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MARITIME  
ORGANIZATION

**E**

MARINE ENVIRONMENT PROTECTION  
COMMITTEE  
84th session  
Agenda item 16

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**REPORT OF THE MARINE ENVIRONMENT PROTECTION COMMITTEE  
ON ITS EIGHTY-FOURTH SESSION**

Attached are annexes 1 to 11 to the report of the Marine Environment Protection Committee on its eighty-fourth session (MEPC 84/16).

(see documents MEPC 84/16/Add.2 for annexes 12 to 20 and MEPC 84/16/Add.3 for annexes 21 to 29)

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**ANNEX 1****OUTCOME OF THE ROLL-CALL VOTE ON THE ADOPTION OF  
RESOLUTION MEPC.406(84)**

| <b>No.</b> | <b>MEMBER STATE</b>                      | <b>YES</b> | <b>NO</b> | <b>ABSTAIN</b> | <b>NOT<br/>PRESENT</b> |
|------------|------------------------------------------|------------|-----------|----------------|------------------------|
| 1.         | ALGERIA                                  |            |           | X              |                        |
| 2.         | ANTIGUA AND BARBUDA                      |            |           |                | X                      |
| 3.         | ARGENTINA                                | X          |           |                |                        |
| 4.         | AUSTRALIA                                | X          |           |                |                        |
| 5.         | AUSTRIA                                  | X          |           |                |                        |
| 6.         | AZERBAIJAN                               |            |           |                | X                      |
| 7.         | BAHAMAS                                  |            |           | X              |                        |
| 8.         | BANGLADESH                               |            |           |                | X                      |
| 9.         | BARBADOS                                 |            |           | X              |                        |
| 10.        | BELGIUM                                  | X          |           |                |                        |
| 11.        | BELIZE                                   |            |           | X              |                        |
| 12.        | BRAZIL                                   |            |           | X              |                        |
| 13.        | BRUNEI DARUSSALAM                        |            |           | X              |                        |
| 14.        | CANADA                                   | X          |           |                |                        |
| 15.        | CHILE                                    | X          |           |                |                        |
| 16.        | CHINA                                    |            |           | X              |                        |
| 17.        | COLOMBIA                                 |            |           | X              |                        |
| 18.        | COOK ISLANDS                             | X          |           |                |                        |
| 19.        | COSTA RICA                               | X          |           |                |                        |
| 20.        | CÔTE D'IVOIRE                            |            |           | X              |                        |
| 21.        | CROATIA                                  | X          |           |                |                        |
| 22.        | CUBA                                     |            |           |                | X                      |
| 23.        | CYPRUS                                   | X          |           |                |                        |
| 24.        | CZECHIA                                  | X          |           |                |                        |
| 25.        | DEMOCRATIC PEOPLE'S REPUBLIC<br>OF KOREA |            | X         |                |                        |
| 26.        | DEMOCRATIC REPUBLIC OF THE<br>CONGO      |            |           |                | X                      |
| 27.        | DENMARK                                  | X          |           |                |                        |
| 28.        | DOMINICA                                 |            |           |                | X                      |
| 29.        | ECUADOR                                  | X          |           |                |                        |
| 30.        | EGYPT                                    | X          |           |                |                        |
| 31.        | ERITREA                                  |            |           |                | X                      |
| 32.        | ESTONIA                                  | X          |           |                |                        |
| 33.        | ETHIOPIA                                 |            |           |                | X                      |
| 34.        | FIJI                                     |            |           |                | X                      |
| 35.        | FINLAND                                  | X          |           |                |                        |
| 36.        | FRANCE                                   | X          |           |                |                        |
| 37.        | GABON                                    |            |           |                | X                      |
| 38.        | GEORGIA                                  |            |           |                | X                      |
| 39.        | GERMANY                                  | X          |           |                |                        |
| 40.        | GHANA                                    |            |           |                | X                      |
| 41.        | GREECE                                   | X          |           |                |                        |
| 42.        | GRENADA                                  |            |           |                | X                      |

| No. | MEMBER STATE                 | YES | NO | ABSTAIN | NOT PRESENT |
|-----|------------------------------|-----|----|---------|-------------|
| 43. | GUATEMALA                    | X   |    |         |             |
| 44. | GUINEA                       |     |    |         | X           |
| 45. | HAITI                        |     |    |         | X           |
| 46. | HUNGARY                      | X   |    |         |             |
| 47. | ICELAND                      |     |    |         | X           |
| 48. | INDIA                        |     |    | X       |             |
| 49. | INDONESIA                    |     |    | X       |             |
| 50. | IRAN (ISLAMIC REPUBLIC OF)   |     | X  |         |             |
| 51. | IRAQ                         |     |    | X       |             |
| 52. | IRELAND                      | X   |    |         |             |
| 53. | ISRAEL                       | X   |    |         |             |
| 54. | ITALY                        | X   |    |         |             |
| 55. | JAMAICA                      |     |    | X       |             |
| 56. | JAPAN                        | X   |    |         |             |
| 57. | JORDAN                       |     |    |         | X           |
| 58. | KAZAKHSTAN                   |     |    |         | X           |
| 59. | KENYA                        |     |    | X       |             |
| 60. | KIRIBATI                     |     |    |         | X           |
| 61. | KUWAIT                       | X   |    |         |             |
| 62. | LATVIA                       | X   |    |         |             |
| 63. | LEBANON                      |     |    |         | X           |
| 64. | LIBERIA                      |     |    | X       |             |
| 65. | LIBYA                        |     |    |         | X           |
| 66. | LITHUANIA                    | X   |    |         |             |
| 67. | LUXEMBOURG                   | X   |    |         |             |
| 68. | MADAGASCAR                   |     |    | X       |             |
| 69. | MALAWI                       |     |    | X       |             |
| 70. | MALAYSIA                     |     |    |         | X           |
| 71. | MALDIVES                     |     |    | X       |             |
| 72. | MALTA                        | X   |    |         |             |
| 73. | MARSHALL ISLANDS             | X   |    |         |             |
| 74. | MAURITIUS                    | X   |    |         |             |
| 75. | MEXICO                       |     |    | X       |             |
| 76. | MONACO                       | X   |    |         |             |
| 77. | MONGOLIA                     |     |    |         | X           |
| 78. | MONTENEGRO                   |     |    |         | X           |
| 79. | MOROCCO                      | X   |    |         |             |
| 80. | MOZAMBIQUE                   |     |    | X       |             |
| 81. | NAMIBIA                      |     |    | X       |             |
| 82. | NAURU                        |     |    |         | X           |
| 83. | NETHERLANDS (KINGDOM OF THE) | X   |    |         |             |
| 84. | NEW ZEALAND                  | X   |    |         |             |
| 85. | NIGERIA                      |     |    | X       |             |
| 86. | NORWAY                       | X   |    |         |             |
| 87. | OMAN                         |     |    | X       |             |
| 88. | PAKISTAN                     |     |    |         | X           |
| 89. | PALAU                        |     |    |         | X           |
| 90. | PANAMA                       | X   |    |         |             |
| 91. | PERU                         | X   |    |         |             |
| 92. | PHILIPPINES                  |     |    | X       |             |

| No.          | MEMBER STATE                                         | YES       | NO       | ABSTAIN   | NOT PRESENT |
|--------------|------------------------------------------------------|-----------|----------|-----------|-------------|
| 93.          | POLAND                                               | X         |          |           |             |
| 94.          | PORTUGAL                                             | X         |          |           |             |
| 95.          | QATAR                                                | X         |          |           |             |
| 96.          | REPUBLIC OF KOREA                                    | X         |          |           |             |
| 97.          | REPUBLIC OF MOLDOVA                                  | X         |          |           |             |
| 98.          | RUSSIAN FEDERATION                                   |           | X        |           |             |
| 99.          | SAINT KITTS AND NEVIS                                | X         |          |           |             |
| 100.         | SAINT LUCIA                                          |           |          |           | X           |
| 101.         | SAINT VINCENT AND THE GRENADINES                     |           |          |           | X           |
| 102.         | SAN MARINO                                           |           |          |           | X           |
| 103.         | SAUDI ARABIA                                         | X         |          |           |             |
| 104.         | SERBIA                                               | X         |          |           |             |
| 105.         | SIERRA LEONE                                         |           |          | X         |             |
| 106.         | SINGAPORE                                            | X         |          |           |             |
| 107.         | SLOVAKIA                                             | X         |          |           |             |
| 108.         | SLOVENIA                                             | X         |          |           |             |
| 109.         | SOLOMON ISLANDS                                      |           |          | X         |             |
| 110.         | SOMALIA                                              | X         |          |           |             |
| 111.         | SOUTH AFRICA                                         |           |          | X         |             |
| 112.         | SPAIN                                                | X         |          |           |             |
| 113.         | SRI LANKA                                            |           |          |           | X           |
| 114.         | SURINAME                                             |           |          | X         |             |
| 115.         | SWEDEN                                               | X         |          |           |             |
| 116.         | SWITZERLAND                                          | X         |          |           |             |
| 117.         | THAILAND                                             |           |          | X         |             |
| 118.         | TIMOR-LESTE                                          |           |          | X         |             |
| 119.         | TOGO                                                 |           |          |           | X           |
| 120.         | TONGA                                                |           |          |           | X           |
| 121.         | TUNISIA                                              |           |          |           | X           |
| 122.         | TÜRKİYE                                              |           |          |           | X           |
| 123.         | TUVALU                                               |           |          |           | X           |
| 124.         | UKRAINE                                              | X         |          |           |             |
| 125.         | UNITED ARAB EMIRATES                                 | X         |          |           |             |
| 126.         | UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND | X         |          |           |             |
| 127.         | UNITED REPUBLIC OF TANZANIA                          |           |          | X         |             |
| 128.         | UNITED STATES OF AMERICA                             | X         |          |           |             |
| 129.         | URUGUAY                                              | X         |          |           |             |
| 130.         | VANUATU                                              |           |          | X         |             |
| 131.         | VENEZUELA (BOLIVARIAN REPUBLIC OF)                   |           |          |           | X           |
| 132.         | YEMEN                                                |           |          |           | X           |
| <b>TOTAL</b> |                                                      | <b>59</b> | <b>3</b> | <b>32</b> | <b>38</b>   |

Only YES and NO votes are counted: 59 + 3 = 62

Simple majority = 32

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**ANNEX 2****RESOLUTION MEPC.406(84)  
(adopted on 1 May 2026)****ACTIONS TO ENSURE THE PROTECTION OF THE MARINE ENVIRONMENT IN THE  
ARABIAN SEA, SEA OF OMAN AND THE GULF REGION, PARTICULARLY IN AND  
AROUND THE STRAIT OF HORMUZ, RESULTING FROM THE UNLAWFUL ACTIVITIES  
OF THE ISLAMIC REPUBLIC OF IRAN**

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(b) of the Convention on the International Maritime Organization concerning the functions of the Committee,

RECALLING ALSO that the purpose of the International Maritime Organization (IMO) as set forth in article 1 of the IMO Convention and reflected in the Strategic Plan of IMO is to promote safe, secure, environmentally sound, efficient and sustainable shipping through cooperation,

RECALLING FURTHER that the International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes, and that the International Convention on Oil Pollution Preparedness, Response and Cooperation, 1990 (OPRC) provide an international framework for preparedness, response and cooperation in respect of oil and hazardous and noxious substance pollution incidents,

NOTING that the Council, at its thirty-sixth extraordinary session, concerning the impact on shipping and seafarers of the situation in the Arabian Sea, Sea of Oman and the Gulf Region, particularly in and around the Strait of Hormuz:

- .1 reaffirmed its commitment to the principles enshrined in the Charter of the United Nations and all relevant international conventions and agreements related to maritime safety, security and environmental protection;
- .2 recalled the purposes of the International Maritime Organization (IMO) as set forth in article 1 of the IMO Convention, and the mission in the Strategic Plan of IMO to promote safe, secure and environmentally sound, efficient and sustainable shipping through cooperation;
- .3 underscored the paramount importance of preserving the security of international shipping and the maritime community, as well as the energy and humanitarian supply chains; and also emphasized the need to preserve the marine environment and marine biodiversity;
- .4 strongly condemned the threats and attacks against vessels and purported closure of the Strait of Hormuz by the Islamic Republic of Iran, adversely affecting merchant and commercial vessels and threatening the safety and welfare of seafarers, which is contrary to the purposes of IMO as set forth in article 1 of the Convention, and represents a grave danger to life and serious risk to the safety of navigation and the marine environment;
- .5 demanded that the Islamic Republic of Iran immediately refrain, in accordance with international law, from any actions or threats aimed at

closing, obstructing or otherwise interfering with international navigation through the Strait of Hormuz or against merchant or commercial vessels in and around the Strait of Hormuz, to ensure the safety and welfare of seafarers and the security of international shipping and the marine environment, and to respect its obligations under international law;

DEEPLY CONCERNED by the impact of the Islamic Republic of Iran's egregious attacks on commercial vessels, maritime infrastructure coastal civilian infrastructure, and the risks they pose to the marine environment of the Gulf region,

