etc.;
- .2 completeness of data (e.g. perform substantive testing based on reconciliation, recalculations, and document cross-check, for example with official logbook and/or arrival/noon/departure reports, auto-log report files; recalculate total quantities of fuel oil used, distance travelled and hours under way); and
- .3 reliability and accuracy of the data (e.g. test that the data quality procedures as described in the Data Collection Plan have been properly implemented, carry out site visits (typically to the company's offices rather than to the ship) to test the systems, processes and the control activities) through

² Refer to the *2022 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP)*, adopted by resolution MEPC.346(78).

³ Refer to the *2018 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships* (resolution MEPC.308(73)), as may be amended.

corroborating fuel oil consumption data with distance travelled and hours under way, comparing reported fuel oil consumption with that which is expected for the ship size, operational profile, and technical characteristics, and/or comparing reported fuel oil consumption total fuel bunkered, etc.

4.3 For a ship which has undergone a transfer addressed in regulations 27.4, 27.5 or 27.6 of MARPOL Annex VI, the losing Administration needs to verify the data before the transfer.

5 VERIFICATION OF THE ATTAINED ANNUAL OPERATIONAL CII AND DETERMINATION OF THE CII RATING

5.1 To facilitate the verification of the attained annual operational CII, the Administration should indicate what additional documentation a ship should submit along with its annual data report. Additional documentation to facilitate the verification may include the following, as well as other documentation that the Administration deems relevant:

- .1 a copy of the verified ship's Operational Carbon Intensity Plan (SEEMP part III);
- .2 documents (IEE certificate, Stability Booklet or International Tonnage Certificate) evidencing the capacity parameter of the ship in the metric relevant for the calculation of its operational carbon intensity (deadweight or gross tonnage);
- .3 aggregated data of fuel oil consumption and distance travelled covering the entire calendar year to calculate the attained annual operational CII (AER or cgDIST) (see sample form of data summary set out in appendix 2);
- .4 the aggregated values of the parameters and associated calculation methods to determine the annual metric value of the trial CII on voluntary basis, if any (see sample form of data summary set out in appendix 2 – Add.1);
- .5 supported by documentary evidence, the correction factors and voyage adjustments⁴ applied in the attained annual operational CII calculation, if any, during the reporting period (see sample form of data summary set out in appendix 2); and
- .6 statements of compliance for previous two calendar years where applicable.

5.2 The attained annual operational CII should be verified using the data over a 12-month period from 1 January to 31 December for the preceding calendar year, by the Administration. In cases where the calculation of the attained annual operational CII is not possible due to the unavailability of some data, such as where a new ship is delivered after 1 January in the preceding year, the attained annual operational CII should be verified using the available data covering the corresponding period of the preceding calendar year.

5.3 In case of a ship with multiple load line certificates or with a load line certificate containing multiple load lines, the highest deadweight value should be used to calculate and verify the required and attained annual operational CII.

⁴ Refer to the *2022 Interim guidelines on correction factors and voyage adjustments for CII calculations* (G5), adopted by resolution MEPC.355(78).

5.4 For a ship which permanently changes its deadweight (DWT) and/or its gross tonnage (GT) during the year, which the SEEMP or a corrective action plan identifies as being undertaken to improve the ship's operational carbon intensity performance:

- .1 the required annual operational CII should always be calculated and verified using the original DWT or GT value before conversion; however, the attained CII which is used to assess compliance should be calculated and verified using the new DWT or GT value after conversion; and
- .2 for the year when the conversion is made, the attained annual operational CII should be calculated and verified for the entire calendar year on the average DWT or GT value weighted on distance travelled before and after conversion.

5.5 Except for those specified in 5.4, for a ship which is regarded by the Administration as a newly constructed ship as per regulation 5.4.3 of MARPOL Annex VI due to major conversion, including extensive changes of carrying capacity and/or ship type during the year, the required and attained annual operational CII should be calculated and verified as per a newly constructed ship for the period after conversion. For the year when the major conversion is made, the data for partial year before conversion should still be reported for verification but will not be included in the calculation and verification of the attained annual operational CII.

5.6 For a ship which has undergone a transfer addressed in regulations 27.4, 27.5 or 27.6 of MARPOL Annex VI, the losing Administration neither needs to verify the attained annual operational CII nor to determine the annual CII rating of the ship for partial year. The attained annual operational CII should be verified by the receiving Administration using the data over an entire calendar year. In such cases, the aggregated data necessary to calculate the attained annual operational CII before transfer, which should have already been verified by the losing Administration, can be directly used by the receiving Administration without further verification (see sample form set out in appendix 3 and appendix 3 – Add.1).

5.7 The administration should determine the operational carbon intensity rating for the ship, taking into account the guidelines developed by the Organization.⁵ The attained and required annual operational CII, as well as the rating boundaries, should be all given with three decimal places. If the attained annual operational CII happens to land on a rating boundary, the ship should be rated as the better of the two ratings.

5.8 The trial CIIs (e.g. EEPI, cbDIST, ciDIST or EEOI),⁶ if voluntarily calculated and reported, should be verified by the Administration following the same procedure as for the attained annual operational CII (AER or cgDIST). The Administration does not need to assign a rating to a ship based on trial CIIs.

6 ISSUE OF A STATEMENT OF COMPLIANCE

6.1 In accordance with regulation 6.6 of MARPOL Annex VI, upon receipt of reported data pursuant to regulation 27 of MARPOL Annex VI and attained annual operational CII pursuant to regulation 28 of MARPOL Annex VI and satisfactory completion of the verification, the Statement of Compliance should be issued by the Administration.

⁵ Refer to the *2022 Guidelines on the operational carbon intensity rating of ships (CII Rating Guidelines, G4)* adopted by resolution MEPC.354(78).

⁶ Refer to the *2022 Guidelines on operational carbon intensity indicators and the calculation methods (CII Guidelines, G1)* adopted by resolution MEPC.352(78).

6.2 Notwithstanding paragraph 6.1, the Administration should consider whether a corrective action plan is required according to regulation 6.8 of MARPOL Annex VI. In the case of a corrective actions plan being required but not submitted together with the attained annual operational CII, the administration should inform the company in a timely manner that a revised SEEMP including a plan of corrective actions, must be submitted for verification no later than one month after reporting the attained annual operational CII. The Statement of Compliance should not be issued in such a case unless a corrective action plan is duly developed and reflected in the SEEMP and verified by the Administration, taking into account the guidelines developed by the Organization.⁷

6.3 Should any material discrepancy be identified by the Administration in the reported data and/or the calculation of required/attained annual operational CII, it should be communicated to the company on a timely basis for clarification or correction. A discrepancy is considered material if the discrepancy or aggregation of discrepancies could influence the reported total by more than $\pm 5\%$. The Statement of Compliance should not be issued in such a case unless the material discrepancy is clarified or corrected.

⁷ Refer to the *Guidelines for the verification and company audits by the Administration of part III of the Ship Energy Efficiency Management Plan (SEEMP)* adopted by resolution MEPC.347(78).

APPENDIX 1

SAMPLE OF THE BDN SUMMARIES

Date of Operations (dd/mm/yyyy)	Fuel Oil Type/Mass(MT)									Descriptions
	DO/GO	LFO	HFO	LPG(P)	LPG(B)	LNG	Methanol	Ethanol	Others(Cr)	
① BDN										
09/01/2023										
02/05/2023			150							
08/07/2023										
09/10/2023										
10/12/2023			300							
① Annual Supply Amount	0	0	450	0	0	0	0	0	0	
② Correction for the tank oil remainings										
01/01/2023			400							
31/12/2023			200							
② Correction for the tank oil remaining	0	0	200	0	0	0	0	0	0	The difference in the amount of the remaining tank oil at the beginning/end of the data collection period.
③ Other corrections										
30/03/2023										
15/09/2023										
31/12/2023										
③ Annual other corrections	0	0	0	0	0	0	0	0	0	
Annual Fuel Consumption										
Annual Fuel Consumption (①+②+③)	0	0	650	0	0	0	0	0	0	

Explanatory remarks:
If bunker supply/correction data have been recorded in a Company's electronic reporting system, the data is acceptable to be submitted in the existing format instead of submitting the data by this format.

APPENDIX 2

SAMPLE OF THE COLLECTED DATA SUMMARIES

Date and time from (dd/mm/yyyy; hh:mm UTC)	* Date and time to (dd/mm/yyyy; hh:mm UTC)	Distance travelled (n.m)	Hours under way (hh:mm)	**exceptional conditions specified in regulation 3.1 of MARPOL Annex VI (Y/N)	**Sailing in ice condition (Y/N)	**STS Operation (Y/N)	Fuel consumption (metric tons)							
							total mass		**mass to be deducted from the total					
									consumed for production of electrical power ($FC_{electrical}$)		consumed by oil-fired boiler for cargo heating/discharge on tankers (FC_{boiler})		consumed by standalone engine driven cargo pumps during discharge operations on tankers (FC_{others})	
							***DO/GO	...	DO/GO	...	DO/GO	...	DO/GO	...
01/01/2023 00:00	01/01/2023 13:20	150	13:20	N	N	N								
01/01/2023 13:20	01/01/2023 24:00	60	10:40	N	Y	N								
02/01/2023 00:00	02/01/2023 24:00	288	24:00	N	N	Y								
03/01/2023 00:00	03/01/2023 24:00	260	24:00	N	N	Y								
.....								
.....								
31/12/2023 00:00	31/12/2023 24:00	290	24:00	N	N	N								
Annual total														

* In the case of daily underlying data, this column would be left blank.

** Refer to the 2022 *Interim guidelines on correction factors and voyage adjustments for CII calculations (G5)*, adopted by resolution MEPC.355(78). Supporting documentation may be additionally submitted to facilitate the verification when necessary, such as Baplie files where the number of in-use reefer containers on board are recorded. Note that voyages in different sailing or operational conditions should be recorded in separate rows so that the correction factors and voyage adjustments can be duly calculated and verified.

*** Refer to fuel types specified in the 2018 *Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships* (resolution MEPC.308(73), as may be amended)

Explanatory remarks: If bunker supply/correction data have been recorded in a company's electronic reporting system, the data is acceptable to be submitted in the existing format instead of submitting the data by this format.

APPENDIX 2 – ADD.1

SAMPLE OF THE COLLECTED DATA SUMMARIES TO CALCULATE TRIAL CII ON A VOLUNTARY BASIS

The following aggregated data should be additionally included in the table in appendix 2, if one or more trial CII metrics have been applied on a voluntary basis:

Date from (dd/mm/yyyy)	*Date to (dd/mm/yyyy)	Laden distance travelled (n.m)	****Transport work (metric of transport work)
01/01/2023			
02/01/2023			
03/01/2023			
31/12/2023			
Annual total			

* In the case of daily underlying data, this column would be left blank.

**** As defined in section 3 of the *Guidelines for voluntary use of the ship energy efficiency operational indicator (EEOI)* circulated by MEPC.1/Circ.684.

Explanatory remarks: If bunker supply/correction data have been recorded in a Company's electronic reporting system, the data is acceptable to be submitted in the existing format instead of submitting the data by this format.

APPENDIX 3

SAMPLE OF THE AGGREGATED DATA BEFORE A TRANSFER OF FLAG/COMPANY ADDRESSED IN REGULATIONS 27.4, 27.5 OR 27.6 OF MARPOL ANNEX VI

Date of transfer (dd/mm/yyyy)	Type of transfer (flag/company/both)	Reporting period		Distance Travelled (n.m)		Hours under way (hh:mm)	Fuel consumption (metric tons)							
		Date from (dd/mm/yyyy)	Date to (dd/mm/yyyy)	Total distance travelled	*distance to be deducted from CII calculation		total mass		*mass to be deducted from the total		**mass consumed in STS operations			
							***DO/GO	...	DO/GO	...	DO/GO	...		
12/05/2023	Flag	01/01/2023	11/05/2023											
15/06/2023	Company	12/05/2023	14/06/2023											
02/11/2023	Both	15/06/2023	01/11/2023											
.....														

* Refer to the aggregated mass of fuel consumption to calculate FC_{voyage} , $FC_{electrical}$, FC_{boiler} and FC_{others} in the 2022 Interim guidelines on correction factors and voyage adjustments for CII calculations (G5), (resolution MEPC.355(78)).

** Refer to the aggregated mass of fuel consumption to calculate $AF_{Tanker, STS}$ in the 2022 Interim guidelines on correction factors and voyage adjustments for CII calculations (G5), (resolution MEPC.355(78)).

*** Refer to fuel types specified in 2018 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships (resolution MEPC.308(73), as may be amended).

APPENDIX 3 – ADD.1

SAMPLE OF THE AGGREGATED DATA BEFORE A TRANSFER OF FLAG/COMPANY ADDRESSED IN REGULATIONS 27.4, 27.5 OR 27.6 OF MARPOL ANNEX VI TO CALCULATE TRIAL CII METRICS ON A VOLUNTARY BASIS

The following aggregated data may be additionally included in the table in appendix 3, if one or more trial CII metrics have been applied on a voluntary basis:

Date of transfer (dd/mm/yyyy)	Type of transfer (flag/company/both)	Reporting period		Laden distance travelled (n.m)	****Transport work (metric of transport work)
		Date from (dd/mm/yyyy)	Date to (dd/mm/yyyy)		
12/05/2023	Flag	01/01/2023	11/05/2023		
15/06/2023	Company	12/05/2023	14/06/2023		
02/11/2023	Both	15/06/2023	01/11/2023		
.....					

**** As defined in section 3 of Guidelines for voluntary use of the ship energy efficiency operational indicator (EEOI) circulated by MEPC.1/Circ.684.

ANNEX 11

RESOLUTION MEPC.349(78)
(adopted on 10 June 2022)

**2022 GUIDELINES FOR THE DEVELOPMENT AND MANAGEMENT OF THE IMO SHIP
FUEL OIL CONSUMPTION DATABASE**

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee (the Committee) conferred upon it by international conventions for the prevention and control of marine pollution from ships,

NOTING that the Committee, at its seventy-sixth session, adopted, by resolution MEPC.328(76), the *2021 Revised MARPOL Annex VI*, which will enter into force on 1 November 2022,

NOTING IN PARTICULAR that the *2021 Revised MARPOL Annex VI* (MARPOL Annex VI) contains amendments concerning mandatory goal-based technical and operational measures to reduce carbon intensity of international shipping,

NOTING ALSO that regulation 27.12 of MARPOL Annex VI specifies that the Secretary-General of the Organization shall maintain an anonymized database such that identification of a specific ship will not be possible,

NOTING FURTHER that regulation 27.13 of MARPOL Annex VI requires that the IMO Ship Fuel Oil Consumption Database be undertaken and managed by the Secretary-General of the Organization, pursuant to guidelines developed by the Organization,

RECOGNIZING that the aforementioned amendments to MARPOL Annex VI require relevant guidelines for uniform and effective implementation of the regulations and to provide sufficient lead time for industry to prepare,

NOTING that the Committee, at its seventy-first session, adopted, by resolution MEPC.293(71), the *2017 Guidelines the development and management of the IMO Ship Fuel Oil Consumption Database*,

HAVING CONSIDERED, at its seventy-eighth session, draft *2022 Guidelines for the development and management of the IMO Ship Fuel Oil Consumption Database*,

1 ADOPTS the *2022 Guidelines for the development and management of the IMO Ship Fuel Oil Consumption Database*, as set out in the annex to the present resolution;

2 INVITES Administrations to take the annexed Guidelines into account when developing and enacting national laws which give force to and implement requirements set forth in regulation 27 of MARPOL Annex VI;

3 REQUESTS the Parties to MARPOL Annex VI and other Member Governments to bring the annexed Guidelines to the attention of masters, seafarers, shipowners, ship operators and any other interested parties;

4 AGREES to keep the Guidelines under review in light of experience gained with their implementation, also taking into consideration that in accordance with regulations 25.3 and 28.11 of MARPOL Annex VI a review of the technical and operational measures to reduce carbon intensity of international shipping shall be completed by 1 January 2026;

5 REVOKES the *2017 Guidelines the development and management of the IMO Ship Fuel Oil Consumption Database* adopted by resolution MEPC.293(71).

ANNEX

2022 GUIDELINES FOR THE DEVELOPMENT AND MANAGEMENT OF THE IMO SHIP FUEL OIL CONSUMPTION DATABASE

1 INTRODUCTION

1.1 These Guidelines provide guidance on the development and management of the IMO Ship Fuel Oil Consumption Database (hereafter "the database"), and describe methods that will be used to anonymize ship data for use by Parties, in accordance with regulation 27 of MARPOL Annex VI, and to ensure the completeness of the database.

1.2 In general, the purpose of the database is to provide data for establishing annual CO₂ emissions from ships and support consideration of further measures for reducing carbon intensity of international shipping.

1.3 With regard to data confidentiality, regulation 27.12 stipulates that "The Secretary-General of the Organization shall maintain an anonymized database such that identification of a specific ship will not be possible. Parties shall have access to the anonymized data strictly for their analysis and consideration." These Guidelines balance data anonymization with the usability of data for analysis by the Parties and Organization.

1.4 Regulation 27.13 states that "The IMO Ship Fuel Oil Consumption Database shall be undertaken and managed by the Secretary-General of the Organization, pursuant to guidelines to be developed by the Organization." With regard to the establishment of the database and for data visualization, it will be developed as a module within the Global Integrated Shipping Information System (GISIS) platform and associated web application, as necessary, with the integrated IMO Web Accounts framework utilized to manage secure access to the module.

2 DEFINITIONS

For the purpose of these Guidelines, the definitions in MARPOL Annex VI apply.

3 DATA ANONYMIZATION

Pursuant to regulation 27.12 of MARPOL Annex VI, the data are to be anonymized such that identification of a specific ship will not be possible. For the purpose of the anonymization of the fuel oil consumption data, the following should apply for the database:

- .1 the IMO number and ship flag should not be shown;
- .2 gross tonnage (GT), net tonnage (NT), deadweight tonnage (DWT) and power output (rated power) should be rounded to two significant digits, for example, a ship tonnage of 167,430 GT should be shown as 170,000 GT;
- .3 attained EEDI and attained EEXI should be rounded to two decimal places;
- .4 required annual operational CII (AER or cgDIST), attained annual operational CII (AER or cgDIST), attained annual operational CII (AER or cgDIST) before any correction and operational carbon intensity indicators for trial purpose on voluntary basis (e.g. EEPI, cbDIST, cDIST and EEOI)¹ should be rounded to one decimal place;

¹ Refer to *2022 Guidelines on operational carbon intensity indicators and the calculation methods (CII guidelines, G1)* (resolution MEPC.352(78)).

- .5 the annual data of fuel oil consumption, distance travelled and hours under way should be provided in full without modification;
- .6 ship types other than those defined in regulation 2 should be shown as "others"; and
- .7 ice class should be shown as "Yes" or "No".

4 DATA SUBMISSION AND ACCESS

4.1 An Administration should be able to log in to the online database to submit its data via an online form. The data input into the database should be checked by the database system to ensure that the data are being submitted in the standardized format and be cross-referenced with the data from the Ship Particulars module of GISIS.

4.2 The Administration should designate a contact person for the purposes of the database who is responsible for communication with the Secretariat if any matter arises with regard to the submission of data by the respective Administration.

4.3 To encourage the consistent submission of data and improve the usability of the database, automatic notifications and reminders concerning data submission, modification and database update could be incorporated as features in the database.

4.4 An Administration will have access to non-anonymized data of ships flying its flag. Furthermore, the Administration of a ship, to which regulation 28 of MARPOL Annex VI applies, will have access to all reported data for the preceding calendar year for that ship regardless of flag history.

4.5 An Administration should be able to log in to the online database to download the anonymized dataset.

5 MEASURES TO ENSURE THE COMPLETENESS OF THE DATABASE

In accordance with the requirements of regulation 27.10 of MARPOL Annex VI concerning reporting of the status of missing data, the Secretary-General should:

- .1 at the beginning of each calendar year, produce a list of ships falling under the scope of regulation 27 by cross-referencing with the data from the Ship Particulars module of GISIS;
- .2 send the aforementioned list of ships to the Administration for reference, in order to receive feedback in case of any discrepancies;
- .3 check the completeness of the database by comparing the list produced under .1 with the reported data;
- .4 remind Administrations which have failed to submit the data in the required form;
- .5 report the status of missing data to the Committee on an annual basis; and
- .6 request non-reporting Administrations to submit the data of all their registered ships falling under the scope of regulation 27.

6 ANNUAL REPORT TO THE MARINE ENVIRONMENT PROTECTION COMMITTEE

Regulation 27.10 states that "the Secretary-General of the Organization shall produce an annual report to the Marine Environment Protection Committee summarizing the data collected, the status of missing data, and such other relevant information as may be requested by the Committee." At a minimum, each annual report should include the following and also any other information as requested by the Committee:

- .1 an aggregated annual amount of each type of fuel oil consumed by all ships of 5,000 GT and above engaged on international voyages;
- .2 the aggregated annual amount of each type of fuel oil consumed, distance travelled and hours under way for ships of 5,000 GT and above engaged on international voyages, by ship type and size category as defined in MARPOL Annex VI,² including the "other" category for ships not defined in MARPOL Annex VI regulation 2;
- .3 the number of ships of 5,000 GT and above engaged on international voyages reported to the database, by ship type and size category as defined in MARPOL Annex VI, **Error! Bookmark not defined.** including the "other" category for ships not defined in MARPOL Annex VI regulation 2;
- .4 the number of ships of 5,000 GT and above engaged on international voyages registered with the Party of Annex VI for which data was not received, by ship type and size category as defined in MARPOL Annex VI, **Error! Bookmark not defined.** including the "other" category for ships not defined in MARPOL Annex VI regulation 2; and
- .5 the annual development in operational carbon intensity of the ship types and international shipping, as well as the uncertainties in the data and results, using both demand-based measurement and supply-based measurement, as stated in paragraph 1.5 of the *2021 Guidelines on the operational carbon intensity reduction factors relative to reference lines (CII reduction factors guidelines, G3)*.

² In order to facilitate year-over-year comparison, the Secretariat may also consider using ship type and size categories as used in the Fourth IMO GHG Study 2020, as appropriate.

ANNEX 12

RESOLUTION MEPC.350(78)
(adopted on 10 June 2022)

2022 GUIDELINES ON THE METHOD OF CALCULATION OF THE ATTAINED ENERGY EFFICIENCY EXISTING SHIP INDEX (EEXI)

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee (the Committee) conferred upon it by international conventions for the prevention and control of marine pollution from ships,

NOTING that the Committee adopted, at its seventy-sixth session, by resolution MEPC.328(76), the *2021 Revised MARPOL Annex VI*, which will enter into force on 1 November 2022,

NOTING IN PARTICULAR that the *2021 Revised MARPOL Annex VI* (MARPOL Annex VI) contains amendments concerning mandatory goal-based technical and operational measures to reduce carbon intensity of international shipping,

NOTING FURTHER that regulation 23 of MARPOL Annex VI requires that the attained Energy Efficiency Existing Ship Index (EEXI) shall be calculated taking into account the guidelines developed by the Organization,

RECOGNIZING that the aforementioned amendments to MARPOL Annex VI require relevant guidelines for uniform and effective implementation of the regulations and to provide sufficient lead time for industry to prepare,

NOTING that, at its seventy-sixth session, the Committee adopted, by resolution MEPC.333(76), the *2021 Guidelines on the method of calculation of the attained Energy Efficiency Existing Ship Index (EEXI)*,

HAVING CONSIDERED, at its seventy-eighth session, the draft *2022 Guidelines on the method of calculation of the attained Energy Efficiency Existing Ship Index (EEXI)*,

1 ADOPTS the *2022 Guidelines on the method of calculation of the attained Energy Efficiency Existing Ship Index (EEXI)*, as set out in the annex to the present resolution;

2 INVITES Administrations to take the annexed Guidelines into account when developing and enacting national laws which give force to and implement requirements set forth in regulation 23 of MARPOL Annex VI;

3 REQUESTS the Parties to MARPOL Annex VI and other Member Governments to bring the annexed Guidelines to the attention of masters, seafarers, shipowners, ship operators and any other interested parties;

4 AGREES to keep the Guidelines under review in light of experience gained with their implementation, also taking into consideration that in accordance with regulation 25.3 of

MARPOL Annex VI a review of the technical measure to reduce carbon intensity of international shipping shall be completed by 1 January 2026;

5 REVOKES the *2021 Guidelines on the method of calculation of the attained Energy Efficiency Existing Ship Index (EEXI)* adopted by resolution MEPC.333(76).

ANNEX

**2022 GUIDELINES ON THE METHOD OF CALCULATION OF THE ATTAINED
ENERGY EFFICIENCY EXISTING SHIP INDEX (EEXI)**

CONTENTS

- 1 Definitions
- 2 Energy Efficiency Existing Ship Index (EEXI)
 - 2.1 EEXI formula
 - 2.2 Parameters
 - 2.2.1 $P_{ME(i)}$; Power of main engines
 - 2.2.2 $P_{AE(i)}$; Power of auxiliary engines
 - 2.2.3 V_{ref} ; Ship speed
 - 2.2.4 SFC ; Certified specific fuel consumption
 - 2.2.5 C_F ; Conversion factor between fuel consumption and CO₂ emission
 - 2.2.6 Correction factor for ro-ro cargo and ro-ro passenger ships (f_{JRORo})
 - 2.2.7 Correction factor for ro-ro cargo ships (vehicle carrier) ($f_{cVEHICLE}$)
- APPENDIX Parameters to calculate $V_{ref,app}$

1 Definitions

1.1 *MARPOL* means the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocols of 1978 and 1997 relating thereto, as amended.

1.2 For the purpose of these Guidelines, the definitions in *MARPOL* Annex VI, as amended, apply.

2 Energy Efficiency Existing Ship Index (EEXI)

2.1 EEXI formula

The attained Energy Efficiency Existing Ship Index (EEXI) is a measure of ship's energy efficiency (g/t*nm) and calculated by the following formula:

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

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

** In case of $P_{PTI(i)} > 0$, the average weighted value of $(SFC_{ME} \cdot C_{FME})$ and $(SFC_{AE} \cdot C_{FAE})$ to be used for calculation of P_{eff}

Note: This formula may not be applicable to a ship having diesel-electric propulsion, turbine propulsion or hybrid propulsion system, except for cruise passenger ships and LNG carriers.

Ships falling into the scope of EEDI requirement can use their attained EEDI calculated in accordance with the *2018 Guidelines on the method of calculation of the attained EEDI for new ships* (resolution MEPC.308(73), as amended, the "EEDI Calculation Guidelines" hereafter) as the attained EEXI if the value of the attained EEDI is equal to or less than that of the required EEXI.

2.2 Parameters

For calculation of the attained EEXI by the formula in paragraph 2.1, parameters under the EEDI Calculation Guidelines apply, unless expressly provided otherwise. In referring to the aforementioned guidelines, the terminology "EEDI" should be read as "EEXI".

2.2.1 $P_{ME(i)}$; Power of main engines

In cases where overridable Shaft / Engine Power Limitation is installed in accordance with the *2021 Guidelines on the shaft / engine power limit to comply with the EEXI requirements and use of a power reserve* (resolution MEPC.335(76)), $P_{ME(i)}$ is 83% of the limited installed power (MCR_{lim}) or 75% of the original installed power (MCR), whichever is lower, for each main engine (i). In cases where the overridable Shaft / Engine Power Limitation and shaft generator(s) are installed, in referring to paragraph 2.2.5.2 (option 1) of the EEDI Calculation Guidelines, " MCR_{ME} " should be read as " MCR_{lim} ".

For LNG carriers having steam turbine or diesel electric propulsion, $P_{ME(i)}$ is 83% of the limited installed power (MCR_{lim} , MPP_{lim}), divided by the electrical efficiency in case of diesel electric propulsion system, for each main engine (i). For LNG carriers, the power from combustion of

the excessive natural boil-off gas in the engines or boilers to avoid releasing to the atmosphere or unnecessary thermal oxidation should be deducted from $P_{ME(i)}$ with the approval of the verifier.

2.2.2 $P_{AE(i)}$; Power of auxiliary engines

2.2.2.1 $P_{AE(i)}$ is calculated in accordance with paragraph 2.2.5.6 of the EEDI Calculation Guidelines.

2.2.2.2 For ships where power of auxiliary engines (P_{AE}) value calculated by paragraphs 2.2.5.6.1 to 2.2.5.6.3 of the EEDI Calculation Guidelines 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 average efficiency of the generator(s) weighted by power (see appendix 2 of the EEDI Calculation Guidelines).

2.2.2.3 In cases where the electric power table is not available, the P_{AE} value may be approximated either by:

- .1 annual average figure of P_{AE} at sea from onboard monitoring obtained prior to the EEXI certification;
- .2 for cruise passenger ships, approximated value of power of auxiliary engines ($P_{AE,app}$), as defined below:

$$P_{AE,app} = 0.1193 \times GT + 1814.4 \quad [\text{kW}]$$

- .3 for ro-ro passenger ships, approximated value of power of auxiliary engines ($P_{AE,app}$), as defined below:

$$P_{AE,app} = 0.866 \times GT^{0.732} \quad [\text{kW}]$$

2.2.3 V_{ref} ; Ship speed

2.2.3.1 For ships falling into the scope of the EEDI requirement, the ship speed V_{ref} should be obtained from an approved speed-power curve as defined in the *2014 Guidelines on survey and certification of the Energy Efficiency Design Index (EEDI)*, as amended (resolution MEPC.254(67), as amended).

2.2.3.2 For ships not falling into the scope of the EEDI requirement, the ship speed V_{ref} should be obtained from an estimated speed-power curve as defined in the *2022 Guidelines on survey and certification of the attained EEXI* (resolution MEPC.351(78)).

2.2.3.3 For ships not falling into the scope of the EEDI requirement but whose sea trial results, which may have been calibrated by the tank test, under the EEDI draught and the sea condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines are included in the sea trial report, the ship speed V_{ref} may be obtained from the sea trial report:

$$V_{ref} = V_{S,EEDI} \times \left[\frac{P_{ME}}{P_{S,EEDI}} \right]^{\frac{1}{3}} \quad [\text{knot}]$$

where,

$V_{S,EEDI}$, is the sea trial service speed under the EEDI draught; and

$P_{S,EEDI}$ is power of the main engine corresponding to $V_{S,EEDI}$.

2.2.3.4 For containerships, bulk carriers or tankers not falling into the scope of the EEDI requirement but whose sea trial results, which may have been calibrated by the tank test, under the design load draught and sea condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines are included in the sea trial report, the ship speed V_{ref} may be obtained from the sea trial report:

$$V_{ref} = k^{\frac{1}{3}} \times \left(\frac{DWT_{S,service}}{Capacity} \right)^{\frac{2}{9}} \times V_{S,service} \times \left[\frac{P_{ME}}{P_{S,service}} \right]^{\frac{1}{3}} \quad [\text{knot}]$$

where,

$V_{S,service}$ is the sea trial service speed under the design load draught;

$DWT_{S,service}$ is the deadweight under the design load draught;

$P_{S,service}$ is the power of the main engine corresponding to $V_{S,service}$;

k is the scale coefficient, which should be:

- .1 0.95 for containerships with 120,000 DWT or less;
- .2 0.93 for containerships with more than 120,000 DWT;
- .3 0.97 for bulk carrier with 200,000 DWT or less;
- .4 1.00 for bulk carrier with more than 200,000 DWT;
- .5 0.97 for tanker with 100,000 DWT or less; and
- .6 1.00 for tanker with more than 100,000 DWT.

2.2.3.5 In cases where the speed-power curve is not available or the sea trial report does not contain the EEDI or design load draught condition, the ship speed V_{ref} can be obtained from the in-service performance measurement method conducted and verified in accordance with the methods and procedures as specified in the *Guidance on methods, procedures and verification of in-service performance measurements* (MEPC.1/Circ.901).

2.2.3.6 In cases where the speed-power curve is not available or the sea trial report does not contain the EEDI or design load draught condition, the ship speed V_{ref} can be approximated by $V_{ref,app}$ to be obtained from statistical mean of distribution of ship speed and engine power, as defined below:

$$V_{ref,app} = (V_{ref,avg} - m_V) \times \left[\frac{\sum P_{ME}}{0.75 \times MCR_{avg}} \right]^{\frac{1}{3}} \quad [\text{knot}]$$

For LNG carriers having diesel electric propulsion system and cruise passenger ships having non-conventional propulsion,

$$V_{ref,app} = (V_{ref,avg} - m_V) \times \left[\frac{\sum MPP_{Motor}}{MPP_{avg}} \right]^{\frac{1}{3}} \quad [\text{knot}]$$

where,

V_{ref}

$V_{ref,avg}$ is a statistical mean of distribution of ship speed in given ship type and ship size, to be calculated as follows:

$$V_{ref,avg} = A \times B^C$$

where

A, B and C are the parameters given in the appendix;

m_V is a performance margin of a ship, which should be 5% of $V_{ref,avg}$ or one knot, whichever is lower; and

MCR_{avg} is a statistical mean of distribution of MCRs for main engines and MPP_{avg} is a statistical mean of distribution of MPPs for motors in given ship type and ship size, to be calculated as follows:

$$MCR_{avg} \text{ or } MPP_{avg} = D \times E^F$$

where

D, E and F are the parameters given in the appendix;

In cases where the overridable Shaft / Engine Power Limitation is installed, the ship speed V_{ref} approximated by $V_{ref,app}$ should be calculated as follows:

$$V_{ref,app} = (V_{ref,avg} - m_V) \times \left[\frac{\sum P_{ME}}{0.75 \times MCR_{avg}} \right]^{\frac{1}{3}} \quad [\text{knot}]$$

For LNG carriers having diesel electric propulsion system and cruise passenger ship having non-conventional propulsion, the ship speed V_{ref} approximated by $V_{ref,app}$ should be calculated as follows:

$$V_{ref,app} = (V_{ref,avg} - m_V) \times \left[\frac{\sum MPP_{lim}}{MPP_{avg}} \right]^{\frac{1}{3}}$$

2.2.3.7 Notwithstanding the above, in cases where the energy-saving device* is installed, the effect of the device may be reflected in the ship speed V_{ref} with the approval of the verifier, based on the following methods in accordance with defined quality and technical standards:

- .1 sea trials after installation of the device; and/or
- .2 in-service performance measurement method; and/or
- .3 dedicated model tests; and/or

* Devices that shift the power curve, which results in the change of P_P and V_{ref} , as specified in MEPC.1/Circ.896 on 2021 Guidance on treatment of innovative energy efficiency technologies for calculation and verification of the attained EEDI and EEXI.

.4 numerical calculations.

2.2.4 SFC; Certified specific fuel consumption

In cases where overridable Shaft / Engine Power Limitation is installed, the *SFC* corresponding to the P_{ME} should be interpolated by using *SFCs* listed in an applicable test report included in an approved NO_x Technical File of the main engine as defined in paragraph 1.3.15 of the NO_x Technical Code.

Notwithstanding the above, the *SFC* specified by the manufacturer or confirmed by the verifier may be used.

For those engines which do not have a test report included in the NO_x Technical File and which do not have the *SFC* specified by the manufacturer or confirmed by the verifier, the *SFC* can be approximated by SFC_{app} defined as follows:

$$SFC_{ME,app} = 190 [g/kWh]$$

$$SFC_{AE,app} = 215 [g/kWh]$$

2.2.5 C_F; Conversion factor between fuel consumption and CO₂ emission

For those engines which do not have a test report included in the NO_x Technical File and which do not have the *SFC* specified by the manufacturer, the C_F corresponding to SFC_{app} should be defined as follows:

$$C_F = 3.114 [t \cdot CO_2/t \cdot Fuel] \text{ for diesel ships (incl. HFO use in practice)}$$

Otherwise, paragraph 2.2.1 of the EEDI Calculation Guidelines applies.

2.2.6 Correction factor for ro-ro cargo and ro-ro passenger ships (f_{jRoRo})

For ro-ro cargo and ro-ro passenger ships, f_{jRoRo} is calculated as follows:

$$f_{jRoRo} = \frac{1}{F_{nL}^\alpha \cdot \left(\frac{L_{pp}}{B_S}\right)^\beta \cdot \left(\frac{B_S}{d_S}\right)^\gamma \cdot \left(\frac{L_{pp}}{V^{1/3}}\right)^\delta} \quad ; \text{ if } f_{jRoRo} > 1 \text{ then } f_j = 1$$

where the Froude number, F_{nL} , is defined as:

$$F_{nL} = \frac{0.5144 \cdot V_{ref,F}}{\sqrt{L_{pp} \cdot g}}$$

where $V_{ref,F}$ is the ship design speed corresponding to 75% of MCR_{ME} :

and the exponents α , β , γ and δ are defined as follows:

Ship type	Exponent:			
	α	β	γ	δ
Ro-ro cargo ship	2.00	0.50	0.75	1.00
Ro-ro passenger ship	2.50	0.75	0.75	1.00

2.2.7 Cubic capacity correction factor for ro-ro cargo ships (vehicle carrier) ($f_{cVEHICLE}$)

For ro-ro cargo ships (vehicle carrier) having a DWT/GT ratio of less than 0.35, the following cubic capacity correction factor, $f_{cVEHICLE}$, should apply:

$$f_{cVEHICLE} = \left(\frac{(DWT/GT)}{0.35} \right)^{-0,8}$$

Where DWT is the capacity and GT is the gross tonnage in accordance with the International Convention of Tonnage Measurement of Ships 1969, annex I, regulation 3.

APPENDIX

Parameters to calculate $V_{ref,avg}$

Ship type	A	B	C
Bulk carrier	10.6585	DWT of the ship	0.02706
Gas carrier	7.4462	DWT of the ship	0.07604
Tanker	8.1358	DWT of the ship	0.05383
Containership	3.2395	DWT of the ship where DWT ≤ 80,000 80,000 where DWT > 80,000	0.18294
General cargo ship	2.4538	DWT of the ship	0.18832
Refrigerated cargo carrier	1.0600	DWT of the ship	0.31518
Combination carrier	8.1391	DWT of the ship	0.05378
LNG carrier	11.0536	DWT of the ship	0.05030
Ro-ro cargo ship (vehicle carrier)	16.6773	DWT of the ship	0.01802
Ro-ro cargo ship	8.0793	DWT of the ship	0.09123
Ro-ro passenger ship	4.1140	DWT of the ship	0.19863
Cruise passenger ship having non-conventional propulsion	5.1240	GT of the ship	0.12714

Parameters to calculate MCR_{avg} or MPP_{avg} (= D x E^F)

Ship type	D	E	F
Bulk carrier	23.7510	DWT of the ship	0.54087
Gas carrier	21.4704	DWT of the ship	0.59522
Tanker	22.8415	DWT of the ship	0.55826
Containership	0.5042	DWT of the ship where DWT ≤ 95,000 95,000 where DWT > 95,000	1.03046
General cargo ship	0.8816	DWT of the ship	0.92050
Refrigerated cargo carrier	0.0272	DWT of the ship	1.38634
Combination carrier	22.8536	DWT of the ship	0.55820
LNG carrier	20.7096	DWT of the ship	0.63477
Ro-ro cargo ship (vehicle carrier)	262.7693	DWT of the ship	0.39973
Ro-ro cargo ship	37.7708	DWT of the ship	0.63450
Ro-ro passenger ship	9.1338	DWT of the ship	0.91116
Cruise passenger ship having non-conventional propulsion	1.3550	GT of the ship	0.88664

Calculation of parameters to calculate $V_{ref,avg}$ and MCR_{avg}

Data sources

1 IHS Fairplay (IHSF) database with the following conditions are used.

Ship type	Ship size	Delivered period	Type of propulsion systems	Population
Bulk carrier	≥ 10,000 DWT	From 1 January 1999 to 1 January 2009	Conventional	2,433
Gas carrier	≥ 2,000 DWT		Conventional	292
Tanker	≥ 4,000 DWT		Conventional	3,345
Containership	≥ 10,000 DWT		Conventional	2,185
General cargo ship	≥ 3,000 DWT		Conventional	1,673
Refrigerated cargo carrier	≥ 3,000 DWT		Conventional	53
Combination carrier	≥ 4,000 DWT		Conventional	3,351
LNG carrier	≥ 10,000 DWT		Conventional, Non-conventional	185
Ro-ro cargo ship (vehicle carrier)	≥ 10,000 DWT		Conventional	301
Ro-ro cargo ship	≥ 1,000 DWT		From 1 January 1998 to 31 December 2010	Conventional
Ro-ro passenger ship	≥ 250 DWT	Conventional		350
Cruise passenger ship having non-conventional propulsion	≥ 25,000 GT	From 1 January 1999 to 1 January 2009	Non-conventional	93

2 Data sets with blank/zero "Service speed", "Capacity" and/or Total kW of M/E" are removed.

3 Ship type is in accordance with table 1 and table 2 of resolution MEPC.231(65) on 2013 Guidelines for calculation of reference lines for use with the Energy Efficiency Design Index (EEDI). However, "Gas carrier" does not include "LNG carrier". Parameters for "LNG carrier" are given separately.