- .1 STRONGLY CONDEMNS the egregious attacks by the Islamic Republic of Iran against the territories, including territorial waters, of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, the United Arab Emirates and Jordan, and against merchant and commercial vessels, which constitutes a breach of international law;
- .2 REAFFIRMS in this regard its strong commitment to ensure the sustainable use of oceans and seas, and the protection of marine and coastal ecosystems;
- .3 STRESSES the critical importance, during situations of armed conflict, of compliance with relevant obligations under international humanitarian law and of protecting the marine environment from pollution by oil, hazardous and noxious substances and other harmful substances;
- .4 RECOGNIZES that the Gulf and adjacent waters constitute an environmentally vulnerable marine area in functional terms, owing to their shallow depths, semi-enclosed character, restricted water exchange, ecological sensitivity and the potentially transboundary consequences of major pollution incidents;
- .5 EXPRESSES DEEP CONCERN that attacks by the Islamic Republic of Iran directed at peaceful tankers and other commercial and merchant vessels, maritime and other coastal infrastructure may give rise to large-scale marine pollution involving oil, hazardous and noxious substances, contaminated fire-fighting water, soot deposition, atmospheric deposition into coastal and marine waters of particulate matter, nitrogen oxides, sulphur compounds, trace metals and hazardous residues arising from missiles, drones, fires and explosions, sediment contamination and debris pollution, as well as to acoustic and physical disruption of marine species, which greatly threatens offshore ecosystems in a part of the world with significant marine biodiversity, with potential long-term and cumulative adverse impacts on marine ecosystems and coastal livelihoods, and carries severe water-security implications of contamination in a desalination-dependent region;
- .6 DEMANDS that the Islamic Republic of Iran immediately cease attacks or threats against commercial and merchant vessels, critical port infrastructure and coastal civilian infrastructure, that threaten to pollute the marine environment from oil, chemicals, sea mines and any other harmful substances;

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- .7 ENCOURAGES Member States and relevant regional and international organizations to strengthen pollution preparedness and response cooperation, including under MARPOL and the OPRC, and to review contingency arrangements for major oil or hazardous and noxious substance incidents affecting the Arabian Sea, Sea of Oman and the Gulf region;
  - .8 INVITES Member States concerned and observer organizations to provide relevant information to the Committee on incidents affecting the marine environment, ship operations, navigational safety, seafarer welfare, and preparedness and response needs, in order to support further consideration by IMO bodies;
  - .9 UNDERSCORES that preventing pollution in the Arabian Sea, Sea of Oman and the Gulf region is essential not only for the protection of the marine environment and marine biodiversity, but also for safeguarding seafarers, fisheries, coastal livelihoods and the resilience of regional and global supply chains;
  - .10 INVITES the Council, in light of the gravity and continuing nature of the situation and its implications for the implementation of the Organization's instruments, to consider placing this matter and any recommendations of IMO bodies before the Assembly for such further action as it may deem appropriate;
  - .11 INVITES the Secretary-General to monitor the negative impact on the marine environment, caused by the Islamic Republic of Iran's actions and threats in the Arabian Sea, Sea of Oman and the Gulf Region, particularly in and around the Strait of Hormuz that fell under IMO's remit, and report to C 137;
  - .12 RESOLVES to keep this matter under review and invites Member States concerned to provide relevant reports to the Committee.

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**ANNEX 3****RESOLUTION MEPC.407(84)  
(adopted on 1 May 2026)****AMENDMENTS TO THE ANNEX OF THE PROTOCOL OF 1997 TO AMEND  
THE INTERNATIONAL CONVENTION FOR THE PREVENTION OF POLLUTION FROM  
SHIPS, 1973, AS MODIFIED BY THE PROTOCOL OF 1978 RELATING THERETO****Amendments to MARPOL Annex VI**

**(Clarification of entries in data reporting required by regulations 27 and 28,  
designation of the North-East Atlantic as an Emission Control Area for  
Nitrogen Oxides, Sulphur Oxides and Particulate Matter, accessibility to  
the IMO Ship Fuel Oil Consumption Database, and review clause of  
the short-term GHG reduction measure)**

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 Protocols of 1978 and 1997 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 eighty-fourth session, proposed amendments to MARPOL Annex VI concerning the clarification of entries in data reporting required by regulations 27 and 28, the designation of the North-East Atlantic as an Emission Control Area for Sulphur Oxides, Particulate Matter and Nitrogen Oxides, the accessibility of the IMO Ship Fuel Oil Consumption Database (IMO DCS), and the review clause of the short-term GHG reduction measure, which were circulated in accordance with article 16(2)(a) of MARPOL,

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

2 DETERMINES, in accordance with article 16(2)(f)(ii) and (iii) of MARPOL, that the amendments shall be deemed to have been accepted on 1 March 2027 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% 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 September 2027 upon their acceptance in accordance with paragraph 2 above;

4 REQUESTS the Secretary-General, for the purpose 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 VI

(Clarification of entries in data reporting required by regulations 27 and 28, designation of the North-East Atlantic as an Emission Control Area for Nitrogen Oxides, Sulphur Oxides and Particulate Matter, accessibility to the IMO Ship Fuel Oil Consumption Database, and review clause of the short-term GHG reduction measure)

## ANNEX VI

### REGULATIONS FOR THE PREVENTION OF AIR POLLUTION FROM SHIPS

#### Regulation 13

*Nitrogen oxides (NO<sub>x</sub>)*

#### Tier III

1 At the end of paragraph 5.1.3.1, "." is replaced with ";" and a new sub-paragraph .2 is added to paragraph 5.1.3, as follows:

"2 that ship is constructed on or after 1 January 2027 and is operating in the North-East Atlantic Emission Control Area. For the North-East Atlantic Emission Control Area, "ship constructed on or after 1 January 2027" means a ship:

- .1 for which the building contract is placed on or after 1 January 2027; 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 2027; or
- .3 the delivery of which is on or after 1 January 2031."

#### Emission control area

2 At the end of sub-paragraph .5 of paragraph 6, the word "and" is deleted, and at the end of sub-paragraph .6 of paragraph 6, "." is replaced with "; and".

3 New sub-paragraph .7 is added to paragraph 6, as follows:

".7 the North-East Atlantic Emission Control Area, which means the area described by the coordinates provided in appendix VII to this Annex."

#### **Regulation 14**

*Sulphur oxides (SO<sub>x</sub>) and particulate matter*

4 At the end of sub-paragraph .6 of paragraph 3, the word "and" is deleted, and at the end of sub-paragraph .7 of paragraph 3, "." is replaced with "; and".

5 New sub-paragraph .8 is added to paragraph 3, as follows:

"8 the North-East Atlantic Emission Control Area, which means the area described by the coordinates provided in appendix VII to this Annex."

#### **Regulation 20**

*Goal*

6 The paragraph is replaced by the following:

"The goal of this chapter is to reduce the carbon intensity of international shipping, working towards the levels of ambition set out in the 2023 IMO Strategy on Reduction of GHG Emissions from Ships."

#### **Regulation 25**

*Required EEXI*

7 Paragraph 3 is replaced by the following:

"3 This regulation shall be kept under review in light of its implementation, taking into account the 2023 IMO Strategy on Reduction of GHG Emissions from Ships."

#### **Regulation 27**

*Collection and reporting of ship fuel oil consumption data*

8 Paragraphs 11 to 15 are replaced by the following new paragraphs 11 to 17:

"11 The Secretary-General of the Organization shall grant the Administration of a ship or any organization duly authorized by it access to all the reported data for all the preceding calendar years in the IMO Ship Fuel Oil Consumption Database for that ship.

12 Parties shall have access to a non-anonymized database containing data for all ships to which this regulation applies strictly for their analysis and consideration.

13 Notwithstanding paragraph 12 of this regulation, the Administration of a Party to the present Convention may notify the Secretary-General of the Organization that its express approval will be necessary before the data of ships entitled to fly its flag are included in the non-anonymized database.

14 The Secretary-General of the Organization shall maintain an anonymized database such that identification of a specific ship will not be possible, and facilitate access to public user accounts.

15 The IMO Ship Fuel Oil Consumption Database shall be undertaken and managed by the Secretary-General of the Organization, pursuant to guidelines developed by the Organization.

16 On an ad hoc basis, the Secretary-General of the Organization may share data with analytical consultancies and research entities, under strict confidentiality rules.

17 The Secretary-General of the Organization, on the request of a company, shall grant access to the fuel oil consumption reports of the company's owned ship(s) in a non-anonymized form to the general public."

## **Regulation 28**

### *Operational carbon intensity*

## **Review**

9 Paragraph 11 is replaced by the following:

"11 This regulation shall be kept under review in light of its implementation, taking into account the 2023 IMO Strategy on Reduction of GHG Emissions from Ships."

## **Appendix VII**

### *Emission control areas (regulations 13.6 and 14.3)*

10 New paragraphs 6 and 7 are inserted, as follows:

"6 The North-East Atlantic Emission Control Area includes the exclusive economic zones and territorial seas, extending up to 200 nautical miles from the baselines of Greenland, Iceland, the Faroes, Ireland, the mainlands of the United Kingdom, France, Spain and Portugal, as set out in paragraph 7 below. This designation excludes the seas bounded by the North Sea area, as defined in regulation 1.14.6 of Annex V of the present Convention.

7 The geographic outer boundaries of the North-East Atlantic Emission Control Area are delineated by a series of geodesic lines connecting specified coordinates of latitude and longitude. These coordinates are referenced to the World Geodetic System 1984 (WGS 1984) datum as outlined below:

- .1 the northernmost outer boundary of the North-East Atlantic Emission Control Area begins at the coordinate 86°19'.18 N, 60°10'.17 W, as outlined in regulation 14.3 and appendix VII of MARPOL Annex VI. From this point, the boundary extends eastward, following the outer boundaries of the exclusive economic zones of Iceland, the Faroes, and the eastern part of the mainland of the United Kingdom, until reaching the coordinate 62°00'.00 N, 01°22'.25 E, where it intersects with the northern boundary of the North Sea area. The boundary of this section is defined by connecting the following coordinates in sequential order:

| Point | Latitude    | Longitude   |
|-------|-------------|-------------|
| 1     | 86°19'.18 N | 60°10'.17 W |
| 2     | 86°57'.80 N | 37°45'.68 W |
| 3     | 86°39'.87 N | 12°26'.95 W |
| 4     | 85°37'.64 N | 01°00'.60 E |
| 5     | 83°42'.56 N | 07°58'.17 E |
| 6     | 82°20'.92 N | 05°51'.60 E |
| 7     | 79°52'.93 N | 01°38'.37 W |
| 8     | 78°19'.00 N | 03°20'.63 W |
| 9     | 76°59'.35 N | 02°49'.70 W |
| 10    | 76°03'.97 N | 04°27'.87 W |
| 11    | 75°18'.13 N | 04°17'.90 W |
| 12    | 74°30'.64 N | 04°50'.57 W |
| 13    | 72°49'.62 N | 11°28'.77 W |
| 14    | 71°52'.99 N | 12°46'.03 W |
| 15    | 69°54'.98 N | 13°37'.77 W |

| Point | Latitude    | Longitude   |
|-------|-------------|-------------|
| 16    | 69°35'.00 N | 13°16'.00 W |
| 17    | 69°34'.77 N | 12°24'.42 W |
| 18    | 69°09'.46 N | 09°42'.43 W |
| 19    | 68°20'.93 N | 07°34'.34 W |
| 20    | 67°30'.09 N | 06°32'.60 W |
| 21    | 66°24'.66 N | 05°45'.14 W |
| 22    | 65°41'.60 N | 05°34'.40 W |
| 23    | 65°15'.62 N | 02°38'.26 W |
| 24    | 64°26'.05 N | 00°29'.18 W |
| 25    | 63°53'.22 N | 00°29'.44 W |
| 26    | 62°53'.47 N | 00°38'.36 E |
| 27    | 62°00'.00 N | 01°22'.25 E |

- .2 continuing from the coordinate 62°00'.00 N, 01°22'.25 E, the boundary proceeds along the northwestern outer limits of the North Sea area, as defined in regulation 1.14.6 of Annex V of the present Convention. The boundary excludes the area south of latitude 62°00'.00 N and east of longitude 04°00'.00 W, connecting the following coordinates:

| Point | Latitude    | Longitude   |
|-------|-------------|-------------|
| 27    | 62°00'.00 N | 01°22'.25 E |
| 28    | 62°00'.00 N | 04°00'.00 W |
| 29    | 58°33'.94 N | 04°00'.00 W |

- .3 continuing southward, the boundary follows the southwestern outer limits of the North Sea area, as defined in regulation 1.14.6 of Annex V of the present Convention, excluding the English Channel and its approaches eastward of longitude 05°00'.00 W and northward of latitude 48°30'.00 N, until the boundary reaches its southernmost coordinate at 48°30'.00 N, 05°00'.00 W.

| Point | Latitude    | Longitude   |
|-------|-------------|-------------|
| 30    | 48°30'.00 N | 05°00'.00 W |

- .4 the following section of the North-East Atlantic Emission Control Area extends southward from the coordinate 48°30'.00 N, 05°00'.00 W, until it reaches the intersection of two boundaries: the line joining Cape Trafalgar, Spain (36°11'.00 N, 06°02'.00 W), and Cape Spartel, Morocco (35°48'.00 N, 05°55'.00 W), as outlined in regulation 14.3 and this appendix; and the eastern outer limit of Spain's mainland exclusive economic zone at the coordinate 35°57'.59 N, 05°58'.27 W. This section of the North-East Atlantic

Emission Control Area encompasses the waters within the exclusive economic zones and territorial seas of the mainland territories of France, Portugal, and Spain. The area is bounded to the east by the coasts of these countries and to the west by the outer limits of their respective exclusive economic zones. The coordinates defining the outer limits, extending from the southernmost points northward, are as follows:

| Point | Latitude    | Longitude   |
|-------|-------------|-------------|
| 31    | 35°57'.59 N | 05°58'.27 W |
| 32    | 35°57'.88 N | 06°02'.14 W |
| 33    | 35°57'.94 N | 06°03'.00 W |
| 34    | 35°57'.98 N | 06°03'.48 W |
| 35    | 35°58'.09 N | 06°04'.90 W |
| 36    | 35°55'.91 N | 06°16'.72 W |
| 37    | 35°54'.85 N | 06°22'.58 W |
| 38    | 35°54'.63 N | 06°23'.83 W |
| 39    | 35°53'.50 N | 06°30'.25 W |
| 40    | 35°53'.34 N | 06°31'.23 W |
| 41    | 35°52'.13 N | 06°38'.74 W |
| 42    | 35°51'.94 N | 06°39'.54 W |
| 43    | 35°49'.70 N | 06°48'.66 W |
| 44    | 35°49'.60 N | 06°49'.22 W |
| 45    | 35°49'.18 N | 06°51'.55 W |
| 46    | 35°48'.61 N | 06°59'.14 W |
| 47    | 35°48'.51 N | 06°59'.81 W |
| 48    | 35°47'.62 N | 07°06'.03 W |
| 49    | 35°46'.01 N | 07°31'.75 W |
| 50    | 35°46'.00 N | 07°32'.00 W |
| 51    | 35°26'.00 N | 08°05'.00 W |
| 52    | 35°19'.00 N | 08°21'.00 W |
| 53    | 35°11'.00 N | 08°53'.00 W |
| 54    | 35°07'.00 N | 09°13'.00 W |
| 55    | 35°01'.00 N | 10°30'.00 W |
| 56    | 34°55'.00 N | 11°40'.00 W |
| 57    | 34°57'.00 N | 12°17'.00 W |
| 58    | 37°00'.00 N | 13°09'.00 W |
| 59    | 38°10'.00 N | 13°42'.00 W |
| 60    | 38°43'.00 N | 13°46'.00 W |
| 61    | 41°09'.00 N | 13°16'.00 W |
| 62    | 41°23'.77 N | 13°18'.00 W |
| 63    | 41°24'.03 N | 13°17'.61 W |
| 64    | 41°24'.04 N | 13°17'.61 W |

| Point | Latitude    | Longitude   |
|-------|-------------|-------------|
| 65    | 41°28'.00 N | 13°18'.00 W |
| 66    | 41°29'.12 N | 13°19'.54 W |
| 67    | 41°30'.12 N | 13°20'.50 W |
| 68    | 41°30'.99 N | 13°21'.34 W |
| 69    | 41°35'.55 N | 13°25'.32 W |
| 70    | 41°44'.00 N | 13°30'.10 W |
| 71    | 41°54'.17 N | 13°35'.21 W |
| 72    | 42°04'.57 N | 13°39'.38 W |
| 73    | 42°15'.70 N | 13°43'.28 W |
| 74    | 42°24'.69 N | 13°45'.77 W |
| 75    | 42°31'.79 N | 13°47'.34 W |
| 76    | 42°39'.44 N | 13°48'.60 W |
| 77    | 42°52'.53 N | 13°50'.12 W |
| 78    | 43°00'.67 N | 13°50'.66 W |
| 79    | 43°09'.85 N | 13°50'.86 W |
| 80    | 43°18'.03 N | 13°50'.54 W |
| 81    | 43°27'.44 N | 13°49'.62 W |
| 82    | 43°41'.45 N | 13°47'.12 W |
| 83    | 43°57'.73 N | 13°42'.42 W |
| 84    | 44°10'.36 N | 13°37'.36 W |
| 85    | 44°20'.93 N | 13°32'.09 W |
| 86    | 44°25'.70 N | 13°29'.41 W |
| 87    | 44°33'.99 N | 13°24'.15 W |
| 88    | 44°43'.13 N | 13°17'.74 W |
| 89    | 44°55'.81 N | 13°08'.03 W |
| 90    | 45°01'.23 N | 13°03'.33 W |
| 91    | 45°01'.37 N | 13°03'.21 W |
| 92    | 45°07'.52 N | 12°57'.42 W |
| 93    | 45°14'.79 N | 12°49'.94 W |
| 94    | 45°22'.20 N | 12°41'.48 W |
| 95    | 45°29'.33 N | 12°32'.60 W |
| 96    | 45°35'.60 N | 12°23'.73 W |
| 97    | 45°43'.59 N | 12°11'.30 W |
| 98    | 45°50'.60 N | 11°59'.37 W |

| Point | Latitude    | Longitude   |
|-------|-------------|-------------|
| 99    | 46°02'.77 N | 11°37'.11 W |
| 100   | 46°08'.97 N | 11°24'.71 W |
| 101   | 46°15'.55 N | 11°09'.69 W |
| 102   | 46°21'.12 N | 10°55'.44 W |
| 103   | 46°25'.27 N | 10°47'.40 W |
| 104   | 46°29'.31 N | 10°39'.08 W |

| Point | Latitude    | Longitude   |
|-------|-------------|-------------|
| 105   | 46°32'.75 N | 10°31'.66 W |
| 106   | 46°37'.94 N | 10°19'.19 W |
| 107   | 46°42'.62 N | 10°06'.98 W |
| 108   | 46°45'.83 N | 09°58'.26 W |
| 109   | 46°48'.86 N | 09°48'.96 W |
| 110   | 46°52'.16 N | 09°37'.92 W |
| 111   | 46°52'.73 N | 09°35'.99 W |

- .5 continuing from the coordinate 46°52'.73 N, 09°35'.99 W, the boundary proceeds in a northern direction, following the western outer limits of the exclusive economic zones of the mainlands of the United Kingdom, Ireland, Iceland, the Faroes, and Greenland, until it reaches the southernmost intersection of the exclusive economic zone of Greenland and the Canadian Arctic Emission Control Area, at the coordinate 61°24'.74 N, 57°16'.16 W, as detailed in regulation 14.3 and this appendix. The coordinates for this section are as follows:

| Point | Latitude    | Longitude   |
|-------|-------------|-------------|
| 112   | 48°10'.49 N | 10°48'.56 W |
| 113   | 48°10'.81 N | 10°48'.56 W |
| 114   | 48°36'.38 N | 12°36'.48 W |
| 115   | 49°12'.41 N | 13°56'.75 W |
| 116   | 49°41'.42 N | 14°39'.12 W |
| 117   | 50°07'.69 N | 15°08'.26 W |
| 118   | 50°34'.07 N | 15°29'.32 W |
| 119   | 51°17'.55 N | 15°54'.73 W |
| 120   | 51°43'.99 N | 16°02'.88 W |
| 121   | 52°11'.47 N | 16°05'.45 W |
| 122   | 52°41'.54 N | 16°01'.85 W |
| 123   | 53°10'.97 N | 15°50'.66 W |
| 124   | 54°05'.16 N | 16°00'.59 W |
| 125   | 54°45'.40 N | 15°55'.82 W |
| 126   | 55°13'.09 N | 15°43'.87 W |
| 127   | 55°38'.99 N | 15°25'.22 W |
| 128   | 56°12'.21 N | 14°50'.96 W |
| 129   | 56°34'.63 N | 14°19'.86 W |
| 130   | 56°57'.19 N | 14°36'.16 W |
| 131   | 57°25'.36 N | 14°48'.11 W |
| 132   | 57°46'.48 N | 14°52'.42 W |

| Point | Latitude    | Longitude   |
|-------|-------------|-------------|
| 133   | 58°10'.58 N | 14°52'.18 W |
| 134   | 58°37'.54 N | 14°47'.13 W |
| 135   | 59°08'.50 N | 14°29'.17 W |
| 136   | 59°36'.59 N | 14°03'.25 W |
| 137   | 59°55'.59 N | 13°37'.56 W |
| 138   | 60°09'.13 N | 13°16'.39 W |
| 139   | 60°42'.23 N | 14°00'.03 W |
| 140   | 60°09'.28 N | 17°03'.21 W |
| 141   | 59°58'.44 N | 20°22'.34 W |
| 142   | 60°03'.00 N | 22°08'.29 W |
| 143   | 60°31'.10 N | 25°30'.33 W |
| 144   | 60°55'.19 N | 27°17'.15 W |
| 145   | 61°31'.52 N | 28°48'.06 W |
| 146   | 62°14'.11 N | 29°52'.18 W |
| 147   | 63°18'.12 N | 30°52'.05 W |
| 148   | 62°30'.13 N | 33°39'.15 W |
| 149   | 61°24'.86 N | 35°02'.45 W |
| 150   | 58°10'.71 N | 37°39'.21 W |
| 151   | 57°12'.46 N | 39°29'.13 W |
| 152   | 56°31'.75 N | 42°11'.97 W |
| 153   | 56°23'.72 N | 44°27'.68 W |

| Point | Latitude    | Longitude   |
|-------|-------------|-------------|
| 154   | 56°42'.83 N | 47°08'.20 W |
| 155   | 57°52'.48 N | 51°48'.36 W |

| Point | Latitude    | Longitude   |
|-------|-------------|-------------|
| 156   | 58°41'.66 N | 53°40'.40 W |
| 157   | 61°24'.74 N | 57°16'.16 W |

- .6 continuing along the outer boundary of the Canadian Arctic Emission Control Area until ending at the south coast of Hans Island (Tartupaluk) at 80°49'.29 N, 66°27'.04 W. The coordinates for this section refer sequentially from Point No.174 through Point No.51 in the table in paragraph 5.2 of appendix VII of MARPOL Annex VI.
- .7 continuing from the north coast of Hans Island (Tartupaluk) at 80°49'.91 N, 66°27'.40 W along the outer boundary of the Canadian Arctic Emission Control Area, until reaching the northernmost outer boundary of the North East Atlantic Emission Control Area at the coordinates 86°19'.18 N, 60°10'.17 W. The coordinates for this section refer sequentially from Point No.50 through Point No.23 in the table in paragraph 5.1 of appendix VII of MARPOL Annex VI.

## Appendix IX

*Information to be submitted to the IMO Ship Fuel Oil Consumption Database (regulation 27)*

- 11 The section "Identity of the ship" is replaced by the following:

### "Identity of the ship"

IMO number .....

Period of calendar year for which the data is submitted.....

For the purpose of regulation 27:

Start date (dd/mm/yyyy) .....

End date (dd/mm/yyyy).....

For the purpose of regulation 28:

Start date (dd/mm/yyyy) .....

End date (dd/mm/yyyy)....."

- 12 In the section on "Fuel oil consumption data", the term "Oil-fired Boiler(s)" is replaced by "Fired Boiler(s)".

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**ANNEX 4**

**RESOLUTION MEPC.408(84)  
(adopted on 1 May 2026)**

**AMENDMENTS TO THE ANNEX OF THE PROTOCOL OF 1997 TO AMEND THE  
INTERNATIONAL CONVENTION FOR THE PREVENTION OF POLLUTION FROM SHIPS,  
1973, AS MODIFIED BY THE PROTOCOL OF 1978 RELATING THERETO**

**Amendments to MARPOL Annex VI**

**(Use of multiple engine operational profiles for a marine diesel engine,  
including clarifying engine test cycles)**

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 Protocols of 1978 and 1997 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,

RECALLING FURTHER the adoption of amendments to the Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines (NO<sub>x</sub> Technical Code 2008), by means of resolution MEPC.397(83), on the use of multiple engine operational profiles for a marine diesel engine, including clarifying engine test cycles,

HAVING CONSIDERED, at its eighty-fourth session, proposed amendments to MARPOL Annex VI concerning the use of multiple engine operational profiles for a marine diesel engine, including clarifying engine test cycles, which were circulated in accordance with article 16(2)(a) of MARPOL,

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

2 DETERMINES, in accordance with article 16(2)(f)(ii) and (iii) of MARPOL, that the amendments shall be deemed to have been accepted on 1 March 2027 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% 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 September 2027 upon their acceptance in accordance with paragraph 2 above;

4 ALSO INVITES the Parties to note that the said amendments shall enter into effect on the dates specified in operative paragraph 4 of resolution MEPC.397(83);

5 REQUESTS the Secretary-General, for the purpose 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;

6        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 VI

(Use of multiple engine operational profiles for a marine diesel engine,  
including clarifying engine test cycles)

ANNEX VI

REGULATIONS FOR THE PREVENTION OF AIR POLLUTION FROM SHIPS

**Regulation 2**

*Definitions*

- 1 Paragraph 1.19 is replaced by the following:

"1.19 *Irrational emission control strategy* means any strategy or measure that, when a marine diesel engine is operated under normal conditions of use, reduces the effectiveness of an emission control system to a level below that expected from the applicable emission test procedures".

**Appendix I**

*Form of International Air Pollution Prevention (IAPP) Certificate (regulation 8)*

*Supplement to the International Air Pollution Prevention Certificate (IAPP Certificate)*

- 2 New rows are to be added to the table in section 2.2.1, as follows:

**.1 For Tier I (below 13.7.1.2) enter new row:**

"

|    |        |                                              |                          |                          |                          |                          |                          |
|----|--------|----------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 9f | Tier I | NTC 8 (Multiple Engine Operational Profiles) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|----|--------|----------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|

"

**.2 For Tier II (below 13.7.1.2) enter new row:**

"

|     |         |                                              |                          |                          |                          |                          |                          |
|-----|---------|----------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 10g | Tier II | NTC 8 (Multiple Engine Operational Profiles) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|-----|---------|----------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|

"

**.3 For Tier III (below 13.7.1.2) enter new row:**

"

|     |          |                                              |                          |                          |                          |                          |                          |
|-----|----------|----------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 11e | Tier III | NTC 8 (Multiple Engine Operational Profiles) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|-----|----------|----------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|

"

## Appendix II

### *Test cycles and weighting factors (regulation 13)*

3 The full text of appendix II is replaced by the following:

"The following test cycles and weighting factors shall be applied for verification of compliance of marine diesel engines with the applicable NO<sub>x</sub> limit in accordance with regulation 13 of MARPOL Annex VI using the test procedure and calculation method as specified in the NO<sub>x</sub> Technical Code.