ANNEX 13

RESOLUTION MEPC.351(78)
(adopted on 10 June 2022)

**2022 GUIDELINES ON SURVEY AND CERTIFICATION OF THE ATTAINED ENERGY
EFFICIENCY EXISTING SHIP INDEX (EEXI)**

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee (the Committee) conferred upon it by international conventions for the prevention and control of marine pollution from ships,

NOTING that the Committee adopted, at its seventy-sixth session, by resolution MEPC.328(76), the *2021 Revised MARPOL Annex VI*, which will enter into force on 1 November 2022,

NOTING IN PARTICULAR that the *2021 Revised MARPOL Annex VI* (MARPOL Annex VI) contains amendments concerning mandatory goal-based technical and operational measures to reduce carbon intensity of international shipping,

NOTING FURTHER that regulation 5.4 (Surveys) of MARPOL Annex VI requires that ships to which chapter 4 applies shall also be subject to survey and certification taking into account guidelines developed by the Organization,

RECOGNIZING that the aforementioned amendments to MARPOL Annex VI require relevant guidelines for uniform and effective implementation of the regulations and to provide sufficient lead time for industry to prepare,

NOTING that, at its seventy-sixth session, the Committee adopted, by resolution MEPC.334(76), the *2021 Guidelines on survey and certification of the attained Energy Efficiency Existing Ship Index (EEXI)*,

HAVING CONSIDERED, at its seventy-eighth session, draft amendments to the *2021 Guidelines on survey and certification of the attained Energy Efficiency Existing Ship Index (EEXI)*,

1 ADOPTS the *2022 Guidelines on survey and certification of the attained Energy Efficiency Existing Ship Index (EEXI)*, as set out in the annex to the present resolution;

2 INVITES Administrations to take the annexed Guidelines into account when developing and enacting national laws which give force to and implement requirements set forth in regulation 5 of MARPOL Annex VI;

3 REQUESTS the Parties to MARPOL Annex VI and other Member Governments to bring the annexed Guidelines to the attention of masters, seafarers, shipowners, ship operators and any other interested parties;

4 AGREES to keep the Guidelines under review in light of experience gained with their implementation, also taking into consideration that in accordance with regulation 25.3 of MARPOL Annex VI a review of the technical measure to reduce carbon intensity of international shipping shall be completed by 1 January 2026;

5 REVOKES the *2021 Guidelines on survey and certification of the attained Energy Efficiency Existing Ship Index (EEXI)*, adopted by resolution MEPC.334(76).

ANNEX

**2022 GUIDELINES ON SURVEY AND CERTIFICATION OF THE ATTAINED ENERGY
EFFICIENCY EXISTING SHIP INDEX (EEXI)**

Table of contents

1	GENERAL
2	DEFINITIONS
3	APPLICATION
4	PROCEDURES FOR SURVEY AND CERTIFICATION
4.1	General
4.2	Verification of the attained EEXI
4.3	Verification of the attained EEXI in case of major conversion
APPENDIX	Sample of EEXI Technical File

1 GENERAL

The purpose of these Guidelines is to assist verifiers of the Energy Efficiency Existing Ship Index (EEXI) of ships in conducting the survey and certification of the EEXI, in accordance with regulations 5, 6, 7, 8 and 9 of MARPOL Annex VI, and assist shipowners, shipbuilders, manufacturers and other interested parties in understanding the procedures for the survey and certification of the EEXI.

2 DEFINITIONS¹

2.1 *Verifier* means an Administration, or organization duly authorized by it, which conducts the survey and certification of the EEXI in accordance with regulations 5, 6, 7, 8 and 9 of MARPOL Annex VI and these Guidelines.

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

2.3 *Tank test* means model towing tests, model self-propulsion tests and model propeller open water tests. Numerical calculations may be accepted as equivalent to model propeller open water tests or used to complement the tank tests conducted (e.g. to evaluate the effect of additional hull features such as fins, etc. on ships' performance), or as a replacement for model tests provided that the methodology and numerical model used have been validated/calibrated against parent hull sea trials and/or model tests, with the approval of the verifier.

2.4 *MARPOL* means the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocols of 1978 and 1997 relating thereto, as amended.

2.5 For the purpose of these Guidelines, the definitions in MARPOL Annex VI, as amended, apply.

3 APPLICATION

These Guidelines should be applied to ships for which an application for a survey for verification of the ship's EEXI specified in regulation 5 of MARPOL Annex VI has been submitted to a verifier.

4 PROCEDURES FOR SURVEY AND CERTIFICATION

4.1 General

4.1.1 The attained EEXI should be calculated in accordance with regulation 23 of MARPOL Annex VI and the *2022 Guidelines on the method of calculation of the attained Energy Efficiency Existing Ship Index (EEXI)* (resolution MEPC.350(78)) (EEXI Calculation Guidelines).

4.1.2 The *2021 Guidance on treatment of innovative energy efficiency technologies for calculation and verification of the attained EEDI and EEXI* (MEPC.1/Circ.896) should be applied for calculation of the attained EEXI, if applicable.

¹ Other terms used in these Guidelines have the same meaning as those defined in the *2018 Guidelines on the method of calculation of the attained EEDI for new ships* (resolution MEPC.308(73), as amended) and the *2022 Guidelines on the method of calculation of the attained Energy Efficiency Existing Ship Index (EEXI)* (resolution MEPC.350(78)).

4.1.3 The information used in the verification process may contain confidential information of submitters, including shipyards, which requires Intellectual Property Rights (IPR) protection. In the case where the submitter wants a non-disclosure agreement with the verifier, the additional information should be provided to the verifier upon mutually agreed terms and conditions.

4.2 Verification of the attained EEXI

4.2.1 For verification of the attained EEXI, an application for a survey and an EEXI Technical File containing the necessary information for the verification and other relevant background documents should be submitted to a verifier, unless the attained EEDI of the ship satisfies the required EEXI.

4.2.2 The EEXI Technical File should be written at least in English. The EEXI Technical File should include, but not be limited to:

- .1 deadweight (DWT) or gross tonnage (GT) for ro-ro passenger ship and cruise passenger ship having non-conventional propulsion;
- .2 the rated installed power (MCR) of the main and auxiliary engines;
- .3 the limited installed power (MCR_{lim}) in cases where the overridable Shaft/Engine Power Limitation system is installed;
- .4 the ship speed (V_{ref});
- .5 the approximate ship speed ($V_{ref,app}$) for pre-EEDI ships in cases where the speed-power curve is not available, as specified in paragraph 2.2.3.5 of the EEXI Calculation Guidelines;
- .6 an approved speed-power curve under the EEDI condition as specified in paragraph 2.2 of the EEDI Calculation Guidelines, which is described in the EEDI Technical File, in cases where regulation 22 of MARPOL Annex VI (Attained EEDI) is applied;
- .7 an estimated speed-power curve under the EEDI condition, or under a different load draught to be calibrated to the EEDI condition, obtained from tank test and/or numerical calculations, if available;
- .8 estimation process and methodology of the power curves, as necessary, including documentation on consistency with the defined quality standards (e.g. ITTC 7.5-03-01-02 and ITTC 7.5-03-01-04 in their latest revisions) and the verification of the numerical set-up with parent hull or the reference set of comparable ships in case of using numerical calculations;
- .9 a sea trial report including sea trial results, which may have been calibrated by the tank test, under the sea condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines, if available;
- .10 an in-service performance measurement report, where applicable, as specified in paragraphs 2.2.3.5 and 2.2.3.7.2 of the EEXI Calculation Guidelines;

- .11 calculation process of $V_{ref,app}$ for pre-EEDI ships in cases where the speed-power curve is not available, as specified in paragraph 2.2.3.6 of the EEXI Calculation Guidelines;
- .12 type of fuel;
- .13 the specific fuel consumption (*SFC*) of the main and auxiliary engines, as specified in paragraph 2.2.4 of the EEXI Calculation Guidelines;
- .14 the electric power table² for certain ship types, as necessary, as defined in the EEDI Calculation Guidelines;
- .15 the documented record of annual average figure of the auxiliary engine load at sea obtained prior to the date of application for a survey for verification of the ship's EEXI, as specified in paragraph 2.2.2.3 of the EEXI Calculation Guidelines, if applicable;
- .16 calculation process of $P_{AE,app}$, as specified in paragraph 2.2.2.3 of the EEXI Calculation Guidelines, if applicable;
- .17 principal particulars, ship type and the relevant information to classify the ship as such a ship type, classification notations and an overview of the propulsion system and electricity supply system on board;
- .18 description of energy-saving equipment, if available;
- .19 calculated value of the attained EEXI, including the calculation summary, which should contain, at a minimum, each value of the calculation parameters and the calculation process used to determine the attained EEXI; and
- .20 for LNG carriers:
 - .1 type and outline of propulsion systems (such as direct drive diesel, diesel electric, steam turbine);
 - .2 LNG cargo tank capacity in m³ and BOR as defined in paragraph 2.2.5.6.3 of the EEDI Calculation Guidelines;
 - .3 shaft power of the propeller shaft after transmission gear at 100% of the rated output of motor (MPP_{Motor}) and $\eta_{(i)}$ for diesel electric;
 - .4 shaft power of the propeller shaft after transmission gear at the de-rated output of motor ($MPP_{Motor,lim}$) in cases where the overridable Shaft / Engine Power Limitation is installed;
 - .5 maximum continuous rated power ($MCR_{SteamTurbine}$) for steam turbine;
 - .6 limited maximum continuous rated power ($MCR_{SteamTurbine,lim}$) for steam turbine in cases where the overridable Shaft / Engine Power Limitation is installed; and

² Electric power tables should be validated separately, taking into account the guidelines set out in appendix 2 of the 2014 Guidelines on survey and certification of the Energy Efficiency Design Index (EEDI) (resolution MEPC.254(67), as amended by resolutions MEPC.261(68) and MEPC.309(73)); consolidated text: MEPC.1/Circ.855/Rev.2, as may be further amended).

- .7 $SFC_{SteamTurbine}$ for steam turbine, as specified in paragraph 2.2.7.2 of the EEDI Calculation Guidelines. If the calculation is not available from the manufacturer, $SFC_{SteamTurbine}$ may be calculated by the submitter.

A sample of an EEXI Technical File is provided in the appendix.

4.2.3 The SFC should be corrected to the value corresponding to the ISO standard reference conditions using the standard lower calorific value of the fuel oil, referring to ISO 15550:2002 and ISO 3046-1:2002. For the confirmation of the SFC , a copy of the approved NO_x Technical File and documented summary of the correction calculations should be submitted to the verifier.

4.2.4 For ships equipped with dual-fuel engine(s) using LNG and fuel oil, the C_F -factor for gas (LNG) and the specific fuel consumption (SFC) of gas fuel should be used by applying the criteria specified in paragraph 4.2.3 of the *2014 Guidelines on survey and certification of the Energy Efficiency Design Index (EEDI)*, as amended,³ as a basis for the guidance of the Administration.

4.2.5 Notwithstanding paragraphs 4.2.3 and 4.2.4, in cases where overridable Shaft/Engine Power Limitation is installed, or in cases where engines do not have a test report included in the NO_x Technical File, SFC should be calculated in accordance with paragraph 2.2.4 of the EEDI Calculation Guidelines. For this purpose, actual performance records of the engine may be used if satisfactory and acceptable to the verifier.

4.2.6 The verifier may request further information from the submitter, as specified in paragraph 4.2.7 of the EEDI Survey and Certification Guidelines, in addition to that contained in the EEXI Technical File, as necessary, to examine the calculation process of the attained EEXI.

4.2.7 In cases where the sea trial report as specified in paragraph 4.2.2.9 is submitted, the verifier should request further information from the submitter to confirm that:

- .1 the sea trial was conducted in accordance with the conditions specified in paragraphs 4.3.3, 4.3.4 and 4.3.7 of the EEDI Survey and Certification Guidelines, as applicable;
- .2 sea conditions were measured in accordance with ISO 15016:2002 or the equivalent if satisfactory and acceptable to the verifier;
- .3 ship speed was measured in accordance with ISO 15016:2002 or the equivalent if satisfactory and acceptable to the verifier; and
- .4 the measured ship speed was calibrated, if necessary, by taking into account the effects of wind, tide, waves, shallow water and displacement in accordance with ISO 15016:2002 or the equivalent which may be acceptable provided that the concept of the method is transparent for the verifier and publicly available/accessible.

4.2.8 In cases where the in-service performance measurement report as specified in paragraph 4.2.2.10 is submitted, the verifier should confirm that the in-service performance measurement was conducted and verified in accordance with the methods and procedures as specified in the *Guidance on methods, procedures and verification of in-service performance measurements* (MEPC.1/Circ.901).

³ Resolution MEPC.254(67), as amended.

4.2.9 The estimated speed-power curve obtained from the tank test and/or numerical calculations and/or the sea trial results calibrated by the tank test should be reviewed on the basis of the relevant documents in accordance with the EEDI Survey and Certification Guidelines, the defined quality standards (e.g. ITTC 7.5-03-01-02 and ITTC 7.5-03-01-04 in their latest revisions) and the verification of the numerical set-up with parent hull or the reference set of comparable ships.

4.2.10 In cases where the overridable Shaft/Engine Power Limitation system is installed, the verifier should confirm that the system is appropriately installed and sealed in accordance with the *2021 Guidelines on the Shaft/Engine Power Limitation system to comply with the EEXI requirements and use of a power reserve* (resolution MEPC.335(76)) and that a verified Onboard Management Manual (OMM) for overridable Shaft/Engine Power Limitation is on board the ship.

4.3 Verification of the attained EEXI in case of major conversion

4.3.1 In cases of a major conversion of a ship taking place at or after the completion date of the survey for EEXI verification specified in regulation 5.4.7 of MARPOL Annex VI, the shipowner should submit to a verifier an application for a general or partial survey with the EEXI Technical File duly revised, based on the conversion made and other relevant background documents.

4.3.2 The background documents should include as a minimum, but are not limited to:

- .1 details of the conversion;
- .2 EEXI parameters changed after the conversion and the technical justifications for each respective parameter;
- .3 reasons for other changes made in the EEXI Technical File, if any; and
- .4 calculated value of the attained EEXI with the calculation summary, which should contain, as a minimum, each value of the calculation parameters and the calculation process used to determine the attained EEXI after the conversion.

4.3.3 The verifier should review the revised EEXI Technical File and other documents submitted and verify the calculation process of the attained EEXI to ensure that it is technically sound and reasonable and follows regulation 23 of MARPOL Annex VI and the EEXI Calculation Guidelines.

4.3.4 For verification of the attained EEXI after the major conversion, speed trials of the ship may be conducted, as necessary.

APPENDIX

SAMPLE OF EEXI TECHNICAL FILE

1 Data

1.1 General information

Shipowner	XXX Shipping Line
Shipbuilder	XXX Shipbuilding Company
Hull no.	12345
IMO no.	94112XX
Ship type	Bulk carrier

1.2 Principal particulars

Length overall	250.0 m
Length between perpendiculars	240.0 m
Breadth, moulded	40.0 m
Depth, moulded	20.0 m
Summer load line draught, moulded	14.0 m
Deadweight at summer load line draught	150,000 tons

1.3 Main engine

Manufacturer	XXX Industries
Type	6J70A
Maximum continuous rating (MCR_{ME})	15,000 kW x 80 rpm
Limited maximum continuous rating with the Engine Power Limitation installed ($MCR_{ME,lim}$)	9,940 kW x 70 rpm
SFC at 75% of MCR_{ME} or 83% of $MCR_{ME,lim}$	166.5 g/kWh
Number of sets	1
Fuel type	Diesel Oil

1.4 Auxiliary engine

Manufacturer	XXX Industries
Type	5J-200
Maximum continuous rating (MCR_{AE})	600 kW x 900 rpm
SFC at 50% MCR_{AE}	220.0 g/kWh
Number of sets	3
Fuel type	Diesel Oil

1.5 Ship speed

Ship speed (V_{ref}) (with the Engine Power Limitation installed)	13.20 knots
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2 Power curve

(Example 1; case of the EEDI ship)

An approved speed-power curve contained in the EEDI Technical File is shown in figure 2.1.

(Example 2; case of the pre-EEDI ship)

An estimated speed-power curve obtained from the tank test and/or numerical calculations, if available, is also shown in figure 2.1.

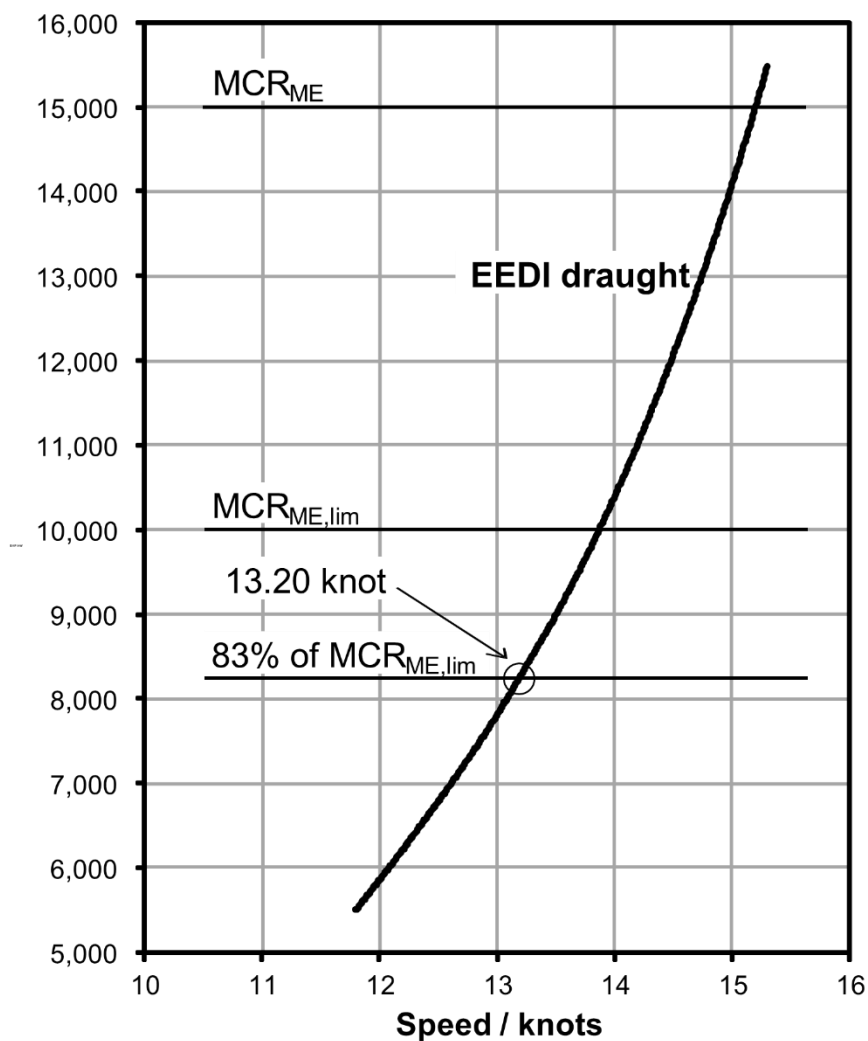


Figure 2.1: Power curve

(Example 3; case of the pre-EEDI ship with sea trial result calibrated to a different load draught)

An estimated speed-power curve under a ballast draught calibrated to the design load draught, obtained from the tank test and/or numerical calculations, if available, is shown in figure 2.2.

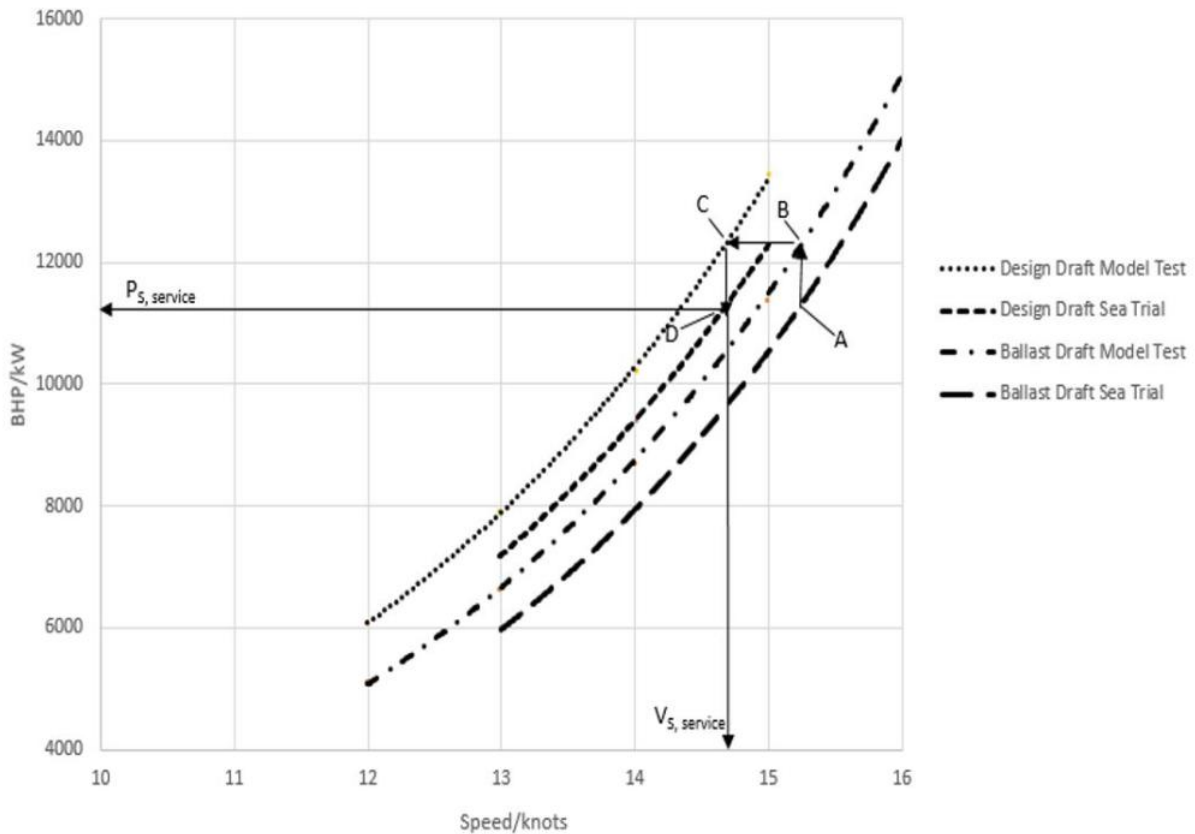


Figure 2.2: Power curve

3 Overview of propulsion system and electric power supply system

3.1 Propulsion system

3.1.1 Main engine

Refer to paragraph 1.3 of this appendix.

3.1.2 Propeller

Type	Fixed pitch propeller
Diameter	7.0 m
Number of blades	4
Number of sets	1

3.2 Electric power supply system

3.2.1 Auxiliary engines

Refer to paragraph 1.4 of this appendix.

3.2.2 Main generators

Manufacturer	XXX Electric
Rated output	560 kW (700 kVA) x 900 rpm
Voltage	AC 450 V
Number of sets	3

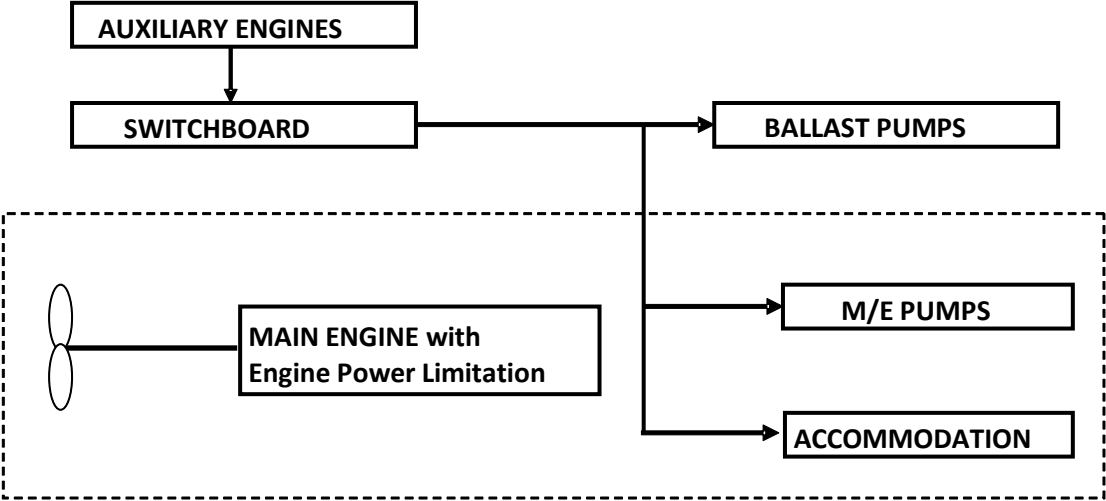


Figure 3.1: Schematic figure of propulsion and electric power supply system

4 Estimation process of speed-power curve

(Example: case of pre-EEDI ship)
 Speed-power curve is estimated based on model test results and/or numerical calculations, if available. The flow of the estimation processes is shown below.

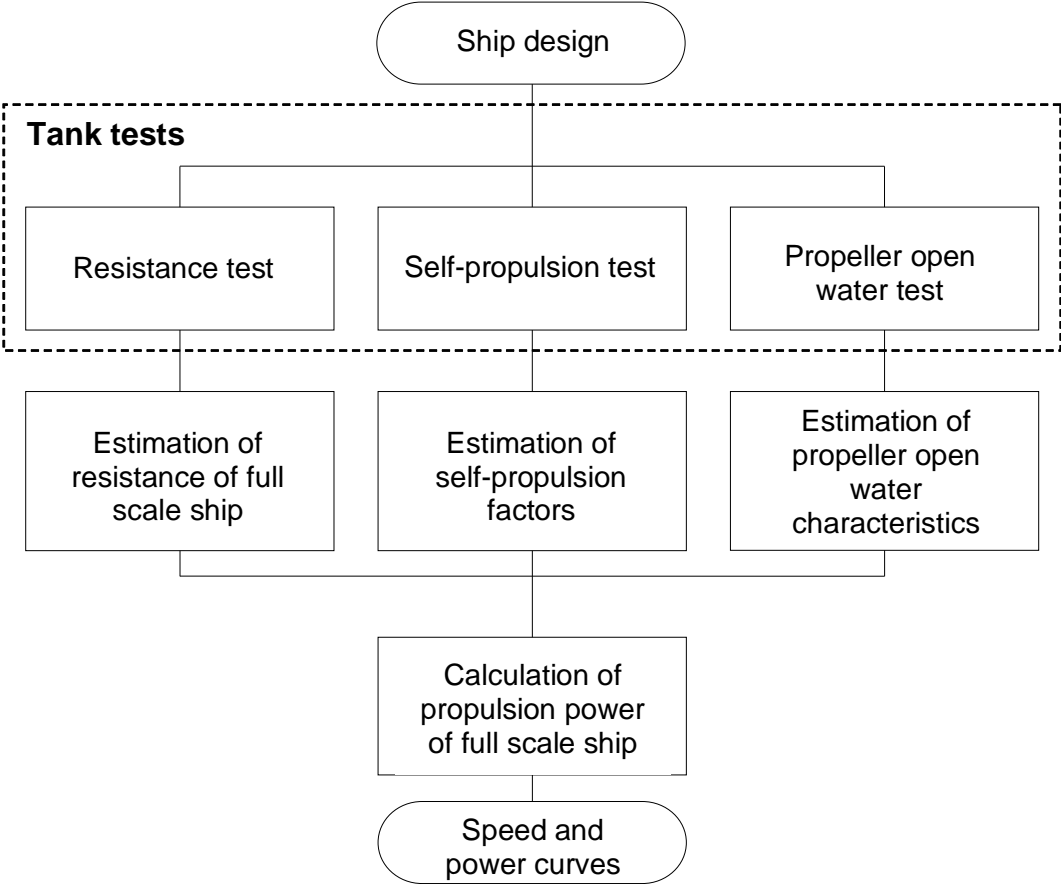


Figure 4: Flow chart of process for estimating speed-power curve from tank tests

5 Description of energy-saving equipment

5.1 Energy-saving equipment the effects of which are expressed as $P_{AEff(i)}$ and/or $P_{eff(i)}$ in the EEXI calculation formula

N/A

5.2 Other energy-saving equipment

(Example)

5.2.1 Rudder fins

5.2.2 Rudder bulb

.....

(Specifications, schematic figures and/or photos, etc. for each piece of equipment or device should be indicated. Alternatively, attachment of a commercial catalogue may be acceptable.)

6 Calculated value of attained EEXI

6.1 Basic data

Type of ship	Capacity DWT	Speed V_{ref} (knots)
Bulk carrier	150,000	13.20

6.2 Main engine

MCR_{ME} (kW)	$MCR_{ME,lim}$ (kW)	P_{ME} (kW)	Type of fuel	C_{FME}	SFC_{ME} (g/kWh)
15,000	9,940	8,250	Diesel oil	3.206	166.5

6.3 Auxiliary engines

P_{AE} (kW)	Type of fuel	C_{FAE}	SFC_{AE} (g/kWh)
625	Diesel oil	3.206	220.0

6.4 Ice class

N/A

6.5 Innovative electrical energy-efficient technology

N/A

6.6 Innovative mechanical energy-efficient technology

N/A

6.7 Cubic capacity correction factor

N/A

6.8 Calculated value of attained EEXI

$$\begin{aligned}
 EEXI &= \frac{(\prod_{j=1}^M f_j)(\sum_{i=1}^{n_{ME}} P_{ME(i)} \cdot C_{FME(i)} \cdot SFC_{ME(i)}) + (P_{AE} \cdot C_{FAE} \cdot SFC_{AE})}{f_i \cdot f_c \cdot f_l \cdot Capacity \cdot f_w \cdot V_{ref} \cdot f_m} \\
 &+ \frac{\{(\prod_{j=1}^M f_j \cdot \sum_{i=1}^{n_{PTI}} P_{PTI(i)} - \sum_{i=1}^{n_{eff}} f_{eff(i)} \cdot P_{AE_{eff(i)}})\} \cdot C_{FAE} \cdot SFC_{AE}}{f_i \cdot f_c \cdot f_l \cdot Capacity \cdot f_w \cdot V_{ref} \cdot f_m} \\
 &- \frac{(\sum_{i=1}^{n_{eff}} f_{eff(i)} \cdot P_{eff(i)} \cdot C_{FME} \cdot SFC_{ME})}{f_i \cdot f_c \cdot f_l \cdot Capacity \cdot f_w \cdot V_{ref} \cdot f_m} \\
 &= \frac{1 \times (8250 \times 3.206 \times 166.5) + (625 \times 3.206 \times 220.0) + 0 - 0}{1 \times 1 \times 1 \times 150000 \times 1 \times 13.20 \times 1} \\
 &= 2.45 \text{ (g - CO}_2\text{/ton \cdot mile)}
 \end{aligned}$$

attained EEXI: 2.45 g-CO₂/ton mile

ANNEX 14

RESOLUTION MEPC.352(78)
(adopted on 10 June 2022)

**2022 GUIDELINES ON OPERATIONAL CARBON INTENSITY INDICATORS AND THE
CALCULATION METHODS (CII GUIDELINES, G1)**

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee, the Committee, conferred upon it by international conventions for the prevention and control of marine pollution from ships,

NOTING that the Committee adopted, at its seventy-sixth session, by resolution MEPC.328(76), the *2021 Revised MARPOL Annex VI*, which will enter into force on 1 November 2022,

NOTING IN PARTICULAR that the *2021 Revised MARPOL Annex VI* (MARPOL Annex VI) contains amendments concerning mandatory goal-based technical and operational measures to reduce carbon intensity of international shipping,

NOTING FURTHER that regulation 28.1 of MARPOL Annex VI requires ships to which this regulation apply to calculate the attained annual operational CII taking into account the guidelines developed by the Organization,

RECOGNIZING that the aforementioned amendments to MARPOL Annex VI require relevant guidelines for uniform and effective implementation of the regulations and to provide sufficient lead time for industry to prepare,

NOTING that the Committee, at its seventy-sixth session, adopted, by resolution MEPC.336(76), the *2021 Guidelines on operational carbon intensity indicators and the calculation methods (CII Guidelines, G1)*,

HAVING CONSIDERED, at its seventy-eighth session, the draft *2022 Guidelines on operational carbon intensity indicators and the calculation methods (CII Guidelines, G1)*,

1 ADOPTS the *2022 Guidelines on operational carbon intensity indicators and the calculation methods (CII Guidelines, G1)*, as set out in the annex to the present resolution;

2 INVITES Administrations to take the annexed Guidelines into account when developing and enacting national laws which give force to and implement requirements set forth in regulation 28.1 of MARPOL Annex VI;

3 REQUESTS the Parties to MARPOL Annex VI and other Member Governments to bring the annexed Guidelines to the attention of masters, seafarers, shipowners, ship operators and any other interested parties;

4 AGREES to keep the Guidelines under review in light of experience gained with their implementation, also taking into consideration that in accordance with regulation 28.11 of

MARPOL Annex VI a review of the operational measure to reduce carbon intensity of international shipping shall be completed by 1 January 2026,

5 REVOKES the *2021 Guidelines on operational carbon intensity indicators and the calculation methods (CII Guidelines, G1)* adopted by resolution MEPC.336(76).

ANNEX

2022 GUIDELINES ON OPERATIONAL CARBON INTENSITY INDICATORS AND THE CALCULATION METHODS (CII GUIDELINES, G1)

1 Introduction

1.1 In the *Initial IMO Strategy on Reduction of GHG Emissions from Ships* (Resolution MEPC.304(72)), the level of ambition on carbon intensity of international shipping is quantified by the CO₂ emissions per transport work, as an average across international shipping.

1.2 These Guidelines address the calculation methods and the applicability of the operational carbon intensity indicator (CII) for individual ships to which chapter 4 of MARPOL Annex VI, as amended, applies.

2 Definitions

2.1 *MARPOL* means the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocols of 1978 and 1997 relating thereto, as amended.

2.2 *IMO DCS* means the data collection system for fuel oil consumption of ships referred to in regulation 27 and related provisions of MARPOL Annex VI.

2.3 For the purpose of these Guidelines, the definitions in MARPOL Annex VI, as amended, apply.

2.4 The metrics indicating the average CO₂ emissions per transport work of a ship are generally referred to as operational carbon intensity indicator (CII) in these Guidelines.

.1 A specific CII calculated based on the actual or estimated mass or volume of the shipment carried on board a ship is generally referred to as *demand-based CII*; and

.2 A specific CII, in which calculation the capacity of a ship is taken as proxy of the actual mass or volume of the shipment carried on board, is generally referred to as *supply-based CII*.

2.5 The supply-based CII which uses DWT as the capacity is referred to as *AER*, and the supply-based CII which uses GT as the capacity is referred to as *cgDIST*.

3 Application

3.1 For all ships to which regulation 28 of MARPOL Annex VI applies, the operational carbon intensity indicators defined in section 4 should be applied.

3.2 The operational carbon intensity indicators defined in section 5 are encouraged to be additionally used by ships, where applicable, for trial purposes.

4 Operational carbon intensity indicator (CII) of individual ships for use in implementing regulation 28 of MARPOL Annex VI

In its most simple form, the attained annual operational CII of individual ships is calculated as the ratio of the total mass of CO₂ (M) emitted to the total transport work (W) undertaken in a given calendar year, as follows:

$$\text{attained } CII_{\text{ship}} = M / W \quad (1)$$

4.1 Mass of CO₂ emissions (M)

The total mass of CO₂ is the sum of CO₂ emissions (in grams) from all the fuel oil consumed on board a ship in a given calendar year, as follows:

$$M = \sum_j FC_j \times C_{F_j} \quad (2)$$

where:

- j is the fuel oil type;
- FC_j is the total mass (in grams) of consumed fuel oil of type j in the calendar year, as reported under IMO DCS; and
- C_{F_j} represents the fuel oil mass to CO₂ mass conversion factor for fuel oil type j , in line with those specified in the *2018 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships (resolution MEPC.308(73))*, as may be further amended. In case the type of the fuel oil is not covered by the guidelines, the conversion factor should be obtained from the fuel oil supplier supported by documentary evidence.

4.2 Transport work (W)

In the absence of the data on actual transport work, the supply-based transport work (W_s) can be taken as a proxy, which is defined as the product of a ship's capacity and the distance travelled in a given calendar year, as follows:

$$W_s = C \times D_t \quad (3)$$

where:

- C represents the ship's capacity:
 - For bulk carriers, tankers, container ships, gas carriers, LNG carriers, general cargo ships, refrigerated cargo carrier and combination carriers, deadweight tonnage (DWT)¹ should be used as Capacity;
 - For cruise passenger ships, ro-ro cargo ships (vehicle carriers), ro-ro cargo

¹ Deadweight tonnage (DWT) means the difference in tonnes between the displacement of a ship in water of relative density of 1,025 kg/m³ at the summer load draught and the lightweight of the ship. The summer load draught should be taken as the maximum summer draught as certified in the stability booklet approved by the Administration or any organization recognized by it.

ships and ro-ro passenger ships, gross tonnage (GT)² should be used as Capacity; and

- D_t represents the total distance travelled (in nautical miles), as reported under IMO DCS.

5 Operational carbon intensity indicator (CII) of individual ships for trial purpose

The following metrics are encouraged to be used for trial purposes, where applicable:

- .1 Energy Efficiency Performance Indicator (EEPI)

$$EEPI = \frac{M}{C \times D_t}$$

- .2 cbDIST

$$cbDIST = \frac{M}{ALB \times D_t}$$

- .3 clDIST

$$clDIST = \frac{M}{Lanemeter \times D_t}$$

- .4 EEOI, as defined in MEPC.1/Circ.684 on *Guidelines for voluntary use of the ship energy efficiency operational indicator (EEOI)*.

In the formulas above:

- the mass of CO₂ (M), the ship's capacity (C) and the total distance travelled (D_t) are identical with those used to calculate the attained CII of individual ships, as specified in section 4.1 and 4.2;
- D_l means the laden distance travelled (in nautical miles) when the ship is loaded;
- ALB means the number of available lower berths of a cruise passenger ship; and
- $Lanemeter$ means the length (in metres) of the lanes of a ro-ro ship.

² Gross tonnage (GT) should be calculated in accordance with the International Convention on Tonnage Measurement of Ships, 1969.

ANNEX 15

RESOLUTION MEPC.353(78)
(adopted on 10 June 2022)

**2022 GUIDELINES ON THE REFERENCE LINES FOR USE WITH OPERATIONAL
CARBON INTENSITY INDICATORS (CII REFERENCE LINES GUIDELINES, G2)**

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee (the Committee) conferred upon it by international conventions for the prevention and control of marine pollution from ships,

NOTING that the Committee adopted, at its seventy-sixth session, by resolution MEPC.328(76), the *2021 Revised MARPOL Annex VI*, which will enter into force on 1 November 2022,

NOTING IN PARTICULAR that the *2021 Revised MARPOL Annex VI* (MARPOL Annex VI) contains amendments concerning mandatory goal-based technical and operational measures to reduce carbon intensity of international shipping,

NOTING FURTHER that regulation 28.4 of MARPOL Annex VI requires reference lines to be established for each ship type to which regulation 28 is applicable,

NOTING that the Committee, at its seventy-sixth session, adopted, by resolution MEPC.337(76), *2021 Guidelines on the reference lines for use with operational carbon intensity indicators (CII Reference Lines Guidelines, G2)*

HAVING CONSIDERED, at its seventy-eighth session, the draft *2022 Guidelines on the reference lines for use with operational carbon intensity indicators (CII reference lines guidelines, G2)*,

1 ADOPTS the *2022 Guidelines on the reference lines for use with operational carbon intensity indicators (CII reference lines guidelines, G2)*, as set out in the annex to the present resolution;

2 INVITES Administrations to take the annexed Guidelines into account when developing and enacting national laws which give force to and implement requirements set forth in regulation 28.4 of MARPOL Annex VI;

3 REQUESTS the Parties to MARPOL Annex VI and other Member Governments to bring the annexed Guidelines to the attention of masters, seafarers, shipowners, ship operators and any other interested parties;

4 AGREES to keep the Guidelines under review in light of experience gained with their implementation, also taking into consideration that in accordance with regulation 28.11 of MARPOL Annex VI a review of the operational measures to reduce carbon intensity of international shipping shall be completed by 1 January 2026;

5 REVOKES the *2021 Guidelines on the reference lines for use with operational carbon intensity indicators (CII Reference Lines Guidelines, G2)*.

ANNEX

2022 GUIDELINES ON THE REFERENCE LINES FOR USE WITH OPERATIONAL CARBON INTENSITY INDICATORS (CII REFERENCE LINES GUIDELINES, G2)

1 Introduction

1.1 These Guidelines provide the methods to calculate the reference lines for use with operational carbon intensity indicators, and the ship type specific carbon intensity reference lines as referred to in regulation 28 of MARPOL Annex VI.

1.2 One reference line is developed for each ship type to which regulation 28 of MARPOL Annex VI applies, based on the specific indicators stipulated in *2022 Guidelines on operational carbon intensity indicators and the calculation methods* (G1) developed by the Organization, ensuring that only data from comparable ships are included in the calculation of each reference line.

2 Definition

2.1 *MARPOL* means the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocols of 1978 and 1997 relating thereto, as amended.

2.2 *IMO DCS* means the data collection system for fuel oil consumption of ships referred to in regulation 27 and related provisions of MARPOL Annex VI.

2.3 For the purpose of these Guidelines, the definitions in MARPOL Annex VI, as amended, apply.

2.4 An operational carbon intensity indicator (CII) reference line is defined as a curve representing the median attained operational carbon intensity performance, as a function of Capacity, of a defined group of ships in year of 2019.

3 Method to develop the CII reference lines

3.1 Given the limited data available for the year of 2008, the operational carbon intensity performance of ship types in year 2019 is taken as the reference.

3.2 For a defined group of ships, the reference line is formulated as follows:

$$CII_{ref} = aCapacity^{-c} \quad (1)$$

where CII_{ref} is the reference value of year 2019, $Capacity$ is identical with the one defined in the specific carbon intensity indicator (CII) for a ship type, as shown in Table. 1; a and c are parameters estimated through median regression fits, taking the attained CII and the Capacity of individual ships collected through IMO DCS in year 2019 as the sample.