- .1 For a fixed pitch propeller propulsion engine or a propeller-law operated non-propulsion engine, test cycle E3 shall be applied in accordance with table 1.
- .2 For a propulsion engine that does not operate with a fixed pitch propeller, including an engine fitted as part of a diesel-electric installation or an engine operated with a controllable-pitch propeller, test cycle E2 shall be applied in accordance with table 2.
- .3 For a non-propulsion engine that is a constant-speed engine, test cycle D2 shall be applied in accordance with table 3.
- .4 For a non-propulsion engine that operates as a variable-speed engine, not included above, test cycle C1 shall be applied in accordance with table 4.

**Table 1 – Test cycle for a marine diesel engine as given by .1 above**

|               |                  |      |     |      |      |
|---------------|------------------|------|-----|------|------|
| Test cycle E3 | Speed            | 100% | 91% | 80%  | 63%  |
|               | Power            | 100% | 75% | 50%  | 25%  |
|               | Weighting factor | 0.2  | 0.5 | 0.15 | 0.15 |

**Table 2 – Test cycle for a marine diesel engine as given by .2 above**

|               |                  |      |      |      |      |
|---------------|------------------|------|------|------|------|
| Test cycle E2 | Speed            | 100% | 100% | 100% | 100% |
|               | Power            | 100% | 75%  | 50%  | 25%  |
|               | Weighting factor | 0.2  | 0.5  | 0.15 | 0.15 |

**Table 3 – Test cycle for a marine diesel engine as given by .3 above**

|               |                  |      |      |      |      |      |
|---------------|------------------|------|------|------|------|------|
| Test cycle D2 | Speed            | 100% | 100% | 100% | 100% | 100% |
|               | Power            | 100% | 75%  | 50%  | 25%  | 10%  |
|               | Weighting factor | 0.05 | 0.25 | 0.3  | 0.3  | 0.1  |

**Table 4 – Test cycle for a marine diesel engine as given by .4 above**

|               |                  |       |      |      |     |              |     |     |      |
|---------------|------------------|-------|------|------|-----|--------------|-----|-----|------|
| Test cycle C1 | Speed            | Rated |      |      |     | Intermediate |     |     | Idle |
|               | Torque           | 100%  | 75%  | 50%  | 10% | 100%         | 75% | 50% | 0%   |
|               | Weighting factor | 0.15  | 0.15 | 0.15 | 0.1 | 0.1          | 0.1 | 0.1 | 0.15 |

In the case of a marine diesel engine to be certified in accordance with paragraph 5.1.1 of regulation 13, the specific emission at each individual mode point shall not exceed the applicable NO<sub>x</sub> emission limit value by more than 50% except as follows:

- .1 The 10% mode point in the D2 test cycle.
- .2 The 10% mode point in the C1 test cycle.
- .3 The idle mode point in the C1 test cycle".

\*\*\*



**ANNEX 5****DRAFT AMENDMENTS TO THE BALLAST WATER MANAGEMENT  
CONVENTION (CONSOLIDATED DRAFT REVISED ANNEX TO THE CONVENTION)****(Revised Annex to the BWM Convention)****REGULATIONS FOR THE CONTROL AND MANAGEMENT OF SHIPS' BALLAST WATER  
AND SEDIMENTS****SECTION A – GENERAL PROVISIONS****Regulation A-1***Definitions*

For the purposes of this annex:

- 1 "Anniversary date" means the day and the month of each year corresponding to the date of expiry of the Certificate.
- 2 "Ballast water capacity" means the total volumetric capacity of any tanks, spaces or compartments on a ship used for carrying, loading or discharging ballast water, including any multi-use tank, space or compartment designed to allow carriage of ballast water.
- 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 operation of the ship from the owner of the ship and who, on assuming such responsibility, has agreed to take over all the duties and responsibilities imposed by the International Safety Management Code.\*
- 4 "Constructed" in respect of a ship means a stage of construction where:
  - .1 the keel is laid; or
  - .2 construction identifiable with the specific ship begins; or
  - .3 assembly of the ship has commenced comprising at least 50 tonnes or 1 per cent of the estimated mass of all structural material, whichever is less; or
  - .4 the ship undergoes a major conversion.
- 5 "Major conversion" means a conversion of a ship:
  - .1 which changes its ballast water carrying capacity by 15 per cent or greater, or
  - .2 which changes the ship type, or
  - .3 which, in the opinion of the Administration, is projected to prolong its life by 10 years or more, or

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\* Refer to the ISM Code adopted by the Organization by resolution A.741(18), as amended.

- .4 which results in modifications to its ballast water system other than component replacement-in-kind. Conversion of a ship to meet the provisions of regulation D-1 shall not be deemed to constitute a major conversion for the purpose of this annex.

6 "From the nearest land" means from the baseline from which the territorial sea of the territory in question is established in accordance with international law except that, for the purposes of the Convention, "from the nearest land" off the north-eastern coast of Australia shall mean from a line drawn from a point on the coast of Australia in

latitude 11°00' S, longitude 142°08' E  
to a point in latitude 10°35' S, longitude 141°55' E  
thence to a point latitude 10°00' S, longitude 142°00' E  
thence to a point latitude 9°10' S, longitude 143°52' E  
thence to a point latitude 9°00' S, longitude 144°30' E  
thence to a point latitude 10°41' S, longitude 145°00' E  
thence to a point latitude 13°00' S, longitude 145°00' E  
thence to a point latitude 15°00' S, longitude 146°00' E  
thence to a point latitude 17°30' S, longitude 147°00' E  
thence to a point latitude 21°00' S, longitude 152°55' E  
thence to a point latitude 24°30' S, longitude 154°00' E  
thence to a point on the coast of Australia  
in latitude 24°42' S, longitude 153°15' E.

7 "Active Substance" means a substance or organism, including a virus or a fungus, that has a general or specific action on or against harmful aquatic organisms and pathogens.

8 "BWMS Code" means the Code for Approval of Ballast Water Management Systems adopted by resolution MEPC.300(72), as may be amended by the Organization, provided that such amendments are adopted and brought into force in accordance with article 19 of the present Convention relating to amendment procedures applicable to the annex.

9 "Electronic record book" means a device or system, approved by the Administration, used to electronically record the entries for each ballast water operation as required under this Convention in lieu of a hard copy record book.

### **Regulation A-2**

#### *General Applicability*

Except where expressly provided otherwise, the discharge of ballast water shall only be conducted through ballast water management in accordance with the provisions of this annex.

### **Regulation A-3**

#### *Exceptions*

The requirements of regulation B-3, or any measures adopted by a Party pursuant to article 2.3 and section C, shall not apply to:

- 1 the uptake or discharge of ballast water and sediments necessary for the purpose of ensuring the safety of a ship in emergency situations or saving life at sea; or

- 2 the accidental discharge or ingress of ballast water and sediments resulting from damage to a ship or its equipment:
  - .1 provided that all reasonable precautions have been taken before and after the occurrence of the damage or discovery of the damage or discharge for the purpose of preventing or minimizing the discharge; and
  - .2 unless the owner, Company or officer in charge wilfully or recklessly caused damage; or
- 3 the uptake and discharge of ballast water and sediments when being used for the purpose of avoiding or minimizing pollution incidents from the ship; or
- 4 the uptake and subsequent discharge on the high seas of the same ballast water and sediments; or
- 5 the discharge of ballast water and sediments on the high seas or in any areas designated by the port State, owing to the ship having operated in challenging water quality conditions or applying a contingency measure, taking into account the Guidelines developed by the Organization<sup>\*</sup>; or
- 6 the discharge of ballast water and sediments from a ship at the same location where the whole of that ballast water and those sediments originated and provided that no mixing with unmanaged ballast water and sediments from other areas has occurred. If mixing has occurred, the ballast water taken from other areas is subject to ballast water management in accordance with this annex.

#### **Regulation A-4**

##### *Exemptions*

1 A Party or Parties, in waters under their jurisdiction, may grant exemptions to any requirements to apply regulations B-3 or C-1, in addition to those exemptions contained elsewhere in this Convention, but only when they are:

- .1 granted to a ship or ships on a voyage or voyages between specified ports or locations; or to a ship which operates exclusively between specified ports or locations;
- .2 effective for a period of no more than five years, subject to intermediate review;
- .3 granted to ships that do not mix ballast water or sediments other than between the ports or locations specified in paragraph 1.1; and
- .4 granted based on the Guidelines on risk assessment developed by the Organization.

<sup>\*</sup>

Refer to the *Interim guidance on the application of the BWM Convention to ships operating in challenging water quality conditions* (resolution MEPC.387(81)) or the *Guidance on contingency measures under the BWM Convention* (BWM.2/Circ.62), as may be amended.

2 Exemptions granted pursuant to paragraph 1 shall not be effective until after communication to the Organization and circulation of relevant information to the Parties.

3 Any exemptions granted under this regulation shall not impair or damage the environment, human health, property or resources of adjacent or other States. Any State that the Party determines may be adversely affected shall be consulted, with a view to resolving any identified concerns.

4 Any exemptions granted under this regulation shall be recorded in the Ballast Water Record Book.

#### **Regulation A-5** *Equivalent Compliance*

Equivalent compliance with this annex for pleasure craft used solely for recreation or competition or craft used primarily for search and rescue, less than 50 metres in length overall, and with a maximum ballast water capacity of 8 cubic metres, shall be determined by the Administration, taking into account the Guidelines developed by the Organization.

### **SECTION B – MANAGEMENT AND CONTROL REQUIREMENTS FOR SHIPS**

#### **Regulation B-1** *Ballast Water Management Plan*

1 Each ship shall have on board and implement a Ballast Water Management Plan. Such a Plan shall be approved by the Administration, taking into account the Guidelines developed by the Organization. The Ballast Water Management Plan shall be specific to each ship and shall at least:

- 1 detail safety procedures for the ship and the crew associated with ballast water management as required by this Convention;
- 2 provide a detailed description of the actions to be taken to implement the ballast water management requirements and supplemental ballast water management practices as set forth in this Convention;
- 3 identify whether any ballast water management system installed on the ship was type-approved in accordance with the BWMS Code\*, as may be amended, or taking into account the Guidelines developed by the Organization†, or is being operated in accordance with regulation D-4;
- 4 include high-level information on maintenance procedures and schedules necessary to keep any ballast water management system installed on the ship operating in good working order, and refer to the operation, maintenance and safety manual for the detailed procedures;
- 5 detail the procedures for the disposal of sediments:

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\* Refer to the Code for Approval of Ballast Water Management Systems (resolution MEPC.300(72), as may be amended).

† Refer to the *Guidelines for approval of ballast water management systems* (G8) (resolutions MEPC.125(53), MEPC.174(58) or MEPC.279(70), as appropriate).

- .1 at sea; and
  - .2 to shore;
- 6 include the procedures for coordinating shipboard ballast water management that involves discharge to the sea with the authorities of the State into whose waters such discharge will take place;
  - 7 include a procedure for safe ballast water exchange, including for partially treated and/or non-neutralized ballast water, taking into account the Guidelines developed by the Organization<sup>\*</sup>;
  - 8 detail how the ship will plan for contingency measures, taking into account the Guidelines developed by the Organization<sup>†</sup>;
  - 9 include, if applicable, a procedure for the temporary storage of treated sewage and/or grey water in ballast water tanks, taking into account the Guidelines developed by the Organization<sup>‡</sup>;
  - 10 designate the officer on board in charge of ensuring that the plan is properly implemented;
  - 11 contain the reporting requirements for ships provided for under this Convention; and
  - 12 be written in the working language of the ship. If the language used is not English, French or Spanish, a translation into one of these languages shall be included.

2 The information contained in the Plan shall be kept up to date to ensure accuracy. Changes to the mandatory provisions of the Plan shall be approved by the Administration. The Plan shall include a version history that reflects any such revisions as approved by the Administration.

## **Regulation B-2**

### *Ballast Water Record Book*

1 Each ship shall have on board a Ballast Water Record Book, which may be an electronic record book, or which may be integrated into another record book or system, and which shall at least contain the information specified in appendix II. Electronic record books shall be approved by the Administration taking into account the Guidelines developed by the Organization<sup>§</sup>.

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<sup>\*</sup> Refer to the *2017 Guidelines for ballast water exchange* (G6) (resolution MEPC.288(71), amended by resolution MEPC.371(80)), the *Interim guidance on the application of the BWM Convention to ships operating in challenging water quality conditions* (resolution MEPC.387(81)) or the *Guidance on contingency measures under the BWM Convention* (BWM.2/Circ.62), as may be amended.

<sup>†</sup> Refer to the *Guidance on contingency measures under the BWM Convention* (BWM.2/Circ.62, as may be amended).

<sup>‡</sup> Refer to the *Guidance for the temporary storage of treated sewage and/or grey water in ballast water tanks* (BWM.2/Circ.82, as may be amended).

<sup>§</sup> Refer to the *Guidelines for the use of electronic record books under the BWM Convention* (resolution MEPC.372(80), as may be amended).

2 Ballast Water Record Book entries shall be maintained on board the ship for a minimum period of two years after the last entry has been made and thereafter in the Company's control for a minimum period of three years.

3 For ships that have an existing recording system providing, to the satisfaction of the Administration, a detailed record of maintenance actions for any ballast water management system installed on the ship, which reflects the operation, maintenance and safety manual and the manufacturer's maintenance schedule of that system, the Ballast Water Record Book shall include high-level information on such maintenance actions and refer to the existing equivalent recording system for the details.

4 For ships that do not have an existing recording system satisfying the requirements of paragraph 3, the Ballast Water Record Book shall include a maintenance log for any ballast water management system installed on the ship, which reflects the operation, maintenance and safety manual and the manufacturer's maintenance schedule of that system, and which shall be kept updated and signed by the officer in charge of the operations concerned.

5 In the event of the discharge of ballast water pursuant to regulations A-3, A-4 or B-3.6 or in the event of other accidental or exceptional discharge of ballast water not otherwise exempted by this Convention, an entry shall be made in the Ballast Water Record Book describing the circumstances of, and the reason for, the discharge.

6 The Ballast Water Record Book shall be kept readily available for inspection at all reasonable times and, in the case of an unmanned ship under tow, may be kept on the towing ship.

7 Each operation concerning ballast water shall be fully recorded without delay in the Ballast Water Record Book. Each entry shall be signed by the officer in charge of the operation concerned and each completed page shall be signed by the master or, in the case of a group of electronic entries, shall be verified by the master in a timely manner. The entries in the Ballast Water Record Book shall be in the working language of the ship. If the language is not English, French or Spanish, the entries shall contain a translation into one of those languages. When entries in an official national language of the State whose flag the ship is entitled to fly are also used, these shall prevail in case of a dispute or discrepancy.

8 Officers duly authorized by a Party may inspect the Ballast Water Record Book on board any ship to which this regulation applies while the ship is in its port or offshore terminal, and may make a copy of any entry, and require the master to certify that the copy is a true copy. Any copy so certified shall be admissible in any judicial proceeding as evidence of the facts stated in the entry. The inspection of a Ballast Water Record Book and the taking of a certified copy shall be performed as expeditiously as possible without causing the ship to be unduly delayed.

### **Regulation B-3**

#### *Ballast Water Management for Ships*

1 A ship constructed before 2009:

- .1 with a ballast water capacity of between 1,500 and 5,000 cubic metres, inclusive, shall conduct ballast water management that at least meets the standard described in regulation D-1 or regulation D-2 until the renewal survey described in paragraph 10, after which time it shall at least meet the standard described in regulation D-2;

- .2 with a ballast water capacity of less than 1,500 or greater than 5,000 cubic metres shall conduct ballast water management that at least meets the standard described in regulation D-1 or regulation D-2 until the renewal survey described in paragraph 10, after which time it shall at least meet the standard described in regulation D-2.

2 A ship constructed in or after 2009 and before 8 September 2017 with a ballast water capacity of less than 5,000 cubic metres shall conduct ballast water management that at least meets the standard described in regulation D-2 from the date of the renewal survey described in paragraph 10.

3 A ship constructed in or after 2009, but before 2012, with a ballast water capacity of 5,000 cubic metres or more shall conduct ballast water management in accordance with paragraph 1.2.

4 A ship constructed in or after 2012 and before 8 September 2017 with a ballast water capacity of 5,000 cubic metres or more shall conduct ballast water management that at least meets the standard described in regulation D-2 from the date of the renewal survey described in paragraph 10.

5 A ship constructed on or after 8 September 2017 shall conduct ballast water management that at least meets the standard described in regulation D-2.

6 The requirements of this regulation do not apply to ships that discharge ballast water to a reception facility designed taking into account the Guidelines developed by the Organization for such facilities.

7 Other methods of ballast water management may also be accepted as alternatives to the requirements described in paragraphs 1 to 5 and paragraph 8, provided that such methods ensure at least the same level of protection to the environment, human health, property or resources, and are approved in principle by the Committee.

8 A ship constructed before 8 September 2017 to which the renewal survey described in paragraph 10 does not apply, shall conduct ballast water management that at least meets the standard described in regulation D-2 from the date decided by the Administration, but not later than 8 September 2024.

9 A ship subject to paragraphs 2, 4 or 8 shall be required to comply with either regulation D-1 or regulation D-2, until such time as it is required to comply with regulation D-2.

10 Notwithstanding regulation E-1.1.2, the renewal survey referred to in paragraphs 1.1, 1.2, 2 and 4 is:

- .1 the first renewal survey, as determined by the Committee,\* on or after 8 September 2017, if:
  - .1 this survey is completed on or after 8 September 2019; or
  - .2 a renewal survey is completed on or after 8 September 2014 but prior to 8 September 2017; and

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\* Reference is made to resolution MEPC.298(72).

- .2 the second renewal survey, as determined by the Committee,\* on or after 8 September 2017, if the first renewal survey on or after 8 September 2017 is completed prior to 8 September 2019, provided that the conditions of paragraph 10.1.2 are not met.

**Regulation B-4**  
*Ballast Water Exchange*

- 1 A ship conducting ballast water exchange to meet the standard in regulation D-1 shall:
- .1 whenever possible, conduct such ballast water exchange at least 200 nautical miles from the nearest land and in water at least 200 metres in depth, taking into account the Guidelines developed by the Organization;
- .2 in cases where the ship is unable to conduct ballast water exchange in accordance with paragraph 1.1, such ballast water exchange shall be conducted taking into account the Guidelines described in paragraph 1.1 and as far from the nearest land as possible, and in all cases at least 50 nautical miles from the nearest land and in water at least 200 metres in depth.
- 2 In sea areas where the distance from the nearest land or the depth does not meet the parameters described in paragraph 1.1 or 1.2, the port State may designate areas, in consultation with adjacent or other States, as appropriate, where a ship may conduct ballast water exchange, taking into account the Guidelines described in paragraph 1.1.
- 3 A ship shall not be required to deviate from its intended voyage, or delay the voyage, in order to comply with any particular requirement of paragraph 1.
- 4 A ship conducting ballast water exchange shall not be required to comply with paragraphs 1 or 2, as appropriate, if the master reasonably decides that such exchange would threaten the safety or stability of the ship, its crew, or its passengers because of adverse weather, ship design or stress, equipment failure, or any other extraordinary condition.
- 5 When a ship is required to conduct ballast water exchange and does not do so in accordance with this regulation, the reasons shall be entered in the Ballast Water Record Book.

**Regulation B-5**  
*Sediment Management for Ships*

- 1 All ships shall remove and dispose of sediments from spaces designated to carry ballast water in accordance with the provisions of the ship's Ballast Water Management Plan.
- 2 Ships described in regulation B-3.3 to B-3.5 should, without compromising safety or operational efficiency, be designed and constructed with a view to minimize the uptake and undesirable entrapment of sediments, facilitating the removal of sediments, and providing safe access to allow for sediment removal and sampling, taking into account the Guidelines developed by the Organization. Ships described in regulation B-3.1 should, to the extent practicable, comply with this paragraph.

**Regulation B-6**  
*Duties of Officers and Crew*

Officers and crew shall be familiar with their duties in the implementation of ballast water management particular to the ship on which they serve and shall, appropriate to their duties,

be familiar with the ship's Ballast Water Management Plan, taking into account the Guidelines developed by the Organization. Evidence of this familiarization shall be maintained on board the ship.

## **SECTION C – SPECIAL REQUIREMENTS IN CERTAIN AREAS**

### **Regulation C-1** *Additional Measures*

1 If a Party, individually or jointly with other Parties, determines that measures in addition to those in section B are necessary to prevent, reduce, or eliminate the transfer of harmful aquatic organisms and pathogens through ships' ballast water and sediments, such Party or Parties may, consistent with international law, require ships to meet a specified standard or requirement.

2 Prior to establishing standards or requirements under paragraph 1, a Party or Parties should consult with adjacent or other States that may be affected by such standards or requirements.

3 A Party or Parties intending to introduce additional measures in accordance with paragraph 1 shall:

- .1 take into account the Guidelines developed by the Organization;
- .2 communicate their intention to establish additional measure(s) to the Organization at least 6 months, except in emergency or epidemic situations, prior to the projected date of implementation of the measure(s). Such communication shall include:
  - .1 the precise coordinates where additional measure(s) is/are applicable;
  - .2 the need and reasoning for the application of the additional measure(s), including, whenever possible, benefits;
  - .3 a description of the additional measure(s); and
  - .4 any arrangements that may be provided to facilitate ships' compliance with the additional measure(s); and
- . 3 to the extent required by customary international law as reflected in the United Nations Convention on the Law of the Sea, as appropriate, obtain the approval of the Organization.

4 A Party or Parties, in introducing such additional measures, shall endeavour to make available all appropriate services, which may include but are not limited to notification to mariners of areas, available and alternative routes or ports, as far as practicable, in order to ease the burden on the ship.

5 Any additional measures adopted by a Party or Parties shall not compromise the safety and security of the ship and in any circumstances not conflict with any other convention with which the ship must comply.

6 A Party or Parties introducing additional measures may waive these measures for a period of time or in specific circumstances as they deem fit.

### **Regulation C-2**

#### *Warnings Concerning Ballast Water Uptake in Certain Areas and Related Flag State Measures*

1 A Party shall endeavour to notify mariners of areas under their jurisdiction where ships should not uptake ballast water owing to known conditions. The Party shall include in such notices the precise coordinates of the area or areas, and, where possible, the location of any alternative area or areas for the uptake of ballast water. Warnings may be issued for areas:

- .1 known to contain outbreaks, infestations, or populations of harmful aquatic organisms and pathogens (e.g. toxic algal blooms) which are likely to be of relevance to ballast water uptake or discharge;
- .2 near sewage outfalls; or
- .3 where tidal flushing is poor or times during which a tidal stream is known to be more turbid.

2 In addition to notifying mariners of areas in accordance with the provisions of paragraph 1, a Party shall notify the Organization and any potentially affected coastal States of any areas identified in paragraph 1 and the time period such warning is likely to be in effect. The notice to the Organization and any potentially affected coastal States shall include the precise coordinates of the area or areas, and, where possible, the location of any alternative area or areas for the uptake of ballast water. The notice shall include advice to ships needing to uptake ballast water in the area, describing arrangements made for alternative supplies. The Party shall also notify mariners, the Organization, and any potentially affected coastal States when a given warning is no longer applicable.

### **Regulation C-3**

#### *Communication of Information*

The Organization shall make available, through any appropriate means, information communicated to it under regulations C-1 and C-2.

## **SECTION D – STANDARDS FOR BALLAST WATER MANAGEMENT**

### **Regulation D-1**

#### *Ballast Water Exchange Standard*

1 Ships performing ballast water exchange in accordance with this regulation shall do so with an efficiency of at least 95 per cent volumetric exchange of ballast water.

2 For ships exchanging ballast water by the pumping-through method, pumping through three times the volume of each ballast water tank shall be considered to meet the standard described in paragraph 1. Pumping through less than three times the volume may be accepted provided the ship can demonstrate that at least 95 per cent volumetric exchange is met.

**Regulation D-2***Ballast Water Performance Standard*

1 Ships conducting ballast water management in accordance with this regulation shall discharge less than 10 viable organisms per cubic metre greater than or equal to 50 micrometres in minimum dimension and less than 10 viable organisms per millilitre less than 50 micrometres in minimum dimension and greater than or equal to 10 micrometres in minimum dimension; and discharge of the indicator microbes shall not exceed the specified concentrations described in paragraph 2.

2 Indicator microbes, as a human health standard, shall include:

- .1 Toxicogenic *Vibrio cholerae* (O1 and O139) with less than 1 colony-forming unit (cfu) per 100 millilitres or less than 1 cfu per 1 gram (wet weight) zooplankton samples;
- .2 *Escherichia coli* less than 250 cfu per 100 millilitres;
- .3 Intestinal Enterococci less than 100 cfu per 100 millilitres.

3 Ships conducting ballast water management in accordance with this regulation shall discharge Active Substances not exceeding the maximum allowable discharge concentration in accordance with the limit set as part of the type approval of any relevant ballast management system that uses Active Substances.

**Regulation D-3***Approval Requirements for Ballast Water Management Systems*

1 Except as specified in paragraph 2, ballast water management systems used to comply with this Convention shall be approved by the Administration as follows:

- .1 ballast water management systems installed on or after 28 October 2020 shall be approved in accordance with the BWMS Code, as may be amended; and
- .2 ballast water management systems installed before 28 October 2020 shall be approved taking into account the Guidelines developed by the Organization or the BWMS Code, as may be amended.

2 Ballast water management systems which make use of Active Substances or preparations containing one or more Active Substances to comply with this Convention shall be approved by the Organization, based on a Procedure developed by the Organization. This procedure shall describe the approval and withdrawal of approval of Active Substances and their proposed manner of application. At withdrawal of approval, the use of the relevant active substance or substances shall be prohibited within one year after the date of such withdrawal.

3 Ballast water management systems used to comply with this Convention must be safe in terms of the ship, its equipment and the crew.

**Regulation D-4***Prototype Ballast Water Treatment Technologies*

1 For any ship that, prior to the date that the standard in regulation D-2 would otherwise become effective for it, participates in a programme approved by the Administration to test and

evaluate promising ballast water treatment technologies, the standard in regulation D-2 shall not apply to that ship until five years from the date on which the ship would otherwise be required to comply with such standard.

2 For any ship that, after the date on which the standard in regulation D-2 has become effective for it, participates in a programme approved by the Administration, taking into account Guidelines developed by the Organization, to test and evaluate promising ballast water technologies with the potential to result in treatment technologies achieving a standard higher than that in regulation D-2, the standard in regulation D-2 shall cease to apply to that ship for five years from the date of installation of such technology.

3 In establishing and carrying out any programme to test and evaluate promising ballast water technologies, Parties shall:

- .1 take into account the Guidelines developed by the Organization; and
- .2 allow participation only by the minimum number of ships necessary to effectively test such technologies.