4 Ship type specific operational carbon intensity reference lines

The parameters for determining the ship type specific reference lines, for use in Eq.(1), are specified as follows:

Table 1: Parameters for determining the 2019 ship type specific reference lines

Ship type		Capacity	<i>a</i>	<i>c</i>
Bulk carrier	279,000 DWT and above	279,000	4745	0.622
	less than 279,000 DWT	DWT	4745	0.622
Gas carrier	65,000 and above	DWT	14405E7	2.071
	less than 65,000 DWT	DWT	8104	0.639
Tanker		DWT	5247	0.610
Container ship		DWT	1984	0.489
General cargo ship	20,000 DWT and above	DWT	31948	0.792
	less than 20,000 DWT	DWT	588	0.3885
Refrigerated cargo carrier		DWT	4600	0.557
Combination carrier		DWT	5119	0.622
LNG carrier	100,000 DWT and above	DWT	9.827	0.000
	65,000 DWT and above, but less than 100,000 DWT	DWT	14479E10	2.673
	less than 65,000 DWT	65,000	14779E10	2.673
Ro-ro cargo ship (vehicle carrier)	57,700 GT and above	57,700	3627	0.590
	30,000 GT and above, but less than 57,700 GT	GT	3627	0.590
	Less than 30,000 GT	GT	330	0.329
Ro-ro cargo ship		GT	1967	0.485
Ro-ro passenger ship	Ro-ro passenger ship	GT	2023	0.460
	High-speed craft designed to SOLAS chapter X	GT	4196	0.460
Cruise passenger ship		GT	930	0.383

ANNEX 16

RESOLUTION MEPC.354(78)
(adopted on 10 June 2022)

**2022 GUIDELINES ON THE OPERATIONAL CARBON INTENSITY
RATING OF SHIPS (CII RATING GUIDELINES, G4)**

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee (the Committee) conferred upon it by international conventions for the prevention and control of marine pollution from ships,

NOTING that the Committee adopted, by resolution MEPC.328(76), the *2021 Revised MARPOL Annex VI*, which will enter into force on 1 November 2022,

NOTING IN PARTICULAR that the *2021 Revised MARPOL Annex VI* (MARPOL Annex VI) contains amendments concerning mandatory goal-based technical and operational measures to reduce carbon intensity of international shipping,

NOTING FURTHER that regulation 28.6 of MARPOL Annex VI requires ships to which this regulation apply to determine operational carbon intensity rating taking into account guidelines developed by the Organization,

RECOGNIZING that the aforementioned amendments to MARPOL Annex VI require relevant guidelines for uniform and effective implementation of the regulations and to provide sufficient lead time for industry to prepare,

NOTING that, at its seventy-sixth session, the Committee adopted, by resolution MEPC.339(76) the *2021 Guidelines on the operational carbon intensity rating of ships (CII rating guidelines, G4)*,

HAVING CONSIDERED, at its seventy-eighth session, draft *2022 Guidelines on the operational carbon intensity rating of ships (CII rating guidelines, G4)*,

1 ADOPTS the *2022 Guidelines on the operational carbon intensity rating of ships (CII rating guidelines, G4)*, as set out in the annex to the present resolution;

2 INVITES Administrations to take the annexed Guidelines into account when developing and enacting national laws which give force to and implement requirements set forth in regulation 28.6 of MARPOL Annex VI;

3 REQUESTS the Parties to MARPOL Annex VI and other Member Governments to bring the annexed Guidelines to the attention of masters, seafarers, shipowners, ship operators and any other interested parties;

4 AGREES to keep the Guidelines under review in light of experience gained with their implementation, of additional data collected and analysed, also taking into consideration that

in accordance with regulation 28.11 of MARPOL Annex VI a review of the operational measure to reduce carbon intensity of international shipping shall be completed by 1 January 2026;

5 REVOKES the *2021 Guidelines on the operational carbon intensity rating of ships (CII rating guidelines, G4)*, adopted by resolution MEPC.339(76).

ANNEX

2022 GUIDELINES ON THE OPERATIONAL CARBON INTENSITY RATING OF SHIPS (CII RATING GUIDELINES, G4)

1 Introduction

1.1 These Guidelines provide the methods to assign operational energy efficiency performance ratings to ships, as referred to in regulation 28 of MARPOL Annex VI. On this basis, the boundaries for determining a ship's annual operational carbon intensity performance from year 2023 to 2030 are also provided.

2 Definitions

2.1 *MARPOL* means the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocols of 1978 and 1997 relating thereto, as amended.

2.2 *IMO DCS* means the data collection system for fuel oil consumption of ships referred to in regulation 27 and related provisions of MARPOL Annex VI.

2.3 For the purpose of these Guidelines, the definitions in MARPOL Annex VI, as amended, apply.

2.4 *Operational carbon intensity rating* means to assign a ranking label from among the five grades (A, B, C, D and E) to the ship based on the attained annual operational carbon intensity indicator, indicating a major superior, minor superior, moderate, minor inferior, or inferior performance level.

3 Framework of the operational energy efficiency performance rating

3.1 An operational energy efficiency performance rating should be assigned annually to each ship to which regulation 28 of MARPOL Annex VI applies, in a transparent and robust manner, based on the deviation of the attained annual operational carbon intensity indicator (CII) of a ship from the required value.

3.2 To facilitate the rating assignment, for each year from 2023 to 2030, four boundaries are defined for the five-grade rating mechanism, namely superior boundary, lower boundary, upper boundary, and inferior boundary. Thus, a rating can be assigned through comparing the attained annual operational CII of a ship with the boundary values.

3.3 The boundaries are set based on the distribution of CIIs of individual ships in year 2019. The appropriate rating boundaries are expected to generate the following results: the middle 30% of individual ships across the fleet segment, in terms of the attained annual operational CIIs, are to be assigned rating C, while the upper 20% and further upper 15% of individuals are to be assigned rating D and E respectively, and the lower 20% and further lower 15% of the individuals are to be assigned rating B and A, respectively, as illustrated in figure 1.

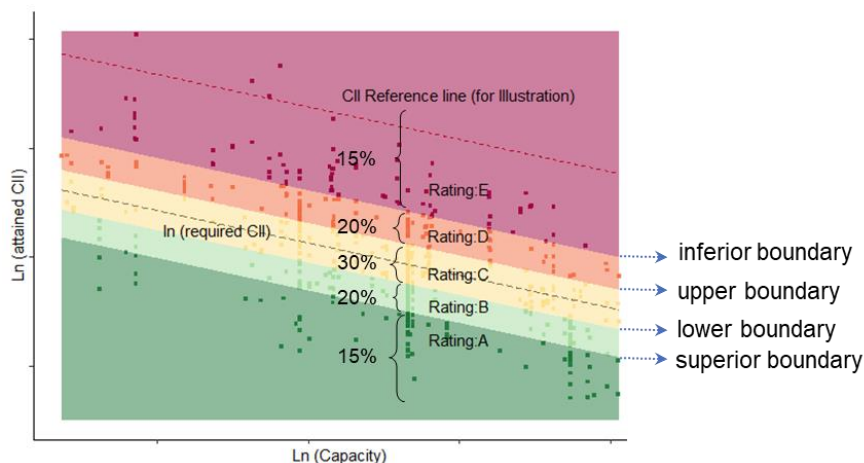


Figure 1: Operational energy efficiency performance rating scale

3.4 Given the incremental operational carbon intensity reduction factors over time, the boundaries for defining performance ratings should be synchronized accordingly, although the relative distance between the boundaries should not change. The rating of a ship would be determined by the attained CII and the predetermined rating boundaries, rather than the attained CII of other ships. Note that the distribution of ship individual ratings in a specific year may not be always identical with the scenario in 2019, where for example 20% may achieve A, 30% may achieve B, 40% may achieve C, 8% may achieve D and 2% may achieve E in a given year.

4 Method to determine the rating boundaries

4.1 The boundaries can be determined by the required annual operational CII in conjunction with the vectors, indicating the direction and distance they deviate from the required value (denoted as dd vectors for easy reference), as illustrated in figure 2.

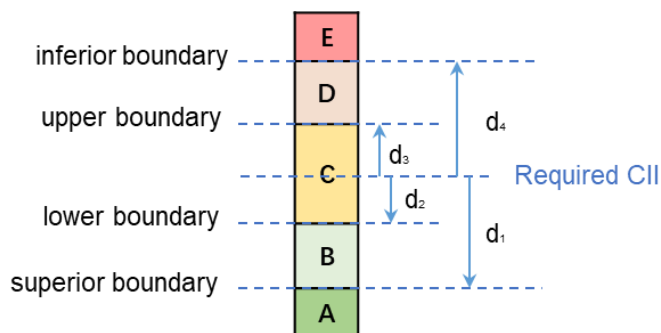


Figure 2: dd vectors and rating bands

4.2 Statistically, the dd vectors depend on the distribution of the attained annual operational CII of ships of the type concerned, which can be estimated through a quantile regression, taking data collected through DCS in year 2019 as the sample.

4.3 The quantile regression model for a specific ship type can be developed as follows:

$$\ln(\text{attained CII}) = \delta^{(p)} - c \ln(\text{Capacity}) + \varepsilon^{(p)}, \quad p = \{0.15, 0.35, 0.50, 0.65, 0.85\} \quad (1)$$

where $Capacity$ is identical with the one used in the operation carbon intensity indicator as specified in the Guidelines on operational carbon intensity indicators and the calculation

methods (G1); p is the typical quantile, meaning the proportion of observations with a lower value is $p\%$; $\delta^{(p)}$ is the constant term, and $\varepsilon^{(p)}$ is the error term.

4.4 The quantile regression lines in logarithm form are illustrated in Fig.3.

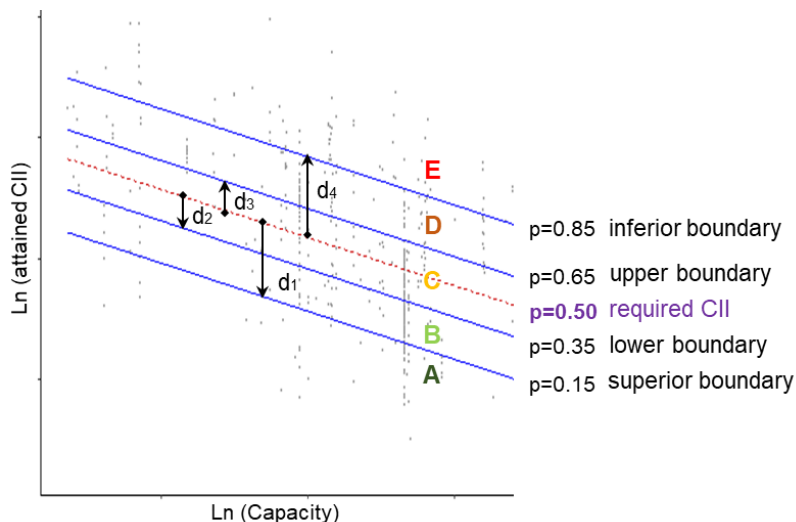


Figure 3: Quantile regression lines in logarithm form

4.5 Then, the dd vectors can be calculated based on the estimates of the intercept ($\hat{\delta}^{(p)}$), in accordance with Eq.(2), as follows:

$$\left. \begin{aligned} d_1 &= \hat{\delta}^{(0.15)} - \hat{\delta}^{(0.50)} \\ d_2 &= \hat{\delta}^{(0.35)} - \hat{\delta}^{(0.50)} \\ d_3 &= \hat{\delta}^{(0.65)} - \hat{\delta}^{(0.50)} \\ d_4 &= \hat{\delta}^{(0.85)} - \hat{\delta}^{(0.50)} \end{aligned} \right\} \quad (2)$$

4.6 Through an exponential transformation of each dd vector, the four boundaries fitted in the original data form can be derived based on the required annual operational carbon intensity indicator ($required\ CII$), as follows:

$$\left. \begin{aligned} \text{superior boundary} &= \exp(d_1) \cdot \text{required } CII \\ \text{lower boundary} &= \exp(d_2) \cdot \text{required } CII \\ \text{upper boundary} &= \exp(d_3) \cdot \text{required } CII \\ \text{inferior boundary} &= \exp(d_4) \cdot \text{required } CII \end{aligned} \right\} \quad (3)$$

Rating boundaries of ship types

The estimated dd vectors after exponential transformation for determining the rating boundaries of ship types are as follows:

Table 1: *dd* vectors for determining the rating boundaries of ship types

Ship type		Capacity in CII calculation	<i>dd</i> vectors (after exponential transformation)			
			exp(d1)	exp(d2)	exp(d3)	exp(d4)
Bulk carrier		DWT	0.86	0.94	1.06	1.18
Gas carrier	65,000 DWT and above	DWT	0.81	0.91	1.12	1.44
	less than 65,000 DWT	DWT	0.85	0.95	1.06	1.25
Tanker		DWT	0.82	0.93	1.08	1.28
Container ship		DWT	0.83	0.94	1.07	1.19
General cargo ship		DWT	0.83	0.94	1.06	1.19
Refrigerated cargo carrier		DWT	0.78	0.91	1.07	1.20
Combination carrier		DWT	0.87	0.96	1.06	1.14
LNG carrier	100,000 DWT and above	DWT	0.89	0.98	1.06	1.13
	less than 100,000 DWT		0.78	0.92	1.10	1.37
Ro-ro cargo ship (vehicle carrier)		GT	0.86	0.94	1.06	1.16
Ro-ro cargo ship		GT	0.76	0.89	1.08	1.27
Ro-ro passenger ship		GT	0.76	0.92	1.14	1.30
Cruise passenger ship		GT	0.87	0.95	1.06	1.16

By comparing the attained annual operational CII of a specific ship with the four boundaries, a rating can then be assigned. For example, given the required CII of a bulk carrier in a specific year as 10 gCO₂/(dwt.nmile), then the superior boundary, lower boundary, upper boundary, and inferior boundary is 8.6, 9.4, 10.6 and 11.8 gCO₂/(dwt.nmile). If the attained CII is 9 gCO₂/(dwt.nmile), the ship would be rated as "B".

ANNEX 17

RESOLUTION MEPC.355(78)
(adopted on 10 June 2022)

**2022 INTERIM GUIDELINES ON CORRECTION FACTORS AND VOYAGE
ADJUSTMENTS FOR CII CALCULATIONS (CII GUIDELINES, G5)**

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee (the Committee) conferred upon it by international conventions for the prevention and control of marine pollution from ships,

NOTING that the Committee, at its seventy-sixth session, adopted, by resolution MEPC.328(76), the *2021 Revised MARPOL Annex VI*, which will enter into force on 1 November 2022,

NOTING IN PARTICULAR that the *2021 Revised MARPOL Annex VI* (MARPOL Annex VI) contains amendments concerning mandatory goal-based technical and operational measures to reduce carbon intensity of international shipping,

NOTING ALSO that regulation 28.1 of MARPOL Annex VI requires ships to which this regulation apply to calculate the attained annual operational carbon intensity indicator (CII) taking into account the guidelines developed by the Organization,

NOTING FURTHER that the in adopting resolution MEPC.336(76) on the *2021 Guidelines on operational carbon intensity indicators and the calculation methods (CII Guidelines, G1)*, the Committee agreed to consider substantiated proposals for CII correction factors for certain ship types, operational profiles and/or voyages with a view to enhancing, as appropriate, the CII Guidelines (G1), before entry into force of the aforementioned amendments to MARPOL Annex VI,

RECOGNIZING that the aforementioned amendments to MARPOL Annex VI require relevant guidelines for uniform and effective implementation of the regulations and to provide sufficient lead time for industry to prepare,

HAVING CONSIDERED, at its seventy-eighth session, the draft *2022 Interim Guidelines on correction factors and voyage adjustments for CII calculations (CII Guidelines, G5)*,

- 1 ADOPTS the *2022 Interim Guidelines on correction factors and voyage adjustments for CII calculations (CII Guidelines, G5)*, as set out in the annex to the present resolution;
- 2 INVITES Administrations to take the annexed Guidelines into account when developing and enacting national laws which give force to and implement requirements set forth in regulation 28.1 of MARPOL Annex VI;
- 3 REQUESTS the Parties to MARPOL Annex VI and other Member Governments to bring the annexed Guidelines to the attention of masters, seafarers, shipowners, ship operators and any other interested parties;

4 AGREES to keep the Guidelines under review in light of experience gained with their implementation, also taking into consideration that in accordance with regulation 28.11 of MARPOL Annex VI a review of the operational measure to reduce carbon intensity of international shipping shall be completed by 1 January 2026.

ANNEX

**2022 INTERIM GUIDELINES ON CORRECTION FACTORS AND VOYAGE
ADJUSTMENTS FOR CII CALCULATIONS (CII GUIDELINES, G5)**

CONTENTS

- 1 INTRODUCTION
- 2 DEFINITIONS
- 3 APPLICATION
- 4 ATTAINED ANNUAL OPERATIONAL CII (CII_{SHIP}) FORMULA FOR VOYAGE
ADJUSTMENTS AND CORRECTION FACTORS

APPENDIX 1 – CORRECTION FACTORS FOR USE IN CII CALCULATION

APPENDIX 2 – GUIDANCE ON REPORTING OF FUEL OIL CONSUMPTION AND
DISTANCE TRAVELLED FOR VOYAGE PERIODS WHERE THE SHIP
MEETS THE CRITERIA TO APPLY ANY VOYAGE ADJUSTMENT

1 Introduction

1.1 These Guidelines address the correction factors and voyage adjustments which may be applied to the calculation of the attained annual operational carbon intensity indicator (CII_{ship}) of regulation 28 of MARPOL Annex VI, and as defined by the *2022 Guidelines on operational carbon intensity indicators and the calculation methods (CII Guidelines, G1)* (resolution MEPC.352 (78)). It should be noted that the use of correction factors and voyage adjustments should in no way undermine the goal of reducing the carbon intensity of international shipping as set out in regulation 20 of MARPOL Annex VI.

2 Definitions

For the purpose of these Guidelines, the definitions in regulation 2 of MARPOL Annex VI, as amended, apply. In addition and for the scope of these guidelines, the following definitions apply.

2.1 *MARPOL* means the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocols of 1978 and 1997 relating thereto, as amended.

2.2 *IMO DCS* means the IMO Ship Fuel Oil Consumption Database referred to in regulation 27 and related provisions of MARPOL Annex VI.

2.3 A *voyage period* is a period of time where the ship meets the criteria to apply a voyage adjustment in these Guidelines.

2.4 A *voyage adjustment* deducts relevant fuel consumption, as well as the associated distance travelled from the calculation of attained CII for a defined period subject to certain threshold conditions being met.

2.5 A *correction factor* means a factor in the numerator or denominator of the CII formula which adjusts the calculation of the attained CII.

2.6 A *refrigerated container* is an intermodal shipping container that is refrigerated (including chilled and frozen containers) or heated for the transportation of temperature-sensitive cargo, which will receive its power from the ship's power supply.

2.7 *Ice edge* is defined by paragraph 4.4. of the WMO Sea-Ice Nomenclature, March 2014 as the demarcation at any given time between the open sea and sea ice of any kind, whether fast or drifting.

2.8 A tanker should be considered in *Ship-to-Ship (STS)* operation when operating in accordance with regulation 41.2 of MARPOL Annex I and applying the best practices in accordance with the OCIMF Ship to Ship Transfer Guide for Petroleum, Chemical and Liquefied Gases. For the purpose of these guidelines, a tanker is engaged in an STS voyage if a voyage between cargo loading and cargo discharging locations, or a voyage between cargo discharging and cargo loading locations does not exceed 600 nautical miles and the time for each of these voyages (which does not include port or discharge time) is limited to 72 hours.

2.9 A *shuttle tanker* is a tanker which is equipped with dynamic positioning and specialized cargo handling equipment making it capable of loading crude oil at offshore installations.

2.10 A *self-unloading bulk carrier* is a bulk carrier with an onboard cargo handling system that is utilized to discharge dry bulk cargo via a boom conveyor or shipboard cargo pipeline equipment.

3 Application

3.1 For all ships to which regulation 28 of MARPOL Annex VI applies, the operational carbon intensity formula defined in section 4 should be applied when using voyage adjustments or correction factors.

3.2 Rating of ships according to the *2022 Guidelines on the operational carbon intensity rating of ships (CII Rating Guidelines G4)* (resolution MEPC.354(78)) should be carried out using the corrected attained annual operational CII.

3.3 Corrections factors for electrical related fuel consumption $FC_{electrical}$, boiler consumption FC_{boiler} , and other related fuel consumption FC_{others} should not be used for periods where voyage adjustments apply.

4 Attained annual operational CII (CII_{ship}) formula for voyage adjustments and correction factors

Use of voyage adjustments and correction factors require changes to be made to the overall attained annual operational CII (CII_{ship}) formula as follows:

$$\frac{\sum_j C_{F_j} \cdot \left\{ FC_j - \left(FC_{voyage,j} + TF_j + (0.75 - 0.03y_i) \cdot (FC_{electrical,j} + FC_{boiler,j} + FC_{others,j}) \right) \right\}}{f_i \cdot f_m \cdot f_c \cdot f_{VSE} \cdot Capacity \cdot (D_t - D_x)}$$

Where:

- j is the fuel type;
- C_{F_j} represents the fuel mass to CO₂ mass conversion factor for fuel type j , in line with those specified in the *2018 Guidelines on the method of calculation of the attained EEDI for new ships* (resolution MEPC.308(73) as amended by resolutions MEPC.322(74) and MEPC.332(76)), as may be further amended);
- FC_j is the total mass of consumed fuel of type j in the calendar year, as reported under IMO DCS, converted to grams;
- $FC_{voyage,j}$ is the mass (in grams) of fuel of type j , consumed in voyage periods during the calendar year which may be deducted according to paragraph 4.1 of these Guidelines;
- $TF_j = (1 - AF_{Tanker}) \cdot FC_{S,j}$ represents the quantity of fuel j removed for STS or shuttle tanker operation, where $FC_{S,j} = FC_j$ for shuttle tankers and $FC_{S,j}$ is the total quantity of fuel j used on STS voyages for STS ships. If $TF_j > 0$ then $FC_{electrical,j} = FC_{boiler,j} = FC_{others,j} = 0$;
- AF_{Tanker} represents the correction factor to be applied to shuttle tankers or STS voyages according to paragraph 4.2 of these Guidelines;
- y_i is a consecutive numbering system starting at $y_{2023} = 0$, $y_{2024} = 1$, $y_{2025} = 2$,

etc;

- $FC_{electrical,j}$ is the mass (in grams) of fuel type j , consumed for production of electrical power which is allowed to be deducted according to paragraph 4.3 of these Guidelines;
- $FC_{boiler,j}$ is the mass (in grams) of fuel type j , consumed by the boiler which may be deducted according to paragraph 4.4 of these Guidelines;
- $FC_{others,j}$ is the mass (in grams) of fuel type j , consumed by other related fuel consumption devices according to paragraph 4.5 of these Guidelines;
- f_i is the capacity correction factor for ice-classed ships as specified in the *2018 Guidelines on the method of calculation of the attained EEDI for new ships* (resolution MEPC.308(73) as amended by resolutions MEPC.322(74) and MEPC.332(76), as may be further amended);
- f_m is the factor for ice-classed ships having IA Super and IA as specified in the *2018 Guidelines on the method of calculation of the attained EEDI for new ships* (resolution MEPC.308(73) as amended by resolutions MEPC.322(74) and MEPC.332(76), as may be further amended);
- f_c represents the cubic capacity correction factors for chemical tankers as specified in paragraph 2.2.12 of the *2018 Guidelines on the method of calculation of the attained EEDI for new ships* (resolution MEPC.308(73) as amended by resolutions MEPC.322(74) and MEPC.332(76), as may be further amended);
- $f_{i,VSE}$ represents the correction factor for ship-specific voluntary structural enhancement as specified in paragraph 2.2.11.2 of the *2018 Guidelines on the method of calculation of the attained EEDI for new ships* (resolution MEPC.308(73) as amended by resolutions MEPC.322(74) and MEPC.332(76), as may be further amended), to be applied only to self-unloading bulk carriers;
- *Capacity* is deadweight or gross tonnes as defined for each specific ship type in the *2022 Guidelines on the reference lines for use with operational carbon intensity indicators (CII Reference lines Guidelines, G2)* (resolution MEPC.353(78));
- D_t represents the total distance travelled (in nautical miles), as reported under IMO DCS; and
- D_x represents distance travelled (in nautical miles) for voyage periods which may be deducted from CII calculation according to paragraph 4.1 of these Guidelines.

In case the above voyage exclusion or correction factors are applied, the ship should still report total fuel oil consumption (t) of each type of fuel, total hours under way (h) and total distance travelled (nm) to the Administration pursuant to regulation 27 of MARPOL Annex VI.

All relevant data should be recorded in the ship's logbook. Each parameter, if used, should also be reported to the Administration.

4.1 $FC_{voyage,j}$ for voyage adjustment

The parameter $FC_{voyage,j}$ is the total mass (in grams) of fuel of type j , consumed in voyage periods during the calendar year which may be deducted from the calculation of the attained CII in case the ship encounters one of the following situations:

- .1 scenarios specified in regulation 3.1 of MARPOL Annex VI, which may endanger safe navigation of a ship; and
- .2 sailing in ice conditions, which means sailing of an ice-classed ship in a sea area within the ice edge.

In cases where $FC_{voyage,j}$ is used:

- any associated distance travelled must also be deducted using D_x otherwise ships will benefit from distance travelled without any associated CO₂ emission.
- the ship should report data for the deductions associated with voyage adjustments to the Administration in accordance with appendix 2 of these guidelines.

4.2 AF_{Tanker} for corrections to shuttle tankers or STS voyages on tankers

Tankers engaged in STS voyages as defined above in paragraph 2.8 may apply the correction factor $AF_{Tanker,STS}$ to all fuel consumption relating to STS voyages, including cargo transfer at offshore location, voyage, cargo discharge and waiting periods at anchor or drifting during which the ship reports being part of an STS operation and voyage. The STS operation includes fuel consumption in port where the transferred cargo is discharged after such a voyage.

The correction is calculated as:

$$AF_{Tanker,STS} = 6.1742 \times DWT^{-0.246}$$

Where $AF_{Tanker,STS}$ is applied, $FC_{electrical}$, FC_{boiler} and FC_{others} should not be used.

Shuttle tankers equipped with dynamic positioning as defined above in paragraph 2.9 may apply the correction factor $AF_{Tanker,Shuttle}$ to total fuel consumption:

The correction factor is calculated as:

$$AF_{Tanker,Shuttle} = 5.6805 \times DWT^{-0.208}$$

Where $AF_{Tanker,Shuttle}$ is applied, $FC_{electrical}$, FC_{boiler} , FC_{others} and $AF_{Tanker,STS}$ should not be used.

4.3 $FC_{electrical,j}$ for corrections relating to electrical power

The parameter $FC_{electrical,j}$ is the mass (in grams) of fuel of type j , consumed for production of electrical power during the calendar year which may be deducted from the calculation of the attained CII for the following purposes:

- .1 Electrical consumption of refrigerated containers (on all ships where they are carried) using the calculation methodology specified in part A of appendix 1.

- .2 Electrical consumption of cargo cooling/reliquefaction systems on gas carriers and LNG Carriers.
- .3 Electrical consumption of discharge pumps on tankers.

4.4 $FC_{Boiler,j}$ for corrections relating to boiler fuel consumption

The parameter $FC_{Boiler,j}$ is the mass (in grams) of fuel of type j , consumed by the oil-fired boiler during the calendar year which may be deducted from the calculation of the attained CII, for the purposes of cargo heating and cargo discharge on tankers. The calculation methodology for $FC_{Boiler,j}$ is specified in part B of appendix 1.

4.5 $FC_{others,j}$ for corrections relating to other related fuel consumption devices

The parameter $FC_{others,j}$ is the mass (in grams) of fuel of type j , consumed by standalone engine driven cargo pumps during discharge operations on tankers which may be deducted from the calculation of the attained CII.

4.6 EEDI and EEXI Correction factors

The EEDI correction factors as defined above in paragraph 4 may be applied, provided they are included in the ship's EEDI Technical File or EEXI Technical file.

APPENDIX 1

CORRECTION FACTORS FOR USE IN CII CALCULATION

Part A. $FC_{\text{Electrical}}$ for Corrections relating to electrical power

1 Refrigerated containers

For ships carrying refrigerated containers, the correction factor $FC_{\text{Electrical}}$ may be applied as follows:

- .1 For ships that have the ability to monitor reefer electrical consumption, the ship may calculate reefer container kWh consumption as follows:

$$FC_{\text{electrical_reefer},j} = \text{Reefer kWh} \times SFOC$$

where:

- $FC_{\text{electrical_reefer},j}$ (Reefer fuel oil consumption) represents the estimated fuel consumption attributed to in-use refrigerated containers carried.
- *Reefer kWh* is measured on the ship by the kWh meter counter on the ship.
- *SFOC* represents the specific fuel consumption in g/kWh as a weighted average of the engines used to provide the electrical power, as per the EEDI/EEXI Technical File or the NO_x Technical File. In the case of ships without a Technical File, a default value of 175 g/kWh for 2 stroke engines and 200 g/kWh for 4 stroke engines may be applied. In the case of waste heat recovery systems as defined under Category C1 in MEPC.1/Circ.896 the SFOC to be used will be at the discretion of the Administration.

Alternatives such as derivation of fuel consumption or kWh from auto-logged data may be used subject to approval by the Administration. Note that ship reefer kWh consumption should not include consumption during voyage adjustment periods.

- .2 For ships that do not have the ability to monitor reefer electrical consumption, the ship may calculate reefer kWh consumption as follows:

$$FC_{\text{electrical_reefer},j} = Cx \cdot 24 \cdot SFOC_{\text{avg}} \cdot \left(\text{Reefer_days}_{\text{sea}} + \sum \text{Reefer_days}_{\text{port}} \right)$$

where:

- *Cx* represents a default reefer consumption of 2.75 kW/h.
- *Reefer_days_{sea}* represents the number of in-use reefer-days over the declared period and may be derived using the number of reefer containers as recorded in the BAPLIE file multiplied by the number of days at sea.
- *SFOC_{avg}* represents the specific fuel consumption in g/kWh as a weighted average of the engines used to provide the electrical power, as per the EEDI/EEXI Technical File or NO_x Technical File. In the case of ships without a Technical File, a default value of 175 g/kWh for 2 stroke engines and 200 g/kWh for 4 stroke

engines may be applied. In the case of waste heat recovery systems as defined under Category C1 in MEPC.1/Circ.896 the SFOC to be used will be at the discretion of the Administration.

In ports where shore-power is not used, the number of in-use reefers at port should be calculated as:

$$Reefer_days_{port} = \frac{No_c\ Arrival + No_c\ Departure}{2} \times Days_{port}$$

where:

- $Days_{port}$ represents number of days in port.
- $Reefer_days_{port}$ represents the number of in-use reefer days while at port.*
- $No_c\ Arrival$ represents number of reefer containers on arrival.
- $No_c\ Departure$ represents number of reefer containers at departure.

In all cases, the actual number of in-use reefers carried is documented in the BAPLIE file.

Note that ship reefer kWh consumption should not include consumption during voyage adjustment periods.

* The number of reefers on board while in port should be calculated to equal the number of reefers at arrival and at departure as calculated above. Same calculation applies for Reefer days_{sea} in port.

2 Cargo cooling systems on gas carriers and LNG carriers

For gas carriers and LNG carriers with electrical cargo cooling systems or reliquefaction plants, the correction factor $FC_{\text{electrical}}$ may be applied as follows:

- .1 Gas carriers and LNG carriers may calculate cargo cooling kWh consumption as follows:

$$FC_{\text{electrical_cooling},j} = \text{Cooling kWh} \times SFOC$$

where:

- $FC_{\text{electrical_cooling},j}$ (cargo cooling fuel oil consumption) represents the estimated fuel consumption attributed to cooling of gas cargoes.
- *Cooling kWh* is measured on the ship by the kWh meter counter on the ship.
- *SFOC* represents the specific fuel consumption in g/kWh associated with the relevant source of electrical power as per the EEDI/EEXI Technical File or NO_x Technical File. In the case of ships without a Technical File, a default value of 175 g/kWh for 2 stroke engines and 200 g/kWh for 4 stroke engines may be applied. In the case of waste heat recovery systems as defined under Category C1 in MEPC.1/Circ.896 the SFOC to be used will be at the discretion of the Administration.

Alternatives such as derivation of fuel consumption or kWh from auto-logged data may be used subject to approval by the Administration. Note that cargo cooling kWh consumption should not include consumption during voyage adjustment periods.

3 Electric cargo discharge pumps on tankers

For tankers with directly or indirectly electrically powered discharge pumps, the correction factor $FC_{\text{electrical}}$ may be applied as follows:

- .1 Tankers may calculate cargo discharge kWh consumption as follows:

$$FC_{\text{electrical_discharge},j} = \text{discharge kWh} \times SFOC$$

where:

- $FC_{\text{electrical_discharge},j}$ (cargo discharge fuel oil consumption) represents the estimated fuel consumption attributed to use of cargo discharge pumps.
- *Discharge kWh* is measured on the ship by the kWh meter counter on the ship.
- *SFOC* represents the specific fuel oil consumption in g/kWh associated with the relevant source of electrical power as per the EEDI/EEXI Technical File or NO_x Technical File. In the case of ships without a Technical File, a default value of 175 g/kWh for 2 stroke engines and 200 g/kWh for 4 stroke engines may be applied. In the case of waste heat recovery systems as defined under Category C1 in MEPC.1/Circ.896 the SFOC to be used will be at the discretion of the Administration.

Alternatives such as derivation of actual fuel consumption from auto-logged data may be used subject to approval by the Administration. Note that cargo cooling kWh consumption should not include consumption during voyage adjustment periods.

Part B. FC_{Boiler} and FC_{Others} for corrections relating to cargo heating and discharge on tankers

1 FC_{Boiler} for cargo heating and discharge pumps on tankers

For tankers with fuel fired boilers used for cargo heating or steam driven cargo pumps, the following correction factor may be applied for the period that the cargo heating or discharge pumps are in operation:

- .1 In the case of boilers used for cargo heating, the amount of fuel used by the boiler (FC_{Boiler}) should be measured by accepted means, e.g. tank soundings, flow meters.
- .2 For tankers which use steam driven cargo pumps, the amount of fuel used by the boiler (FC_{Boiler}) should be measured by accepted means, e.g. tank soundings, flow meters.

Some amount of fuel consumed by the boiler during cargo heating or discharge operations may be attributed to other purposes, e.g. calorifiers. It is not necessary to split these out from reporting.

Note that boiler consumption should not include consumption during voyage adjustment periods.

2 FC_{Others} for discharge pumps on tankers

For tankers with discharge pumps powered by their own generator, the amount of fuel used for the period that the discharge pumps are in operation (FC_{Others}) should be measured by accepted means, e.g. tank soundings, flow meters.

Note that fuel deducted under FC_{Others} should not include consumption during voyage adjustment periods.

APPENDIX 2

GUIDANCE ON REPORTING OF FUEL OIL CONSUMPTION AND DISTANCE TRAVELLED FOR VOYAGE PERIODS WHERE THE SHIP MEETS THE CRITERIA TO APPLY ANY VOYAGE ADJUSTMENT

In this appendix guidance is given for reporting and verification of fuel oil consumption and distance travelled concerning voyage adjustments when a scenario specified in regulation 3.1 of MARPOL Annex VI applies, which may endanger safe navigation of a ship, or when sailing in ice conditions.

1 Fuel oil consumption for voyage periods should include all the fuel oil consumed on board including but not limited to the fuel oil consumed by the main engines, auxiliary engines, gas turbines, boilers and inert gas generator, for each type of fuel oil consumed, regardless of whether a ship is under way or not. Methods for collecting data on fuel oil consumption in metric tonnes include the method using flow meters or method using bunker fuel oil tank monitoring on board as described in paragraphs 7.1.2 and 7.1.3 of the *2022 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP Guidelines)* (resolution MEPC.346(78)) correspondingly.

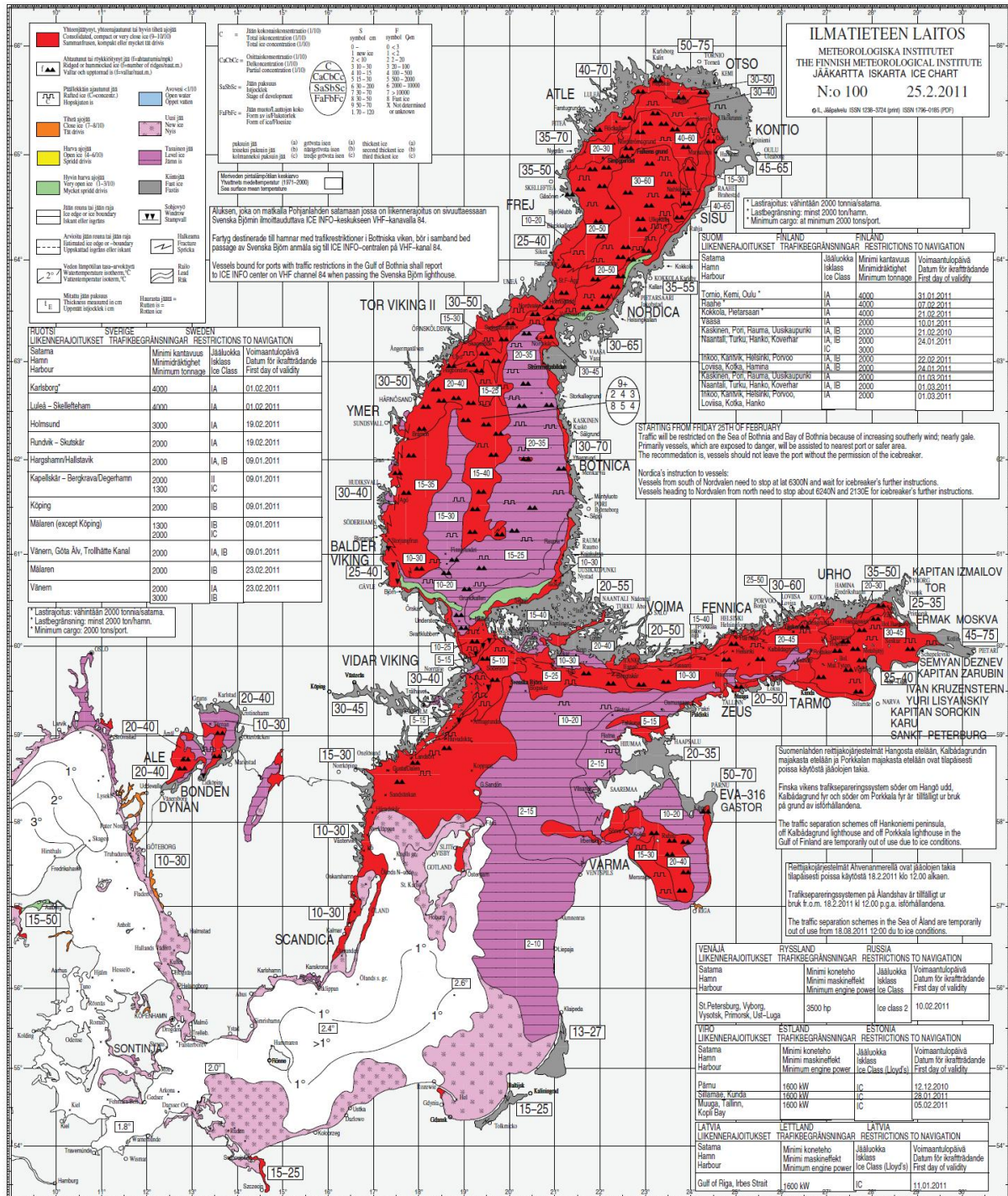
2 The distance travelled over ground in nautical miles for voyage periods should be recorded in the logbook in accordance with SOLAS regulation V/28.1 and submitted to the Administration.

3 At the end of the voyage, if the ship has encountered ice conditions during its voyage, when the ship was under way sailing between the ice edges or between the ice edge and the port, or when a scenario specified in regulation 3.1 of MARPOL Annex VI applies:

- .1 the fuel oil consumed measured in accordance with 7.1.2 or 7.1.3 of the SEEMP Guidelines for the voyage period should not be included in the calculations for the annual average attained CII index value;
- .2 if the voyage period is excluded from calculations of the attained CII index value when a scenario specified in regulation 3.1 of MARPOL Annex VI applies, the distance travelled should be clearly marked in the SEEMP monitoring plan, the ship's logbook should include data entries for the voyage period with date, time and position of the ship, when a scenario specified in regulation 3.1 of MARPOL Annex VI started to apply and ceased to apply, and data should be added to the data reporting format;
- .3 if the voyage period is excluded from calculations of the attained CII index value due to sailing in ice conditions, the distance travelled should be clearly marked in the SEEMP monitoring plan, the ship's logbook should include data entries for the voyage period with date, time and position of the ship when the ship encountered ice conditions and left ice conditions, and data should be added to the data reporting format.

4 The summary of monitoring data containing records of measured fuel oil consumption and distance travelled for voyage periods should be available on board. Ice charts related to the voyage periods should also be available if the ship has sailed in ice conditions.