4 Throughout the test and evaluation period, the treatment system must be operated consistently and as designed.

#### **Regulation D-5**

##### *Review of Standards by the Organization*

1 At a meeting of the Committee held no later than three years before the earliest effective date of the standard set forth in regulation D-2, the Committee shall undertake a review which includes a determination of whether appropriate technologies are available to achieve the standard, an assessment of the criteria in paragraph 2, and an assessment of the socio-economic effect(s) specifically in relation to the developmental needs of developing countries, particularly small island developing States. The Committee shall also undertake periodic reviews, as appropriate, to examine the applicable requirements for ships described in regulation B-3.1 as well as any other aspect of ballast water management addressed in this annex, including any Guidelines developed by the Organization.

2 Such reviews of appropriate technologies shall also take into account:

- .1 safety considerations relating to the ship and the crew;
- .2 environmental acceptability, i.e. not causing more or greater environmental impacts than they solve;
- .3 practicability, i.e. compatibility with ship design and operations;
- .4 cost effectiveness, i.e. economics; and
- .5 biological effectiveness in terms of removing, or otherwise rendering not viable, harmful aquatic organisms and pathogens in ballast water.

3 The Committee may form a group or groups to conduct the review(s) described in paragraph 1. The Committee shall determine the composition, terms of reference and specific issues to be addressed by any such group formed. Such groups may develop and recommend proposals for amendment of this annex for consideration by the Parties. Only Parties may

participate in the formulation of recommendations and amendment decisions taken by the Committee.

4 If, based on the reviews described in this regulation, the Parties decide to adopt amendments to this annex, such amendments shall be adopted and enter into force in accordance with the procedures contained in article 19 of this Convention.

## **SECTION E – SURVEY AND CERTIFICATION REQUIREMENTS FOR BALLAST WATER MANAGEMENT**

### **Regulation E-1**

#### *Surveys*

1 Ships of 400 gross tonnage and above to which this Convention applies, excluding floating platforms, FSUs and FPSOs, shall be subject to surveys specified below:

- .1 An initial survey before the ship is put in service or before the Certificate required under regulation E-2 or E-3 is issued for the first time. This survey shall verify that the Ballast Water Management Plan required by regulation B-1 and any associated structure, equipment, systems, fittings, arrangements and material or processes comply fully with the requirements of this Convention. This survey shall confirm that a commissioning test has been conducted to validate the installation of any ballast water management system by demonstrating that its mechanical, physical, chemical and biological processes are working properly, taking into account the Guidelines developed by the Organization.
- .2 A renewal survey at intervals specified by the Administration, but not exceeding five years, except where regulation E-5.2, E-5.5, E-5.6, or E-5.7 is applicable. This survey shall verify that:
  - .1 the Ballast Water Management Plan required by regulation B-1 and any associated structure, equipment, systems, fittings, arrangements and materials or processes comply fully with the applicable requirements of this Convention; and
  - .2 any ballast water management system is properly installed, in good working order and achieves the standard described in regulation D-2 taking into account the Guidelines developed by the Organization.
- .3 An intermediate survey within three months before or after the second Anniversary date or within three months before or after the third Anniversary date of the Certificate, which shall take the place of one of the annual surveys specified in paragraph 1.4. The intermediate surveys shall ensure that the equipment, associated systems and processes for ballast water management fully comply with the applicable requirements of this annex and that any ballast water management system on the ship is properly installed, in good working order and achieves the standard described in regulation D-2 taking into account the Guidelines developed by the Organization. Such intermediate surveys shall be endorsed on the Certificate issued under regulation E-2 or E-3.

- .4 An annual survey within three months before or after each Anniversary date, which shall include:
- .1 a general inspection of the structure, any equipment, systems, fittings, arrangements and material or processes associated with the Ballast Water Management Plan required by regulation B-1 to ensure that they have been maintained in accordance with paragraph 9 and remain satisfactory for the service for which the ship is intended;
  - .2 confirmation that required maintenance has been undertaken by verifying the Ballast Water Record Book and/or other equivalent maintenance recording system as prescribed in regulations B-2.3 and B-2.4; and
  - .3 annual sampling of residual Active Substances to ensure that any ballast water management system is operating in accordance with its type approval.

Such annual surveys shall be endorsed on the Certificate issued under regulation E-2 or E-3.

- .5 An additional survey, either general or partial, according to the circumstances, shall be made after a change, replacement, or significant repair of the structure, equipment, systems, fittings, arrangements and material necessary to achieve full compliance with this Convention. The survey shall be such as to ensure that any such change, replacement or significant repair has been effectively made, so that the ship complies with the requirements of this Convention. An additional survey shall also be made when a ship, without changing its equipment, transitions its ballast water management method from compliance with regulation D-4 to regulation D-2.
- .1 When an additional survey is undertaken for the installation of any ballast water management system, this survey shall confirm that a commissioning test has been conducted to validate the installation of the system by demonstrating that its mechanical, physical, chemical and biological processes are working properly, taking into account the Guidelines developed by the Organization.
  - .2 When an additional survey is undertaken for the transition of the ship's ballast water management method from compliance with regulation D-4 to regulation D-2:
    - .1 in cases where the prototype ballast water management system is identical to the type-approved ballast water management system, a commissioning test is not required if an equivalent test was successfully undertaken, taking into account the Guidelines developed by the Organization\*, within 12 months prior to the transition date. The installation date of the ballast water management system shall be designated on the Certificate issued under

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\* Refer to the *2020 Guidance for the commissioning testing of ballast water management systems* (BWM.2/Circ.70/Rev.1, as may be amended).

regulation E-2 or E-3 as the completion date of the survey;  
and

- .2 in cases where the prototype ballast water management system is not identical to the type-approved ballast water management system, the survey shall include a commissioning test, and the installation date of the ballast water management system shall be designated on the Certificate issued under regulation E-2 or E-3 as the completion date of the commissioning test.

2 The Administration shall establish appropriate measures for ships that are not subject to the provisions of paragraph 1 in order to ensure that the applicable provisions of this Convention are complied with.

3 Surveys of ships for the purpose of enforcement of the provisions of this Convention shall be carried out by officers of the Administration. The Administration may, however, entrust the surveys either to surveyors nominated for the purpose or to organizations recognized by it.

4 An Administration nominating surveyors or recognizing organizations to conduct surveys, as described in paragraph 3 shall, as a minimum, empower such nominated surveyors or recognized organizations to:

- .1 require a ship that they survey to comply with the provisions of this Convention; and
- .2 carry out surveys and inspections if requested by the appropriate authorities of a port State that is a Party.

5 The Administration shall notify the Organization of the specific responsibilities and conditions of the authority delegated to the nominated surveyors or recognized organizations, for circulation to Parties for the information of their officers.

6 When the Administration, a nominated surveyor, or a recognized organization determines that the ship's ballast water management does not conform to the particulars of the Certificate required under regulation E-2 or E-3 or is such that the ship is not fit to proceed to sea without presenting a threat of harm to the environment, human health, property or resources, such surveyor or organization shall immediately ensure that corrective action is taken to bring the ship into compliance. A surveyor or organization shall be notified immediately, and it shall ensure that the Certificate is not issued or is withdrawn as appropriate. If the ship is in the port of another Party, the appropriate authorities of the port State shall be notified immediately. When an officer of the Administration, a nominated surveyor, or a recognized organization has notified the appropriate authorities of the port State, the Government of the port State concerned shall give such officer, surveyor or organization any necessary assistance to carry out their obligations under this regulation, including any action described in article 9.

7 Whenever an accident occurs to a ship or a defect is discovered which substantially affects the ability of the ship to conduct ballast water management in accordance with this Convention, the owner, operator or other person in charge of the ship shall report at the earliest opportunity to the Administration, the recognized organization or the nominated surveyor responsible for issuing the relevant Certificate, who shall cause investigations to be initiated to determine whether a survey as required by paragraph 1 is necessary. The owner, operator or other person in charge shall:

- .1 if the ship is in a port of another Party, also report immediately to the appropriate authorities of the port State and the nominated surveyor or recognized organization shall ascertain that such report has been made; and
- .2 submit a time-bound repair plan for restoring the ship's equipment, systems and processes to good working order to both the flag and destination port State(s) for their approval.

8 In every case, the Administration concerned shall fully guarantee the completeness and efficiency of the survey and shall undertake to ensure the necessary arrangements to satisfy this obligation.

9 The condition of the ship and its equipment, systems and processes shall be maintained to conform with the provisions of this Convention to ensure that the ship in all respects will remain fit to proceed to sea without presenting a threat of harm to the environment, human health, property or resources. In cases where any of the ship's equipment, systems and processes are damaged or defective, the owner, operator or other person in charge shall undertake the reporting processes required in paragraph 7.

10 After any survey of the ship under paragraph 1 has been completed, no change shall be made in the structure, any equipment, fittings, arrangements or material associated with the Ballast Water Management Plan required by regulation B-1 and covered by the survey without the sanction of the Administration, except for the direct replacement of such equipment or fittings.

### **Regulation E-2**

#### *Issuance or Endorsement of a Certificate*

1 The Administration shall ensure that a ship to which regulation E-1 applies is issued a Certificate after successful completion of a survey conducted in accordance with regulation E-1. A Certificate issued under the authority of a Party shall be accepted by the other Parties and regarded for all purposes covered by this Convention as having the same validity as a Certificate issued by them.

2 Certificates shall be issued or endorsed either by the Administration or by any person or organization duly authorized by it. In every case, the Administration assumes full responsibility for the Certificate.

### **Regulation E-3**

#### *Issuance or Endorsement of a Certificate by Another Party*

1 At the request of the Administration, another Party may cause a ship to be surveyed and, if satisfied that the provisions of this Convention are complied with, shall issue or authorize the issuance of a Certificate to the ship, and where appropriate, endorse or authorize the endorsement of that Certificate on the ship, in accordance with this annex.

2 A copy of the Certificate and a copy of the survey report shall be transmitted as soon as possible to the requesting Administration.

3 A Certificate so issued shall contain a statement to the effect that it has been issued at the request of the Administration, and it shall have the same force and receive the same recognition as a Certificate issued by the Administration.

4 No Certificate shall be issued to a ship entitled to fly the flag of a State which is not a Party.

**Regulation E-4**  
*Form of the Certificate*

The Certificate shall be drawn up in the official language of the issuing Party, in the form set forth in appendix I. If the language used is neither English, French, nor Spanish, the text shall include a translation into one of these languages.

**Regulation E-5**  
*Duration and Validity of the Certificate*

1 A Certificate shall be issued for a period specified by the Administration that shall not exceed five years.

2 For renewal surveys:

- .1 Notwithstanding the requirements of paragraph 1, when the renewal survey is completed within three months before the expiry date of the existing Certificate, the new Certificate shall be valid from the date of completion of the renewal survey to a date not exceeding five years from the date of expiry of the existing Certificate.
- .2 When the renewal survey is completed after the expiry date of the existing Certificate, the new Certificate shall be valid from the date of completion of the renewal survey to a date not exceeding five years from the date of expiry of the existing Certificate.
- .3 When the renewal survey is completed more than three months before the expiry date of the existing Certificate, the new Certificate shall be valid from the date of completion of the renewal survey to a date not exceeding five years from the date of completion of the renewal survey.

3 If a Certificate is issued for a period of less than five years, the Administration may extend the validity of the Certificate beyond the expiry date to the maximum period specified in paragraph 1, provided that the surveys referred to in regulation E-1.1.3 applicable when a Certificate is issued for a period of five years are carried out as appropriate.

4 If a renewal survey has been completed and a new Certificate cannot be issued or placed on board the ship before the expiry date of the existing Certificate, the person or organization authorized by the Administration may endorse the existing Certificate and such a Certificate shall be accepted as valid for a further period which shall not exceed five months from the expiry date.

5 If a ship at the time when the Certificate expires is not in a port in which it is to be surveyed, the Administration may extend the period of validity of the Certificate, but this extension shall be granted only for the purpose of allowing the ship to complete its voyage to the port in which it is to be surveyed, and then only in cases where it appears proper and reasonable to do so. No Certificate shall be extended for a period longer than three months, and a ship to which such extension is granted shall not, on its arrival in the port in which it is to be surveyed, be entitled by virtue of such extension to leave that port without having a new Certificate. When the renewal survey is completed, the new Certificate shall be valid to a date not exceeding five years from the date of expiry of the existing Certificate before the extension was granted.

6 A Certificate issued to a ship engaged on short voyages which has not been extended under the foregoing provisions of this regulation may be extended by the Administration for a period of grace of up to one month from the date of expiry stated on it. When the renewal survey is completed, the new Certificate shall be valid to a date not exceeding five years from the date of expiry of the existing Certificate before the extension was granted.

7 In special circumstances, as determined by the Administration, a new Certificate need not be dated from the date of expiry of the existing Certificate as required by paragraph 2.2, 5 or 6 of this regulation. In these special circumstances, the new Certificate shall be valid for a date not exceeding five years from the date of completion of the renewal survey.

8 If an annual or intermediate survey is completed before the period specified in regulation E-1, then:

- .1 the Anniversary date shown on the Certificate shall be amended by endorsement to a date which shall not be more than three months later than the date on which the survey was completed;
- .2 the subsequent annual or intermediate survey required by regulation E-1 shall be completed at the intervals prescribed by that regulation using the new Anniversary date; and
- .3 the expiry date may remain unchanged provided one or more annual or intermediate surveys, as appropriate, are carried out so that the maximum intervals between the surveys prescribed by regulation E-1 are not exceeded.

9 A Certificate issued under regulation E-2 or E-3 shall cease to be valid in any of the following cases:

- .1 upon transfer of the ship to the flag of another State. A new Certificate shall only be issued when the Party issuing the new Certificate is fully satisfied that the ship is in compliance with the requirements of regulation E-1. In the case of a transfer between Parties, if requested within three months after the transfer has taken place, the Party whose flag the ship was formerly entitled to fly shall, as soon as possible, transmit to the Administration copies of the Certificates carried by the ship before the transfer and, if available, copies of the relevant survey reports;
- .2 if the relevant surveys are not completed within the periods specified under regulation E-1.1; or
- .3 if the Certificate is not endorsed in accordance with regulation E-1.1.

## APPENDIX I

### FORM OF INTERNATIONAL BALLAST WATER MANAGEMENT CERTIFICATE

#### INTERNATIONAL BALLAST WATER MANAGEMENT CERTIFICATE

Issued under the provisions of the International Convention for the Control and Management of Ships' Ballast Water and Sediments (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<sup>\*</sup>

Name of ship .....

Distinctive number or letters .....

Port of registry .....

Gross tonnage .....

IMO number<sup>†</sup> .....

Date of construction .....

Ballast water capacity (in cubic metres) .....

#### Details of ballast water management method(s) used

Method of ballast water management used .....

Date installed (if applicable) (dd/mm/yyyy) .....

Name of manufacturer (if applicable) .....

Type Approval Certificate number/s (if applicable) .....

Type Approval Certificate issuance date (if applicable) (dd/mm/yyyy) .....

Type Approval Certificate issuing Administration (if applicable) .....

The principal ballast water management method(s) employed on this ship is/are:

<sup>\*</sup> Alternatively, the particulars of the ship may be placed horizontally in boxes.

<sup>†</sup> IMO Ship Identification Number Scheme adopted by the Organization by resolution A.1117(30), as may be amended.

- ☐ in accordance with regulation D-2  
(describe) .....
- ☐ the ship is subject to regulation D-4
- ☐ other approach in accordance with regulation.....

A Ballast Water Management Plan has been approved in accordance with regulation B-1, taking into account the Guidelines developed by the Organization. ☐

THIS IS TO CERTIFY:

1 That the ship has been surveyed in accordance with regulation E-1 of the annex to the Convention; and

2 That the survey shows that ballast water management on the ship complies with the annex to the Convention.

This certificate is valid until ..... subject to surveys in accordance with regulation E-1 of the annex to the Convention.

Completion date of the survey on which this certificate is based: dd/mm/yyyy

Issued at .....  
(Place of issue of certificate)

.....  
(Date of issue)

.....  
*Signature of authorized official issuing the certificate*

(Seal or stamp of the authority, as appropriate)

ENDORSEMENT FOR ANNUAL AND INTERMEDIATE SURVEY(S)

THIS IS TO CERTIFY that at a survey required by regulation E-1 of the annex to the Convention the ship was found to comply with the relevant provisions of the Convention:

Annual survey: Signed .....  
(Signature of duly authorized official)

Place .....

Date.....

(Seal or stamp of the authority, as appropriate)

Annual\*/Intermediate survey\*: Signed .....  
(Signature of duly authorized official)

Place .....

Date.....

*(Seal or stamp of the authority, as appropriate)*

Annual\*/Intermediate survey\*: Signed .....  
(Signature of duly authorized official)

Place .....

Date.....

(Seal or stamp of the authority, as appropriate)

Annual survey: Signed .....  
(Signature of duly authorized official)

Place .....

Date.....

(Seal or stamp of the authority, as appropriate)

\* Delete as appropriate.

**ANNUAL/INTERMEDIATE SURVEY  
IN ACCORDANCE WITH REGULATION E-5.8.3**

THIS IS TO CERTIFY that, at an annual/intermediate\* survey in accordance with regulation E-5.8.3 of the annex to the Convention, the ship was found to comply with the relevant provisions of the Convention:

Signed .....  
(Signature of authorized official)

Place .....

Date.....

(Seal or stamp of the authority, as appropriate)

**ENDORSEMENT TO EXTEND THE CERTIFICATE IF VALID  
FOR LESS THAN FIVE YEARS WHERE REGULATION E-5.3 APPLIES**

The ship complies with the relevant provisions of the Convention, and this Certificate shall, in accordance with regulation E-5.3 of the annex to the Convention, be accepted as valid until.....

Signed .....  
(Signature of authorized official)

Place .....

Date.....

(Seal or stamp of the authority, as appropriate)

**ENDORSEMENT WHERE THE RENEWAL SURVEY HAS BEEN  
COMPLETED AND REGULATION E-5.4 APPLIES**

The ship complies with the relevant provisions of the Convention, and this Certificate shall, in accordance with regulation E-5.4 of the annex to the Convention, be accepted as valid until .....

Signed .....  
(Signature of authorized official)

Place .....

Date.....

(Seal or stamp of the authority, as appropriate)

---

\* Delete as appropriate.

**ENDORSEMENT TO EXTEND THE VALIDITY OF THE CERTIFICATE UNTIL REACHING  
THE PORT OF SURVEY OR FOR A PERIOD OF GRACE  
WHERE REGULATION E-5.5 OR E-5.6 APPLIES**

This Certificate shall, in accordance with regulation E-5.5 or E-5.6\* of the annex to the Convention, be accepted as valid until .....

Signed .....  
(Signature of authorized official)

Place .....

Date.....

(Seal or stamp of the authority, as appropriate)

**ENDORSEMENT FOR ADVANCEMENT OF ANNIVERSARY DATE  
WHERE REGULATION E-5.8 APPLIES**

In accordance with regulation E-5.8 of the annex to the Convention, the new anniversary date is .....

Signed .....  
(Signature of authorized official)

Place .....

Date.....

(Seal or stamp of the authority, as appropriate)

In accordance with regulation E-5.8 of the annex to the Convention, the new anniversary date is .....

Signed .....  
(Signature of duly authorized official)

Place .....

Date.....

(Seal or stamp of the authority, as appropriate)

---

\* Delete as appropriate.

## APPENDIX II

### FORM OF BALLAST WATER RECORD BOOK

#### BALLAST WATER RECORD BOOK

#### INTERNATIONAL CONVENTION FOR THE CONTROL AND MANAGEMENT OF SHIPS' BALLAST WATER AND SEDIMENTS

Name of ship: .....

IMO number, distinctive numbers or letters: .....

Gross tonnage: .....

Flag: .....

Total ballast water capacity (in cubic metres): .....

Number of the International Ballast Water Management Certificate: .....

Period From: ..... To: .....

**A diagram identifying the ballast tanks of the ship, corresponding to the Ballast Water Management Plan, including any multi-use tank, space or compartment designed to allow carriage of ballast water, is integral to and shall be a part of this Ballast Water Record Book.**

## Introduction

In accordance with regulation B-2 of the annex to the International Convention for the Control and Management of Ships' Ballast Water and Sediments, a record is to be kept of each ballast water operation. This includes discharges at sea and to reception facilities.

"Ballast water" means water with its suspended matter taken on board a ship to control trim, list, draught, stability, or stresses of a ship. Management of ballast water shall be in accordance with an approved Ballast Water Management Plan and taking into account the Guidelines developed by the Organization.

"Final total quantity retained on board" means the aggregated volume of ballast water remaining in all ballast water tanks on board upon completion of the relevant operation.

The Ballast Water Record Book entries should be completed, taking into account any guidelines developed by the Organization.

The quantity of ballast water should be estimated in cubic metres. It is recognized that ballast water quantities are estimated values and may vary based on tank sounding or other measurement methods.

## ENTRIES IN THE BALLAST WATER RECORD BOOK

Entries in the Ballast Water Record Book shall be made on each of the following occasions:

### **(A) When ballast water is taken on board from the aquatic environment (ballasting operation)**

- .1 Start time and location (port of uptake or latitude/longitude)
- .2 Completion time and location (port of uptake or latitude/longitude and minimum depth of water during uptake)
- .3 The identity of the tanks affected
- .4 Total quantity of uptake and final total quantity retained on board in cubic metres
- .5 Whether conducted in accordance with the approved Ballast Water Management Plan
- .6 Ballast water treatment method

### **(B) When ballast water is discharged into the aquatic environment (deballasting operation)**

- .1 Start time and location (port of discharge or latitude/longitude)
- .2 Completion time and location (port of discharge or latitude/longitude and minimum depth of water during discharge)
- .3 The identity of the tanks affected
- .4 Total quantity of discharge and final total quantity retained on board in cubic metres

.5 Whether conducted in accordance with the approved Ballast Water Management Plan

.6 Ballast water treatment method

**(C) Whenever ballast water is exchanged, treated through internal circulation or treated in a tank**

**1 Ballast water exchange**

.1 Start time and location (latitude/longitude)

.2 Completion time and location (latitude/longitude)

.3 Minimum distance from the nearest land and minimum depth of water during the exchange or, if applicable, identify the designated exchange area in accordance with regulation B-4.2

.4 Whether conducted in accordance with the Ballast Water Management Plan and state the ballast water exchange method (sequential or flow-through or dilution) used

.5 The identity of the tanks affected

.6 Total quantity exchanged and final total quantity retained on board in cubic metres

.7 Treatment method for the incoming ballast water

**2 Ballast water internal circulation for treatment or in-tank treatment**

.1 Start time

.2 Completion time

.3 The identity of the tanks affected (identifying source and destination tanks if applicable)

.4 Total quantity treated (through circulation or in tank) in cubic metres

.5 Ballast water treatment method

**(D) Uptake or discharge of ballast water from/to a port-based or reception facility**

.1 Start time and location of uptake/discharge (state facility name)

.2 Completion time

.3 Operation carried out (whether uptake or discharge)

.4 The identity of the tanks affected

.5 Total quantity of uptake or discharge and final total quantity retained on board in cubic metres

- .6 Whether conducted in accordance with the approved Ballast Water Management Plan
- .7 Onboard ballast water treatment method

**(E) Accidental discharge/ingress or other exceptional uptake or discharge of ballast water**

- .1 Start time and location of ingress/uptake/discharge (port name or latitude/longitude)
- .2 Completion time
- .3 Operation carried out (whether ingress, uptake or discharge)
- .4 The identity of the tanks affected
- .5 Total quantity of accidental discharge/ingress or other exceptional uptake or discharge in cubic metres
- .6 State the circumstances of ingress, uptake, discharge or loss, the reason thereof, any treatment method used and general remarks

**(F) Failures and inoperabilities\* of the ballast water management system**

- .1 Time and location (port name or latitude/longitude) of failure of the ballast water management system
- .2 Operation carried out (state whether uptake or discharge)
- .3 Description of the issue (e.g. kind of alarm or other description of circumstances)
- .4 Time and location (port name or latitude/longitude) when the ballast water management system has been made operational

**(G) Ballast tank cleaning/flushing, removal and disposal of sediments**

- .1 Time and ship's location on commencement of ballast tank cleaning/flushing, removal or disposal of sediments (port name or latitude/longitude)
- .2 Time and ship's location on completion of ballast tank cleaning/flushing, removal or disposal of sediments (port name or latitude/longitude)
- .3 Tank(s) identification (name of the ballast tanks as per the Ballast Water Management Plan)
- .4 Discharge or disposal to a reception facility (state quantity in cubic metres and name of the facility)

---

\* Failures and inoperabilities include malfunctions, shutdowns or critical alarms indicating a failure of the ballast water management system which may indicate non-compliance with the D-2 standard (except routine information and warnings).

- .5 Disposal or discharge to the aquatic environment as per Ballast Water Management Plan (state quantity in cubic metres, minimum distance from the nearest land in nm and minimum depth of water in metres)

**(H) Additional operational procedures and general remarks**

## Sample Ballast Water Record Book Page

Name of ship: .....

IMO number, distinctive numbers or letters: .....

[illegible]

Signature of the master .....

## APPENDIX

## BALLAST WATER MANAGEMENT SYSTEM MAINTENANCE LOG

(To be used only by ships that do not have an existing recording system that fulfils the requirements of regulation B-2 to the satisfaction of the Administration)

**Introduction**

In accordance with regulation B-2 of the annex to the International Convention for the Control and Management of Ships' Ballast Water and Sediments, a record is to be kept of any maintenance operation that is undertaken on any ballast water management system installed on the ship. This includes both planned maintenance and unplanned maintenance or repairs to any ballast water management system. For ships that do not have an existing maintenance recording system that fulfils the requirements of regulation B-2 to the satisfaction of the Administration, records of maintenance are to be kept in a log within the Ballast Water Record Book.

The Ballast Water Management System Maintenance Log entries should be completed, taking into account any guidelines to be developed by the Organization.

Entries in the Ballast Water Management System Maintenance Log shall be made on each of the following occasions:

**(I) Planned maintenance of the ballast water management system**

- .1 Ballast water management system operation, maintenance and safety manual reference for maintenance item
- .2 Details of maintenance (state details of what was required and undertaken)
- .3 State who conducted the maintenance (e.g. ballast water management system technician, engineer, crew member)

**(J) Unplanned maintenance or repair of the ballast water management system**

- .1 State the reason for the unplanned maintenance or repair (e.g. issue requiring to be addressed)
- .2 Details of the unplanned maintenance or repair (state details of what was required and undertaken)
- .3 State who conducted the unplanned maintenance or repair (e.g. ballast water management system technician, engineer, crew member)

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**ANNEX 6****RESOLUTION MEPC.409(84)  
(adopted on 1 May 2026)****2026 GUIDELINES FOR BALLAST WATER MANAGEMENT AND DEVELOPMENT  
OF BALLAST WATER MANAGEMENT PLANS (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 conferred upon it by the international conventions for the prevention and control of marine pollution,

RECALLING ALSO that the International Conference on Ballast Water Management for Ships held in February 2004 adopted the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (the Ballast Water Management Convention) together with four Conference resolutions,

NOTING that regulation A-2 of the Ballast Water Management Convention requires that the discharge of ballast water shall only be conducted through ballast water management in accordance with the provisions of the Annex to the Convention,

NOTING ALSO that regulation B-1 of the Annex to the Ballast Water Management Convention provides that each ship shall have on board and implement a Ballast Water Management Plan approved by the Administration, taking into account Guidelines developed by the Organization,

NOTING FURTHER resolution MEPC.127(53), by which the Committee adopted the *Guidelines for ballast water management and development of Ballast Water Management Plans* (G4) and resolved to keep them under review, and resolutions MEPC.306(73) and MEPC.370(80), by which the Committee adopted amendments to the Guidelines (G4),

HAVING CONSIDERED, at its eighty-fourth session, the outcome of the Correspondence Group on Review of the BWM Convention,

- 1 ADOPTS the *2026 Guidelines for ballast water management and development of Ballast Water Management Plans*, as set out in the annex to this resolution;
- 2 INVITES Member Governments to bring these Guidelines to the attention of all parties concerned and to apply the Guidelines as soon as possible, or when the Convention becomes applicable to them;
- 3 AGREES to keep the Guidelines under review; and
- 4 RESOLVES to revoke the *Guidelines for ballast water management and development of Ballast Water Management Plans* adopted by resolution MEPC.127(53) and amended by resolutions MEPC.306(73) and MEPC.370(80) when the amendments to the BWM Convention approved at the same session enter into force.