Figure 1: An example of an ice chart of the Baltic Sea area



ANNEX 19

RESOLUTION MEPC.356(78)
(adopted on 10 June 2022)

2022 GUIDELINES FOR BRIEF SAMPLING OF ANTI-FOULING SYSTEMS ON SHIPS

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee conferred upon it by the international conventions for the prevention and control of marine pollution,

RECALLING ALSO that the International Conference on the Control of Harmful Anti-fouling Systems for Ships, 2001, held in October 2001, adopted the International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001 (the AFS Convention) together with four Conference resolutions,

NOTING that article 11(1) of the AFS Convention prescribes that ships to which this Convention applies may, in any port, shipyard, or offshore terminal of a Party, be inspected by officers authorized by that Party for the purpose of determining whether the ship is in compliance with this Convention, that such inspection may include brief sampling of the ship's anti-fouling system, and that article 11(1) of the AFS Convention refers to the guidelines to be developed by the Organization,

NOTING ALSO resolution MEPC.104(49) by which the Committee adopted the *Guidelines for brief sampling of anti-fouling systems on ships*,

RECALLING FURTHER that at its seventy-sixth session it adopted amendments to the AFS Convention to introduce controls on cybutryne through resolution MEPC.331(76),

RECOGNIZING the need for a consequential revision of the guidelines associated with the AFS Convention due to the aforementioned amendments,

NOTING FURTHER that through resolutions MEPC.358(78) and MEPC.357(78) the Organization adopted *2022 Guidelines for survey and certification of anti-fouling systems on ships* and *2022 Guidelines for inspection of anti-fouling systems on ships*, respectively,

HAVING CONSIDERED a revised text of the *Guidelines for brief sampling of anti-fouling systems on ships* prepared by the Sub-Committee on Pollution Prevention and Response at its ninth session,

1 ADOPTS the *2022 Guidelines for brief sampling of anti-fouling systems on ships* (2022 Guidelines), the text of which is set out in the annex to this resolution;

2 INVITES Governments to apply the 2022 Guidelines as soon as possible, or when the Convention becomes applicable to them;

3 RECOMMENDS that the Guidelines be reviewed on a regular basis;

4 REVOKES resolution MEPC.104(49).

ANNEX

**2022 GUIDELINES FOR
BRIEF SAMPLING OF ANTI-FOULING SYSTEMS ON SHIPS**

TABLE OF CONTENTS

1. General
 - Purpose
 - Structure of these Guidelines
2. Definitions
3. Personnel safety when sampling
 - Health
 - Safety
4. Sampling and analysis
 - Sampling methods
 - Technical aspects
 - Sampling strategy and number of samples
 - Analysis
5. Thresholds and tolerance limits
 - Thresholds
 - Tolerance range
6. Definition of compliance
7. Documentation and recording of information

APPENDIX – Possible methods for brief sampling and analysis of anti-fouling systems on ships
- organotin and/or cybutryne

Method 1

Appendix to method 1 Record sheet for the brief sampling procedure for compliance with the Convention in terms of the presence of organotin and/or cybutryne acting as a biocide in anti-fouling systems on ship hulls

Method 2

Appendix to method 2 Record sheet for the sampling and analysis of anti-fouling systems on ship hulls - organotin compounds and/or cybutryne

1 General

Purpose

1.1 Article 11 of the International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001, hereinafter referred to as "the Convention", and resolution MEPC.358(78) on *2022 Guidelines for survey and certification of anti-fouling systems on ships*, refer to sampling as a method of verification of compliance of a ship's anti-fouling system with the Convention for inspection and survey.

1.2 The *Guidelines for brief sampling of anti-fouling systems on ships*, hereinafter referred to as "the Guidelines", provide procedures for sampling to support the effectiveness of survey and inspection to ensure that a ship's anti-fouling system complies with the Convention and thus assists:

- .1 Administrations and recognized organizations (ROs) in the uniform application of the provisions of the Convention;
- .2 port State control officers with guidance on methods and handling of brief sampling in accordance with article 11(1)(b) of the Convention; and
- .3 companies, shipbuilders, manufacturers of anti-fouling systems, as well as any other interested parties, in understanding the process of sampling as required in terms of the Convention.

1.3 However, inspections or surveys do not necessarily always need to include sampling of the anti-fouling system.

1.4 These Guidelines apply to surveys and inspections of ships subject to the Convention.

1.5 The sole purpose of the sampling activities described in the Guidelines is to verify compliance with the provisions of the Convention. Consequently, such activities do not relate to any aspect not regulated by the Convention (even if such aspects relate to the performance of an anti-fouling system on the hull of a ship, including the quality of workmanship).

Structure of these Guidelines

1.6 These Guidelines contain:

- .1 a main body covering aspects of general nature common to "sampling" procedures related to the regulation of anti-fouling systems controlled by the Convention; and
- .2 appendices describing the unique procedures associated with the sampling and analysis of anti-fouling systems controlled by the Convention. These appendices only serve as examples of sampling and analytical methods, and other sampling methods not described in an appendix may be used subject to the satisfaction of the Administration or the port State, as appropriate.

1.7 For reasons including the event of further anti-fouling systems becoming controlled under the Convention, or in the light of new experience acquired, these Guidelines may need to be reviewed or amended in the future.

2 Definitions

For the purposes of these Guidelines:

2.1 "Administration" means the Government of the State under whose authority the ship is operating. With respect to a ship entitled to fly a flag of a State, the Administration is the Government of that State. With respect to fixed or floating platforms engaged in exploration and exploitation of the seabed and subsoil thereof adjacent to the coast over which the coastal State exercises sovereign rights for the purposes of exploration and exploitation of their natural resources, the Administration is the Government of the coastal State concerned.

2.2 "Anti-fouling system" means a coating, paint, surface treatment, surface or device that is used on a ship in order to control or prevent attachment of unwanted organisms.

2.3 "Threshold value" means the concentration limit of the chemical under investigation below which compliance with the relevant provisions of the Convention may be assumed.

2.4 "Company" means the owner of the ship or any other organization or person such as the manager or the bareboat charterer, who has assumed the responsibility for the operation of the ship from the owner of the ship and who, on assuming such responsibility, has agreed to take over all duties and responsibilities imposed by the International Safety Management (ISM) Code.

2.5 "Length" means the length as defined in the International Convention on Load Lines, 1966, as modified by the Protocol of 1988 relating thereto, or any successor Convention.

2.6 "Tolerance range" means the numerical range added to the threshold value indicating the range where detected concentrations above the threshold value are acceptable due to recognized analytical inaccuracy and thus do not compromise the assumption of compliance.

3 Personnel safety when sampling

Health

3.1 Persons carrying out sampling should be aware that solvents or other materials used for sampling may be harmful. Wet paint which is sampled may also be harmful. In these cases, the material safety data sheet (MSDS) for the solvent or paint should be read and appropriate precautions should be taken. This will normally include the wearing of long sleeve solvent resistant gloves of suitable impervious material, e.g. nitrile rubber.

3.2 Quantities of dry anti-fouling paint removed during sampling from ships' hulls will normally be too small to cause significant health effects.

Safety

3.3 Access to ships to carry out sampling safely may be difficult. If a ship is moored alongside, persons carrying out sampling must ensure they have safe access to reach the hull from, for example, platforms, crane baskets, cherry pickers or gangways. They must ensure that they are protected by railings or a climbing harness or take other precautions so that they cannot fall into the water between the quay and the ship. If in doubt a lifejacket, and possibly a safety line, should be worn when sampling.

3.4 Access to ships in dry dock should be made by secure means. Scaffolding should be securely constructed and cherry pickers or dock-arms should be properly constructed and maintained if they are to be used to gain access. There should be a system to record the presence of the inspector in the dock area, and he or she should preferably be accompanied. Safety harnesses should be worn in cherry-picker baskets, if used.

4 Sampling and analysis

Sampling methods

4.1 During sampling, care should be taken not to affect the integrity or operation of the anti-fouling system.

4.2 Sampling where the anti-fouling coating is visibly damaged¹ or on block mark areas on the flat bottom of the ship (where the intact anti-fouling system is not applied) should be avoided. Sampling adjacent to or below areas where the anti-fouling system is damaged should also be avoided. When a sample point on the hull has been selected, any fouling present should be removed with water and a soft sponge/cloth before taking a specimen of the anti-fouling system (to avoid contamination of the sample). Where possible, if carried out in dry dock, sampling should be carried out after the hull has been water-washed.

4.3 The materials required for brief sampling methodologies should ideally be inexpensive, widely available and therefore readily accessible, irrespective of sampling conditions and/or location.

4.4 The sampling procedure should ideally be easily and reliably undertaken. Persons conducting sampling should receive appropriate training in sampling methods.

Technical aspects

4.5 The sampling method should take into account the type of anti-fouling system used on the ship (taking into account that different parts of the hull may be treated with different anti-fouling systems).

4.6 Sampling and analysis of the ship's anti-fouling system could be related to only one or to all of the substances listed in Annex 1 of the AFS Convention. The following cases could be considered:

Case A. Analysis of organotin only

Case B. Analysis of cybutryne only

Case C. Simplified approach to detect organotin and cybutryne

4.7 Depending on the case, the number of samples, analysis, and definition of compliance will differ.

¹ During in-service periods, anti-fouling coatings on ships' hulls often become damaged. The extent of damage varies between ships and damaged areas can be visually recognized. Typically, damage can be restricted to localized areas, e.g. anchor chain damage (bow region), fender damage (vertical sides of hull), "rust through areas" (underlying rust causing coating failure), or in some cases can be in smaller areas scattered over larger areas of the hull (usually older ships where over-coating of the original system has taken place many times).

4.8 Specimens of paint for analysis during survey and certification can be taken either as wet paint² from product containers, or dry paint film sampled from the hull.

Sampling strategy and number of samples

4.9 The sampling strategy is dependent on the precision of the sampling method, the analytical requirements, costs, and required time and the purpose of the sampling. The number of paint specimens taken of each sample should allow for a retention quantity for back-up/storage in the event of a dispute. For dry samples, triplicate specimens of paint at each sampling point should be taken in close proximity to each other on the hull (e.g. within 10 cm of each other).

4.10 In cases where it is recognized that more than one type of anti-fouling system is present on the hull, where access can be gained, samples should be taken from each type of system:

- .1 For survey purposes or for more thorough inspections pursuant to article 11(2) of the Convention, in order to verify the compliance of an anti-fouling system, the number of sample points should reflect representative areas of the ship's hull.
- .2 For inspection purposes pursuant to article 11(1) of the Convention sample points on the hull should be selected covering representative areas where the anti-fouling system is intact. Depending on the size of the ship and accessibility to the hull, at least four sample points should be equally spaced down the length of the hull. If sampling is undertaken in dry dock, flat bottom areas of the hull should be sampled in addition to vertical sides as different anti-fouling systems can be present on these different areas.

4.11 The distribution of any remaining anti-fouling paint on the hull surface may not be uniform. Therefore, it is important that the sampling is representative of the hull status; see *Guidelines for survey and certification of anti-fouling systems on ships*, appendix I, paragraph 2).

Analysis

4.12 The analysis of the anti-fouling system should ideally involve minimal analytical effort and economic cost.

4.13 The analysis should be conducted by a recognized laboratory meeting the ISO 17025 standard or another appropriate facility at the discretion of the Administration or the port State.

4.14 The analytical process should be expeditious, such that results are rapidly communicated to the officers authorized to enforce the Convention.

² In order to prevent contamination, wet paint samples should be taken from a newly opened container. Paint should be stirred to ensure even consistency before sampling and all equipment used should be cleaned prior to use. Liquid paint samples should be stored in appropriate sealed packaging which will not react with or contaminate the sample. In the case of multi-component coatings (where on-site mixing of several components is required prior to application), samples of each component should be taken and the required mixing ratio recorded. When a sample of wet paint is taken from a container, details of the paint should be recorded, e.g. details required for the IAFS Certificate along with a batch number for the product.

4.15 The analysis should produce unambiguous results expressed in units consistent with the Convention and its associated guidelines. For example, for organotin, results should be expressed as: mg tin (Sn) per kg of dry paint, and, for cybutryne: mg of cybutryne per kg of dry paint.

NOTE: Compound-specific sampling and analytical methodologies are described in the appendices to these Guidelines.

5 Thresholds and tolerance limits

Thresholds

5.1 The analysis should be quantitative to the point of being able to accurately verify the threshold limits within the given tolerance.

5.2 In cases where compliance with acceptable limits, or lack thereof, is unclear, additional sampling or other methodologies for sampling should be considered.

Tolerance range

5.3 Statistical reliability for each (compound-specific) brief sampling procedure should be documented. The analysis should be quantitative to the point of being able to accurately verify the threshold limits within the given tolerance. On the basis of these data a compound-specific tolerance range should be derived and stated in the method description. In general, the tolerance range should not be higher than the standard deviation under typical conditions for testing and should under no circumstances go beyond 30%.

6 Definition of compliance

6.1 Compliance with Annex 1 to the Convention is assumed if the anti-fouling system contains:

- .1 organotin at a level which does not provide a biocidal effect. In practice organotin compounds should not be present above 2,500 mg organotin (measured as Sn) per kg of dry paint; and
- .2 cybutryne at a level which does not provide a biocidal effect. It should not be present above 1,000 mg of cybutryne per kg of dry paint.

6.2 Compliance is largely dependent on the results of sampling and subsequent analysis. As every method of sampling and analysis has its specific accuracy, a compound-specific tolerance level may be applied in borderline cases with concentrations very close to the threshold level.

6.3 In general, compliance is assumed when the samples yield results below the threshold value.

7 Documentation and recording of information

7.1 The results of the sampling procedure should be fully documented on a method-specific record sheet. Examples are provided in the appendices to these Guidelines.

7.2 Such record sheets should be completed by the sampler and should be submitted to the competent authority of the port State or Administration.

APPENDIX

POSSIBLE METHODS FOR BRIEF SAMPLING AND ANALYSIS OF ANTI-FOULING SYSTEMS ON SHIPS

- ORGANOTIN AND/OR CYBUTRYNE -

METHOD 1

1 Purpose of this method concerning brief sampling and analysis of anti-fouling systems

1.1 This method has been developed in order to describe a rapid methodology appropriate for the identification of anti-fouling systems on ship hulls containing organotin compounds and/or cybutryne acting as biocide. This method has been designed such that sealers should not be affected, and any underlying anti-fouling agent (or primer) is not taken up in the sampling procedure. The method is not recommended for silicon-based anti-fouling systems.

1.2 The method for organotin compounds (Case A under paragraph 4.6 of the Guidelines) is based on a two-step analysis. The first step detects total tin as an indicator for organotin; the second step, detecting specific organotin compounds, is only necessary in the case of the first step proving positive.

1.3 The method for cybutryne (Case B under paragraph 4.6 of the Guidelines) is based on a one-step analysis.

1.4 The simplified approach (Case C under paragraph 4.6 of the Guidelines) to detect organotin compounds and cybutryne is based on a one-step analysis.

2 Sampling device and materials

2.1 The sampling device is constructed in a way that only the upper layer of paint is removed, thereby it should leave any underlying paint (sealer, primer, etc.) intact. This result is achieved through the use of a moving disk (eccentric rotation), which is covered by an abrasive material like quartz or glass fibre fabric. This abrasive material has to be suitable for its use as a supporting material for the removed paint.

2.2 The device fulfils the following requirements:

- .1 the device has to work independently from any stationary power supply. The device may be driven by an electrical motor (battery-driven) or may be mechanically driven by a clockwork-like spring, provided it is able to sustain the movement over the required time period;
- .2 the applied force has to be constant during the operation, and the area for paint removal has to be defined;
- .3 the abrasive material has to be inert against chemical solvents and acids and must not contain more than trace amounts of tin or tin compounds and/or cybutryne; and
- .4 the amount of paint removed after a regular operation of the device has to be shown to exceed 20 mg per sample.

2.3 The device as described in the following section has been shown to be suitable for the brief sampling procedure. Any other device may be used however, provided such a device has proven to meet all the above-mentioned requirements.

2.4 The sampling device described here consists of a polyethylene disk, on which fibre glass fabric can be mounted by the use of an O-ring. The disk is moved on an eccentrically rotating axis.

3 Sampling procedure

3.1 The sampling procedure should be performed in the following manner:

- .1 control samples should be taken through the entire sampling and analytical process to account for possible contamination;
- .2 the mass of the fibreglass pads is weighed with a precision of at least 1 mg. The weight should be documented for each sample;
- .3 the fabric should be moistened thoroughly with isopropanol (0.7 mL per sample) immediately before sampling;
- .4 when a sample point on the hull has been selected, any fouling present should be removed with water and a soft sponge/cloth before taking a specimen of the anti-fouling system (to avoid contamination of the sample). Where possible, if carried out in dry dock, sampling should be carried out after the hull has been water-washed;
- .5 the sampling device is then held against the surface to be sampled for a period of five seconds, prior to the sampling device being switched on;
- .6 the sampling device is switched on, thereby removing paint by the circular motion of the fibre glass fabric against the surface of the ship;
- .7 the sampling device should be applied to the surface of the hull for a suitable period of time, such that at least 20 mg of paint is taken up by the pad. As a general rule, if the pad colour after sampling matches the colour of the hull coating a sufficient sample has been taken;
- .8 the specimens should be taken as close to each other as possible, but without overlap;
- .9 upon completion of the sampling, the fibreglass fabric pads should be left to dry and re-weighed;
- .10 the number of samples will differ depending on the substances targeted as listed in Annex 1 of the AFS Convention.

Case A. Analysis of organotin only, every sample should be taken in triplicate.

Specimen 'A' – for Step 1
Specimen 'B' – for Step 2
Specimen 'X' – for storage/back-up

Case B. Analysis of cybutryne only, every sample should be taken in duplicate.

Specimen 'C' – for a one-step analysis

Specimen 'X' – for storage/back-up

Case C. Simplified approach to detect organotin and cybutryne, every sample should be taken in duplicate.

Specimen 'C' – for a one-step analysis

Specimen 'X' – for storage/back-up

3.2 Samples should be stored in appropriate sealed packaging which will not react with or contaminate the sample.

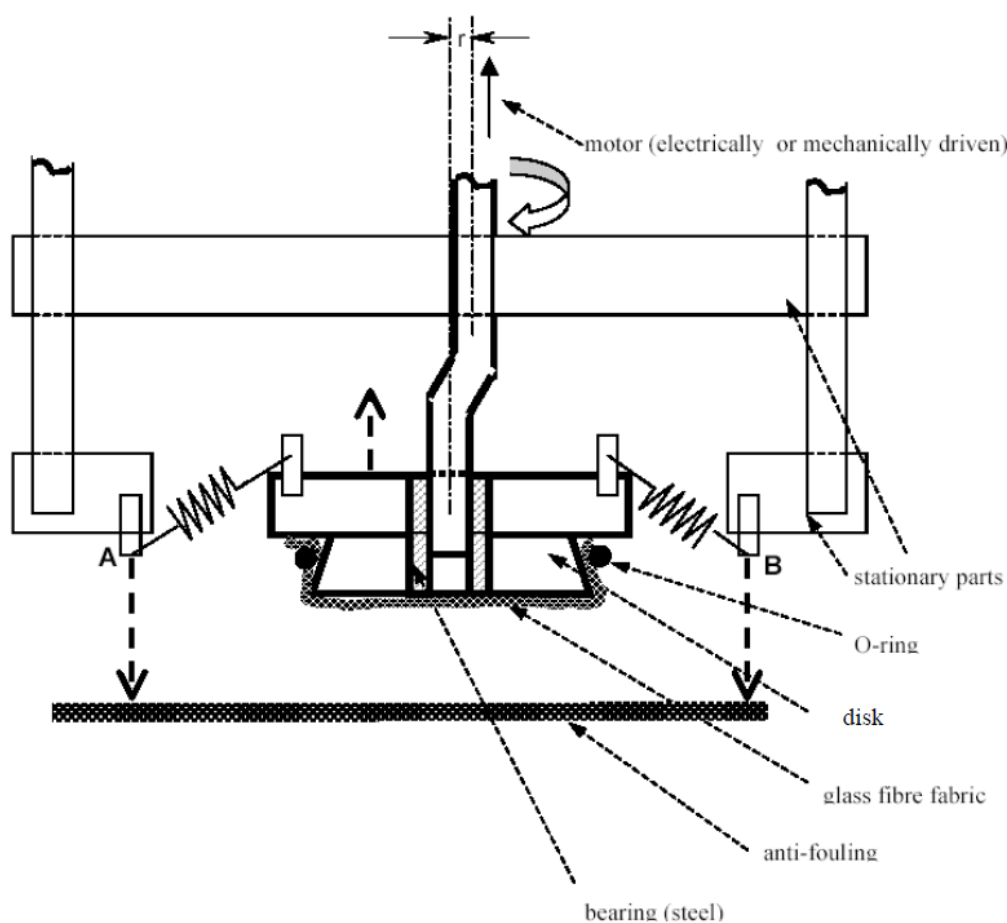


Diagram A: Schematic cross section of the sampling device

The indicated points A and B are to be pressed against the surface. The polyethylene disk, covered with the glass fibre fabric, is moved with an amplitude of $2r$ ($r = 1.0$ cm) on the surface.

Specific data:

Force applied on the paint surface:	25 N (Newton)
Effective diameter of the disk:	5 cm
Frequency of rotation:	6 rotations/s
Solvent used:	isopropanol (0.8 mL per sample).

4 Sampling strategy

4.1 Sampling should be conducted in accordance with paragraph 4 of the Guidelines.

4.2 For inspection purposes in most cases accessibility to all parts of the hull will not be given. A minimum number of eight independent samples should be taken from different accessible parts of the hull.

5 Analytical procedure

5.1 The analytical procedure will differ depending on the substances targeted as listed in Annex 1 of the AFS Convention.

Case A. Analysis of organotin only

5.2 The two components comprising the analytical procedure are illustrated in the flow diagram B. The two components, or steps, are as follows:

- .1 (Step 1) – An analysis of Specimen 'A' for the presence of total tin; and
- .2 (Step 2) – A more cost- and time-consuming analysis of Specimen 'B', that is applied only when Step 1 produces positive results. This test involves organotin analysis by gas chromatography/mass spectrophotometry (GC/MS) after derivatization and provides specific data on the respective organotin species.

Step 1: Investigation of total tin content in Specimen 'A'

Analysis of Specimen 'A'

5.3 Specimen 'A' is analysed for mass of total tin per kilogram of dry paint (or mass of tin per sample) by applying inductively coupled plasma/mass spectrometry (ICP/MS), once the material had been solubilized by digestion using aqua regia. It should be noted that any other scientifically recognized procedure for tin analysis (such as AAS, XRF and ICP-OES) is acceptable.

Step 2: Characterization of organotin in Specimen 'B'

Analysis of Specimen 'B'

5.4 Should Specimen 'A' produce positive results, organotin compounds should be identified and quantified in Specimen 'B'. Specimen 'B' may be analysed using the following procedure:

- .1 solvent extraction of Specimen 'B' as supported by sonication in an ultrasonic bath;
- .2 derivatization with ethylmagnesium bromide;
- .3 clean-up of the extract;
- .4 analysis using high resolution gas chromatography/mass spectrophotometry (GC/MS); and

.5 quantifications using tripropyltin as a standard.

5.5 Any equally reliable method for the chemical identification and quantification of organotin compounds is acceptable.

Case B. Analysis of cybutryne only

5.6 A one-step analysis of 'Specimen C' for determining the amount of cybutryne, using gas chromatography/mass spectrophotometry (GC/MS).

One-step analysis: Characterization of cybutryne in Specimen 'C'

Analysis of Specimen 'C'

5.7 Specimen 'C' should be analysed using the following procedure:

- .1 sample extraction using ethyl acetate with added internal standard (ametryn) using an ultrasonic bath for 15 minutes;
- .2 centrifugation of the samples at 600 rcf for 5 minutes;
- .3 analysis of the supernatant using high resolution capillary GC/MS, with the MS operating in SIM mode;
- .4 quantification using reference cybutryne solutions and an internal standard normalization procedure; and
- .5 modified GC/MS methods resulting in an expanded measurement uncertainty ($k=2$; 95% confidence) of 25% are acceptable.

5.8 Other methods for the chemical identification and quantification of cybutryne, if proven equally reliable, could be accepted by the Administration or the port State.

Case C. simplified approach to detect organotin and cybutryne

5.9 A one-step analysis of Specimen 'C' for determining the amount of organotin and cybutryne using gas chromatography/mass spectrophotometry (GC/MS).

One-step analysis: Characterization of organotin and cybutryne in Specimen 'C'

- .1 sample extraction using toluene with added internal standard (ametryn) using an ultrasonic bath for 15 minutes;
- .2 derivatization with ethylmagnesium bromide;
- .3 clean-up of the extract;
- .4 centrifugation of the samples at 600 rcf for 5 minutes;
- .5 analysis of the supernatant using high resolution capillary GC/MS, with the MS operating in SIM mode;

- .6 cybutryne quantification using reference cybutryne solutions and an internal standard normalization procedure. Organotin quantification using tripropyltin as the internal standard; and
- .7 modified GC/MS methods resulting in an expanded measurement uncertainty ($k=2$; 95% confidence) of 25% are acceptable.

5.10 Other methods for the chemical identification and quantification of organotin and cybutryne, if proven equally reliable, could be accepted by the Administration or the port State.

6 Threshold and tolerance range

6.1 The threshold value for organotin compounds for the brief sampling method as described here is:

"2,500 mg tin (Sn) per kg of dry paint."

6.2 The threshold value for cybutryne for the brief sampling method as described here is:

"1,000 mg of cybutryne per kg of dry paint."

Tolerance range

6.3 The tolerance range is 500 mg Sn / kg of dry paint (20%) in addition to the threshold value.

6.4 The tolerance range is 250 mg cybutryne / kg of dry paint (25%) in addition to the threshold value.

Organotin-containing compounds acting as biocides or catalysts

6.5 As stated in appendix I of resolution MEPC.358(78), for the purposes of defining compliance with Annex 1 to the Convention, it should be noted that small quantities of organotin compounds, acting as chemical catalysts (such as mono- and di-substituted organotin compounds), are allowed, provided they are not acting as a biocide.

6.6 Inorganic impurities in the constituents of the paints should be considered.

6.7 At present neither organotin catalysts nor inorganic impurities are found at concentrations which will be close to the threshold level (2,500 mg Sn/kg of dry paint) or higher. However, organotin-containing compounds, when present in paint in order to act as a biocide, were found in concentrations up to 50,000 mg Sn/kg of dry paint. Thus, the discrimination between anti-fouling systems containing organotin compounds acting as a biocide and anti-fouling systems not containing these compounds or not containing these compounds at concentrations where they act as a biocide is reliably possible.

7 Definition of compliance

7.1 The analytical verification of the compliance will differ depending on the substances targeted as listed in Annex 1 of the AFS Convention.

Case A. Analysis of organotin only Two-step procedure

7.2 The analytical verification of the compliance with the Convention for organotin compounds is performed in a two-step procedure according to the flow-diagram (diagram B).

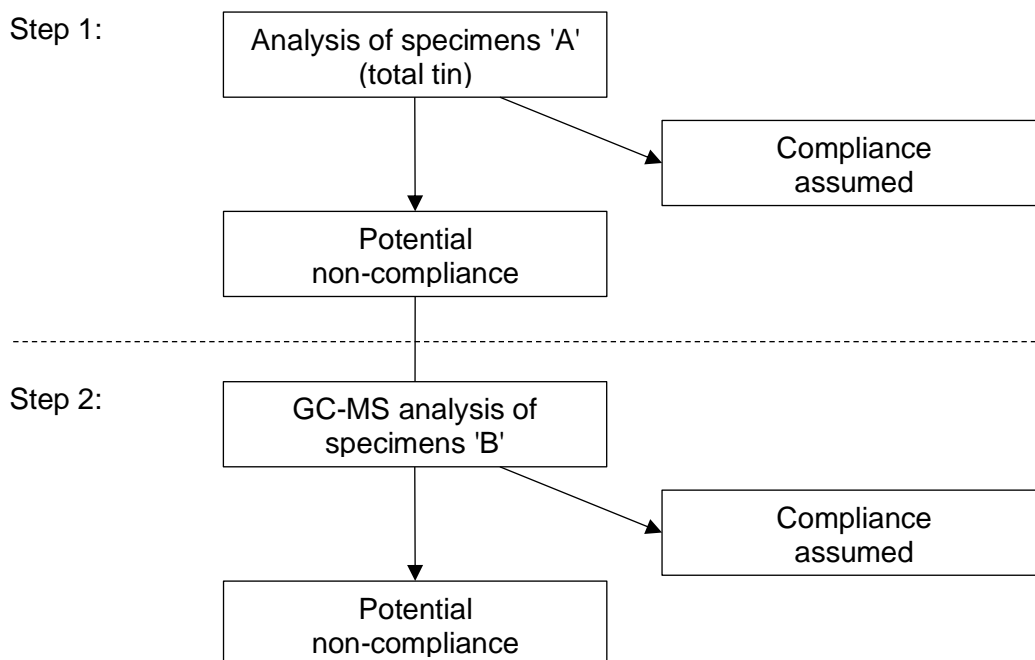


Diagram B: Flow diagram illustrating the two-step analysis procedure for organotin compounds

Compliance with the criteria at the 'Step 1-level'

7.3 Compliance with the Convention is assumed when the results from the specimens 'A', analysed in step 1, meet the following:

- .1 no more than 25% of the total number of samples yield results above 2,500 milligrams total tin per kilogram dry paint (2,500 mg Sn/kg of dry paint); and
- .2 no sample of the total number of at least eight samples shows a concentration of total tin higher than the sum of threshold value plus the tolerance range, i.e. no sample must exceed the concentration 3,000 mg Sn/kg of dry paint.

7.4 If the results in specimen 'A' indicate that no organotin acting as biocide is present, then performing step 2 is not necessary.

Non-compliance with the criteria at the 'Step 1-level'

7.5 A positive result (non-compliance) is indicated if the provisions of paragraph 7.3 are not met.

7.6 A positive result at step 1 (specimen 'A') would indicate that step 2 should be undertaken, and those samples labelled specimen 'B' should be analysed in order to determine and characterize the organotin present (see diagram B).

Compliance with the criteria at the 'Step 2-level'

7.7 Compliance with the Convention is assumed when the results from the specimens 'B', analysed in step 2, meet the following requirements at the same time:

- .1 no more than 25% of the total number of samples yield results above 2,500 milligrams total tin per kilogram dry paint (2,500 mg Sn/kg of dry paint); and
- .2 no sample of the total number of at least eight samples shows a concentration of total tin higher than the sum of threshold value plus the tolerance range, i.e. no sample must exceed the concentration 3,000 mg Sn/kg of dry paint.

Non-compliance at 'Step 2-level'

7.8 A positive result in step 2 indicates non-compliance if the provisions of paragraph 7.7 are not met. Such results should be interpreted to mean that organotin compounds are present in the anti-fouling system at a level at which it would act as a biocide.

Case B. Analysis of cybutryne only

7.9 Compliance with the Convention is assumed when the results from specimen 'C', analysed in a one-step analysis for cybutryne, meet the following requirement:

- .1 The average value of the total number of specimens shows a concentration below the threshold plus the tolerance range, i.e. 1,250 mg of cybutryne per kg of dry paint.

Non-compliance at the one-step analysis for cybutryne

7.10 An average value of the total number of specimens showing a concentration above the threshold plus the tolerance range, i.e. 1,250 mg of cybutryne per kg of dry paint, indicates non-compliance.

Case C. Simplified approach to detect organotin and cybutryne

7.11 Compliance with the Convention is assumed when the results from specimen 'C', analysed in a one-step analysis for organotin and cybutryne, meet the two conditions below:

- .1 for organotin, the average value of the total number of specimens shows a concentration below the threshold plus the tolerance range, i.e. 3,000 mg Sn/kg of dry paint; and
- .2 for cybutryne, the average value of the total number of specimens shows a concentration below the threshold plus the tolerance range, i.e. 1,250 mg of cybutryne per kg of dry paint.

Non-compliance at the one-step analysis for organotin and cybutryne

7.12 If one of the conditions set out in paragraph 7.11 above is not met, this indicates non-compliance. Such results should be interpreted to mean that cybutryne or organotin is present in the anti-fouling system at a level at which it would act as a biocide.

APPENDIX TO METHOD 1

RECORD SHEET FOR THE BRIEF SAMPLING PROCEDURE FOR COMPLIANCE WITH THE CONVENTION IN TERMS OF THE PRESENCE OF ORGANOTIN AND/OR CYBUTRYNE ACTING AS A BIOCIDES IN ANTI-FOULING SYSTEMS ON SHIP HULLS

RECORD SHEET: GUIDELINES FOR BRIEF SAMPLING OF ANTI-FOULING SYSTEMS ON SHIPS – ORGANOTIN AND CYBUTRYNE		RECORD NUMBER:
<u>SECTION 1: Administration</u>		
1. Country	2. Name of port	3. Date
4. Reason for sampling		
<input type="checkbox"/> Port State control <input type="checkbox"/> Survey & certification <input type="checkbox"/> Other flag State compliance inspection		
5. Company details:		6. Inspecting official's details
1. Name of ship:		1. Name:
2. Distinctive number or letters:		2. Comments:
3. Port of registry		
4. Gross tonnage:		
5. IMO number:		
<u>SECTION 2: Sampling</u>		
1. Time sampling procedure initiated:		
2. Description of location from where samples were taken (frame number and distance from boot topping, refer to paragraph 3.2):		
3. Number of samples taken (three or two specimens per sample):		
4. Photographs taken of the sample point prior to sampling?		
<input type="checkbox"/> Yes <input type="checkbox"/> No		
5. Time sampling procedure completed:		
6. Additional comments concerning sampling procedure:		

<u>Case B. Analysis of cybutryne only</u>	
1. A one-step analysis using gas chromatography/mass spectrophotometry (GC/MS)	
Company name:	
Analyst responsible:	Date:
2. Specimen 'C' results:	
Total number of specimens 'C' analysed by GC-MS:	
Average concentration of cybutryne (mg of cybutryne per kg of dry paint):	
3. Conclusions:	
The average concentration of cybutryne exceeds the threshold of 1,250 mg of cybutryne per kg of dry paint <input type="checkbox"/> Yes <input type="checkbox"/> No	
4. Additional comments concerning analysis of results from Specimens 'C':	

<u>Case C. Simplified approach to detect organotin and cybutryne</u>	
1. A one-step analysis using gas chromatography/mass spectrophotometry (GC/MS)	
Company name:	
Analyst responsible:	Date:
2. Specimen 'C' results:	
Total number of specimens 'C' analysed by GC-MS:	
Average concentration of organotin (mg Sn per kg of dry paint):	
Average concentration of cybutryne (mg of cybutryne per kg of dry paint):	
3. Conclusions:	
The average concentration of organotin exceeds the threshold of 3,000 mg Sn/kg of dry paint <input type="checkbox"/> Yes <input type="checkbox"/> No	
The average concentration of cybutryne exceeds the threshold of 1,250 mg of cybutryne/kg of dry paint <input type="checkbox"/> Yes <input type="checkbox"/> No	
4. Additional comments concerning analysis of results from Specimens 'C':	

<u>SECTION 4: Final conclusion</u>
Summarized conclusion:
Compliance with AFS Convention assumed <input type="checkbox"/>
Non-compliance with AFS Convention assumed <input type="checkbox"/>

THIS IS TO CERTIFY that this Record is correct in all respects.

Issued at

(Place of issue of Record)

(Date of issue) (Printed name and signature of authorized official issuing the Record)

(Seal or stamp of the authority/organization)

METHOD 2

1 Purpose of this method

1.1 This method provides sampling and analysis procedures to identify the presence of organotin compounds and/or cybutryne in the anti-fouling systems on ships. The method is designed such that the sampling and the first stage analysis could be carried out by ship surveyors or port State control officers (PSCOs) on the survey/inspection site, e.g. at a dry dock.

1.2 The method for organotin compounds is based on a two-stage analysis (case A under paragraph 4.6 of the Guidelines). The first stage detects total tin as an indicator for the presence of organotin and the second stage is necessary only in the case that the first stage analysis providing a positive result to detect specific organotin compounds.

1.3 The method for cybutryne analysis (case B under paragraph 4.6 of the Guidelines) is based on a one-step analysis based on the gas chromatography/mass spectrophotometry analytical method (GC/MS).

1.4 A simplified approach to detect organotin and cybutryne (case C under paragraph 4.6 of the Guidelines) is based on a one-step analysis using the gas chromatography/mass spectrophotometry analytical method (GC/MS).

2 Sampling

2.1 The sampling is carried out by using abrasive paper rubbing on the surface of the anti-fouling system. This results in collection of paint fragments of the anti-fouling system from a thin area, less than several micrometres in depth from the surface, which do not affect the coatings lying underneath such as sealers.

2.2 Abrasive paper is pasted on a disc of approximately 10 mm in diameter. Rubbing the surface of the anti-fouling system with the disc collects several milligrams of the sample on to the abrasive paper.

2.3 The sampling device consists of an electric motor, two (or three) rotating rods on each of which a disc is attached, and a battery for electric power supply. The discs are pressed on to the surface of the ship's hull by spring coils. The discs rotate counter-clockwise while the rods turn clockwise around the centre of the device. A schematic diagram is given in figure 1.

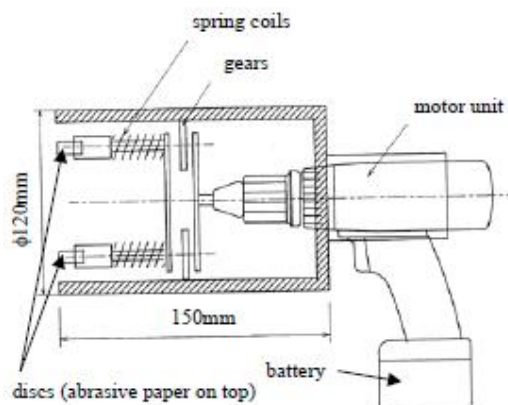


Figure 1. Schematic diagram of sampling device

2.4 A sampling point is selected such that the anti-fouling system is intact over an area of approximately 50 cm x 50 cm or more.

2.5 Depending on the substances targeted as listed in Annex 1 of the AFS Convention:

Case A. For the analysis of organotin only, at each sampling point, three sets of sampling, or more if necessary, should be carried out to obtain at least six specimens.

Case B. For the analysis of cybutryne only, at each sampling point, three sets of sampling, or more if necessary, should be carried out to obtain at least six specimens.

Case C. For the analysis of organotin and cybutryne, at each sampling point, three sets of sampling, or more if necessary, should be carried out to obtain at least six specimens.

2.6 The device is pressed on the ship's hull where it is appropriate to be sampled and held by hand. The electric motor is switched on to slide along the painted surface to lightly scrape off the fragments of the paint onto the abrasive paper. After the sample collection, each disc is removed from the device and stored in an inert container.

2.7 Sampling should normally be carried out with the sampling device. However, in the case that accessibility to the sampling point is poor, it is acceptable to collect samples with the discs by hand if necessary.

3 Analysis

Case A. Analysis of organotin only

3.1 The first-stage analysis

.1 The first-stage analysis is assumed to be carried out on the spot of the survey or inspection, e.g. dry docks and sea ports. In order to accomplish the on-site analysis, X-ray fluorescence analysis (XRF) is used in this method to detect total tin content.

.2 Analytical characteristics, such as detection limit and accuracy, are highly dependent on the type of the instrument, i.e. type of X-ray tube, spectrometer, optical arrangement (filters or collimators), etc. Among several types of the XRF instruments, an energy-dispersive spectrometer with a silicon drift detector (SDD), which is compact in size and able to be operated without liquid nitrogen, is preferable to the present analytical system for a field use, whereas wave-length dispersion system or solid-state detector are also available if the analysis is carried out at laboratories.

.3 Software customized for the tin analysis is prepared to assist the operator, who is assumed to be a ship surveyor or PSCO, to detect total tin in the specimens.

.4 The customized software may in advance need a calibration curve of the characteristic X-ray intensity of tin in relation to the tin content particularly in the range of 0.1 to 0.5%.

- .5 After the preparation including the warming-up of the XRF instrument and starting-up of the computer, a specimen (sampling disc) is placed on the sample stage of the instrument. Afterwards, analysis is executed by the customized software. A single batch of analysis for one specimen normally takes five minutes and the result is shown on a display automatically.
6. Since the XRF analysis does not affect any properties of the specimens, all of the collected specimens (six to nine specimens), including those for the second analysis and storage, are able to be used for this analysis.

3.2 Interpretation of the result at the first-stage analysis

- .1 Following the procedures above, XRF data of six, or nine, specimens are obtained for each sampling point. Omitting the maximum and minimum values from the data, an average of the tin content is calculated from the intermediate values for the representing value of the sampling point.
- .2 Compliance with the Convention is assumed when none of the tin contents (average values) from the samples do not exceed the sum of the threshold (2,500 mg per kg) and a tolerance (500 mg per kg).
- .3 When one or more average values of samples from different sampling points do not meet the above criteria, the samples should be sent to a laboratory for the second stage analysis. Regardless of the results, it is also possible to undergo the second stage analysis when the surveyor or PSCO considers that it is necessary to do so.

3.3 Second-stage analysis

- .1 Since the second-stage analysis provides the final and definitive results of the samples, the method should be thoroughly reviewed by experts based on scientific evidence. The following is a brief summary of a tentative methodology for the second stage analysis.
- .2 The collected paint specimens are removed from the abrasive paper and total mass is measured with an electronic balance to an order of 0.1 mg. The specimens are hydrolysed with sodium hydroxide aqueous solution, extracted with organic solvent, and then derivatized with propylmagnesium bromide. After cleaning up the extract, analysis using high resolution gas chromatography/mass spectrometry (GC/MS) is carried out. For quantification analysis, tetrabutyl tin d36 is added as the internal standard.
- .3 These analyses provide the data of chemical species and their content (mg per kg of the specimens). The content of organotin is obtained in a unit of mg per kg of dry paint.

Case B. For the analysis of cybutryne only

3.4 The collected paint specimens are removed from the abrasive paper and total mass is measured with an electronic balance to an order of 0.1 mg. The following procedure is proposed for determining the concentration of cybutryne:

- .1 sample extraction using ethyl acetate with added internal standard (ametryn) using an ultrasonic bath for 15 minutes;

- .2 centrifugation of the samples at 600 rcf for 5 minutes;
- .3 analysis of the supernatant using high resolution capillary GC/MS, with the MS operating in SIM mode;
- .4 quantification using reference cybutryne solutions and an internal standard normalization procedure; and
- .5 modified GC/MS methods resulting in an expanded measurement uncertainty ($k=2$; 95% confidence) of 25% are acceptable.

Case C. Simplified approach to detect organotin and cybutryne

3.5 The collected paint specimens are removed from the abrasive paper and total mass is measured with an electronic balance to an order of 0.1 mg. The following procedure is proposed for determining the concentration of organotin and cybutryne:

- .1 sample extraction using toluene with added internal standard (ametryn) using an ultrasonic bath for 15 minutes;
- .2 addition of sodium hydroxide aqueous solution to hydrolyse the sample and to facilitate the extraction to the toluene;
- .3 centrifugation of the samples at 600 rcf for 5 minutes;
- .4 collection of the supernatant and derivatization with propylmagnesium bromide;
- .5 clean-up of the extract;
- .6 analysis of the toluene solution using high resolution capillary GC/MS, with the MS operating in SIM mode;
- .7 cybutryne quantification using reference cybutryne solutions and an internal standard normalization procedure; organotin quantification using tetrabutyl tin d36 is added as the internal standard; and
- .8 modified GC/MS methods resulting in an expanded measurement uncertainty ($k=2$; 95% confidence) of 25% are acceptable.

4 Compliance with the Convention

Case A. Analysis of organotin only

4.1 Compliance with the Convention for organotin compounds is assumed when the results from the second-stage analysis meet the following requirements at the same time:

- .1 no more than 25% of the total number of samples yield results above 2,500 milligrams tin as organic form per kilogram dry paint (2,500 mg Sn/kg of dry paint); and
- .2 no sample of the total number of specimens shows a concentration of tin as organic form higher than the sum of the threshold value plus the tolerance range, i.e. no sample must exceed the concentration 3,000 mg Sn/kg dry paint.

4.2 When the result does not meet the above criteria, it is interpreted to mean that organotin compounds are present in the anti-fouling system at a level where they would act as a biocide.

Case B. Analysis of cybutryne only

4.3 Compliance with the Convention for cybutryne is assumed when the results from the cybutryne analysis meet the following criterion:

- .1 the average value of the total number of specimens shows a concentration below the threshold plus the tolerance range, i.e. 1,250 mg of cybutryne per kg of dry paint.

4.4 When the result does not meet the above criterion, it is interpreted to mean that cybutryne is present in the anti-fouling system at a level where it would act as a biocide.

Case C. Simplified approach to detect organotin and cybutryne

4.5 Compliance with the Convention for organotin compounds and cybutryne is assumed when the results from the cybutryne and organotin analysis meet the two conditions below:

- .1 for organotin, the average value of the total number of specimens shows a concentration below the threshold plus the tolerance range i.e. 3,000 mg Sn/kg of dry paint; and
- .2 for cybutryne, the average value of the total number of specimens shows a concentration below the threshold plus the tolerance range, i.e. 1,250 mg of cybutryne per kg of dry paint.

4.6 When the results do not meet one of the conditions above, it is interpreted to mean that organotin compounds or cybutryne are present in the anti-fouling system at a level where they would act as a biocide.

APPENDIX TO METHOD 2

**RECORD SHEET FOR THE SAMPLING AND ANALYSIS OF ANTI-FOULING SYSTEMS
ON SHIP HULLS – ORGANOTIN COMPOUNDS AND/OR CYBUTRYNE**

Record number:

<u>Section 1: Administration</u>	
1. Country	2. Location
3. Date	
4. Reason for survey/inspection	
5. Details of the ship	
5.1 Name of ship	
5.2 Distinctive number or letters	
5.3 Gross tonnage	5.4. Year of build
5.5 Owner or operator of ship	
5.6 Flag State	5.7 Class of ship
5.8 Authority of AFS certificate	
5.9 Date of issue	
5.10 Date of last endorsement	
5.11 IMO number	
5.12 Name of shipmaster	
5.13 Product name of anti-fouling system	
5.14 Name of manufacturer	
5.15 Name of shipyard where applied	
5.16 Comments	
6. Inspecting official's details	
6.1 Name	
6.2 Comments	

Section 2: Sampling and analysis
Case A. Analysis of organotin only

Record number

Sampling and Stage 1 analysis (X-ray fluorescence analysis)

Date: Instrument I.D.

Sample location	Specimen I.D.	Sample disc	Content of tin (mg/ kg)	max	min	Average
A	A1	<input type="checkbox"/> abrasive				Average mg/kg <input type="checkbox"/> >2,500 mg/kg <input type="checkbox"/> >3,000 mg/kg
	A2	<input type="checkbox"/> metal				
	A3	<input type="checkbox"/> others				
	A4	<input type="checkbox"/> abrasive				
	A5	<input type="checkbox"/> metal				
	A6	<input type="checkbox"/> others				
	A7	<input type="checkbox"/> abrasive				
	A8	<input type="checkbox"/> metal				
	A9	<input type="checkbox"/> others				
B	B1	<input type="checkbox"/> abrasive				Average mg/kg <input type="checkbox"/> >2,500 mg/kg <input type="checkbox"/> >3,000 mg/kg
	B2	<input type="checkbox"/> metal				
	B3	<input type="checkbox"/> others				
	B4	<input type="checkbox"/> abrasive				
	B5	<input type="checkbox"/> metal				
	B6	<input type="checkbox"/> others				
	B7	<input type="checkbox"/> abrasive				
	B8	<input type="checkbox"/> metal				
	B9	<input type="checkbox"/> others				
C	C1	<input type="checkbox"/> abrasive				Average mg/kg <input type="checkbox"/> >2,500 mg/kg <input type="checkbox"/> >3,000 mg/kg
	C2	<input type="checkbox"/> metal				
	C3	<input type="checkbox"/> others				
	C4	<input type="checkbox"/> abrasive				
	C5	<input type="checkbox"/> metal				
	C6	<input type="checkbox"/> others				
	C7	<input type="checkbox"/> abrasive				
	C8	<input type="checkbox"/> metal				
	C9	<input type="checkbox"/> others				
D	D1	<input type="checkbox"/> abrasive				Average mg/kg <input type="checkbox"/> >2,500 mg/kg <input type="checkbox"/> >3,000 mg/kg
	D2	<input type="checkbox"/> metal				
	D3	<input type="checkbox"/> others				
	D4	<input type="checkbox"/> abrasive				
	D5	<input type="checkbox"/> metal				
	D6	<input type="checkbox"/> others				
	D7	<input type="checkbox"/> abrasive				
	D8	<input type="checkbox"/> metal				
	D9	<input type="checkbox"/> others				

<input type="checkbox"/> Stage 2 required	<input type="checkbox"/> ___ samples out of ___ are above 2,500 mg/kg	<input type="checkbox"/> Compliant
	<input type="checkbox"/> sample(s) ___ is (are) above 3,000 mg/kg	
Sampled by	Analysed by	
Signature	Signature	

Record number:

Stage 2 analysis (Gas chromatography/mass spectrometry)				
Date				
Instrument I.D.				
Comments on the method				
Sample I.D.	Specimen used	Content of tin (XFR analysis) (mg/kg)	Content of tin (as organotin) (mg/kg)	Compliance
A				<input type="checkbox"/> >2,500 mg/kg <input type="checkbox"/> >3,000 mg/kg
B				<input type="checkbox"/> >2,500 mg/kg <input type="checkbox"/> >3,000 mg/kg
C				<input type="checkbox"/> >2,500 mg/kg <input type="checkbox"/> >3,000 mg/kg
D				<input type="checkbox"/> >2,500 mg/kg <input type="checkbox"/> >3,000 mg/kg
4. Conclusion <input type="checkbox"/> Not compliant _____ samples out of _____ are above 2,500 mg/kg sample(s) _____ is (are) above 3,000 mg/kg <input type="checkbox"/> Compliant				
5. Additional comments				
6. Laboratory name				
7. Analysed by			8. Signature	

Case B. Analysis of cybutryne only

Record number

Sampling and gas chromatography/mass spectrometry analysis
Date: Instrument I.D.

Sample location	Specimen I.D.	Sample disc	Comments on the samples and sampling procedure	Comments on the sample location
A	A1	<input type="checkbox"/> abrasive		
	A2	<input type="checkbox"/> metal		
	A3	<input type="checkbox"/> others		
	A4	<input type="checkbox"/> abrasive		
	A5	<input type="checkbox"/> metal		
	A6	<input type="checkbox"/> others		
	A7	<input type="checkbox"/> abrasive		
	A8	<input type="checkbox"/> metal		
	A9	<input type="checkbox"/> others		
B	B1	<input type="checkbox"/> abrasive		
	B2	<input type="checkbox"/> metal		
	B3	<input type="checkbox"/> others		
	B4	<input type="checkbox"/> abrasive		
	B5	<input type="checkbox"/> metal		
	B6	<input type="checkbox"/> others		
	B7	<input type="checkbox"/> abrasive		
	B8	<input type="checkbox"/> metal		
	B9	<input type="checkbox"/> others		
C	C1	<input type="checkbox"/> abrasive		
	C2	<input type="checkbox"/> metal		
	C3	<input type="checkbox"/> others		
	C4	<input type="checkbox"/> abrasive		
	C5	<input type="checkbox"/> metal		
	C6	<input type="checkbox"/> others		
	C7	<input type="checkbox"/> abrasive		
	C8	<input type="checkbox"/> metal		
	C9	<input type="checkbox"/> others		
D	D1	<input type="checkbox"/> abrasive		
	D2	<input type="checkbox"/> metal		
	D3	<input type="checkbox"/> others		
	D4	<input type="checkbox"/> abrasive		
	D5	<input type="checkbox"/> metal		
	D6	<input type="checkbox"/> others		
	D7	<input type="checkbox"/> abrasive		
	D8	<input type="checkbox"/> metal		
	D9	<input type="checkbox"/> others		

Average concentration of cybutryne (mg of cybutryne per kg of dry paint)	
Sampled by	Analysed by
Signature	Signature

Case C. Simplified approach to detect organotin and cybutryne

		Record number
Sampling and gas chromatography/mass spectrometry analysis		
Date:	Instrument I.D.	

Sample location	Specimen I.D.	Sample disc	Comments on the samples and sampling procedure	Comments on the sample location
A	A1	<input type="checkbox"/> abrasive		
	A2	<input type="checkbox"/> metal		
	A3	<input type="checkbox"/> others		
	A4	<input type="checkbox"/> abrasive		
	A5	<input type="checkbox"/> metal		
	A6	<input type="checkbox"/> others		
	A7	<input type="checkbox"/> abrasive		
	A8	<input type="checkbox"/> metal		
	A9	<input type="checkbox"/> others		
B	B1	<input type="checkbox"/> abrasive		
	B2	<input type="checkbox"/> metal		
	B3	<input type="checkbox"/> others		
	B4	<input type="checkbox"/> abrasive		
	B5	<input type="checkbox"/> metal		
	B6	<input type="checkbox"/> others		
	B7	<input type="checkbox"/> abrasive		
	B8	<input type="checkbox"/> metal		
	B9	<input type="checkbox"/> others		
C	C1	<input type="checkbox"/> abrasive		
	C2	<input type="checkbox"/> metal		
	C3	<input type="checkbox"/> others		
	C4	<input type="checkbox"/> abrasive		
	C5	<input type="checkbox"/> metal		
	C6	<input type="checkbox"/> others		
	C7	<input type="checkbox"/> abrasive		
	C8	<input type="checkbox"/> metal		
	C9	<input type="checkbox"/> others		
D	D1	<input type="checkbox"/> abrasive		
	D2	<input type="checkbox"/> metal		
	D3	<input type="checkbox"/> others		
	D4	<input type="checkbox"/> abrasive		
	D5	<input type="checkbox"/> metal		
	D6	<input type="checkbox"/> others		
	D7	<input type="checkbox"/> abrasive		
	D8	<input type="checkbox"/> metal		
	D9	<input type="checkbox"/> others		

Average content of organotin (mg of organotin per kg of dry paint)	
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Average concentration of cybutryne (mg of cybutryne per kg of dry paint)	
Sampled by	Analysed by
Signature	Signature

Section 3: Final conclusion

1. Conclusion

- Anti-fouling system is compliant with the AFS Convention 2001.
 Anti-fouling system is NOT compliant with the AFS Convention 2001.

2. Comments

3. Processed official

3.1 Name

3.2 Date

3.3 Signature

4. Authorized administrator

4.1 Name

4.2 Date

4.3 Signature

ANNEX 20

**RESOLUTION MEPC.357(78)
(adopted on 10 June 2022)**

2022 GUIDELINES FOR INSPECTION OF ANTI-FOULING SYSTEMS ON SHIPS

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee conferred upon it by international conventions for the prevention and control of marine pollution,

RECALLING ALSO that the International Conference on the Control of Harmful Anti-fouling Systems for Ships, 2001, held in October 2001, adopted the International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001 (the AFS Convention) together with four Conference resolutions,

RECALLING FURTHER that article 11(1) of the AFS Convention prescribes that ships to which this Convention applies may, in any port, shipyard, or offshore terminal of a Party, be inspected by officers authorized by that Party for the purpose of determining whether the ship is in compliance with this Convention,

NOTING that article 3(3) of the AFS Convention prescribes that Parties to this Convention shall apply the requirements of this Convention as may be necessary to ensure that no more favourable treatment is given to ships of non-Parties to this Convention,

NOTING ALSO resolution MEPC.208(62) by which the Committee adopted the 2011 Guidelines for Inspection of Anti-fouling Systems on Ships,

RECALLING FURTHER that at its seventy-sixth session it adopted amendments to the AFS Convention to introduce controls on cybutryne through resolution MEPC.331(76),

RECOGNIZING the need for a consequential revision of the guidelines associated with the AFS Convention due to the aforementioned amendments,

NOTING FURTHER that through resolutions MEPC.358(78) and MEPC.356(78) the Organization adopted *2022 Guidelines for survey and certification of anti-fouling systems on ships* and *2022 Guidelines for brief sampling of anti-fouling systems on ships*, respectively, and

HAVING CONSIDERED a revised text of the *Guidelines for inspection of anti-fouling systems on ships* prepared by the Sub-Committee on Pollution Prevention and Response at its ninth session,

1 ADOPTS the *2022 Guidelines for inspection of anti-fouling systems on ships* (2022 Guidelines), the text of which is set out in the annex to this resolution;

2 INVITES Governments to apply the 2022 Guidelines when exercising port State control inspections;

3 RECOMMENDS that the 2022 Guidelines incorporated in the future revision of resolution A.1155(32) on *Procedures for port State control, 2021*;

- 4 RECOMMENDS that the Guidelines be reviewed on a regular basis;
- 5 REVOKES resolution MEPC.208(62).

ANNEX

2022 GUIDELINES FOR INSPECTION OF ANTI-FOULING SYSTEMS ON SHIPS

1 INTRODUCTION

1.1 The right of the port State to conduct inspections of anti-fouling systems on ships is laid down in article 11 of the AFS Convention. The guidelines for conducting these inspections are described below.

1.2 Ships of 400 gross tonnage and above engaged in international voyages (excluding fixed or floating platforms, FSUs and FPSOs) will be required to undergo an initial survey before the ship is put into service or before the International Anti-fouling System Certificate (IAFS) is issued for the first time; and a survey should be carried out when the anti-fouling systems are changed or replaced.

1.3 Ships of 24 metres in length or more but less than 400 gross tonnage engaged in international voyages (excluding fixed or floating platforms, FSUs and FPSOs) will have to carry a Declaration on Anti-fouling Systems signed by the owner or authorized agent. Such declaration shall be accompanied by appropriate documentation (such as a paint receipt or a contractor invoice) or contain appropriate endorsement.

2 INITIAL INSPECTION

2.1 Ships required to carry an IAFS Certificate or Declaration on Anti-Fouling Systems (Parties of the AFS Convention)

2.1.1 The PSCO should check the validity of the IAFS Certificate or Declaration on Anti-Fouling Systems, and the attached Record of Anti-Fouling Systems, if appropriate.

2.1.2 The only practical way to apply paint to the ship's bottom (underwater part) is in a dry dock. This means that the date of application of paint on the IAFS Certificate should be checked by comparing the period of dry-docking with the date on the certificate.

2.1.3 If the paint has been applied during a scheduled dry-dock period, it has to be registered in the ship's logbook. Furthermore, this scheduled dry-docking can be verified by the endorsement date on the (statutory) Cargo Ship Safety Construction Certificate or the Cargo Ship Safety Certificate (SOLAS, regulation I/12(a)(v)) and Passenger Ship Safety Certificate (SOLAS, regulation I/7).

2.1.4 In case of an unscheduled dry-dock period, it could be verified by the registration in the ship's logbook.

2.1.5 It can be additionally verified by the endorsement date on the (Class) Hull Certificate, the dates on the Manufacturer's Declaration or by confirmation of the shipyard.

2.1.6 The IAFS Certificate includes a series of tick boxes indicating for each of the anti-fouling systems, describing the following situations:

- .1 if an anti-fouling system controlled under Annex 1 to the AFS Convention has not been applied during or after construction of this ship;

- .2 if an anti-fouling system controlled under Annex 1 to the AFS Convention has been applied on this ship previously, but has been removed;
- .3 if an anti-fouling system controlled under Annex 1 to the AFS Convention has been applied on this ship previously, but has been covered with a sealer coat;
- .4 if an anti-fouling system controlled under Annex 1 of the AFS Convention has been applied on this ship previously, but is not in the external coating layer of the hull or external parts or surfaces on 1 January 2023 (not applicable for organotin); and
- .5 if an anti-fouling system controlled under Annex 1 of the AFS Convention was applied on this ship prior to 1 January 2023, but must be removed or covered with a sealer coat no later than 60 months following the last application to the ship of an anti-fouling systems containing cybutryne (not applicable for organotin).

2.1.7 Particular attention should be given to verifying that the survey for issuance of the current IAFS Certificate matches the dry-dock period listed in the ship's log(s)¹ and that only one tick box is marked for each of the substances controlled under Annex 1.

2.1.8 The Record of Anti-Fouling Systems should be attached to the IAFS Certificate and be up to date. The most recent record should agree with the tick box on the front of the IAFS Certificate. The issuing of the IAFS Certificate should be in accordance with regulation 2(3) of Annex 4 of the AFS Convention.

2.2 Ships of non-Parties to the AFS Convention

2.2.1 Ships of non-Parties to the AFS Convention are not entitled to be issued with an IAFS Certificate. Therefore, the PSCO should ask for documentation that contains the same information as in an IAFS Certificate and take this into account in determining compliance with the requirements.

2.2.2 If the existing anti-fouling system is declared not to be controlled under Annex 1 to the Convention, without being documented by an International Anti-Fouling System Certificate, verification should be carried out to confirm that the anti-fouling system complies with the requirements of the Convention. This verification may be based on sampling and/or testing and/or reliable documentation, as deemed necessary, based on experience gained and the existing circumstances. Documentation for verification could be, for example, MSDS (Material Safety Data Sheets), or similar, a declaration of compliance from the anti-fouling system manufacturer, invoices from the shipyard and/or the anti-fouling system manufacturer.

2.2.3 Ships of non-Parties may have Statements of Compliance issued in order to comply with regional requirements, for example, Regulation (EC) 782/2003 as amended by Regulation (EC) 536/2008, which could be considered as providing sufficient evidence of compliance for organotin compounds.

2.2.4 In all other aspects the PSCO should be guided by the procedures for ships required to carry an IAFS Certificate.

¹ This provision, regarding the matching of the survey with the dry-dock period, is not applicable for the survey referred to in operative paragraph 4 of resolution MEPC.331(76).

2.2.5 The PSCO should ensure that no more favourable treatment is applied to ships of non-Parties to the AFS Convention.

3 MORE DETAILED INSPECTION

3.1 Clear grounds

3.1.1 A more detailed inspection may be carried out when there have been clear grounds to believe that the ship does not substantially meet the requirements of the AFS Convention. Clear grounds for a more detailed inspection may be when:

- .1 the ship is from a flag of a non-Party to the Convention and there is no AFS documentation;
- .2 the ship is from a flag of a Party to the Convention but there is no valid IAFS Certificate;
- .3 the painting date shown on the IAFS Certificate does not match the dry-dock period of the ship;
- .4 the ship's hull shows excessive patches of different paints; and
- .5 the IAFS Certificate is not properly completed.

3.1.2 If the IAFS Certificate is not properly completed, the following questions may be pertinent:

- .1 "When was the ship's anti-fouling system last applied?";
- .2 "If the anti-fouling system is controlled under Annex 1 to the AFS Convention and was removed, what was the name of the facility and date of the work performed?";
- .3 "If the anti-fouling system is controlled under Annex 1 to the AFS Convention and has been covered by a sealer coat, what was the name of the facility and date applied?";
- .4 "What is the name of the anti-fouling/sealer products and the manufacturer or distributor for the existing anti-fouling system?"; and
- .5 "If the current anti-fouling system was changed from the previous system, what was the type of anti-fouling system and name of the previous manufacturer or distributor?".

3.2 Sampling

3.2.1 A more detailed inspection may include sampling and analysis of the ship's anti-fouling system, if necessary, to establish whether or not the ship complies with the AFS Convention. Such sampling and analysis may involve the use of laboratories and detailed scientific testing procedures.

3.2.2 If sampling is carried out, the time to process the samples cannot be used as a reason to delay the ship.

3.2.3 Any decision to carry out sampling should be subject to practical feasibility or to constraints relating to the safety of persons, the ship or the port (see appendix 1 for sampling procedures; an AFS Inspection Report template for sampling and analysis is attached to the Guidelines).

3.3 Action taken under the AFS Convention

Detention

3.3.1 The port State could decide to detain the ship following detection of deficiencies during an inspection on board.

3.3.2 Detention could be appropriate in any of the following cases:

- .1 certification is invalid or missing;
- .2 the ship admits it does not comply (thereby removing the need to prove by sampling); and
- .3 sampling proves it is non-compliant within the port's jurisdiction.

3.3.3 Further action would depend on whether the problem is with the certification or the anti-fouling system itself.

3.3.4 If there are no facilities in the port of detention to bring the ship into compliance, the port State could allow the ship to sail to another port to bring the anti-fouling system into compliance. This would require an agreement of that port.

Dismissal

3.3.5 The port State could dismiss the ship, meaning that the port State demands that the ship leave port – for example if the ship chooses not to bring the AFS into compliance but the port State is concerned that the ship is leaching tributyltin (TBTs) or cybutryne into its waters.

3.3.6 Dismissal could be appropriate if the ship admits it does not comply or sampling proves it is non-compliant while the ship is still in port. Since this would also be a detainable deficiency the PSCO can detain first and require rectification before release. However, there may not be available facilities for rectification in the port of detention. In this case the port State could allow the ship to sail to another port to bring the anti-fouling system into compliance. This could require the agreement of that port.

3.3.7 Dismissal could be appropriate in any of the following cases:

- .1 certification is invalid or missing;
- .2 the ship admits it does not comply (thereby removing the need to collect proof by sampling); and
- .3 sampling proves that the ship is non-compliant within the port's jurisdiction.

3.3.8 In these cases the ship will probably already have been detained. However, detention does not force the ship to bring the AFS into compliance (only if it wants to depart). In such a situation the port State may be concerned that the ship is leaching TBTs or cybutryne while it remains in its waters.

Exclusion

3.3.9 The port State could decide to exclude the ship to prevent it entering its waters. Exclusion could be appropriate if sampling proves that the ship is non-compliant but the results have been obtained after it has sailed or after it has been dismissed.

3.3.10 Exclusion could be appropriate if sampling proves that the ship is non-compliant but the results have been obtained after it has sailed or after it has been dismissed. Article 11(3) of the AFS Convention only mentions that the "party carrying out the inspection" may take such steps. This means that, if a port State excludes a ship, the exclusion cannot be automatically applied by other port States.

3.3.11 In accordance with the Procedures for Port State Control (resolution A.1155(32), as amended), where deficiencies cannot be remedied at the port of inspection, the PSCO may allow the ship to proceed to another port, subject to any appropriate conditions determined. In such circumstances, the PSCO should ensure that the competent authority of the next port of call and the flag State are notified.

Reporting to the flag State

3.3.12 Article 11(3) of the AFS Convention requires that, when a ship is detained, dismissed or excluded from a port for violation of the Convention, the Party taking such action shall immediately inform the flag Administration of the ship and any recognized organization which has issued a relevant certificate.

4 AFS REPORT TO FLAG STATE IN RESPONSE TO ALLEGED CONTRAVENTIONS

4.1 Article 11(4) of the AFS Convention allows Parties to inspect ships at the request of another Party, if sufficient evidence that the ship is operating or has operated in violation of the Convention is provided. Article 12(2) permits port States conducting the inspection to send the Administration (flag State) of the ship concerned any information and evidence it has that a violation has occurred. Information sent to the flag State is often inadequate for a prosecution. The following paragraphs detail the sort of information needed.

4.2 The report to the authorities of the port or coastal State should include as much as possible the information listed in section 3. The information in the report should be supported by facts which, when considered as a whole, would lead the port or coastal State to believe a contravention had occurred.

4.3 The report should be supplemented by documents such as:

- .1 the port State report on deficiencies;
- .2 a statement by the PSCO, including their rank and organization, about the suspected non-conforming anti-fouling system. In addition to the information required in section 3, the statement should include the grounds the PSCO had for carrying out a more detailed inspection;
- .3 a statement about any sampling of the anti-fouling system including:
 - .1 the ship's location;
 - .2 where the sample was taken from the hull, including the vertical distance from the boot topping;

- .3 the time of sampling;
- .4 person(s) taking the samples; and
- .5 receipts identifying the persons having custody and receiving transfer of the samples;
- .4 reports of the analyses of any samples including:
 - .1 the results of the analyses;
 - .2 the method employed;
 - .3 reference to or copies of scientific documentation attesting the accuracy and validity of the method employed;
 - .4 the names of persons performing the analyses and their experience; and
 - .5 a description of the quality assurance measures of the analyses;
- .5 statements of persons questioned;
- .6 statements of witnesses;
- .7 photographs of the hull and sample areas; and
- .8 a copy of the IAFS Certificate, including copies of relevant pages of the Record of Anti-fouling Systems, logbooks, MSDS or similar, declaration of compliance from the anti-fouling system manufacturer, invoices from the shipyard and other dry dock records pertaining to the anti-fouling system.

4.4 All observations, photographs and documentation should be supported by a signed verification of their authenticity. All certifications, authentications or verifications should be in accordance with the laws of the State preparing them. All statements should be signed and dated by the person making them, with their name printed clearly above or below the signature.

4.5 The reports referred to under paragraphs 2 and 3 of this section should be sent to the flag State. If the coastal State observing the contravention and the port State carrying out the investigation on board are not the same, the port State carrying out the investigation should also send a copy of its findings to the coastal State.

APPENDIX 1

SAMPLING

Considerations related to brief sampling may be found in section 2.1 of the *Guidelines for brief sampling of anti-fouling systems on ships* (resolution MEPC.356(78)).

Any obligation to take a sample should be subject to practical feasibility or to constraints relating to the safety of persons, the ship or the port.

The PSCO should consider the following:

- liaise with the ship on the location and time needed to take samples; the PSCO should verify that the time required will not unduly prevent the loading/unloading, movement or departure of the ship;
- do not expect the ship to arrange safe access but liaise with the ship over the arrangements that the port State competent authority has made, for example boat, cherry picker, staging;
- select sampling points covering representative areas;
- take photographs of the hull, sample areas and sampling process;
- avoid making judgements on the quality of the paint (e.g. surface, condition, thickness, application);
- the need of inviting the ship representative's presence during brief sampling to ensure that the evidence is legally obtained;
- complete and sign the inspection report form together with the included sampling record sheets (to be filled in by the sampler), as far as possible, and leave a copy with the ship as a proof of inspection/sampling;
- inform the next port State where the inspected ship is to call;
- agree with or advise the ship on to whom the ship's copy of the finalized inspection report will be sent in cases when it cannot be completed in the course of the inspection; and
- ensure that receipts identifying the persons having custody and receiving transfer of the samples accompany the samples are filled in to reflect the transfer chain of the samples. PSCOs are reminded that the procedures set in national legislation regarding custody of evidence are not affected by the regulation. These guidelines therefore do not address this issue in detail.

1 Sampling methodologies

It is at the discretion of the port State to choose the sampling methodology. The *Guidelines for brief sampling of anti-fouling systems on ships* adopted by resolution MEPC.356(78) allow that any other scientifically recognized method of sampling and analysis of AFS controlled under the Convention than those described in the appendix to the Guidelines may be used (subject to the satisfaction of the Administration or the port State). The sampling methodology will depend, inter alia, on the surface hardness of the paint, which may vary considerably. The amount of paint mass removed may vary correspondingly.

Based on the onboard International Anti-fouling System Certificate or a Declaration on Anti-fouling System, the port State competent authority would decide if the brief sampling analysis should focus on only organotin, cybutryne or both and apply the appropriate methodology including the number of samples, analysis, and definition of compliance.

Sampling procedures, based on the removal of paint material from the hull, require the determination of paint mass. It is important that procedures used are validated, produce unambiguous results and contain an adequate control.

The competent port State authority can decide to contract specialist companies to carry out sampling. In this case the PSCO should attend the ship during the sampling procedure to ensure the liaison and arrangements mentioned above are in place.

If a specialist company is not used, the port State competent authority should provide appropriate training to the PSCO in the available sampling methods and procedures and ensure that agreed procedures are followed.

The following general terms should be observed:

- the PSCO should choose a number of sample points preferably covering all the representative areas of the hull, but it is desirable to have at least eight (8) sample points equally spaced down and over the length of the hull, if possible divided over PS and SB (keeping in mind that different parts of the hull may be treated with different anti-fouling systems);
- triplicate specimens of paint at each sampling point should be taken in close proximity to each other on the hull (e.g. within 10 cm of each other);
- contamination of the samples should be avoided, which normally includes the wearing of non-sterilized non-powdered disposable gloves of suitable impervious material – e.g. nitrile rubber;
- the samples should be collected and stored in an inert container (e.g. containers should not consist of materials containing organotins and cybutryne or have the capacity to absorb organotins and cybutryne);
- samples should be taken from an area where the surface of the anti-fouling system is intact, clean and free of fouling;
- loose paint chips coming from detached, peeled or blistered hull areas should not be used for sampling;
- samples should not be taken from a heated or area where the paint is otherwise softened (e.g. heavy fuel tanks);
- the underlying layers (primers, sealers, TBT containing AFS) should not be sampled if there is no clear evidence of exposure of extended areas; and
- ships bearing an anti-fouling system that does not contain cybutryne in the external coating layer are not required to be controlled under Annex 1 of the Convention. Such ships carrying an IAFS Certificate indicating the situation described in paragraph 2.1.6.4 of these Guidelines should be deemed compliant with the Convention except if there is a doubt on the validity of the IAFS Certificate.

2 Validity of the sampling

In order to safeguard the validity of the sampling as evidence of non-compliance, the following should be considered:

- only samples taken directly from the hull and free of possible contamination should be used;
- all samples should be stored in containers, marked and annotated on the record sheet. This record sheet should be submitted to the Administration;
- the receipts identifying the persons having custody and receiving transfer of the samples should be filled in and accompany the samples to reflect the transfer chain of the samples;
- the PSCO should verify the validity of the instrument's calibration validity date (according to the manufacturer instruction);
- in cases when a contracted specialist company is used for carrying out sampling, the PSCO should accompany its representative to verify sampling; and
- photographs of the hull, sample areas and sampling process could serve as additional proof.

It is also the case that sampling companies and/or procedures can be certified.

3 Health and safety when sampling

Any obligation to take a sample should be subject to practical feasibility or any constraints relating to the safety of persons, the ship or the port.

The PSCO is advised to ensure their safety taking the following points into account:

- general requirements enforced by the terminal or port authority and national health, safety and environmental policy;
- condition of the ship (ballast condition, ship's operations, mooring, anchorage, etc.);
- surroundings (position of ship, traffic, ships movement, quay operations, barges or other floating vessels alongside);
- safety measures for the use of access equipment (platforms, cherry picker, staging, ladders, railings, climbing harness, etc.), e.g. ISO 18001;
- weather (sea state, wind, rain, temperature, etc.); and
- precautions to avoid falling into the water between the quay and the ship. If in doubt, a lifejacket and if possible a safety line should be worn when sampling.

Any adverse situation encountered during sampling that could endanger the safety of personnel shall be reported to the safety coordinator.

Care should be taken to avoid contact of the removed paint with the skin and the eyes, and no particles should be swallowed or come into contact with foodstuffs. Eating or drinking during sampling is prohibited and hands should be cleaned afterwards. Persons carrying out sampling should be aware that the AFS and solvents or other materials used for sampling may be harmful and appropriate precautions should be taken. Personal protection should be considered by using long sleeve solvent-resistant gloves, dust mask, safety glasses, etc.

Standard (and specific, if applicable) laboratory safety procedures should be followed at all times when undertaking the sampling procedures and subsequent analysis.

4 Conducting analyses

The *Guidelines for brief sampling of anti-fouling systems on ships* envisage a two-stage analysis for organotin analysis for both methods presented in the appendix to the Guidelines. The first stage is a basic test, which can be carried out on site as in the case of Method 2. The second stage is carried out when the first stage results are positive. It is noted that in the IMO Guidelines these stages are referred to as Steps 1 and 2 as in the case of Method 1. It is at the discretion of the port State competent authorities to choose which analysis methods are used.

The method for cybutryne determination is based on a one-step analysis.

The following points are presented for port State consideration:

- approval procedure for the recognition of laboratories meeting ISO 17025 standards or other appropriate facilities should be set up by the port State competent authorities. These procedures should define the recognition criteria. Exchange of information between port States on these procedures, criteria and laboratories/facilities would be beneficial, i.e. for the purposes of exchange of best practices and possible cross-border recognition and provision of services;
- the company that undertakes the analysis and/or samples should comply with national regulations and be independent from paint manufacturers;
- the PSCO carrying out the AFS inspection of a ship should verify the validity of the ISO 17025 certificate and/or the recognition of the laboratory;
- if more time is needed for analysis than available considering the ship's scheduled time of departure, the PSCO shall inform the ship and report the situation to the port State competent authority. However, the time needed for analysis does not warrant undue delay of the ship; and
- PSCOs should ensure completion of the record sheets for the sampling procedure as proof of analysis. In cases when the laboratory procedures prescribe presentation of the analyses' results in a different format, this technical report could be added to the record sheets.

5 The first-stage analysis for organotin

The first-stage analysis serves to detect the total amount of tin in the AFS applied.

It is at the discretion of the port State competent authority to choose the first-stage analysis methodology. However, the use of a portable X-ray fluorescence analyser (mentioned under

Method 2) or any other scientifically justified method allowing the conduction of first-stage analyses on site could be considered best practice.

The port State competent authority has to decide whether the first-stage analysis should be carried out by PSCOs or by contracted companies.

The port State competent authority could provide PSCOs with this equipment (e.g. portable X-ray fluorescence analyser) and provide the appropriate training.

6 The second-stage analysis for organotin

The second-stage (final) analysis is used to verify whether or not the AFS system complies with the Convention requirements, i.e. whether organotin compounds are present in the AFS at a level which would act as a biocide.

The port State could consider implementing only a second-stage analysis.

It is at the discretion of the Authority to choose the second-stage analysis methodology. In this respect it is hereby noted that the second-stage analysis methodology for sampling Method 2 provided in the Guidelines is only tentative and "should be thoroughly reviewed by experts based on scientific evidence" (section 5.1 of Method 2).

7 One-stage analysis for cybutryne

For cybutryne a one-stage analysis is described in both Method 1 and Method 2 of the brief sampling guidelines. The specimens are to be analysed in a GC-MS analysis. The procedure is the same for both methods.

8 One-stage analysis for cybutryne and organotin

For cybutryne and organotin a one-stage analysis is described in both Method 1 and Method 2 of the brief sampling guidelines. The specimens are to be analysed in a GC-MS analysis.

9 Conclusions on compliance

The Authority should only make conclusions on compliance based on the second-stage analysis of the sample (organotin). In case the results indicate non-compliance at that stage, there are clear grounds to take further steps.

For cybutryne the authority could make conclusions on compliance based on the one-stage analysis.

If considered necessary, more thorough sampling can be also carried out in addition or instead of brief sampling.

Sampling results should be communicated as soon as possible to the ship (as part of the inspection report) and in the case of non-compliance also to the flag State and recognized organization acting on behalf of the flag State if relevant.

Authorities should, in accordance with section 5.2 of the *Guidelines for brief sampling of anti-fouling systems on ships*, develop and adopt procedures to be followed for those cases where compliance with acceptable limits or lack thereof is unclear, considering additional sampling or other methodologies for sampling.

FORM S/1

REPORT OF INSPECTION OF A SHIP'S ANTI-FOULING SYSTEM (AFS)

SHIP PARTICULARS

1. Name of ship: _____ 2. IMO number: _____
3. Type of ship: _____ 4. Call sign: _____
5. Flag of ship: _____ 6. Gross tonnage: _____
7. Date keel laid / major conversion commenced: _____

INSPECTION PARTICULARS

8. Date & time: _____
9. Name of facility: _____
(dry dock, quay, location)
Place & country: _____
10. Areas inspected Ship's logbook Certificates Ship's hull
11. Relevant certificate(s)
(a) title (b) issuing authority (c) dates of issue
1. IAFS Certificate _____
2. Record of AFS _____
3. Declaration of AFS _____
4. _____
12. Dry-dock period AFS applied: _____
13. Name of facility AFS applied: _____
14. Place & country AFS applied: _____
15. AFS samples taken No Yes Nature of sampling: Brief Extent
16. Reason for sampling of AFS: _____

17. Record sheet attached : _____
(country-code / IMO
number / dd-mm-yy)
18. Copy to: PSCO Flag State Recognized organization
 Head office Master Other: _____

PORT STATE PARTICULARS

Reporting authority: _____ District office _____

Address: _____

Telephone/Fax/Mobile: _____

E-mail: _____

Name:
*(duly authorized
inspector of reporting
authority)* _____

Date: _____ Signature: _____

PORT STATE PARTICULARS

Reporting authority: _____ **District office:** _____

Address: _____

**Telephone/Fax/
Mobile:** _____

E-mail: _____

Name:
*(duly authorized
inspector of reporting
authority)* _____

Date: _____ **Signature:** _____

FORM S/3

RECORD NUMBER	
---------------	--

Name of ship _____ IMO number: _____

METHOD 1 ANALYSIS

Case A - Analysis of organotin only

1.	Instrument I.D.:		Calibration expire date:			
2.	Specimens 'A' results		Total number of specimens 'A' analysed:			
3.	No.	Sample location (frame & distance from boot topping)	mg Sn/kg	No.	Sample location (frame & distance from boot topping)	mg Sn/kg
	1			9		
	2			10		
	3			11		
	4			12		
	5			13		
	6			14		
	7			15		
	8			16		
4.	Results Number of specimens exceeding 2,500 mg/kg: 1 or more specimens exceeding 3,000 mg/kg <input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Step 2 required <input type="checkbox"/> Compliance, no further analysis		
5.	Additional comments concerning analysis of results from Specimens 'A'					
6.	Company			Name: Date: Signature:		

7.	Instrument I.D.:		Calibration expire date:	
8.	Specimens 'B' results			Total number of specimens "B" analysed:
9.	No.	organotin (mg Sn/kg) as Sn	No.	organotin (mg Sn/kg) as Sn
	1		5	9
	2		6	10
	3		7	11
	4		8	12
10.	Results			
	Number of specimens exceeding 2,500 mg/kg:			<input type="checkbox"/> Non-compliance assumed
	1 or more specimens exceeding 3,000 mg/kg <input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Compliance assumed
11.	Additional comments concerning analysis of results from Specimens 'B'			
12.	Company			Name: Date: Signature:

Case B - Analysis of cybutryne only

Gas chromatography/mass spectrophotometry (GC/MS) analysis

1.	Instrument I.D.:		Calibration expire date:	
2.	Specimens 'C' results			
	Total number of specimens 'C' analysed by GC-MS:			
	Average concentration of cybutryne (mg of cybutryne per kg of dry paint):			
3.	Conclusions			
	The average concentration of cybutryne exceeds the threshold of 1,250 mg of cybutryne per kg of dry paint			<input type="checkbox"/> Yes <input type="checkbox"/> No. Compliance assumed.
4.	Additional comments concerning analysis of results from Specimens 'C'			
5.	Company			Name: Date: Signature:

Case C - Simplified approach to detect organotin and cybutryne

Gas chromatography/mass spectrophotometry (GC/MS) analysis

1.	Instrument I.D.:		Calibration expire date:	
2.	Specimens 'C' results			
	Total number of specimens 'C' analysed by GC-MS:			
	Average concentration of organotin (mg Sn/kg of dry paint)			
	Average concentration of cybutryne (mg of cybutryne per kg of dry paint):			
3.	Conclusions			
	The average concentration of organotin exceeds the threshold of 3,000 mg Sn per kg of dry paint		<input type="checkbox"/> Yes <input type="checkbox"/> No. Compliance assumed.	
	The average concentration of cybutryne exceeds the threshold of 1,250 mg of cybutryne per kg of dry paint		<input type="checkbox"/> Yes <input type="checkbox"/> No. Compliance assumed.	
4.	Additional comments concerning analysis of results from Specimens 'C'			
5.	Company		Name: Date: Signature:	

FORM S/4

RECORD NUMBER	
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Name of ship _____ IMO number: _____

METHOD 2 ANALYSIS

Case A - Analysis of organotin only

First stage

1.	Instrument I.D.:	Calibration expire date:
----	------------------	--------------------------

2.	Sample location (frame & distance from boot topping)	Specimen I.D.	Sample disc	Content of tin (mg/ kg)	max	min	Average
A		A1	<input type="checkbox"/> abrasive				
		A2	<input type="checkbox"/> metal				
		A3	<input type="checkbox"/> others				Average
		A4	<input type="checkbox"/> abrasive				
		A5	<input type="checkbox"/> metal				mg/kg
		A6	<input type="checkbox"/> others				<input type="checkbox"/> >2,500 mg/kg
		A7	<input type="checkbox"/> abrasive				<input type="checkbox"/> >3,000 mg/kg
		A8	<input type="checkbox"/> metal				
		A9	<input type="checkbox"/> others				
B		B1	<input type="checkbox"/> abrasive				
		B2	<input type="checkbox"/> metal				
		B3	<input type="checkbox"/> others				Average
		B4	<input type="checkbox"/> abrasive				
		B5	<input type="checkbox"/> metal				mg/kg
		B6	<input type="checkbox"/> others				<input type="checkbox"/> >2,500 mg/kg
		B7	<input type="checkbox"/> abrasive				<input type="checkbox"/> >3,000 mg/kg
		B8	<input type="checkbox"/> metal				
		B9	<input type="checkbox"/> others				
C		C1	<input type="checkbox"/> abrasive				
		C2	<input type="checkbox"/> metal				
		C3	<input type="checkbox"/> others				Average
		C4	<input type="checkbox"/> abrasive				
		C5	<input type="checkbox"/> metal				mg/kg
		C6	<input type="checkbox"/> others				<input type="checkbox"/> >2,500 mg/kg
		C7	<input type="checkbox"/> abrasive				<input type="checkbox"/> >3,000 mg/kg
		C8	<input type="checkbox"/> metal				
		C9	<input type="checkbox"/> others				
D		D1	<input type="checkbox"/> abrasive				
		D2	<input type="checkbox"/> metal				
		D3	<input type="checkbox"/> others				Average
		D4	<input type="checkbox"/> abrasive				
		D5	<input type="checkbox"/> metal				mg/kg

	D6	<input type="checkbox"/> others			<input type="checkbox"/> >2,500 mg/kg
	D7	<input type="checkbox"/> abrasive			<input type="checkbox"/> >3,000 mg/kg
	D8	<input type="checkbox"/> metal			
	D9	<input type="checkbox"/> others			
3.	Results first-stage analysis				
	<input type="checkbox"/> ___ samples out of ___ are above 2,500 mg/kg <input type="checkbox"/> sample(s) ___ is (are) above 3,000 mg/kg				<input type="checkbox"/> Compliant <input type="checkbox"/> Second stage required
4.	Comments				
5.	Company		Name		
			Date		
			Signature		

Second stage

1.	Instrument I.D.:	Calibration expire date:			
2.	Specimen used <i>(Specimen I.D.)</i>	Content of tin first stage <i>(XRF analysis)</i> <i>(mg Sn/kg)</i>	Content of tin second stage <i>(as organotin)</i> (mg Sn/kg)	Compliance	
A				<input type="checkbox"/> >2,500 mg/kg <input type="checkbox"/> >3,000 mg/kg	
B				<input type="checkbox"/> >2,500 mg/kg <input type="checkbox"/> >3,000 mg/kg	
C				<input type="checkbox"/> >2,500 mg/kg <input type="checkbox"/> >3,000 mg/kg	
D				<input type="checkbox"/> >2,500 mg/kg <input type="checkbox"/> >3,000 mg/kg	
3.	Results second stage analysis				
	<input type="checkbox"/> ___ samples out of ___ are above 2,500 mg/kg (dry paint) <input type="checkbox"/> sample(s) ___ is (are) above 3,000 mg/kg (dry paint)				<input type="checkbox"/> Compliant <input type="checkbox"/> Not compliant
4.	Comments				
5.	Company		Name		
			Date		
			Signature		

Case B – Analysis of cybutryne only

Gas chromatography/mass spectrophotometry (GC/MS) analysis for cybutryne determination

1.	Instrument I.D.:	Calibration expire date:
2.	Results of GC-MS analysis	
	Average concentration (mg of cybutryne per kg of dry paint)	<input type="checkbox"/> Compliant <input type="checkbox"/> Not compliant
3.	Comments	
4.	Company	Name Date

Case C – Simplified approach to detect organotin and cybutryne

Gas chromatography/mass spectrophotometry (GC/MS) analysis for cybutryne and organotin determination

1.	Instrument I.D.:	Calibration expire date:
2.	Results of GC-MS analysis	
	Average concentration of organotin (mg Sn/kg)	<input type="checkbox"/> Compliant <input type="checkbox"/> Not compliant
	Average concentration of cybutryne (mg of cybutryne per kg of dry paint)	<input type="checkbox"/> Compliant <input type="checkbox"/> Not compliant
3.	Comments	
4.	Company	Name Date

PORT STATE PARTICULARS

Reporting authority:

District office:

Address:

Telephone/Fax/Mobile:

E-mail:

Name:

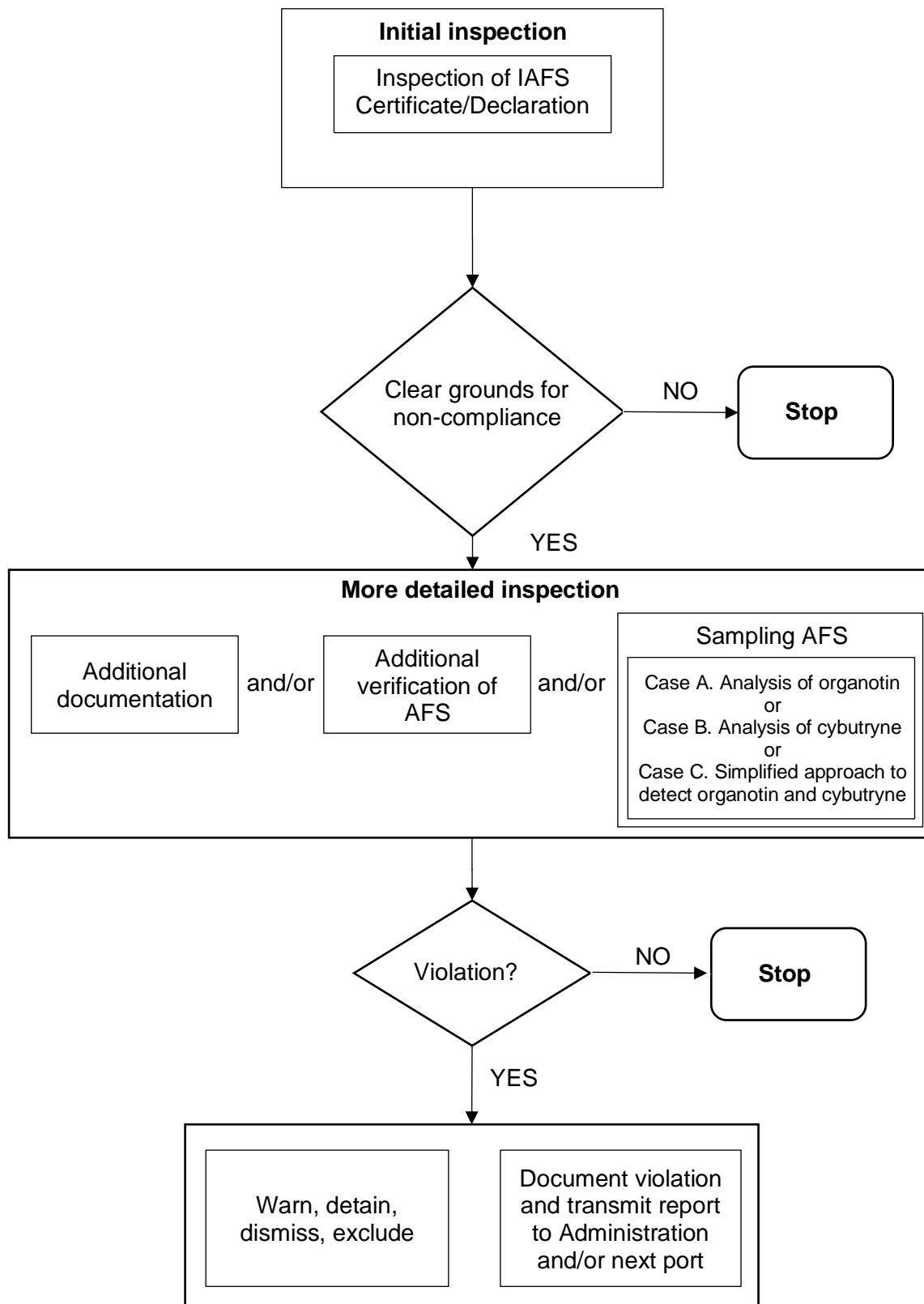
*(duly authorized
inspector of reporting
authority)*

Date:

Signature:

APPENDIX 2

AFS INSPECTION PROCESS



ANNEX 21

RESOLUTION MEPC.358(78)
(adopted on 10 June 2022)

**2022 GUIDELINES FOR SURVEY AND CERTIFICATION
OF ANTI-FOULING SYSTEMS ON SHIPS**

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee conferred upon it by the international conventions for the prevention and control of marine pollution,

RECALLING ALSO that the International Conference on the Control of Harmful Anti-fouling Systems for Ships, 2001, held in October 2001, adopted the International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001 (the AFS Convention) together with four Conference resolutions,

NOTING that article 10 of the AFS Convention prescribes that ships shall be surveyed and certified in accordance with the regulations of annex 4 of the Convention,

NOTING ALSO that regulation 1(4)(a) of annex 4 of the AFS Convention refers to the guidelines to be developed by the Organization,

NOTING FURTHER resolution MEPC.195(61) by which the Committee adopted the *2010 Guidelines for survey and certification of anti-fouling systems on ships*,

RECALLING FURTHER that at its seventy-sixth session it adopted amendments to the AFS Convention to introduce controls on cybutryne through resolution MEPC.331(76),

RECOGNIZING the need for a consequential revision of the guidelines associated with the AFS Convention due to the aforementioned amendments,

NOTING FURTHER that through resolutions MEPC.356(78) and MEPC.357(78) the Organization adopted *2022 Guidelines for brief sampling of anti-fouling systems on ships* and *2022 Guidelines for inspection of anti-fouling systems on ships*, respectively, and

HAVING CONSIDERED a revised text of the *Guidelines for survey and certification of anti-fouling systems on ships* prepared by the Sub-Committee on Pollution Prevention and Response at its ninth session,

- 1 ADOPTS the *2022 Guidelines for survey and certification of anti-fouling systems on ships* (2022 Guidelines), the text of which is set out in the annex to this resolution;
- 2 INVITES Governments to apply the 2022 Guidelines as soon as possible, or when the Convention becomes applicable to them;
- 3 RECOMMENDS that the Guidelines be reviewed on a regular basis;
- 4 REVOKES resolution MEPC.195(61).

ANNEX

2022 GUIDELINES FOR SURVEY AND CERTIFICATION OF ANTI-FOULING SYSTEMS ON SHIPS

1 General

1.1 Article 10 of the International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001, hereinafter referred to as "the Convention", prescribes that ships shall be surveyed and certified in accordance with the regulations of annex 4 to the Convention. The purpose of this document is to provide the *Guidelines for surveys and certification of anti-fouling systems on ships* referred to in regulation 1(4)(a) of annex 4, hereinafter referred to as the "Guidelines", that will assist the Administrations and recognized organizations in the uniform application of the provisions of the Convention and assist companies, shipbuilders, manufacturers of anti-fouling systems, as well as other interested parties to understand the process of the surveys and issuance and endorsement of the certificates.

1.2 These Guidelines provide the procedures for survey to ensure that a ship's anti-fouling system complies with the Convention, and those necessary for issuance and endorsement of an International Anti-fouling System Certificate. A guidance for compliant anti-fouling systems is given in appendix I to this annex.

1.3 These Guidelines apply to surveys of ships of 400 gross tonnage and above engaged in international voyages, excluding fixed or floating platforms, floating storage units (FSUs), and floating production storage and off-loading units (FPSOs), as specified in regulation 1(1) of annex 4 to the Convention.

1.4 The sole purpose of the survey activities described in these Guidelines is to verify compliance with the provisions of the Convention. Consequently, such surveys do not relate to any aspect not regulated by the Convention even if such aspects relate to the performance of an anti-fouling system on the hull of a ship, including the quality of workmanship during the application process.

1.5 In the event that a new survey method is developed, or in the event that the use of a certain anti-fouling system is prohibited and/or restricted, or in the light of experience gained, these Guidelines may need to be revised in the future.

2 Definitions

For the purposes of these guidelines:

2.1 "Administration" means the Government of the State under whose authority the ship is operating. With respect to a ship entitled to fly a flag of a State, the Administration is the Government of that State. With respect to fixed or floating platforms engaged in exploration and exploitation of the seabed and subsoil thereof adjacent to the coast over which the coastal State exercises sovereign rights for the purposes of exploration and exploitation of their natural resources, the Administration is the Government of the coastal State concerned.

2.2 "Anti-fouling system" means a coating, paint, surface treatment, surface, or device that is used on a ship to control or prevent attachment of unwanted organisms.

2.3 "Company" means the owner of the ship or any other organization or person such as the manager or the bareboat charterer, who has assumed the responsibility for the operation of the ship from the owner of the ship and who, on assuming such responsibility, has agreed to take over all duties and responsibilities imposed by the International Safety Management (ISM) Code.

2.4 "Gross tonnage" means the gross tonnage calculated in accordance with the tonnage measurement regulations contained in annex 1 to the International Convention on Tonnage Measurement of Ships, 1969, or any successor Convention.

2.5 "International voyage" means a voyage by a ship entitled to fly the flag of one State to or from a port, shipyard, or offshore terminal under the jurisdiction of another State.

2.6 "Length" means the length as defined in the International Convention on Load Lines, 1966, as modified by the Protocol of 1988 relating thereto, or any successor Convention.

2.7 "Ship" means a vessel of any type whatsoever operating in the marine environment and includes hydrofoil boats, air-cushion vehicles, submersibles, floating craft, fixed or floating platforms, floating storage units (FSUs) and floating production storage and off-loading units (FPSOs).

3 General requirements for surveys

3.1 An initial survey covering at least the scope as in paragraph 1 of appendix II to these Guidelines should be held before the ship is put into service and the International Anti-fouling System Certificate required under regulation 2 or 3 of annex 4 to the Convention is issued for the first time.

3.2 A survey should be carried out whenever an anti-fouling system is changed or replaced. Such surveys should cover the scope as in paragraph 2 of appendix II to these Guidelines.

3.3 A major conversion affecting the anti-fouling system of a ship may be considered as a newbuilding as determined by the Administration.

3.4 Repairs generally do not require a survey. However, repairs affecting approximately twenty-five (25) per cent or more of the anti-fouling system should be considered as a change or replacement of the anti-fouling system.

3.5 A non-compliant anti-fouling system controlled under annex 1 to the Convention that undergoes repair must be repaired or replaced with a compliant anti-fouling system.

4 Request for survey

4.1 Prior to any survey, a request for survey should be submitted by the Company to the Administration, or to a recognized organization, along with the ship's data required in the International Anti-fouling System Certificate as listed:

- .1 Name of ship
- .2 Distinctive number or letters
- .3 Port of registry
- .4 Gross tonnage
- .5 IMO number.

4.2 A request for survey should be supplemented by a declaration and supporting information from the anti-fouling system manufacturer, confirming that the anti-fouling system

applied, or intended to be applied to the ship is in compliance with the requirements of the Convention (with an identification of the version of the Convention referred to). Such declaration should provide the following information contained in the Record of Anti-fouling System, as can be found in appendix I to annex 4 to the Convention:

- .1 Type of anti-fouling system*.
- .2 Name of anti-fouling system manufacturer.
- .3 Name and colour of anti-fouling system.
- .4 Active ingredient(s) and their Chemical Abstract Service Registry Number(s) (CAS number(s)).

4.3 Information required by the surveyor regarding compliance of the product with the Convention should be found in a declaration from the anti-fouling system manufacturer which may be provided on the anti-fouling system container and/or on supportive documentation (such as Material Safety Data Sheets (MSDS), or similar). A link between the supportive documentation and the relevant container should exist.

5 Conduct of surveys

5.1 **Initial surveys** (Surveys in accordance with regulation 1(1)(a) of annex 4 to the Convention)

- .1 The initial survey should verify that all applicable requirements of the Convention are complied with.
- .2 As part of the survey, it should be verified that the anti-fouling system specified by the documentation submitted with the request for survey complies with the Convention. The survey should include verification that the anti-fouling system applied is identical to the system specified in the request for survey.
- .3 Taking into account experience gained and the prevailing circumstances, the initial survey should include the tasks as listed in paragraph 1 of appendix II to these Guidelines.
- .4 The verification tasks set out in paragraph 5.1.2 should be conducted at any time, either before, during, or after the anti-fouling system has been applied to the ship, as deemed necessary to verify compliance. No checks or tests must affect the integrity, structure or operation of the anti-fouling system.

5.2 **Surveys when the anti-fouling systems are changed or replaced** (Surveys in accordance with regulation 1(1)(b) of Annex 4 to the Convention)

- .1 If the existing anti-fouling system is confirmed by an International Anti-fouling System Certificate not to be controlled under annex 1 to the Convention, the provisions described in paragraphs 5.1 and 5.2 apply.

* Examples of suitable wording could be: Organotin-free self-polishing type, Organotin-free ablative type, Organotin-free conventional, Biocide-free silicon type paint, others. In the case of an anti-fouling system containing no active ingredients, the words "biocide-free" should be used.

- .2 If the existing anti-fouling system is declared not to be controlled under annex 1 of the Convention, without being documented by an International Anti-fouling System Certificate, a verification should be carried out to confirm that the anti-fouling system complies with the requirements of the Convention. This verification may be based on sampling and/or testing and/or reliable documentation, as deemed necessary based on experience gained and the existing circumstances. Documentation for verification could, for example, be MSDS, or similar, a declaration of compliance from the anti-fouling system manufacturer, invoices from the shipyard and/or the anti-fouling system manufacturer. To verify the new anti-fouling system, the provisions described in paragraph 5.1 apply.
- .3 If the existing anti-fouling system has been removed, the removal should be verified in addition to the provisions described in paragraph 5.1.
- .4 If a sealer coat has been applied, a verification should be carried out to confirm that the name, type and colour of the sealer coat applied to the ship match those specified in the request for survey, and that the existing anti-fouling system has been covered with that sealer coat. Additionally the provisions described in paragraph 5.1 apply.
- .5 An existing anti-fouling system controlled under annex 1 of the Convention, containing organotin:
 - .1 applied on/after 1 January 2003 or a later date if specified by the Administration, should be removed in accordance with paragraph 5.2.3;
 - .2 applied before 1 January 2003 or a later date if specified by the Administration, must have been removed or covered by a sealer coat in accordance with paragraph 5.2.4, not later than 60 months after its application and latest on 1 January 2008.
- .6 An existing anti-fouling system controlled under annex 1 of the Convention, containing cybutryne in the external coating layer:
 - .1 applied before 1 January 2023, should be removed or covered by a sealer coat in accordance with paragraph 5.2.4.
- .7 The survey should include the tasks as listed in paragraph 2 of appendix II to these Guidelines.

5.3 **Surveys of existing ships requesting only an International Anti-fouling System Certificate**

- .1 If the existing anti-fouling system is declared not to be controlled under Annex 1 to the Convention, a verification should be carried out to confirm that the anti-fouling system complies with the requirements of the Convention. This verification may be based on sampling and/or testing and/or reliable documentation, as deemed necessary based on experience gained and the existing circumstances. Such documentation could be MSDS or similar, a declaration of compliance from the anti-fouling system manufacturer, invoices from the shipyard and/or the anti-fouling system manufacturer. If this information raises no reasonable doubt that the system applied is compliant with annex 1 of the Convention, the International Anti-fouling System Certificate may be issued on this basis.

6 Issuing or endorsing the International Anti-fouling System Certificate

6.1 The International Anti-fouling System Certificate along with the Record of Anti-fouling Systems should be:

- .1 issued upon satisfactory completion of the initial survey;
- .2 issued upon acceptance of another Party's International Anti-fouling System Certificate; or
- .3 endorsed upon satisfactory completion of a survey for change or replacement of an anti-fouling system.

APPENDIX I

Guidance for compliant anti-fouling systems

1 For the purpose of compliance with annex 1 to the Convention in respect to organotin compounds

Small quantities of organotin compounds acting as a chemical catalyst (such as mono- and di-substituted organotin compounds) are allowed, provided that they are present at a level which does not provide a biocidal effect to the coating. On a practical level, when used as a catalyst, an organotin compound should not be present above 2,500 mg total tin per kilogram of dry paint.

2 For the purpose of compliance with annex 1 to the Convention in respect to cybutryne

2.1 When samples are directly taken from the hull

It could be expected that the distribution of the remaining anti-fouling paint on the hull surface is not uniform. Due to hull design and consequent action of the sea water during the service life of the paint, the paint may not have uniformly eroded, some parts in the hull may still have some paint, other parts may not have any paint left. Therefore, the brief samples taken from the hull surface should be representative of the anti-fouling system applied. Average values of cybutryne should not be present above 1,000 mg of cybutryne per kilogram of dry paint. Below this level any remaining cybutryne is expected not to create a negative impact to the marine environment.

2.2 When samples are taken from wet paint containers

Cybutryne should not be present at a level which does provide a biocidal effect (i.e. average values of cybutryne should not be present above 200 mg of cybutryne per kilogram of dry paint).

APPENDIX II

Guidance for surveys under the International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS 2001)

- (FI) 1 Initial survey (AFS 2001, annex 4, regulation 1(1)(a))
- (FI) 1.1 confirming that a Declaration and supporting information from the anti-fouling system manufacturer, specifying that the anti-fouling system and, where applicable, the sealer coat intended to be applied to the ship are in compliance with the requirements of the Convention, is provided (AFS 2001);
 - (FI) 1.2 verifying that the relevant containers of the anti-fouling system show same data as the supporting information (AFS 2001);
 - (FI) 1.3 confirming that the existing anti-fouling system, if controlled under annex 1 of the Convention, has been removed or that a sealer coat has been applied (AFS 2001);
 - (FI) 1.4 verifying, where applicable, that the relevant containers of the sealer coat applied show same data as the supporting information (AFS 2001);
 - (FI) 1.5 where supporting information from the anti-fouling system manufacturer is not available or does not provide sufficient information, sampling or testing or other checks conducted on site, of the anti-fouling system;
 - (FI) 1.6 for ships of 24 m or more in length but less than 400 GT and engaged in international voyages, confirming that the owner or owner's authorized agent has completed a Declaration on Anti-fouling System (AFS 2001);
- (FR) 2 Surveys when anti-fouling systems are changed or replaced (AFS 2001, annex 4, regulation 1(1)(b));
- (FR) 2.1 confirming that a Declaration and supporting information from the anti-fouling system manufacturer, specifying that the anti-fouling system and, where applicable, the sealer coat intended to be applied to the ship are in compliance with the requirements of the Convention, is provided (AFS 2001);
 - (FR) 2.2 verifying that the relevant containers of the anti-fouling system show same data as the supporting information (AFS 2001);
 - (FR) 2.3 confirming that the existing anti-fouling system, if controlled under annex 1 of the Convention, has been removed or that a sealer coat has been applied (AFS 2001);
 - (FR) 2.4 verifying, where applicable, that the relevant containers of the sealer coat applied show same data as the supporting information (AFS 2001);
 - (FR) 2.5 for ships of 24 m or more in length but less than 400 GT, confirming that the owner or owner's authorized agent has completed a Declaration on Anti-fouling System (AFS 2001);
 - (FR) 2.6 endorsement of the Record of Anti-fouling Systems.

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MEPC.1/Circ.795/Rev.6
10 June 2022

UNIFIED INTERPRETATIONS TO MARPOL ANNEX VI

1 The Marine Environment Protection Committee, at its seventy-eighth session (6 to 10 June 2022), approved unified interpretations to regulation 18.3 of MARPOL Annex VI concerning the use of biofuels.

2 The updated consolidated text of all existing unified interpretations to MARPOL Annex VI, including those set out in circular MEPC.1/Circ.795/Rev.5, are set out in the annex.

3 The regulation numbers in the annexed unified interpretations refer to the *2021 Revised MARPOL Annex VI*, as adopted by resolution MEPC.328(76), which was accepted on 1 May 2022 in accordance with article 16(2)(f)(iii) of MARPOL and which will enter into force on 1 November 2022.

4 Member Governments are invited to apply the annexed unified interpretations to MARPOL Annex VI, as appropriate, and bring them to the attention of all Parties concerned.

5 Member Governments are also invited to note MEPC.1/Circ.897 setting out cross-reference tables between the *2021 Revised MARPOL Annex VI* and the previous MARPOL Annex VI.

6 This circular revokes MEPC.1/Circ.795/Rev.5.

ANNEX

UNIFIED INTERPRETATIONS TO MARPOL ANNEX VI

1 Definition of "new ship"

Regulation 2

Definitions

Regulation 2.2.18 reads as follows:

"*New ship* means a ship:

- .1 for which the building contract is placed on or after 1 January 2013;
or
- .2 in the absence of a building contract, the keel of which is laid or which is at a similar stage of construction on or after 1 July 2013; or
- .3 the delivery of which is on or after 1 July 2015."

Interpretation:

1.1 For the application of the definition "new ship" as specified in regulation 2.2.18 to each Phase specified in table 1 of regulation 24, it should be interpreted as follows:

- .1 the date specified in regulation 2.2.18.1 should be replaced with the start date of each Phase;
- .2 the date specified in regulation 2.2.18.2 should be replaced with the date six months after the start date and end date of each Phase; and
- .3 the date specified in regulation 2.2.18.3 should, for Phase 1, 2 and 3, be replaced with the date 48 months after the start date and end date of each Phase.

1.2 With the above interpretations, the required EEDI of each phase is applied to the following new ship which falls into one of the categories defined in regulations 2.2.5, 2.2.7, 2.2.9, 2.2.14, 2.2.15, 2.2.22, 2.2.29 and to which chapter 4 is applicable:

- .1 the required EEDI of Phase 0 is applied to the following new ship:
 - .1 the building contract of which is placed in Phase 0, and the delivery is before 1 January 2019; or
 - .2 the building contract of which is placed before Phase 0, and the delivery is on or after 1 July 2015 and before 1 January 2019; orin the absence of a building contract:
 - .3 the keel of which is laid or which is at a similar stage of construction on or after 1 July 2013 and before 1 July 2015, and the delivery is before 1 January 2019; or

- .4 the keel of which is laid or which is at a similar stage of construction before 1 July 2013, and the delivery is on or after 1 July 2015 and before 1 January 2019;
- .2 the required EEDI of Phase 1 is applied to the following new ship:
 - .1 the building contract of which is placed in Phase 1, and the delivery is before 1 January 2024; or
 - .2 the building contract of which is placed before Phase 1, and the delivery is on or after 1 January 2019 and before 1 January 2024; orin the absence of a building contract:
 - .3 the keel of which is laid or which is at a similar stage of construction on or after 1 July 2015 and before 1 July 2020, and the delivery is before 1 January 2024; or
 - .4 the keel of which is laid or which is at a similar stage of construction before 1 July 2015, and the delivery is on or after 1 January 2019 and before 1 January 2024;
- .3 the required EEDI of Phase 2 is applied to the following new ship:
 - .1 for ship types where Phase 2 ends on 31 March 2022:
 - .1 the building contract of which is placed in Phase 2, and the delivery is before 1 April 2026; or
 - .2 the building contract of which is placed before Phase 2, and the delivery is on or after 1 January 2024 and before 1 April 2026; orin the absence of a building contract:
 - .3 the keel of which is laid or which is at a similar stage of construction on or after 1 July 2020 and before 1 October 2022, and the delivery is before 1 April 2026; or
 - .4 the keel of which is laid or which is at a similar stage of construction before 1 July 2020, and the delivery is on or after 1 January 2024 and before 1 April 2026;
 - .2 for ship types where Phase 2 ends on 31 December 2024:
 - .1 the building contract of which is placed in Phase 2, and the delivery is before 1 January 2029; or
 - .2 the building contract of which is placed before Phase 2, and the delivery is on or after 1 January 2024 and before 1 January 2029; or

in the absence of a building contract:

- .3 the keel of which is laid or which is at a similar stage of construction on or after 1 July 2020 and before 1 July 2025, and the delivery is before 1 January 2029; or
- .4 the keel of which is laid or which is at a similar stage of construction before 1 July 2020, and the delivery is on or after 1 January 2024 and before 1 January 2029;

.4 the required EEDI of Phase 3 is applied to the following new ship:

.1 for ship types where Phase 3 commences with 1 April 2022 and onwards:

- .1 the building contract of which is placed in Phase 3; or
- .2 the building contract of which is placed before Phase 3, and the delivery is on or after 1 April 2026; or

in the absence of a building contract:

- .3 the keel of which is laid or which is at a similar stage of construction on or after 1 October 2022; or
- .4 the keel of which is laid or which is at a similar stage of construction before 1 October 2022 and the delivery of which is on or after 1 April 2026;

.2 for ship types where Phase 3 commences with 1 January 2025 and onwards:

- .1 the building contract of which is placed in Phase 3; or
- .2 the building contract of which is placed before Phase 3, and the delivery is on or after 1 January 2029; or

in the absence of a building contract:

- .3 the keel of which is laid or which is at a similar stage of construction on or after 1 July 2025; or
- .4 the keel of which is laid or which is at a similar stage of construction before 1 July 2025 and the delivery of which is on or after 1 January 2029.

2 Major conversion

Regulation 2

Definitions

Regulation 2.2.17 reads as follows:

"Major conversion means in relation to chapter 4 of this Annex a conversion of a ship:

- .1 which substantially alters the dimensions, carrying capacity or engine power of the ship; or
- .2 which changes the type of the ship; or
- .3 the intent of which in the opinion of the Administration is substantially to prolong the life of the ship; or
- .4 which otherwise so alters the ship that, if it were a new ship, it would become subject to relevant provisions of the present Convention not applicable to it as an existing ship; or
- .5 which substantially alters the energy efficiency of the ship and includes any modifications that could cause the ship to exceed the applicable required EEDI as set out in regulation 24 of this Annex or the applicable required EEXI as set out in regulation 25 of this Annex."

Interpretation:

2.1 For regulation 2.2.17.1, any substantial change in hull dimensions and/or capacity (e.g. change of length between perpendiculars (L_{PP}) or change of assigned freeboard) should be considered a major conversion. Any substantial increase of total engine power for propulsion (e.g. 5% or more) should be considered a major conversion. In any case, it is the Administration's authority to evaluate and decide whether an alteration should be considered as major conversion, consistent with chapter 4.

Note: Notwithstanding paragraph 2.1, assuming no alteration to the ship structure, both decrease of assigned freeboard and temporary increase of assigned freeboard due to the limitation of deadweight or draft at calling port should not be construed as a major conversion. However, an increase of assigned freeboard, except a temporary increase, should be construed as a major conversion.

2.2 Notwithstanding paragraph 2.1, for regulation 2.2.17.5, the effect on Attained EEDI as a result of any change of ships' parameters, particularly any increase in total engine power for propulsion, should be investigated. In any case, it is the Administration's authority to evaluate and decide whether an alteration should be considered as major conversion, consistent with chapter 4.

2.3 A company may, at any time, voluntarily request re-certification of the EEDI, with IEE Certificate reissuance, on the basis of any new improvements to the ships' efficiency that are not considered to be major conversions.

2.4 In regulation 2.2.17.4, the terms "new ship" and "existing ship" should be understood as they are used in MARPOL Annex I, regulation 1.9.1.4, rather than as the defined terms in regulations 2.2.13 and 2.2.18.

2.5 The term "a ship" referred to in regulation 5.4.2 is interpreted as "new ship".

3 Ships dedicated to the carriage of fruit juice in refrigerated cargo tanks

Regulation 2

Definitions

Regulation 2.2.22 reads as follows:

"Refrigerated cargo carrier means a ship designed exclusively for the carriage of refrigerated cargoes in holds."

Interpretation:

3.1 Ships dedicated to the carriage of fruit juice in refrigerated cargo tanks should be categorized as refrigerated cargo carrier.

4 Timing for existing ships to have on board a SEEMP

Regulation 5

Surveys

Regulation 5.4.4 reads as follows:

"For existing ships, the verification of the requirement to have a SEEMP on board according to regulation 26 of this Annex shall take place at the first intermediate or renewal survey identified in paragraph 1 of this regulation, whichever is the first, on or after 1 January 2013."

Regulation 6

Issue or endorsement of Certificates and Statements of Compliance related to fuel oil consumption reporting and operational carbon intensity rating

Regulation 6.4 reads as follows:

"An International Energy Efficiency Certificate for the ship shall be issued after a survey in accordance with the provisions of regulation 5.4 of this Annex to any ship of 400 gross tonnage and above before that ship may engage in voyages to ports or offshore terminals under the jurisdiction of other Parties."

Regulation 26

Ship Energy Efficiency Management Plan (SEEMP)

Regulation 26.1 reads as follows:

"Each ship shall keep on board a ship specific Ship Energy Efficiency Management Plan (SEEMP). This may form part of the ship's Safety Management System (SMS)."

Interpretation:

4.1 The International Energy Efficiency Certificate (IEEC) should be issued for both new and existing ships to which chapter 4 applies. Ships which are not required to keep an SEEMP on board are not required to be issued with an IEEC.

4.2 The SEEMP required by regulation 26.1 is not required to be placed on board an existing ship to which this regulation applies until the verification survey specified in regulation 5.4.4 is carried out.

4.3 For existing ships, a SEEMP required in accordance with regulation 26 should be verified on board according to regulation 5.4.4, and an IEEC should be issued, not later than the first intermediate or renewal survey, in accordance with chapter 2, whichever is earlier, on or after 1 January 2013, i.e. a survey connected to an intermediate/renewal survey of the IAPP Certificate.

4.4 The intermediate or renewal survey referenced in paragraph 4.3 relates solely to the timing of the verification of the SEEMP on board, i.e. these IAPP Certificate survey windows will also become the IEEC initial survey date for existing ships. The SEEMP is, however, a survey item solely under chapter 4 and is not a survey item relating to IAPP Certificate surveys.

4.5 In the event that the SEEMP is not available on board during the first intermediate/renewal survey of the IAPP Certificate on or after 1 January 2013, the RO should seek the advice of the Administration concerning the issuance of an IEEC and be guided accordingly. However, the validity of the IAPP Certificate is not impacted by the lack of a SEEMP as the SEEMP is a survey item solely under chapter 4 and not under the IAPP Certificate surveys.

4.6 With respect to ships required to keep on board a SEEMP, such ships exclude platforms (including FPSOs and FSUs) and drilling rigs, regardless of their propulsion, and any other ship without means of propulsion.

4.7 The SEEMP should be written in a working language or languages understood by ships' personnel.

5 Section 2.3 of the supplement to the IAPP Certificate

Regulation 8

Form of Certificates and Statements of Compliance related to fuel oil consumption reporting and operational carbon intensity rating

Regulation 8.1 reads as follows:

"The International Air Pollution Prevention Certificate shall be drawn up in a form corresponding to the model given in appendix I to this Annex and shall be at least in English, French or Spanish. If an official language of the issuing country is also used, this shall prevail in case of a dispute or discrepancy."

Appendix I

Form of International Air Pollution Prevention (IAPP) Certificate (Regulation 8)

Section 2.3 of the supplement to International Air Pollution Prevention Certificate reads as follows:

- "2.3 Sulphur oxides (SO_x) and particulate matter (regulation 14).
- 2.3.1 When the ship operates outside of an emission control area specified in regulation 14.3, the ship uses:
 - .1 fuel oil with a sulphur content as documented by bunker delivery notes that does not exceed the limit value of 0.50% m/m, and/or
 - .2 an equivalent arrangement approved in accordance with regulation 4.1 as listed in paragraph 2.6 that is at least as effective in terms of SO_x emission reductions as compared to using a fuel oil with a sulphur content limit value of 0.50% m/m
- 2.3.2 When the ship operates inside an emission control area specified in regulation 14.3, the ship uses:
 - .1 fuel oil with a sulphur content as documented by bunker delivery notes that does not exceed the limit value of 0.10% m/m, and/or
 - .2 an equivalent arrangement approved in accordance with regulation 4.1 as listed in paragraph 2.6 that is at least as effective in terms of SO_x emission reductions as compared to using a fuel oil with a sulphur content limit value of 0.10% m/m
- 2.3.3 For a ship without an equivalent arrangement approved in accordance with regulation 4.1 as listed in paragraph 2.6, the sulphur content of fuel oil carried for use on board the ship shall not exceed 0.50% m/m as documented by bunker delivery notes

Interpretation:

5.1 Section 2.3 of the Supplement ("as documented by bunker delivery notes") allows for an "x" to be entered in advance of the dates indicated in all of the relevant check boxes recognizing that the bunker delivery notes, required to be retained on board for a minimum period of three years, provide the subsequent means to check that a ship is actually operating in a manner consistent with the intent as given in section 2.3.

6 Identical replacement engines

Regulation 13

Nitrogen oxides (NO_x)

Regulation 13.1.1.2 reads as follows:

"Each marine diesel engine with a power output of more than 130 kW that undergoes a major conversion on or after 1 January 2000 except when demonstrated to the satisfaction of the Administration that such engine is an identical replacement to the engine that it is replacing and is otherwise not covered under paragraph 1.1.1 of this regulation."

Regulation 13.2.2 reads as follows:

"For a major conversion involving the replacement of a marine diesel engine with a non-identical marine diesel engine or the installation of an additional marine diesel engine, the standards in this regulation at the time of the replacement or addition of the engine shall apply."

Interpretation:

6.1 In regulation 13.1.1.2, the term "identical" (and hence, by application of the converse, in regulation 13.2.2 the term "non-identical") as applied to engines under regulation 13 should be taken as:

6.2 An "identical engine" is, as compared to the engine being replaced,¹ an engine which is of the same:

- .1 design and model;
- .2 rated power;
- .3 rated speed;
- .4 use;
- .5 number of cylinders; and
- .6 fuel system type (including, if applicable, injection control software):

¹ In those instances where the replaced engine will not be available to be directly compared with the replacing engine at the time of updating the Supplement to the IAPP Certificate reflecting that engine change it is to be ensured that the necessary records in respect of the replaced engine are available in order that it can be confirmed that the replacing engine represents "an identical engine".

- .1 for engines without EIAPP certification, have the same NO_x critical components and settings;² or
- .2 for engines with EIAPP certification, belonging to the same Engine Group/Engine Family.

7 Time of replacement of an engine

Regulation 13

Nitrogen oxides (NO_x)

Regulation 13.2.2 reads as follows:

"For a major conversion involving the replacement of a marine diesel engine with a non-identical marine diesel engine, or the installation of an additional marine diesel engine, the standards in this regulation at the time of the replacement or addition of the engine shall apply."

Interpretation:

7.1 The term "time of the replacement or addition" of the engine in regulation 13.2.2 should be taken as the date of:

- .1 the contractual delivery date of the engine to the ship;³ or
- .2 in the absence of a contractual delivery date, the actual delivery date of the engine to the ship,³ provided that the date is confirmed by a delivery receipt; or
- .3 in the event the engine is fitted on board and tested for its intended purpose on or after six months from the date specified in sub-paragraphs of regulation 13.5.1.2, as appropriate, the actual date that the engine is tested on board for its intended purpose applies in determining the standards in this regulation in force at the time of the replacement or addition of the engine.

7.2 Entry of the date in paragraph 7.1 above, provided the conditions associated with those dates apply, should be made in the item 8.a "Major conversion – According to regulations 13.2.1.1 and 13.2.2" of the Supplement of IAPP Certificate.

² For engines without EIAPP Certification there will not be the defining NO_x critical component markings or setting values as usually given in the approved Technical File. Consequently, in these instances, the assessment of "... same NO_x critical components and settings ..." shall be established on the basis that the following components and settings are the same:

Fuel system:

- .1 fuel pump model and injection timing; and
- .2 injection nozzle model.

Charge air:

- .1 configuration and, if applicable, turbocharger model and auxiliary blower specification; and
- .2 Cooling medium (seawater/freshwater).

³ The engine is to be fitted on board and tested for its intended purpose within six months after the date specified in sub-paragraphs of regulation 13.5.1.2, as appropriate.

7.3 If the engine is not tested within six months after the date specified in sub-paragraphs of regulation 13.5.1.2, as appropriate due to unforeseen circumstances beyond the control of the shipowner, then the provisions of "unforeseen delay in delivery" may be considered by the Administration in a manner similar to UI4 of MARPOL Annex I.

8 Engine changeover/on-off recording requirements

Regulation 13

Nitrogen oxides (NO_x)

Regulation 13.5.3 reads as follows:

"The tier and on/off status of marine diesel engines installed on board a ship to which paragraph 5.1 of this regulation applies which are certified to both Tier II and Tier III or which are certified to Tier II only shall be recorded in such logbook or electronic record book as prescribed by the Administration at entry into and exit from a NO_x Tier III emission control area, or when the on/off status changes within such an area, together with the date, time and position of the ship."

Interpretation:

8.1 For the application of this regulation:

- .1 "marine diesel engines installed on board a ship to which paragraph 5.1 of this regulation applies" includes additional or replaced engines;⁴ installed on or after the relevant emission control area takes effect;
- .2 "certified to Tier II only" means a Tier II engine that is installed on board a ship which is constructed on or after the emission control area where the ship is operating takes effect;
- .3 Tier II engines stipulated under the Tier II requirement of regulation 13.4, i.e. Tier II engines installed on board a ship constructed before the entry into force of the emission control area where the ship is operating, are not considered to be a "Tier II only" engine in the context of record keeping. Such exclusion is extended to Tier II engines replaced after the entry into force of the relevant emission control areas on board ships of this category, if the replacement engines meet resolution MEPC.230(65);
- .4 if an engine installed on a ship constructed before the entry into force of the emission control area where the ship is operating has undergone a major conversion as described in regulation 13.2.1, those engines are to be Tier III engines; thus the above interpretation in .1 above applies; and
- .5 recording is required for the Tier II engine operation in a NECA under the exemption according to regulation 13.5.4.

⁴ Additional or replaced engine: refer to section 7.1 of MEPC.1/Circ.795/Rev.6.

9 Application of sulphur limit to emergency equipment

Regulation 14

Sulphur oxides (SO_x) and particulate matter

Regulation 14.1 reads as follows:

"The sulphur content of fuel oil used or carried for use on board a ship shall not exceed 0.50% m/m."

Interpretation:

9.1 Regulation 14.1 of MARPOL Annex VI for the prohibition on the carriage of non-compliant fuel oil should be applied to the fuel oil of emergency equipment.

10 VOC management plan

Regulation 15

Volatile organic compounds (VOCs)

Regulations 15.6 and 15.7 read as follows:

- "6 A tanker carrying crude oil shall have on board and implement a VOC management plan approved by the Administration. Such a plan shall be prepared taking into account the guidelines developed by the Organization. The plan shall be specific to each ship and shall at least:
- .1 provide written procedures for minimizing VOC emissions during the loading, sea passage and discharge of cargo;
 - .2 give consideration to the additional VOC generated by crude oil washing;
 - .3 identify a person responsible for implementing the plan; and
 - .4 for ships on international voyages, be written in the working language of the master and officers and, if the working language of the master and officers is not English, French or Spanish, include a translation into one of these languages.
- 7 This regulation shall also apply to gas carriers only if the types of loading and containment systems allow safe retention of non-methane VOCs on board or their safe return ashore.⁵"

Interpretation:

10.1 The requirement for a VOC management plan applies only to a tanker carrying crude oil.

⁵ Resolution MSC.30(61), *International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk*.

11 Continuous-feed type shipboard incinerators

Regulation 16

Shipboard incineration

Regulation 16.9 reads as follows:

"For incinerators installed in accordance with the requirements of paragraph 6.1 of this regulation the combustion chamber gas outlet temperature shall be monitored at all times the unit is in operation. Where that incinerator is of the continuous-feed type, waste shall not be fed into the unit when the combustion chamber gas outlet temperature is below 850°C. Where that incinerator is of the batch-loaded type, the unit shall be designed so that the combustion chamber gas outlet temperature shall reach 600°C within five minutes after start-up and will thereafter stabilize at a temperature not less than 850°C."

Interpretation:

11.1 For the application of this regulation, the term "waste shall not be fed into the unit" should be interpreted as follows:

For continuous-feed incinerators solid waste shall not be fed into the unit when the combustion chamber flue gas outlet temperature is below 850°C. Sludge oil generated during normal operation of a ship should not be regarded as waste in connection with this regulation, and can be fed into the unit when the required preheat temperature of 650°C in the combustion chamber is achieved.

11.2 For the application of this regulation, the term "the unit shall be designed so that the combustion chamber gas outlet temperature shall reach 600°C within five minutes after start up" should be interpreted as follows:

Batch loaded incinerators should be designed so that the temperature in the actual combustion space where the solid waste is combusted should reach 600°C within five minutes after start-up.

12 Applicability of the requirements for a bunker delivery note

Regulation 18

Fuel oil availability and quality

Regulation 18.5 reads as follows:

"For each ship subject to regulations 5 and 6 of this Annex, details of fuel oil for combustion purposes delivered to and used on board shall be recorded by means of a bunker delivery note that shall contain at least the information specified in appendix V to this Annex."

Regulation 18.6 reads as follows:

"The bunker delivery note shall be kept on board the ship in such a place as to be readily available for inspection at all reasonable times. It shall be retained for a period of three years after the fuel oil has been delivered on board."

Interpretation:

12.1 For the application of these regulations, they should be interpreted as being applicable to all ships of 400 gross tonnage or above and, at the Administration's discretion, to ships of less than 400 gross tonnage.

13 Application of regulation 18.3 for biofuels

Regulation 18

Fuel oil availability and quality

Regulation 18.3 reads as follows:

"Fuel oil for combustion purposes delivered to and used on board ships to which this Annex applies shall meet the following requirements."

Interpretation

13.1 A fuel oil which is a blend of not more than 30% by volume of biofuel should meet the requirements of regulation 18.3.1 of MARPOL Annex VI. A fuel oil which is a blend of more than 30% by volume of biofuel should meet the requirements of regulation 18.3.2 of MARPOL Annex VI. For the purposes of this interpretation, a biofuel is a fuel oil which is derived from biomass and hence includes, but is not limited to, processed used cooking oils, fatty-acid-methyl-esters (FAME) or fatty-acid-ethyl-esters (FAEE), straight vegetable oils (SVO), hydrotreated vegetable oils (HVO), glycerol or other biomass to liquid (BTL) type products. The Product Name, as entered onto the bunker delivery note, should be of sufficient detail to identify whether, and to what extent, a biofuel is blended into the product as supplied.

Regulation 18.3.2.2 reads as follows:

"fuel oil for combustion purposes derived by methods other than petroleum refining shall not cause an engine to exceed the applicable NO_x emission limit set forth in paragraphs 3, 4, 5.1.1 and 7.4 of regulation 13."

Interpretation

13.2 A marine diesel engine certified in accordance with the requirements of regulation 13 of MARPOL Annex VI, which can operate on a biofuel or a biofuel blend without changes to its NO_x critical components or settings/operating values outside those as given by that engine's approved Technical File, should be permitted to use such a fuel oil without having to undertake the assessment as given by regulation 18.3.2.2 of MARPOL Annex VI. For the purposes of this interpretation, parent engine emissions tests undertaken on DM or RM grade fuels to the ISO 8217:2005 standard, as required by paragraph 5.3.2 of the NO_x Technical Code, should be valid for all DM or RM grade fuels used in operation, or that the engine may be designed for, or capable of operation on, including those meeting the ISO 8217 standards superseding ISO 8217:2005.

13.3 Where fuel oils are derived from methods other than petroleum refining, or fuel oil which is a blend of more than 30% by volume of biofuel and does not fall under 13.2 of this unified interpretation, or other fuels required to undertake the assessment as given by regulation 18.3.2.2 of MARPOL Annex VI and for which have not been specifically certified in accordance with the regulation 13 limits at test bed for that specific fuel and Engine Group/Family, the following is interpreted as an acceptable route to demonstrate compliance with regulation 18.3.2.2:

- .1 the ship's IAPP Certificate may continue to be issued where the overall NO_x emissions performance has been verified to not cause the specified engine to exceed the applicable NO_x emissions limit when burning said fuels using the onboard simplified measurement method in accordance with 6.3 of the NO_x Technical Code 2008, or the direct measurement and monitoring method in accordance with 6.4 of the NO_x Technical Code 2008, or by reference to relevant test-bed testing. For the purposes of this interpretation and demonstration of compliance with regulation 18.3.2.2 of MARPOL Annex VI, and as applicable to possible deviations when undertaking measurements on board, an allowance of 10% of the applicable limit may be accepted.

14 Confirmation of compliance for new ships

Regulation 5 *Surveys*

Regulation 5.4.5 reads as follows:

"The Administration shall ensure that for each ship to which regulation 27 applies, the SEEMP complies with regulation 26.2 of this Annex. This shall be done prior to collecting data under regulation 27 of this Annex in order to ensure the methodology and processes are in place prior to the beginning of the ship's first reporting period. Confirmation of compliance shall be provided to and retained on board the ship."

Regulation 26 *Ship Energy Efficiency Management Plan (SEEMP)*

Regulation 26.2 reads as follows:

"In the case of a ship of 5,000 gross tonnage and above, the SEEMP shall include a description of the methodology that will be used to collect the data required by regulation 27.1 of this Annex and the processes that will be used to report the data to the ship's Administration."

Interpretation:

14.1 Ships should keep on board both a SEEMP that is in compliance with regulation 26.2 and confirmation of compliance as required by regulation 5.4.5.

15 Boil-off gas consumed on board ships

Regulation 2 *Definitions*

Regulation 2.1.14 reads as follows:

"*Fuel oil* means any fuel delivered to and intended for combustion purposes for propulsion or operation on board a ship, including gas, distillate and residual fuels."

Regulation 27

Collection and reporting of ship fuel oil consumption data

Regulation 27.1 reads as follows:

"From calendar year 2019, each ship of 5,000 gross tonnage and above shall collect the data specified in appendix IX to this Annex, for that and each subsequent calendar year or portion thereof, as appropriate, according to the methodology included in the SEEMP."

Appendix IX

Information to be submitted to the IMO Ship Fuel Oil Consumption Database

Appendix IX reads as follows:

"Fuel oil consumption, by fuel oil type in metric tonnes and methods used for collecting fuel oil consumption data"

Interpretation:

15.1 For Data relating to Boil-off Gas (BOG) consumed on board the ship for propulsion or operation is required to be collected and reported as fuel as part of the Data Collection System for fuel oil consumption of ships.

16 Access to the disaggregated data

Regulation 27

Collection and reporting of ship fuel oil consumption data

Regulation 27.8 reads as follows:

"Except as provided for in paragraphs 4, 5 and 6 of this regulation, the disaggregated data that underlies the reported data noted in appendix IX to this Annex for the previous calendar year shall be readily accessible for a period of not less than 12 months from the end of that calendar year and be made available to the Administration upon request."

Interpretation:

16.1 The disaggregated data is not required to be kept on board the ship provided that the disaggregated data can be made available by the Company.

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MEPC.1/Circ.899
10 June 2022

**2022 GUIDELINES FOR RISK AND IMPACT ASSESSMENTS OF THE DISCHARGE
WATER FROM EXHAUST GAS CLEANING SYSTEMS**

1 The Marine Environment Protection Committee, at its seventy-eighth session (6 to 10 June 2022), approved the *2022 Guidelines for risk and impact assessments of the discharge water from exhaust gas cleaning systems*, as set out in the annex.

2 Member Governments are invited to bring the annexed Guidelines to the attention of Administrations, port State control authorities, industry, relevant shipping organizations, shipping companies and other stakeholders concerned.

3 The Committee agreed to keep these Guidelines under review in light of experience gained.

ANNEX

2022 GUIDELINES FOR RISK AND IMPACT ASSESSMENTS OF THE DISCHARGE WATER FROM EXHAUST GAS CLEANING SYSTEMS

CONTENTS

- 1 INTRODUCTION
- 2 DEFINITIONS AND ABBREVIATIONS
 - 2.1 Definitions
 - 2.2 Abbreviations
- 3 PRINCIPLES
- 4 APPLICATION
- 5 GENERAL REQUIREMENTS
 - 5.1 Targeted chemical substances and their data-set
 - 5.2 Information of the area to be assessed
- 6 RISK CHARACTERIZATION
 - 6.1 Introduction
 - 6.2 Emission scenarios
 - 6.3 Exposure assessment for PEC
 - 6.4 Human exposure scenarios
 - 6.5 Risk assessment
 - 6.6 Risk characterization and analysis
 - 6.7 Whole Effluent Toxicity
- 7 IMPACT ASSESSMENT
- 8 NOTIFICATION TO THE ORGANIZATION
- APPENDIX 1 GENERAL INFORMATION ON MAMPEC
- APPENDIX 2 HOW TO ESTIMATE HUMAN EXPOSURE

1 INTRODUCTION

1.1 These guidelines provide information on recommended methodology for risk and impact assessments that Member States should follow when considering local or regional regulations to protect the sensitive waters/environment from the discharge water from EGCS that complies with the Convention. These guidelines include assessments of the risks from a long-term perspective, with respect to aquatic quality, aquatic organism, and/or human health, and the impact assessment approach which may be applied to the specific receiving environment.

1.2 Member States are recommended to conduct an environmental risk assessment according to these guidelines when considering local or regional regulations.

1.3 The purpose of these guidelines is to provide a unified approach containing procedures that would support Member States to judge whether the introduction of restrictions/conditions of discharge water from EGCS would be needed and justifiable or not. In all aspects of risk and impact assessments the need for evidence-based decision-making should be balanced with the precautionary approach as set out in resolution MEPC.67(37).¹

2 DEFINITIONS AND ABBREVIATIONS

2.1 Definitions

2.1.1 For the purpose of these guidelines,

- .1 "Discharge water" means any water from an EGCS to be discharged overboard;
- .2 "Washwater" means cleaning medium brought into contact with the exhaust gas stream for the reduction of SO_x;
- .3 "Bleed-off water" means an amount of aqueous solution removed from the washwater of an EGCS operating in closed-loop mode to keep its required operating properties and efficiency;
- .4 "EGCS residue" means material removed from the washwater or the bleed-off water by a treatment system or discharge water that does not meet the discharge criterion, or other residue material removed from the EGCS;
- .5 "Emissions" means any release of substances, subject to control by this annex, from ships into the atmosphere or sea according to regulation 2.1.12 of MARPOL Annex VI²;
- .6 "Aggregated exposure approach" in relation to human exposure scenarios means the assessment of the total exposure to one substance resulting from more than one exposure pathway (inhalation, dermal and oral) and/or from more than one exposure scenario;

¹ *Guidelines on Incorporation of the precautionary approach in the context of specific IMO activities.*

² The regulation numbers in these Guidelines refer to the 2021 Revised MARPOL Annex VI, as adopted by resolution MEPC.328(76), which was accepted on 1 May 2022 in accordance with article 16(2)(f)(iii) of MARPOL and which will enter into force on 1 November 2022.

- .7 "Area to be assessed" means sea area where discharge water from EGCS is intended to be restricted under certain conditions;
- .8 "Emission factor" means the concentration of the product of individual substance in discharge water from EGCS per the typical flow rate, expressed as mg/MWh; and
- .9 "Sea Area for calculating PEC (SAP)" means sea area selected for simulation to estimate Predicted Environmental Concentrations (PECs) of the targeted chemicals, which should be a part of the area to be assessed.

2.1.2 Furthermore, the definitions in *2021 Guidelines for exhaust gas cleaning systems* adopted by resolution MEPC.340(77) apply.

2.2 Abbreviations

2.2.1 For the purpose of these guidelines, the following abbreviations apply.

2021 EGCS Guidelines	<i>2021 Guidelines for Exhaust Gas Cleaning Systems</i> adopted by resolution MEPC.340(77)
AIS	Automatic Identification System
AIST	National Institute of Advanced Industrial Science and Technology of Japan
BCF	Bioconcentration Factor
BMD	Benchmark Dose
BMDL ₁₀	Benchmark Dose Lower Confidence Limit 10%
CFD	Computational Fluid Dynamics
CMR	Carcinogenicity, Mutagenicity and Reproductive Toxicity
DMEL	Derived Minimal Effect Level
DNEL	Derived No-Effect Level
EFSA	European Food Safety Authority
EQS	Environmental Quality Standards
ERA	Environmental Risk Assessment
EUSES	European Union System for The Evaluation of Substances
GESAMP	IMO/FAO/UNESCOIOC/WMO/IAEA/UN/UNDP/UNEP/UNIDO Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection
JECFA	Joint FAO/WHO Expert Committee on Food Additives
GESAMP EGCS TT	GESAMP Task Team on Exhaust Gas Cleaning Systems
K _{oc}	Organic Carbon-Water Partition Coefficient
K _p	Permeability Coefficient
MAMPEC	Marine Anti-Foulant Model for PEC Calculation
MOE	Margin of Exposure
NOAEL	No Observed Adverse Effect Level
PBT	Persistence, Bioaccumulation and Toxicity
PEC	Predicted Environmental Concentration
PNEC	Predicted No Effect Concentration
PTMI	Provisional Tolerable Monthly Intake
PTWI	Provisional Tolerable Weekly Intake
(Q)SAR	(Quantitative) Structure-Activity Relationship
RCR	Risk Characterization Ratio
RO	Reverse Osmosis
SAP	Sea Area For Calculating PEC
SOG	Speed Over Ground

TDI	Tolerable Daily Intake
US EPA	The United States Environmental Protection Agency
WET	Whole Effluent Toxicity Test
WHO	World Health Organization
WHO/IPCS	World Health Organization/International Programme on Chemical Safety

3 PRINCIPLES

3.1 The use of EGCS in the area to be assessed should not cause unacceptable risks, especially from a long-term perspective with respect to marine organisms, aquatic quality and/or human health, as assessed in accordance with these Guidelines.

4 APPLICATION

4.1 These Guidelines can be used by Member States when undertaking risk and impact assessments to ascertain whether EGCS discharge water can be discharged in their ports, harbours, estuaries, or coastal and other territorial waters.

4.2 The risk and impact assessments can be done at local, national or regional level (e.g. regional sea conventions) and be conducted at least in cooperation with neighbouring States. Alternatively, Member States can take into consideration risk and impact assessments undertaken by another Party.

5 GENERAL REQUIREMENTS

5.1 Targeted chemical substances and their data-set

5.1.1 The targeted chemical substances for environmental risk assessment (ERA)

5.1.1.1 The targeted chemical substances for ERA should at least include the following "priority hazardous substances":

- .1 cadmium;
- .2 lead;
- .3 mercury;
- .4 nickel;
- .5 vanadium;
- .6 chromium;
- .7 copper;
- .8 zinc;
- .9 acenaphthene;
- .10 acenaphthylene;
- .11 anthracene;
- .12 benzo(a)anthracene;
- .13 benzo(a)pyrene;
- .14 benzo(b)fluoranthene;
- .15 benzo(k)fluoranthene;
- .16 benzo(g,h,i)perylene;
- .17 chrysene;
- .18 fluoranthene;
- .19 fluorene;
- .20 indeno(1,2,3cd)pyrene;
- .21 naphthalene;

- .22 pyrene;
- .23 phenanthrene; and
- .24 dibenzo(a,h)anthracene.

5.1.1.2 The targeted chemical substances for ERA are not limited to the above priority hazardous substances. Other contaminants found in EGCS discharge waters may be added, taking into account the domestic regulations and specific factors from the sensitivity of the area to be assessed.

5.1.1.3 Also, for the area where the administration has concerns on eutrophication, relevant substances (e.g. nitrate, nitrite, ammonia and/or phosphate), which may dissolve into EGCS discharge waters, may be added.

5.1.2 Data-set for ERA

5.1.2.1 The Database of priority hazardous substances developed by the Organization, including physico-chemical data, ecotoxicological data and toxicological data, should be used for ERA.

5.1.2.2 Furthermore, the worst-case emission factors of the priority hazardous substances listed in paragraph 5.1.1.1 should be used for reasonable worst-case scenarios (see paragraph 6.2.2).

- .1 Emission Factors for the chemical substances are needed for ERA. In addition, the flow rate of the discharge water against exhaust flow may vary among EGCSs type and the load of engines connected to the EGCSs. However, such information does not depend on the location of the area to be assessed. Therefore, it is recommended that unified and representative Emission Factors (mg/MWh) based on the data for discharge water concentration and flow rate collected by the Organization be utilized.
- .2 If the Member States propose to use their original Emission Factors with a scientific reasoning based on their original measurement of EGCS discharge water, all the measurements should be analysed in accordance with the 2021 EGCS Guidelines.

5.1.2.3 The database will be placed to the IMO GISIS under a separate new item titled "Chemicals in EGCS Discharge Water".

5.1.2.4 For the targeted chemical substances for ERA, which are not included in the list of priority hazardous substances, the Member States should prepare the information as in paragraphs 5.1.2.1 and 5.1.2.2.

5.2 Information of the area to be assessed

5.2.1 Data stated in paragraph 5.2.2 should be collected by the Member States implementing the risk assessment in accordance with these guidelines.

5.2.2 Information of the area to be assessed

5.2.2.1 The following information of the area to be assessed is required:

- .1 geographical designation of the area to be assessed;

- .2 representative water and sediment quality of the area to be assessed;
- .3 the meteorographic/oceanographic information in table 1 on each Sea Area for calculating PECs (SAP);
- .4 existing threshold concentrations (PNEC, Predicted No Effect Concentration or EQS, Environmental Quality Standards) for each substance (in water, sediment and/or biota) indicating the level in the environment below which there should be no harm (lethal or sub-lethal) to the aquatic ecosystem or human health, taking account of the likely bioavailability of the substances where relevant; and
- .5 information on how chemical, biological and physical characteristics of the receiving environments, including their pH and salinity, could affect the level of risk.

Table 1: Parameters used for long-term environmental assessment

Parameter	Unit	Remarks
Current	m/s	Representative value of each SAP.
Wind speed	m/s	Representative value of each SAP.
Wind direction	-	Consider the direction that affects the inflow to the mouth of each SAP.
Temperature	In Celsius	Annual average value of each SAP.
Salinity	PSU (Practical Salinity Unit)*	Representative value of each SAP.
pH	-	Representative value of each SAP.
Tidal difference	m	Representative value of each SAP.
Tidal period	hours	Representative value of each SAP.
Suspended particulate matter (SPM)	mg/L	Representative value of each SAP.
Depth of sediment layer	m	Representative value of each SAP.
Alkalinity	mg/l CaCO ₃	Representative value of each SAP.

* PSU \approx Salinity concentration in ppt (absolute salinity)

5.2.2.2 It is recommended that the information of the area to be assessed be collected by actual measurements, while representative values from literature can be used in case actual measurements are difficult. For parameters that change according to the season/time of the year, the changes of such parameters should be all-inclusively taken into account to ensure the representativeness of values.

6 RISK CHARACTERIZATION

6.1 Introduction

6.1.1 In this chapter, the methodology to assess the quantitative risks is described. Related international standards and/or existing guidance may be taken into account for risk characterization.

6.1.2 First, the daily loads (g/day) of all the chemical substances, which are discharged from EGCS, should be delivered based on the actual ship activities. Secondly, the PECs (ppt) of the chemical substances should be determined, taking into account the physico-chemical characteristics and the geographical and meteorographical/oceanographical conditions.

Also, the human exposure amount (g/kg-BW/day) may be delivered from the PECs. Finally, for risk characterization, the PEC and/or exposure amount, as predicted risk, is compared with the acceptance criteria. In general, if the ratios of PEC and PNEC, i.e. Risk Characterization Ratios (RCR) are less than 1, then the potential risks in the area to be assessed are acceptable. The cumulative effects of mixtures should be taken into account and a PEC/PNEC summation approach is recommended where PEC/PNEC ratios of all mixture components (PAHs and metals) are summed up to a final Risk Quotient. In addition, the Whole Effluent Toxicity testing may also be used to assess the cumulative effects of the targeted substances.

6.2 Emission scenarios

6.2.1 Activities

6.2.1.1 The actual activities (in total power output) of all ships operating in the SAP should be estimated, using received AIS data by satellites and/or local stations. The same methods described in the Fourth IMO GHG Study 2020 should be applied to calculate the hourly outputs of the main engine as kWh for each ship when operating in the SAP, using the information of SOG in the AIS signal. More simplified methodology may be used, such as utilising the averaged fuel consumption by ship types and sizes reported in the study and adjusting them by applying power curve between the actual power needed and speed obtained from AIS data.

6.2.1.2 The activities should include the power consumed in the auxiliary engines with the assumption that those would be all connected to EGCS, as far as corresponding data is available. To estimate the activities when the ships are stopped (mooring loading or unloading), relevant data from the ship or statistic data of ships³ should be used to assume the hourly outputs of the auxiliary engines as kWh for each ship when actual ship data is not available. Use of shore power or compliant fuel should be accounted for and excluded.

6.2.2 Reasonable worst-case scenarios

6.2.2.1 For Reasonable worst-case scenarios, the following assumptions should be applied:

- .1 the maximum ratio of ships using EGCS in the SAP should be set by the Member States, taking into account the current situation in the SAP and future increase;
- .2 all EGCSs installed onboard will be operated under open-loop operation, unless information to the contrary is available; and
- .3 the increase of the numbers of ships may be assumed taking into account the future growth of transportation amount and possible infrastructure expansion, as far as corresponding data is available.

6.2.3 The load of the targeted substances in discharge water

6.2.3.1 By multiplying the emission factors to the total activities, the load of each targeted substance in discharge water will be provided (g/day as the input for MAMPEC calculations).

³ Annex G to the Fourth IMO GHG Study 2020 shows auxiliary engine and boiler power demand assumptions in KW.

6.3 Exposure assessment for PEC

6.3.1 Introduction

6.3.1.1 To assess the risk of EGCS discharge water, in principle, the worst PEC in the area to be assessed should be identified. However, when designating a wide area to be assessed with complex geographical conditions, it may be difficult to simulate the total area with a single SAP with simplified assumption. In this case, multiple SAPs may be set, and PECs should be estimated for all SAPs.

6.3.1.2 It should be noted that PECs from the long-term viewpoint should be estimated. The tools for PECs should be appropriately selected for the purpose or time scale (the exposure time experienced by an organism) of PNEC, DNEL and/or DMEL.

6.3.2 Tools for long-term PEC of substances

6.3.2.1 The environmental concentrations of each substance after 10 years should be predicted using MAMPEC (see appendix 1). The MAMPEC model can take into account the fate of pollutants (e.g. accumulation and persistency) when predicting the concentrations that may be influenced by the hydrodynamical properties of local situations.

6.3.2.2 Although MAMPEC provides default geographical parameters for each "typical" marine environment (e.g. open sea, shipping lane, estuary, commercial harbour, yachting marina and open harbour), the actual geographical parameters collected for each SAP should be applied. Also, if the SAP(s) are too complicated to apply MAMPEC because of complex geography and/or more discharge points than MAMPEC model allows, the other simulation using 3D CFD may be used.

6.3.2.3 As a first assessment, the maximum value in the surroundings from the MAMPEC-BW calculations (e.g. the maximum PEC in the surroundings area outside the harbour. See section 6.8 of the MAMPEC 3.1 HANDBOOK) should be used as a representative concentration. If the result of the first assessment indicates potential risks comparing with the acceptance criteria, the average value from the MAMPEC-BW calculations may be used.

6.3.2.4 When calculating PECs in the SAP(s), the background concentrations of chemical substances should be added.

6.3.3 Selection of SAP for long-term calculation

6.3.3.1 It is recommended that SAP(s) for long-term calculation using a representative area in the area to be assessed including consideration of highest-risk area where the pollutants tend to accumulate, taking into account the geography, oceanic currents and tides, and/or the area with a higher traffic density compared to other areas.

6.3.3.2 To avoid insufficient risk assessment, an SAP should not be too small compared to the area to be assessed, and all SAPs for long-term calculation should, at least, cover the size of typical marinas. In addition, to ensure that SAPs appropriately represent the area to be assessed, SAPs for long-term calculation should cover a large part of the area to be assessed. Though SAPs for long-term calculation will be selected by the Member States, taking into account geographical conditions, in case of simple shape of the area to be assessed, it is recommended that the total SAP(s) cover more than 50% of the area to be assessed or that the ship activities in the total SAP(s) are more than 50% of those in the area to be assessed. The risk assessment for at least half of the area or the ship activities would prevent the arbitrary consequences of the assessment that result from specific small SAP(s).

6.4 Human exposure scenarios

6.4.1 Exposure scenarios involving the general public

6.4.1.1 In addition to the PECs of the targeted chemical substances, the human exposure amount of these substances may be assessed by applying exposure scenarios.

6.4.1.2 Exposure may occur indirectly, as is the case for the general public who may swim in water in areas where EGCS discharge water has been discharged, who eat seafood that has been caught in (the vicinity of) a discharge area, and/or who drink water prepared from the receiving water that may have been exposed to the EGCS discharge water. The following situations have been identified as probable exposure scenarios for the general public. It is recognized that there will be situations when the risk of human exposure is greater, such as amongst subsistence harvesters, and in these instances additional consideration should be given. Each exposure scenario should take into account concentrations in the water (PECs) estimated, as described in paragraph 6.3:

- .1 recreational activities in the sea (swimming);
- .2 eating seafood exposed to EGCS discharge water; and
- .3 drinking water prepared from receiving water that may have been contaminated by the EGCS discharge water.

6.4.1.3 For each scenario, exposure amount may be calculated based on the PEC. An aggregated exposure approach may be applied (see appendix 2).

6.5 Risk assessment

6.5.1 Introduction

6.5.1.1 Prior to the comparison between exposure levels and acceptance criteria, screening on PBT and CMR for each targeted chemical substance should be performed. The ratio of the estimated exposure to the acceptance criteria defines the risk assessment quotient: PEC/PNEC for the aquatic quality and aquatic organism and/or exposure/DNEL or exposure/DMEL for the human health risk assessment.

6.5.1.2 In addition to the PEC/PNEC ratio approach, a whole effluent assessment taking into account the EGCS discharge water may be performed. More details are stated in paragraph 6.7.

6.5.2 Environmental risk assessment

6.5.2.1 Screening for potential Persistence (i.e. poor degradation in the environment), Bioaccumulation (i.e. accumulation in organisms and food chains) and Toxicity (PBT) are necessary, taking into account the following elements:

- .1 Persistence:

Persistence should preferably be assessed in simulation test systems that determine the half-life under relevant conditions. Biodegradation screening tests may be used to show that the substances are readily biodegradable.

.2 Bioaccumulation:

The assessment of the (potential for) bioaccumulation should use measured bioconcentration factors in marine (or freshwater) organisms. Where these tests are not applicable, or if $\log P_{ow} < 3$, Bioconcentration Factor (BCF) values may be estimated using (Quantitative) Structure-Activity Relationship ((Q)SAR) models.

.3 Toxicity:

Acute and chronic ecotoxicity data, ideally covering the sensitive life stages, should in principle be used for the assessment of the toxicity criterion.

6.5.2.2 When assessing the environmental risk, discharge of pollutants from other sources impacting the area assessed should be taken into account.

6.5.3 Human health risk assessment

6.5.3.1 Screening for Carcinogenicity, Mutagenicity and Reproductive toxicity (CMR) properties for the chemicals is necessary.

6.6 Risk characterization and analysis

6.6.1 The ratio between the resulting PEC from the MAMPEC and PNEC is calculated, and where the result is below 1, the assumption is that no unacceptable risk will result from exposure to that chemical. In case that a background concentration of a chemical substance exceeds PNEC, it is assumed that unacceptable risk already exists from exposure to that chemical.

6.6.2 In addition to paragraph 6.6.1, the pH drops delivered from the additional PECs of sulfate/sulfite (i.e. sulphuric/sulphurous acid) should be assessed from the viewpoint of marine acidification. The pH drops can be estimated using the identified concentration (PEC) of sulfate/sulfite and the current and future alkalinity of seawater.

6.6.3 An assessment of secondary poisoning is redundant if the substance of concern demonstrates a lack of bioaccumulation potential (e.g. BCF < 500 L/kg wet weight for the whole organism at 6% fat).

6.6.4 An assessment of sediment species is redundant if the potential of the substance of concern to partition into the sediment is low (e.g. $K_{oc} < 500$ L/kg).

6.6.5 Accumulation of priority hazardous substances in sediments should be assessed in the port area

6.7 Whole Effluent Toxicity

6.7.1 Whole Effluent Toxicity (WET) testing using the actual discharge water from EGCS may be performed by the Member States.

6.7.2 The advantage of conducting a WET testing on the EGCS discharge water is that it aggregates and addresses the potential for interactions (i.e. cocktail effects) of the contents of the discharge water.

6.7.3 The Member States should provide both acute and chronic toxicity test data using internationally accepted test procedures to determine the toxicity of the EGCS discharge water when conducting WET testing.

6.7.4 To assess the adverse effects of the discharge water, either the use of pH buffer or filtration process should be avoided.

6.7.5 These toxicity tests should include chronic test methods with multiple test species (a fish, an invertebrate and a plant) that address the sensitive life-stage. The preference is to include both a sub-lethal endpoint (growth) and a survival endpoint.

6.7.6 The test results to be provided include: acute 24-hour, 48-hour, 72-hour and 96-hour Lethal (or Effect) Concentration at which 50% of the test organisms die (or effect) (L(E)C₅₀), chronic No Observed Effect Concentration (NOEC) and/or Effect Concentration at which 10% of test organisms show effect (EC₁₀), as appropriate based on the experimental design.

6.7.7 A dilution series including a 100% EGCS discharge water would be tested to determine the 50% of the test organisms die (or effect) using the statistical endpoints for acute ecotoxicity (EC₅₀).

6.7.8 Applying the assessment factor (see paragraph 6.3.3.1 and Table 5 in the Annex to BWM.2/Circ.13/Rev.4 on *Methodology for information gathering and conduct of work of the GESAMP-BWWG*) on the results of WET, PNEC_{general} expressed as dilution ratio should be determined both for short term and long term, the former delivered from the results of acute WET tests and the latter from chronic WET tests.

6.7.9 For the risk characterization applying the WET approach, the comparison between the risk thresholds and PEC will be needed.

6.7.10 From the short-term viewpoints, the ratio between the resulting dilution ratio from the short-term calculation of PECs and the PNEC_{general} from acute WET tests should be calculated, and where the result is below 1, the assumption is that no unacceptable risk will result from exposure to the aggregated ecotoxicity among the discharge water from EGCS.

6.7.11 An initial analysis could use a conservative approach where the dilution capacity would not be taken into consideration (no modelling or plumes analysis would be used). The rationale for taking a conservative approach is that there could be multiple discharges into one location (even though this is not necessarily the case).

6.7.12 From the long-term viewpoints, the ratio between the resulting dilution ratio from the long-term calculation of PECs and the PNEC_{general} from chronic WET tests should be calculated, and where the result is below 1, the assumption is that no unacceptable risk will result from exposure to the aggregated ecotoxicity of the discharge water from EGCS.

6.7.13 As the WET testing will cost, and should be performed at the laboratory with quality assessment and quality control (QA/QC) and with high expertise, the Member States may utilize the data collected by the Organization. NOTE: the results of WET both for acute and chronic may be included in the database developed by the Organization.

7 IMPACT ASSESSMENT

7.1 The impact assessment approach may be applied to the specific receiving environment that is being assessed, at the relevant geographical levels, taking account of the type of water body, i.e. marine (open water), coastal and other territorial waters (within 12 nm

from the coastline), estuarine, large harbour and small enclosed harbour environments and areas in the vicinity of dense shipping routes. In addition, saltwater, brackish water and freshwater situations and the effect of tides or their absence may be considered, as appropriate.

7.2 Application of impact assessment approach to the specific receiving environment by identifying and defining:

- .1 the existing status (ecological, chemical, environmental, cultural) of the receiving water bodies;
- .2 the likely effect on status of the discharge water discharges, in particular whether the discharge could result in failure to meet the objectives of the applicable environmental legislation;
- .3 the specific environmental stressors that may be affected by discharge water discharges;
- .4 the adverse effects arising from these stressors; and
- .5 the presence of priority hazardous substances on sediments affecting dredging operations in port areas.

7.3 Incorporation of the following steps for the specific receiving environment:

- .1 a systematic review of the impacts of the discharge water;
- .2 specific modelling for physical distribution and fate of the components in discharge water and comparing the PNEC and PEC considering the cumulative effects of the mixture, i.e. use the PEC/PNEC summation approach;
- .3 identification of the overall vulnerability of and potential damage to the environment, habitats or organisms that may be impacted, and the potential cost of restoration;
- .4 the identification of any direct or indirect socio-economic, cultural and human health impacts of the discharge water discharge;
- .5 whether there are any seasonal or temporal impacts that need to be considered;
- .6 identification of any practical mitigation measures that could minimise the potential impacts identified at this stage; and
- .7 water exchange rate in water bodies that may be affected by the presence of port infrastructures.

7.4 The adoption of restrictions or a ban on discharge water from EGCSs should be considered in areas where any of the following indicative criteria are fulfilled:

- .1 environmental objectives in the areas are not met, e.g. good chemical status, good ecological status or good environmental status are not achieved under applicable legislation;

- .2 the discharge of EGCS effluents represents an additional risk of deteriorating the environment and the resiliency of the climate system;
- .3 the EGCS discharge water conflicts with the conventions and regulations formulated to protect the marine environment (see UNCLOS Article 195, etc.); and
- .4 the EGCS discharge effluent represents an increase in the costs of management of dredged materials in ports.

7.5 An uncertainty analysis can be undertaken by identifying whether the potential adverse effects from discharge water discharges are well understood. This may include the effects on the immediate and downstream environment taking into account both spatial and temporal factors.

7.6 When restricting EGCS discharges, consideration should be given to investments already made by industry to comply with regulation 14 of MARPOL Annex VI and other relevant legislation, also taking, however, into account that the choice of EGCS as an alternative compliance option under regulation 4 of MARPOL Annex VI was primarily based on considerations of favourable economic competitiveness. In any case, not restricting EGCS discharges could also lead to the economic burden on governments (for example in relation to management of dredged materials), due to their need to restore environmental degradation, protect human health and impacts on the fishing or tourism sector deriving from. These impacts should also be overall taken into account. The sooner such measures are taken, the lower the consequent impact will be on industry on Member States.

8 NOTIFICATION TO THE ORGANIZATION

8.1 The Member States that have undertaken risk and impact assessments should notify the Organization of the result of the assessments together with the notification of local regulations on the discharges of discharge water from EGCSs.

APPENDIX 1

GENERAL INFORMATION ON MAMPEC

1 MAMPEC was originally developed to calculate Predicted Environmental Concentrations (PECs) for the exposure assessment of antifoulants (i.e. marine paints on the hull below waterline of ships) leached out in harbours, rivers, estuaries and open water. MAMPEC is a steady-state, 2D-integrated hydrodynamic and chemical fate model.

2 The MAMPEC-BW model was adapted for exposure assessment of chemicals discharged by the use of ballast water treatment systems and has the extended features from the original MAMPEC. On the request of the GESAMP-BWWG and IMO, a special standardised version of MAMPEC-BW for ballast water was developed in 2011, with a dedicated environment, a compound and an emission scenario for the use of BWMS.

3 The MAMPEC calculation for Ballast Water (MAMPEC-BW 3.1) model or the latest available version can be downloaded from the website of Deltares in the Netherlands. The website is as provided below:

<https://download.deltares.nl/en/download/mampec/>

4 The model and supporting documents have been distributed freely via the internet (<https://www.deltares.nl/en/software/mampec/>). The model predicts concentrations of targeted chemical substances in generalised "typical" marine environment (e.g. open sea, shipping lane, estuary, commercial harbour, yachting marina and open harbour). For ballast water, a representative harbour model has been defined. Users can specify emission factors (e.g. daily loads), compound-related properties and processes (e.g. K_d , K_{ow} , K_{oc} , volatilisation, speciation, hydrolysis, photolysis, biodegradation) and properties and hydrodynamics related to the specific environment (e.g. currents, tides, salinity, DOC, suspended matter load, port dimensions). MAMPEC includes options for advanced photolysis modelling, incorporation of wind-driven hydrodynamic exchange and other non-tidal exchange processes important for areas without tidal action or inland freshwater environments. MAMPEC can calculate concentrations of targeted chemical substances for individual grids specified by users.

5 In MAMPEC calculation, the total calculation will be located automatically depending on the feature of sea-area.

APPENDIX 2

HOW TO ESTIMATE HUMAN EXPOSURE

1 Introduction

Appendix 2 presents the various steps in human health risk assessment associated with the discharge water from EGCS.

2 The steps in the human health risk assessment

2.1 Hazard characterization

2.1.1 Establishing guidance levels (DNELs and DMELs) for the general public

2.1.1.1 Derivation of guidance levels

The derivation of guidance levels involves the following steps:

- Hazard identification;
- Hazard characterization;
 - Definition of dose descriptor; and
 - Definition of assessment factor.

As part of the hazard identification the type and nature of adverse health effects to humans are identified. The data may consist of information from epidemiological studies and animal-based toxicology studies.

The hazard characterization includes establishing guidance levels (DNELs and DMELs).

The guidance levels are levels, for chemicals with a threshold effect, below which no adverse health effects to humans are expected to occur.

However, for chemicals with a non-threshold effect, such as genotoxic carcinogens, where no lower safe limit exists, the guidance levels are associated with a low, possibly hypothetical, acceptable risk.

2.1.1.2 Dose descriptor

For all chemicals, an effect level, or reference dose, linked to potential adverse effects has to be defined. The Benchmark Dose (BMD) approach is regarded to represent a scientifically more advanced method compared to the NOAEL approach for deriving a reference dose (sometimes referred to as point-of-departure (EFSA, 2017)). The BMD₁₀ is defined as the dose for a predetermined level of response, 10% increase or decrease, compared with the background response. It is recommended to use the lower bound of a BMD₁₀, i.e. the BMDL₁₀ (US EPA, 2012).

2.1.1.3 Assessment factor or adjustment factor

When results from animal-based studies are extrapolated to the general public, one or more assessment factors are used to reduce the likelihood that the actual risks to humans are underestimated. When results from human are used, adjustment factors may be used to account for human variability.

2.1.2 Guidance values for the general public (threshold effects)

Guidance values based on epidemiological studies, when available, are always preferred (WHO, 2000), and may be retrieved from internationally recognized bodies. These include guidance values established by, for example, JECFA or EFSA for food contaminants, such as TDI, and by WHO for chemicals in drinking water.

Guideline values for chemicals in drinking-water have been established for chemicals that cause adverse health effects after prolonged periods of time. A guideline value normally represents the concentration of a chemical that does not result in any significant risk to health over a lifetime of consumption. The guideline values assume a water consumption of 2 litres per day, and a body weight of 60 kg.

A number of provisional guideline values have, however, been established based on the practical level of treatment performance or analytical achievability. In these cases, the guideline value is higher than the calculated health-based value.

Table 1: Summary of examples of guidance values used for the general public

Type of outcome	Term (units)	Abbreviation	Definition
Non-cancer, including laboratory animal carcinogens not relevant to humans	Tolerable daily intake (mg/kg bw/day)	TDI	An estimate of the amount of a substance in air, food, soil or drinking-water that can be taken in daily, weekly or monthly per unit body weight over a lifetime without appreciable health risk.
	Provisional tolerable weekly intake (mg/kg bw/week)	PTWI	
	Provisional tolerable monthly intake (mg/kg bw/month)	PTMI	
	Derived No Effect Level (mg/kg bw/day)	DNEL	

2.1.3 Guidance values for the general public (non-threshold effects)

2.1.3.1 Approaches to risk assessment

Carcinogens can have a threshold or non-threshold mode of action. As a general rule, a risk for the general public from secondary exposure to a non-threshold carcinogenic substance is unacceptable. When it comes to the threshold carcinogens, these can be assessed by using a DNEL approach. In the case of the non-threshold carcinogens (i.e. with mutagenic potential), a different approach to risk assessment is recommended. In this guideline, the lifetime excess cancer risk level of 10^{-5} is used where possible (in accordance with the WHO Drinking Water Methodology, (WHO, 2001)).

2.1.3.2 Derived Minimal Effect Level

Calculation of an exposure level corresponding to a defined low risk, a Derived Minimal Effect Level (DMEL) is possible based on a semi quantitative approach. In contrast to a DNEL, a DMEL does not represent a "safe" level of exposure. It is a risk related reference value that could be used to better target risk management measures.

2.1.3.3 The large assessment factor approach

The "large assessment factor" approach results in DMEL values represents a low concern from a public health point of view. The basis for this assessment factor is that for substances that are both genotoxic and carcinogenic, an MOE of 10,000 or higher, based on a BMDL₁₀ from an animal study, is regarded to be of low concern (EFSA, 2017).

When a $BMDL_{10}$ from an animal study (oral rat carcinogenicity study) is used the assessment factors shown in table 2 should be used.

Table 2: Default assessment factors in the "large assessment factor approach" (modified from ECHA, 2012)

Assessment factor	Default value systemic tumours
Interspecies	10
Intraspecies	10
Nature of the carcinogenic process	10
The point of comparison	10
Total assessment factor	10,000

$$DMEL = \frac{BMDL_{10}}{\text{total assessment factor}} \quad (\text{Equation 1})$$

A DMEL derived according to this approach represents an excess cancer risk of 10^{-5} .

2.1.3.4 The slope factor approach

A slope factor is an estimate of the life-time cancer risk associated with a unit dose of a chemical through ingestion (or inhalation). The slope factor is defined as increased cancer risk from lifetime exposure to a substance by ingestion (or inhalation). It is expressed as an estimate of cancer risk associated with a unit concentration (mg/kg bw/d) or risk per mg/kg bw/d (US EPA, 2005). The slope factor may be used to derive the dose (mg/kg bw/d) associated with cancer at a specified risk level, for instance 10^{-5} (or 1 in 100 000). This dose may then be used as a DMEL.

2.1.3.5 Drinking-water guideline values

Drinking-water guideline values are normally determined using a mathematical model (the linearised multistage model) for chemicals considered to be genotoxic carcinogens. These guideline values are presented as concentrations in drinking-water associated with an estimated upper-bound excess lifetime cancer risk of 10^{-5} .

2.2 Exposure assessment

2.2.1 How and where humans may be exposed to EGCS discharge water

Humans may be exposed to EGCS discharge water when swimming in the water where the EGCS discharge water has been discharged, or when consuming seafood that has been caught in the vicinity of the area where the EGCS discharge water has been discharged. In some areas of the world, desalinated seawater is used as drinking water which will add another way of probable exposure. In this guideline, the aggregate exposure approach, as defined by WHO/IPCS (WHO/IPCS, 2009), is applied, that is the combined exposure applicable to each scenario. The term "aggregated exposure" (or "combined exposure"), as defined by the WHO/IPCS, takes into account all relevant pathways (e.g. food, water and residential uses) as well as all relevant routes (oral, dermal and inhalation).

2.2.2 Human exposure scenario

The exposure assessment is carried out through an evaluation of different exposure scenarios. An exposure scenario is a set of information and/or assumptions that describes the situations associated with the potential exposure.

2.2.3 Situations in which the general public might be exposed to EGCS discharge water

2.2.3.1 Exposure scenarios for the general public

Indirect exposure of humans via the environment associated with EGCS discharge water may occur by consumption of seafood and swimming in the receiving water. As a general principle, consumer exposure is normally assessed as being chronic and thus taking place throughout the whole lifetime in order to protect the most vulnerable population groups.

The following situations, as shown in table 3, have been identified as likely exposure scenarios for the general public, and have been regarded as a worst-case exposure.

As the human activities listed in table 3 are not performed near the discharge points for MAMPEC calculations, the maximum PECs in the surroundings should be used as representative concentration in a worst-case exposure.

Table 3: Summary of exposure scenarios for the general public

Situations in which the general public may be exposed to EGCS discharge water containing chemicals		
Situation	Exposure	Duration/quantity
Recreational activities in the sea	Inhalation of chemicals partitioning into the air above the sea	2 events of 0.5 hours/day
	Dermal exposure to chemicals whilst swimming in the sea	2 events of 0.5 hours/day
	Swallowing of seawater contaminated with EGCS discharge water	2 events of 0.5 hours/day
Eating seafood exposed to EGCS discharge water	Oral consumption	Once or twice/day equivalent to 0.107 kg/day
Drinking water prepared from receiving water that may have been contaminated by the EGCS discharge water	Inhalation of chemicals volatilising from drinking water while showering	0.75 hours/day
	Dermal exposure to chemicals in drinking water while showering	0.75 hours/day
	Ingestion exposure to chemicals in drinking water	Daily total drinking water intake of 2 L/day
Aggregated exposure (through swimming, consumption of seafood and using drinking water)		

A number of assumptions are being used in the human exposure scenarios for the general public. These assumptions are listed in table 4. In all scenarios, default parameters leading to worst-case assessment are applied. Accordingly, the body surface area of men is assumed, but the body weight of women (60 kg) is applied. The whole-body surface area for men is 1.94 m². One parameter, ingestion rate of water while swimming, is taken from the Swimodel (US EPA, 2003).

Table 4: Summary of physiological parameters in human exposure scenarios for the general public

Parameter	Value	Reference
Body weight	60 kg	WHO (2017)
Whole body, surface area	1.94 m ²	US EPA (1997)
Ventilation rate (light activity)	1.25 m ³ /h	ECHA (2012)
Ingestion rate of water while swimming	0.025 L/h	Swimodel, US EPA (2003)
Ingestion rate of drinking water	2 L/d	WHO (2017)
Showering	0.75 h/d	US EPA (2011)
Quantity of fish consumed	0.107 kg/d	AIST, Japan (2007)
Temperature	293 K	GESAMP assumption
Dilution factor, swimming	100	EUSES (2016)
Reduction rate of chemicals through the desalination process for making up drinking water	10	Average reduction rate of chemicals through the RO treatment: 90% (Smol, M. and Włodarczyk-Makuła, M., 2017)

2.2.3.2 Recreational activities (swimming) in the sea

- .1 Inhalation of chemicals partitioning into the air above the sea
Exposure in this scenario is through inhalation of air above the sea while swimming. The concentration of chemicals in the air may be calculated while using the Henry's law constant as described below.

The worst concentration of chemicals in the air may theoretically be calculated using the Henry's law constant. This physical law states that, the mass of gas dissolved by a given volume of solvent, is proportional to the pressure of the gas with which it is in equilibrium. The relative constant quantifies the partitioning of chemicals between the aqueous phase and the gas phase such as rivers, lakes and seas with respect to the atmosphere (gas phase). While making use of the concentration in the water phase, the concentration in the air phase is calculated accordingly:

$$C_{air} = \frac{H}{R \cdot T} \cdot C_{water} \quad (\text{Equation 2})$$

where:

- C_{air} = concentration in air (mg/m³);
 H = Henry's law constant (Pa m³/mole);
 R = gas constant (8.314 Pa m³/mole K);
 T = absolute temperature (K) (default = 293 K); and
 C_{water} = concentration in the water, i.e. maximum PECMAMPEC in surroundings (µg/L).

The concentration in water is the maximum predicted environmental concentration (PEC) value in surroundings as calculated by MAMPEC, and taking into account a dilution factor of 100 (due to wind, turbulence and insufficient time for the chemical to reach equilibrium) (EUSES, 2016). The inhaled dose may be estimated using the equation below, while taking into account various assumptions (number of swims, etc.).

$$Dose_{Inh} = \frac{C_{air} \cdot VR \cdot n \cdot Dur_{swim} \cdot Bio_{inh} \cdot 1000}{BW} \quad (\text{Equation 3})$$

where:

$Dose_{Inh}$ = inhalation intake of chemical during swimming ($\mu\text{g}/\text{kg}$ bw/d);
 C_{air} = concentration in air (mg/m^3);
 VR = ventilation rate – light activity assumed ($1.25 \text{ m}^3/\text{h}$);
 n = number of swims per day (2/d);
 Dur_{swim} = duration of each swim (0.5 h);
 Bio_{inh} = fraction of chemical absorbed through the lungs (default = 1); and
 BW = body weight (default = 60 kg).

.2 Dermal exposure to chemicals while swimming in the sea

Option 1.

Exposure in this scenario is via dermal uptake of chemicals when swimming and where the permeability coefficient (K_p) is known, using the following equation,

$$Dose_{der} = \frac{C_{water} \cdot K_p \cdot Dur_{swim} \cdot n \cdot A_{skin} \cdot Bio_{der} \cdot 1000}{BW} \quad (\text{Equation 4.1})$$

where:

$Dose_{der}$ = dermal uptake per day during swimming ($\mu\text{g}/\text{kg}$ bw/d);
 C_{water} = concentration in the water, i.e. maximum PECMAMPEC in surroundings ($\mu\text{g}/\text{L}$);
 K_p = dermal permeability coefficient (cm/h);
 Dur_{swim} = duration of each swim (0.5 h);
 n = number of swims per day (2/d);
 A_{skin} = surface area of whole body being exposed to water (1.94 m^2);
 Bio_{der} = bioavailability for dermal intake (default = 1); and
 BW = body weight (60 kg).

Option 2

If the K_p value is unknown, the following equation may be used as a conservative approach (ECHA, 2016),

$$Dose_{Der} = \frac{C_{water} \cdot TH_{der} \cdot n \cdot A_{skin} \cdot Bio_{der} \cdot 1000}{BW} \quad (\text{Equation 4.2})$$

where:

$Dose_{Der}$ = dermal uptake per day during swimming ($\mu\text{g}/\text{kg}$ bw/d);
 C_{water} = concentration in the water, i.e. maximum PECMAMPEC in surroundings ($\mu\text{g}/\text{L}$);
 TH_{der} = thickness of the product layer on the skin (0.0001 m);
 N = number of swims per day (2/d);
 A_{skin} = surface area of whole body being exposed to water (1.94 m^2);
 Bio_{der} = bioavailability for dermal intake (default = 1); and
 BW = body weight (default = 60 kg).

- .3 Swallowing of water contaminated with EGCS discharge water
The oral uptake via swimming is calculated according to the following:

$$Dose_{Oral} = \frac{C_{water} \cdot IR_{swim} \cdot n \cdot Dur_{swim} \cdot Bio_{oral}}{BW} \quad (\text{Equation 5})$$

where:

Dose_{Oral} = amount of chemical swallowed (µg/kg bw/d);
C_{water} = concentration in the water, i.e. maximum PECMAMPEC in surroundings (µg/L);
IR_{swim} = ingestion rate of water while swimming (0.025 L/h);
N = number of swims per day (2/d);
Dur_{swim} = duration of each swim (0.5 h);
Bio_{oral} = bioavailability for oral intake (default = 1); and
BW = body weight (default = 60 kg).

2.2.3.3 Eating seafood exposed to EGCS discharge water

The concentration of chemicals in the seafood that is being consumed is calculated in this way:

$$C_{fish} = BCF \cdot C_{water} \quad (\text{Equation 6})$$

where:

C_{fish} = concentration in fish (µg/kg);
BCF = bioconcentration factor (L/kg); and
C_{water} = concentration in the water, i.e. maximum PECMAMPEC in surroundings (µg/L).

The calculation of concentrations in seafood has to be carried out for all chemicals. The cut-off value for the bioconcentration factor as described for the environmental risk assessment (paragraph 6.6.3) is not applicable in the risk assessment for human health. Making the assumption that people in the area only consume fish that is being caught locally (worst-case scenario), the daily intake may be calculated in the following way:

$$Dose_{fish} = \frac{QFC \cdot C_{fish} \cdot Bio_{oral}}{BW} \quad (\text{Equation 7})$$

where:

Dose_{fish} = uptake of chemical from eating fish (µg/kg bw/d);
QFC = quantity of fish consumed/day (= 0.107 kg/d (AIST, Japan (2007)));
C_{fish} = maximum concentration of chemical in fish (µg/kg);
Bio_{oral} = bioavailability for oral intake (default = 1); and
BW = body weight (default = 60 kg).

2.2.3.4 Drinking water made from receiving water that may have been contaminated by EGCS discharge water:

- .1 Inhalation of chemicals volatilisation from drinking water while showering

Exposure in this scenario is through inhalation of chemicals volatilising from drinking water while showering. The concentration of chemicals in the air may be calculated while using the Henry's law constant as already described in equation 1. The concentration in the drinking water is the same as in the scenario 2.2.3.2 and 2.2.3.3, while also taking into consideration a removal ratio of 10 in Reverse Osmosis (RO) desalination process (Smol, M. and

Włodarczyk-Makula, M., 2017), based on the concentration in the receiving water (i.e. the maximum PECs in the surroundings of MAMPEC calculation).

$$C_{air} = \frac{H}{R \cdot T} \cdot C_{DW} \quad (\text{Equation 8})$$

where:

C_{air} = concentration in air (mg/m³);
 H = Henry's law constant (Pa m³/mole);
 R = gas constant (8.314 Pa m³/mole K);
 T = absolute temperature (K) (default = 293 K); and
 C_{DW} = concentration in the drinking water, i.e. maximum PECMAMPEC in surroundings (µg/L)·0.9 (µg/L).

The inhaled dose, while showering, may be estimated using the equation below, while taking into account various assumptions,

$$Dose_{Inh} = \frac{C_{air} \cdot VR \cdot n \cdot Dur_{show} \cdot Bio_{inh} \cdot 1000}{BW} \quad (\text{Equation 9})$$

where:

$Dose_{Inh}$ = inhalation intake of chemical while showering (µg/kg bw/d);
 C_{air} = concentration in air (mg/m³);
 VR = ventilation rate – light activity assumed (1.25 m³/h);
 N = number of showers per day (1/d);
 Dur_{show} = duration of each shower (0.75 h);
 Bio_{inh} = fraction of chemical absorbed through the lungs (default = 1); and
 BW = body weight (default = 60 kg).

.2 Dermal exposure to chemicals while showering

Option 1

Exposure in this scenario is via dermal uptake of chemicals when taking a shower, and where the dermal permeability coefficient (K_p) is known, is calculated using the following equation,

$$Dose_{der} = \frac{C_{DW} \cdot K_p \cdot Dur_{show} \cdot n \cdot A_{skin} \cdot Bio_{der} \cdot 1000}{BW} \quad (\text{Equation 10.1})$$

where:

$Dose_{der}$ = dermal uptake per day during showering (µg/kg bw/d);
 C_{DW} = concentration in the drinking water, i.e. maximum PECMAMPEC in surroundings (µg/L)·0.9 (µg/L);
 K_p = dermal permeability coefficient (cm/h);
 Dur_{show} = duration of each shower (0.75 h);
 N = number of showers per day (1/d);
 A_{skin} = surface area of whole body being exposed to water (1.94 m²);
 Bio_{der} = bioavailability for dermal intake (default = 1); and
 BW = body weight (60 kg).

Option 2

If the K_p value is unknown, the following equation may be used as a conservative approach,

$$Dose_{Der} = \frac{C_{DW} \cdot TH_{der} \cdot n \cdot A_{skin} \cdot Bio_{der} \cdot 1000}{BW} \quad (\text{Equation 10.2})$$

where:

$Dose_{Der}$ = dermal uptake per day during showering ($\mu\text{g}/\text{kg}$ bw/d);
 C_{DW} = concentration in the drinking water, i.e. maximum PECMAMPEC in surroundings ($\mu\text{g}/\text{L}$) \cdot 0.9 ($\mu\text{g}/\text{L}$);
 TH_{der} = thickness of the product layer on the skin (0.0001 m);
 N = number of showers per day (1/d);
 A_{skin} = surface area of whole body being exposed to water (1.94 m²);
 Bio_{der} = bioavailability for dermal intake (default = 1); and
 BW = body weight (default = 60 kg).

.3 Ingestion exposure to chemicals in drinking water

The oral uptake via drinking water is calculated according to the following,

$$Dose_{Oral} = \frac{C_{DW} \cdot IR_{drink} \cdot Bio_{oral}}{BW} \quad (\text{Equation 11})$$

where:

$Dose_{Oral}$ = amount of chemical swallowed ($\mu\text{g}/\text{kg}$ bw/d);
 C_{DW} = concentration in the drinking water. i.e. maximum PECMAMPEC in surroundings ($\mu\text{g}/\text{L}$) \cdot 0.9 ($\mu\text{g}/\text{L}$);
 IR_{drink} = ingestion rate of drinking water (2 L/d);
 Bio_{oral} = bioavailability for oral intake (default = 1); and
 BW = body weight (default = 60 kg).

2.2.4 Concluding remarks

It should be noted that while the above situations have been identified as typical worst-case exposure scenarios, it is recognized that there will be other situations when exposure of the general public may be greater or less, and consideration should be given to such situations. In addition, the consumer exposure (general public) is normally assessed as chronic/lifetime risk in order to protect the most vulnerable population groups.

2.3 Risk characterization and acceptance criteria

2.3.1 General approach

The Risk Characterization Ratios (RCR) compares the exposure estimates to various DNELs or DMELs. The RCR is calculated according to the following formulae:

$$RCR = \frac{Exposure}{DNEL} \quad (\text{Equation 12})$$

or

$$RCR = \frac{Exposure}{DMEL} \quad \text{(Equation 13)}$$

In both cases, RCR should be used as acceptance criteria. If the $RCR < 1$, the exposure will lead to no unacceptable risk. However, risks are regarded to be controlled when the estimated exposure levels exceed the DNEL and/or the DMEL, that is, if the $RCR \geq 1$.

2.3.2 Health risks for the general public

In the three scenarios applicable for the general public, swimming in seawater contaminated with EGCS discharge water, ingestion of seafood which has been exposed to EGCS discharge water and ingestion of drinking water prepared from receiving water that may have been contaminated by the EGCS discharge water, are taken into consideration.

Aggregated exposure (through swimming, consumption of seafood and drinking water prepared from receiving water that may have been contaminated by the EGCS discharge water), that is the combined exposure applicable to each scenario, is estimated.

The total amount of chemicals that is absorbed as a result of the exposure to the general public, whilst swimming in the sea, eating fish and being exposed to drinking water through showering and drinking water consumption, may be summarised as in table 5.

Table 5: General public scenario – DNEL approach

Chemical Name	Scenario ($\mu\text{g}/\text{kg bw}/\text{d}$)							Aggregated exposure ($\mu\text{g}/\text{kg bw}/\text{d}$)	DNEL ($\mu\text{g}/\text{kg bw}/\text{d}$)	RCR
	Swimming			Consumption of seafood	Drinking water					
	Inhalation	Dermal	Oral	Oral	Inhalation	Dermal	Oral			
A										
B										
C										

The risk-related reference value (DMEL) may be used to calculate an indicative RCR regarding potential cancer risk. DMELs can be used to estimate a risk dose based on the probability of increased cancer incidence over a lifetime (10^{-5}) for the general public (table 6).

Table 6: General public scenario – DMEL approach

Chemical name	Aggregated exposure ($\mu\text{g}/\text{kg bw}/\text{d}$)	DMEL ($\mu\text{g}/\text{kg bw}/\text{d}$)	Indicative RCR
A			
B			
C			

2.3.3 Mixture toxicity (including dose addition approach)

EGCS discharge water frequently contains mixtures of several chemicals which lead similar mechanism in human systems. One possible way to deal with this situation is to adopt an established international risk assessment approach (known as "grouping" or "dose addition"; Kortenkamp, et al., 2009), which entails a summation of the Risk Characterization Ratios (RCRs) of all substances with recognized carcinogenic potential. This approach had, for example, been used previously for carcinogens by the US EPA (US EPA, 1989), where it is based on the assumption that for carcinogens no dose threshold exists, and that the dose-response function is therefore essentially linear. Thus, if the EGCS discharge water

contains two or more chemicals with the same toxicological effect, these could be evaluated as an "assessment group". The RCR for an assessment group is calculated by the addition of all RCRs of the individual components,

$$RCR_{group} = RCR_A + RCR_B + RCR_C + \dots + RCR_n \quad (\text{Equation 14})$$

where:

RCR_n = the Risk Characterization Ratios shown in table 5 or table 6.

For the group RCR, the same conclusions apply as described above, that is, if the RCR < 1 using the RCRs in table 6, the exposure is deemed to represent no unacceptable risk. If still an unacceptable risk is identified, further refinement of the exposure assessment and/or the assessment factors might be performed giving special attention to route-specific contributions and additional RMM.

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MEPC.1/Circ.901
24 June 2022

**GUIDANCE ON METHODS, PROCEDURES AND VERIFICATION OF
IN-SERVICE PERFORMANCE MEASUREMENTS**

1 The Marine Environment Protection Committee, at its seventy-eighth session (6 to 10 June 2022), approved the *Guidance on methods, procedures and verification of in-service performance measurements* for the purpose of the EEXI calculation, as set out in the annex.

2 Member Governments are invited to bring the annexed Guidance to the attention of their Administrations, industry, relevant shipping organizations, shipping companies and other stakeholders concerned.

ANNEX

GUIDANCE ON METHODS, PROCEDURES AND VERIFICATION OF IN-SERVICE PERFORMANCE MEASUREMENTS

CONTENTS

- 1 INTRODUCTION
- 2 OVERVIEW
- 3 PREPARATIONS
- 4 DURING THE IN-SERVICE PERFORMANCE MEASUREMENTS
- 5 AFTER THE IN-SERVICE PERFORMANCE MEASUREMENTS

APPENDIX A – INFORMATION TO BE SUBMITTED PRIOR TO CONDUCTING THE IN-SERVICE PERFORMANCE MEASUREMENTS.

APPENDIX B – INFORMATION TO BE SUBMITTED FOR VERIFICATION AFTER THE IN-SERVICE PERFORMANCE MEASUREMENTS.

APPENDIX C – EXAMPLE OF THE IN-SERVICE PERFORMANCE MEASUREMENTS REPORTING FORM

1 Introduction

In cases where the speed-power curve is not available or the sea trial report does not contain the EEDI or design load draught condition, the ship speed V_{ref} can be obtained from the in-service performance measurement method for the purpose of the EEXI calculation, in accordance with paragraph 2.2.3.5 of the EEXI Calculation Guidelines, as set out in resolution MEPC.350(78).

2 Overview

2.1 When carrying out the in-service performance measurements, common international standards¹ should be referred to, unless explicitly specified in this guidance.

2.2 An overview of preparations and procedures are outlined in the table below. The preparations and the processes should be discussed and agreed at the pre-meeting, see section "Preparations".

Table 1: In-service performance sea trial preparations and procedures

In-service performance measurement analysis	
Step 1: Preparing sensors	<ul style="list-style-type: none"> • Speed log / GPS • Echosounder • Heading control • Fuel flow meter • Shaft torsion meter • Draft measurement • Gyro compass
Step 2: Pre-trial parameters	<ul style="list-style-type: none"> • Displacement • Forward/Aft draughts • Water depth • Air/Sea temperature • Seawater density • Anemometer height • Fuel density • Fuel LCV
Step 3: In-service performance measurement	<ul style="list-style-type: none"> • Sea state • Wind • Water depth • Currents
Step 4: During trial parameters	<ul style="list-style-type: none"> • Reported data • System prints • Equipment control • Fuel analysis
Step 5: Documentation	<ul style="list-style-type: none"> • Shaft RPM/Power • Heading • Ship's speed • Distance • Wind speed/direction • Current speed/direction • Wave height/period/direction

¹ Such as ITTC quality procedures, ISO 15016:2002, ISO 15016:2015 and/or ISO 19030:2016.

2.3 When using the in-service performance measurement method, a meeting should be arranged between all stakeholders involved in the process: the owner, the possible consultant, the verifier and the authority before conducting the in-service performance measurements. An overview of the available information including but not limited to ship design, energy saving devices (ESD) and measurement sensors should be included. The plan for the period of the in-service performance measurements should be agreed upon and expectations regarding the delivery of the analysis and its format should be aligned.

3 Preparations

3.1 One of the most important aspects of a successful in-service performance measurement procedure is the preparation. Relevant instruments should be calibrated and their operational conditions prior to the commencement of the trials should be confirmed by the verifier.² The list below indicates the primary instruments to be used for collecting the data:

Table 2: Sensors for In-service performance trials

Sensor	Remarks
Shaft torque meter	The measurement system should be certified for power measurements with a bias error as small as practicable. Zero setting checked before and after test.
GPS	The GPS system should operate in the differential mode to ensure sufficient accuracy.
Anemometer	It should be clear of possible obstructions (superstructure, masts, funnel, etc.) and its height from sea level recorded.
Draft measurements	Draft measurement system (if available and calibrated): Otherwise, physical observation is required.
Speed log	The sensor should have been cleaned recently.
Echo sounder	Important for checking water depth for safety and ensuring there are no effects from shallow water on the ship performance.
Course recorder	Should be checked before the trial and be able to provide a course printout following each trial run.
Fuel flow meter	Either volume flow or mass flow meters to be fitted to ships. Both should be calibrated and cleaned/maintained as per manufacturer's recommendations.
Gyro compass	Record the ship's heading during the voyage and should be calibrated prior to the trials.

3.2 The ship should be equipped with a calibrated shaft torque meter, at least for the complete duration of the in-service performance measurement. For verification and cross checks, the detailed fuel properties information, the logged engine room conditions and the fuel oil consumption details will give an estimate of the power used at a certain fuel oil consumption value.

3.3 If an automated data acquisition system is installed on board, this should be checked for accuracy prior to the performance measurements, to ensure that the system has the required precision and measurement frequency, that can provide a trace of all the data required.

² The Verifier is the flag Administration, or a competent organization delegated by the flag Administration.

3.4 Before the start of each performance measurement run, the following should be noted in the data logging template form (example appendix C):

Table 3: In-service environment and conditions

Parameter	Remarks
Displacement	Speed trials should be performed at displacement and draught conditions, which are comparable to those of the delivery sea trials or model tests or assumed ballast conditions. The trim shall be maintained within very narrow limits. For the even keel condition, the trim shall be less than 0.1 % of the length between perpendiculars. For the trimmed trial condition, the fore draught shall be within ± 0.1 m of the ship's ideal condition.
Draught forward, mid and aft	
Water depth	No remarks
Air temperature	Air temperature and pressure should be measured using a calibrated thermometer and barometer.
Air pressure	
Sea water temperature	The local seawater temperature and density at the trial site should be recorded to enable the calculation of the ship's displacement and corrections with regards to viscosity. The water temperature should be taken at the waterline level.
Sea water density	
Anemometer height	Its height from sea level should be recorded.
Fuel density	The fuel's density and LCV to be obtained from a laboratory's analysis report.
Fuel LCV	

3.5 The in-service performance measurements should be performed at the EEXI draught condition, and if data exists for a reference condition, then a set of in-service performance measurements may also be performed at this condition in order to better calibrate the speed-power relation.

- .1 The reference condition is the condition for which the ship documentation exists, e.g. a sea trial curve in ballast or a sea trial/model test curve in design conditions. The in-service performance measurement result may be calibrated towards the reference condition curve. The use of a reference condition, if available, should not lead to overestimation of the V_{ref} but can be a useful tool to verify and calibrate the speed-power relation. If a reference condition is used, this calibration result may also be used for the EEXI draught condition.
- .2 The EEXI draught condition is the draught condition as provided by paragraph 2.2.2 of the *2018 Guidelines on the method of calculation of the attained EEDI for new ships* (resolution MEPC.308(73), as amended, the "EEDI Calculation Guidelines" hereafter). The performance measurements results are used with the same calibration factor as at the reference condition if available.

3.6 In case the exact EEXI draught condition cannot be met, the Admiralty Coefficient formula may be accepted to adjust the speed-power relation, only for displacement variations of up to 2%, or to the satisfaction of the verifier.

3.7 The ship should perform at least one set of in-service performance measurements for the EEXI draught condition, and at power settings equivalent to the EEDI trial conditions (set out in MEPC.1/Circ.855/Rev.2, as amended). If that is not possible, then at each of the following power settings of 30%, 60%, 75% and 90% of MCR, with a margin of +/- 5%. If data for a reference condition is available, another set of in-service performance measurements should also be carried out at this condition for calibration purposes.

3.8 In case where an overridable Shaft/Engine Power Limitation is installed, the power settings of 30%, 60%, 83% and 90% of the limited power may be used, with a margin of +/- 5% for both sets of in-service performance measurements, to the satisfaction of the verifier.

3.9 If the in-service performance measurements are performed at consecutive power settings, sufficient time in between change of settings should be considered, to be sure that steady state conditions are obtained.

3.10 The duration of each run should be performed according to table 4.

3.11 Prior to the in-service performance measurements, the weather forecast should be studied to ensure that favourable weather conditions will prevail during the trials (close to calm conditions).

3.12 Crew members involved in the execution should be familiar with the performance measurements and be aware of their tasks and the importance of the measurements collected.

3.13 Safety of the ship is paramount, and the performance measurements should be suspended should any risks to the ship and/or crew be detected. All rules and regulations, as well as good seamanship, are to be followed at all times.

3.14 The conditions and plans specified in this section should be examined and confirmed by the verifier prior to the in-service performance measurements.

3.15 The ship may experience fouling of the hull and the propeller, which may influence the performance of the ship. If the ship is heavily fouled during the in-service performance measurements, the V_{ref} attained may be less than expected and this will lead to a penalty in the attained EEXI. It is recommended to carry out in-service performance measurements when the ship has a clean hull and propeller.

3.16 The ship may have installed ESDs post delivery. This will affect the performance and the in-service measurement may be used to reflect the effect of ESDs, as provided in paragraph 2.2.3.7 of the EEXI Calculation Guidelines.

4 During the in-service performance measurements

4.1 Once the in-service performance measurements have begun, variations should be minimized, as the accuracy of the ship performance measurements can be influenced greatly by fluctuations in the parameters. Thus, all control levers should remain unchanged.

4.2 An experienced helmsman or adaptive autopilot will be required to maintain heading during each run. Minimum rudder angles are to be used while maintaining a steady heading. The helm corrections should be limited to five (5) degrees or less.

4.3 The following conditions should be met, in order to reduce the influence of corrections and obtain the best possible accuracy of the results of the performance measurements:

Table 4: Environmental conditions for in-service performance measurements

Parameter	Remarks
Sea state	Conditions as specified in ISO 15016: 2015
Wind speed	Conditions as specified in ISO 15016: 2015
Water depth	Conditions as specified in ISO 15016: 2015
Currents	Avoid areas with known high current values and variations. During the trials, the following condition should be met: $V_{GPS} - V_{STW} < 0.3 \text{ knots}$, or conditions as specified in ISO 15016: 2015
Trials period	Trials should be conducted in daylight
Duration	The run duration should be the same for all speed runs with a minimum of 10 minutes, see figure 1 below

4.4 If any of above conditions are no longer met during in-service performance measurements, it should be necessary to abandon the run.

4.5 Each set of the in-service performance measurements in the respective load condition should be executed as at least one set of double runs. It is important that the ship is running on the same track and when the monitoring begins, the conditions are in steady state conditions. Each speed run should be commenced and completed at the same place.

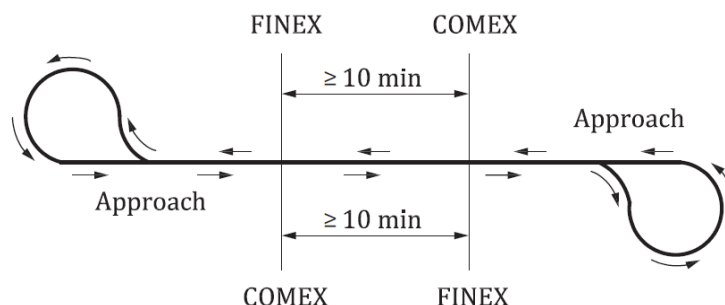


Figure 1: Sea trials with double runs

4.6 During the in-service performance measurements, accurate recordings of the required parameters are of great importance. Recording of parameters for each run should start when steady state ship conditions are met.

4.7 The following data should be collected at the beginning and end of each performance measurement run:

Main engine supply flowmeter reading	[ltr/h] or [kg/h]
Main engine supply flowmeter temperature	[deg]
Main engine return line flowmeter reading*	[ltr/h] or [kg/h]
Main engine return line flowmeter temperature*	[deg]

(*For ships fitted with flowmeter on return line)

4.8 The following data should be collected with a sampling rate of at least 1 Hz during the in-service performance measurement:

Table 5: Logged parameters during in-service performance measurements

Parameter	Unit
Date	dd-mm-yyyy
Time	hh:mm:ss
Revolution counter reading	[s ⁻¹]
Shaft power	[kW]
Heading	[deg]
Ship's speed (GPS and Speed Log)	[knots]
Distance ("0" should be at the beginning of each run)	[nm]
Relative wind speed	[m/s]
Relative wind direction (coming from)	[deg]
Current speed	[knots]
Relative current direction (going to)	[deg]
Observed wave height	[m]
Observed wave period	[s]
Observed wave direction (going to)	[deg]

4.9 Apart from power, rpm and consumption, average prevailing values for the following main engine parameters should be provided for each run for the following:

Scavenge air temperature	[deg]
Scavenge air pressure	[kg/cm ²]
Blower air inlet temperature	[deg]

4.10 These, as well as any other main engine data should be collected at local sensors' display and not their repeaters inside the ECR.

4.11 As far as practicable, the in-service performance measurement should be witnessed by the verifier. The verifier should be able to confirm that the in-service performance measurement was conducted in accordance with the agreed procedures.

5 After the in-service performance measurements

5.1 All information collected should be checked by the verifier and any errors/typos should be noted in supplementary documentation, including any corrected/replaced values clearly marked in the form. Data which is continually recorded should be provided "as is" and non-variable data should be noted at the beginning and the end of the in-service performance measurements in order to confirm that any changes are set to a minimum.

5.2 For each run the following should be submitted:

- .1 one filled-in soft copy of the "In-service performance monitoring reporting form" (appendix C);
- .2 printouts and/or soft copies from the performance monitoring system output;

- .3 printouts and/or soft copies from the loading computer calculations representing the loading condition at which the run took place; and
- .4 printouts and/or soft copies from the course recorder for the period covering the run.

5.3 Also, a copy of the fuel oil analysis for the fuel used during the in-service performance measurements should be submitted.

5.4 Any comments about the in-service performance measurements, including any large variations in environmental conditions, should be noted.

5.5 A summary of the required information to be submitted for verification can be found in appendix A, B, and C.

APPENDIX A

INFORMATION TO BE SUBMITTED PRIOR TO CONDUCTING THE IN-SERVICE
PERFORMANCE MEASUREMENTS

The following information should be submitted prior to conducting the performance measurements.

Document	Mandatory	Optional
Hydrostatics	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Shop tests of main engine	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sea trials (machinery and hull part)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Model tests	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Propeller characteristics and structural drawings	<input type="checkbox"/>	<input checked="" type="checkbox"/>
GA drawing	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Details of appendages and rudder	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Fuel oil piping diagram	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Ship's main particulars

IMO number:	
Date delivered:	
Ship's email address(s):	
Date ship was launched (when did ship enter the water):	
Ship's name:	
Owner:	
Managing company:	
Ship type:	
Ship capacity	
Yard:	
Length overall (m):	
Length between perpendiculars (m):	
Breadth moulded (m):	
Depth to upper deck (m):	
Design draft (m):	
Design displacement (mt):	
EEXI draft (m):	
Displacement at EEXI draft (mt)	
Lightship weight (mt)	

Design speed (knots):	
------------------------------	--

Dry-docking history (within the last five years):			
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Date	Yard	Coating specs	Hull treatment
		Please attach	Please attach

Hull cleaning and propeller polishing history since last dry-dock:			
---	--	--	--

Date	Place	Brief description of works	Propeller polishing standard*

*only for propeller polishing events

Main engine(s)

Maker:	
Type:	
Number:	
Type of fuel:	
MCR (kW):	
SMCR (kW) x RPM:	

Main engine modifications/upgrades		
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	Yes	No
Derating	<input type="checkbox"/>	<input type="checkbox"/>
T/C cut offs	<input type="checkbox"/>	<input type="checkbox"/>
Part load tuning	<input type="checkbox"/>	<input type="checkbox"/>
Low load tuning	<input type="checkbox"/>	<input type="checkbox"/>
Retrofit	<input type="checkbox"/>	<input type="checkbox"/>
(please provide details)		
Other modifications	<input type="checkbox"/>	<input type="checkbox"/>
(please provide details)		

Propeller(s) including modifications/upgrades		
Type: (FP or CPP)		
Diameter (m)		
Pitch (m)		
Number		
	Yes	No
Trimmed	<input type="checkbox"/>	<input type="checkbox"/>
Other (please state)	<input type="checkbox"/>	<input type="checkbox"/>

Propulsion improvement devices		
	Yes	No
Ducts	<input type="checkbox"/>	<input type="checkbox"/>
Fins	<input type="checkbox"/>	<input type="checkbox"/>
Other (please provide details)	<input type="checkbox"/>	<input type="checkbox"/>

Power measurements		
	Yes	No
By torsion meter	<input type="checkbox"/>	<input type="checkbox"/>
(Details of torsion meter including last calibration)		
By load indicator diagrams	<input type="checkbox"/>	<input type="checkbox"/>
Other method (please provide details)		

Performance monitoring systems		
	Yes	No
PMS	<input type="checkbox"/>	<input type="checkbox"/>
please provide details of type and maker		

Fuel measurements		
	Yes	No
By volume flowmeter	<input type="checkbox"/>	<input type="checkbox"/>
(Details of flowmeter including last calibration)		
By mass flowmeter	<input type="checkbox"/>	<input type="checkbox"/>
(Details of flowmeter including last calibration)		
Soundings	<input type="checkbox"/>	<input type="checkbox"/>

Other instruments & gauges used for data collection	
	Dates of Calibration
Speed log	
DGPS	
Anemometer Provide height of anemometer in metres:	
Other (please provide details)	

Additional information		
	Yes	No
Reduction gear (please provide details)	<input type="checkbox"/>	<input type="checkbox"/>
Shaft motor (please provide details)	<input type="checkbox"/>	<input type="checkbox"/>
Shaft generator (please provide details)	<input type="checkbox"/>	<input type="checkbox"/>

Person to be contacted for further info:	
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APPENDIX B

INFORMATION TO BE SUBMITTED FOR VERIFICATION AFTER THE IN-SERVICE
PERFORMANCE MEASUREMENTS

The following information needs to be submitted after conducting the in-service performance measurements.

Document	Mandatory	Optional
Calibration certificate of torquemeter	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Calibration certificate of flowmeters	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Calibration certificate of anemometer	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Calibration certificate of speed log	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Calibration certificate of GPS	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Calibration certificate of echosounder	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Calibration certificate of gyro compass	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Fuel oil analysis	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Furthermore, for each run, the following needs to be submitted:

Document	Mandatory	Optional
Sea trial reporting form	<input checked="" type="checkbox"/>	<input type="checkbox"/>
A printout of course recorder	<input checked="" type="checkbox"/>	<input type="checkbox"/>
A printout of ME load indicator (depicting the loading condition of the ship during the trials)	<input type="checkbox"/>	<input checked="" type="checkbox"/> *
A printout/soft copy of the anemometer output (if the anemometer is digital)	<input type="checkbox"/>	<input checked="" type="checkbox"/> *

* Optional, but highly recommended outputs

APPENDIX C

EXAMPLE OF THE IN-SERVICE PERFORMANCE MEASUREMENTS REPORTING FORM

The form below includes all in service measurements at one loading condition.

In-service Performance Monitoring reporting form																	
Vessel name _____										IMO # _____							
Air temperature [°C]		SW temp [°C]		SW density [ton/m ³]		Displacement [ton]		Water depth [m]									
Draught fore [m]		Draught aft [m]		Avenometer height [m]													
Fuel density [kg/m ³]		Fuel LCV [kJ/kg]															
Engine Room										Bridge							
Observation #	Run #	Obs. Start	Elapsed time	ME Supply Flowmeter Reading	ME Return Flowmeter Reading	ME Return Flowmeter Temperature	Revolution Counter Reading	Shaft Power	Heading	Speed	Distance	Relative Wind Speed	Relative Wind Direction	Current Speed	Observed Wave height	Observed Wave Period	Observed Wave Direction
		hh:mm	mm	ltr(l)	ltr(l)	°C	rounds	kW	*True	knots	nm	knots	coming from *Relative	going to knots	m	sec	going to *True
1			10														
2			10														
3			10														
4			10														
Average Value for power setting #1		Scavenging Air Temperature		°C		Scavenging Air Pressure		kg/cm ²		Blower Air Inlet temperature		°C					
Average Value for power setting #2		Scavenging Air Temperature		°C		Scavenging Air Pressure		kg/cm ²		Blower Air Inlet temperature		°C					
Average Value for power setting #3		Scavenging Air Temperature		°C		Scavenging Air Pressure		kg/cm ²		Blower Air Inlet temperature		°C					
Average Value for power setting #4		Scavenging Air Temperature		°C		Scavenging Air Pressure		kg/cm ²		Blower Air Inlet temperature		°C					