## ANNEX

### 2026 GUIDELINES FOR BALLAST WATER MANAGEMENT AND DEVELOPMENT OF BALLAST WATER MANAGEMENT PLANS (G4)

#### 1 INTRODUCTION

1.1 Ballast water is essential to control trim, list, draught, stability, or stresses of the ship. However, ballast water may contain aquatic organisms or pathogens which, if introduced into the sea, including estuaries, or into freshwater courses, may create hazards to the environment, human health, property or resources, impair biological diversity or interfere with other legitimate uses of such areas.

1.2 The selection of appropriate methods of ballast water management should take into account the need to ensure that ballast water management practices used to comply with this Convention do not cause greater harm than they prevent to the environment, human health, property or resources of any States and the safety of ships.

1.3 The objectives of these Guidelines are to assist Governments, appropriate authorities, ships masters, operators and owners, and port authorities, as well as other interested parties, in preventing, minimizing and ultimately eliminating the risk of introducing harmful aquatic organisms and pathogens from ships' ballast water and associated sediments while protecting ships' safety in applying the *International Convention for the Control and Management of Ships' Ballast Water and Sediments* (hereinafter referred to as "the Convention").

1.4 These guidelines consist of two parts:

Part A – "Guidelines for ballast water management", which contains guidance on the general principles of ballast water management; and

Part B – "Guidelines for the development of Ballast Water Management Plans", which contains guidance on the structure and content of Ballast Water Management Plans required by regulation B-1 of the Convention.

#### 2 DEFINITIONS

2.1 For the purposes of these Guidelines, the definitions in the Convention apply.

2.2 Ballast water tank means any tank, hold, or space used for the carriage of ballast water.

#### 3 APPLICATION

3.1 The Guidelines apply to all ships and to flag Administrations, port States, coastal States, ship owners, ship operators, ships' personnel involved in ballast water management, ship designers, ship builders, classification societies as well as other interested parties.

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## **PART A – GUIDELINES FOR BALLAST WATER MANAGEMENT**

### **1 SHIP OPERATIONAL PROCEDURES**

#### **1.1 Precautionary practices**

##### ***Avoiding unnecessary discharge of ballast water***

1.1.1 If it is necessary to take on and discharge ballast water in the same port to facilitate safe cargo operations, care should be taken to avoid unnecessary discharge of ballast water that has been taken up in another port.

1.1.2 Managed ballast water, which is mixed with unmanaged ballast water, is no longer in compliance with regulations D-1 and D-2 of the annex to the Convention.

##### ***Minimizing the uptake of harmful aquatic organisms, pathogens and sediments***

1.1.3 When loading ballast water, every effort should be made to avoid the uptake of potentially harmful aquatic organisms, pathogens, and sediment that may contain such organisms. The uptake of ballast water should be minimized or, where practicable, avoided in areas and situations such as:

- .1 in areas identified by the port State in connection with advice provided by ports under paragraph 2.2.2;
- .2 in darkness when organisms may rise up in the water column;
- .3 in very shallow water;
- .4 where propellers may stir up sediment; or
- .5 where dredging is or recently has been carried out.

#### **1.2 Ballast water management options**

##### ***1.2.1 Ballast water exchange***

1.2.1.1 Ballast water exchange is to be conducted in accordance with regulation B-4 of the Convention and in accordance with the Guidelines for ballast water exchange.

1.2.1.2 The voyage should be planned taking into account when ballast water exchange in accordance with regulation B-4 of the Convention can be carried out.

1.2.1.3 Because of the possibility that partial exchange may encourage re-growth of organisms, ballast water exchange should only be commenced in any tank if there is sufficient time to complete the exchange to comply with the standard in regulation D-1 and the ship can comply with the distance from land and minimum water depth criteria in regulation B-4. As many complete tanks should be exchanged to the standard in regulation D-1 as the time allows; if for any tank the standard in regulation D-1 can not be fully met the exchange should not be commenced for that tank.

1.2.1.4 If ballast water exchange is not undertaken for the reasons in regulation B-4.4, i.e. if the master reasonably decides that such exchange would threaten the safety or stability of the ship, its crew, or its passengers because of adverse weather, ship design or stress, equipment failure, or any other extraordinary condition, then details of the reasons ballast water exchange was not undertaken are to be recorded in the Ballast Water Record Book.

1.2.1.5 A port State may designate areas in which exchange may be conducted taking into account the Guidelines on designation of areas for ballast water exchange. Designated areas should only be used for those ballast water tanks that are intended to be discharged in the port of that State, and that could not be exchanged in accordance with regulation B-4.1 of the Convention.

### **1.2.2 *Ballast water management systems***

1.2.2.1 Ballast water management systems installed for compliance with regulation B-3 are to be approved in accordance with regulation D-3. Such systems are to be operated in accordance with the system design criteria and the manufacturer's operational and maintenance instructions. The use of such systems should be detailed in the ship's Ballast Water Management Plan. All failures and malfunctions of the system are to be recorded in the Ballast Water Record Book.

### **1.2.3 *Discharge to ballast water reception facilities***

1.2.3.1 If ballast water reception facilities provided by a port State are utilized, regulation B-3.6 applies.

### **1.2.4 *Prototype ballast water treatment technologies***

1.2.4.1 Prototype ballast water treatment technologies should be used within a programme approved by the Administration in accordance with regulation D-4.

## **1.3 *Sediment management***

1.3.1 Regulation B-5 requires that all ships shall remove and dispose of sediments from spaces designated to carry ballast water in accordance with the Ballast Water Management Plan.

1.3.2 All practical steps should be taken during ballast water uptake to avoid sediment accumulation, however, it is recognized that sediment will be taken on board and will settle on tank surfaces. When sediment has accumulated, consideration should be given to flushing tank bottoms and other surfaces when in suitable areas, i.e. areas complying with the minimum depth and distance described by regulations B-4.1.1 and B-4.1.2.

1.3.3 The volume of sediment in a ballast water tank should be monitored on a regular basis.

1.3.4 Sediment in ballast water tanks should be removed in a timely basis in accordance with the Ballast Water Management Plan and as found necessary. The frequency and timing of removal will depend on factors such as sediment build-up, ship's trading pattern, availability of reception facilities, workload of the ship's personnel and safety considerations.

1.3.5 Removal of sediment from ballast water tanks should preferably be undertaken under controlled conditions in port, at a repair facility or in dry dock. The removed sediment should preferably be disposed of in a sediment reception facility if available, reasonable and practicable.

1.3.6 When sediment is removed from the ship's ballast water tanks and is to be disposed of by that ship at sea, such disposal should only take place in areas outside 200 nm from land and in water depths of over 200 m.

1.3.7 Regulation B-5 requires that ships constructed in or after 2009 should, without compromising safety or operational efficiency, be designed and constructed with a view to minimizing the uptake and undesirable entrapment of sediment, facilitating removal of sediment, and providing safe access to allow for sediment removal and sampling, taking into account the *Guidelines on design and construction to facilitate sediment control on ships* (G12). This also applies to ships constructed prior to 2009, to the extent practicable.

## **1.4 Additional measures**

1.4.1 Ships to which additional measures apply, under regulation C-1, should take them into account in the ship's voyage planning. Actions taken to comply with any additional measures should be recorded in the Ballast Water Record Book.

## **1.5 Exemptions**

1.5.1 Regulation A-4 provides that an exemption may be granted from the requirements of regulations B-3 or C-1 by a Party or Parties to a ship in specific circumstances. Applications for and the granting of such exemptions should be completed in accordance with the *2017 Guidelines for risk assessment under regulation A-4 of the BWM Convention* (G7).

1.5.2 Ships granted an exemption referred to in paragraph 1.5.1 above should record the exemption in the Ballast Water Record Book and what actions have been taken with regard to the ship's ballast water.

# **2 RECORDING PROCEDURES**

## **2.1 Procedures for ships**

2.1.1 To facilitate the administration of ballast water management and treatment procedures on board each ship, a responsible officer is to be designated in accordance with regulation B-1 to ensure the maintenance of appropriate records and to ensure that ballast water management and/or treatment procedures are followed and recorded.

2.1.2 When carrying out any ballast water operation, the details are to be recorded in the Ballast Water Record Book together with any exemptions granted in accordance with regulation B-3 or C-1. In recording these operations and exemptions, the *2024 Guidance on ballast water record-keeping and reporting* (BWM.2/Circ.80/Rev.1, as may be amended) should be taken into account.

2.1.3 Where a port State requires specific information regarding the management of ballast water on a ship bound for a port, offshore terminal or anchorage area in that port State, a completed ballast water reporting form (BWRF) as set out in the *2024 Guidance on ballast water record-keeping and reporting* (BWM.2/Circ.80/Rev.1, as may be amended) may be submitted prior to entry into that port State in a time frame required by that port State. Keeping records on a tank-by-tank basis, while not mandatory, may facilitate the completion of a BWRF. An example form for maintaining voluntary tank-by-tank records is annexed to the *2024 Guidance on ballast water record-keeping and reporting*.

2.1.4 Where a port State requires information on a ship's ballast operations, relevant documentation, which takes account of the information requirements of the Convention, should be made available to the port State.

## **2.2 Procedures for port States**

2.2.1 Port States should provide ships with details of their requirements concerning ballast water management, including:

- .1 the location and terms of use of areas designated for ballast water exchange under regulation B-4.2 of the Convention;
- .2 any additional measures determined under regulation C-1 of the Convention;
- .3 warnings concerning ballast uptake and any other port contingency arrangements in the event of emergency situations; and
- .4 the availability, location and capacities of reception facilities that are provided for the environmentally safe disposal of ballast water and/or sediments, under article 5 and regulation B-3.6.

2.2.2 To assist ships in applying the precautionary practices described in section 1.1 of part A, port States are required by regulation C-2 of the Convention to endeavour to notify mariners of area(s) where ships should not uptake ballast water owing to known conditions. Similar notification should be given for areas where the uptake of ballast water should be minimized, such as:

- .1 areas with outbreaks, infestations or known populations of harmful organisms and pathogens;
- .2 areas with current phytoplankton blooms (algal blooms, such as red tides);
- .3 nearby sewage outfalls;
- .4 areas where a tidal stream is known to be the more turbid;
- .5 areas where tidal flushing is known to be poor;
- .6 nearby dredging operations; and
- .7 nearby or in sensitive or estuarine sea areas.

## **3 TRAINING AND EDUCATION**

3.1 Regulation B-6 requires that officers and crew shall be familiar with their duties in the implementation of ballast water management particular to the ship on which they serve. Owners, managers, operators, and others involved in officer and crew training for ballast water management should consider the following:

3.2 Training for ships' masters and crews as appropriate should include instructions on the requirements of the Convention, the ballast water and sediment management procedures and the Ballast Water Record Book particularly having regard to matters of ship safety and maintenance of records taking into account the information contained in these Guidelines.

3.3 The Ballast Water Management Plan should include training and education on ballast water management practices and the systems and procedures used on board the ship.

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## **PART B – GUIDELINES FOR THE DEVELOPMENT OF BALLAST WATER MANAGEMENT PLANS**

### **1 INTRODUCTION**

1.1 These Guidelines have been developed to assist with the preparation of a ship's Ballast Water Management Plan (hereafter referred to as "the Plan"). The Plan must be approved by the Administration in accordance with regulation B-1 of the Convention.

1.2 This part is comprised of three primary sections:

- .1 General: this section provides the objectives and a general overview of the subject matter and introduces the reader to the basic concept of the Guidelines and the Plan that is expected to be developed from them. This section also contains guidance on updating and use of the Plan.
- .2 Mandatory provisions: this section provides guidance to ensure that the mandatory provisions of regulation B-1 of the annex to the Convention are met.
- .3 Non-mandatory provisions: this section provides guidance concerning the inclusion of other information in the Plan. This information, although not required under regulation B-1 of the Convention, may be found useful by local authorities in ports visited by the ship, or may provide additional assistance to the ship's master.

1.3 The format for a Ballast Water Management Plan is given in the appendix. Ships should consider utilizing the standard format to provide greater consistency.

### **2 GENERAL**

#### **2.1 Concept of the Guidelines**

2.1.1 These Guidelines are intended to provide a basis for the preparation of the Plans for individual ships. The broad spectrum of ships for which Plans are required makes it impractical to provide specific guidelines for each ship type. For a Plan to be effective and to comply with regulation B-1 of the annex of the Convention, it must be carefully tailored to the particular ship for which it is intended. Properly used, the Guidelines will ensure that all appropriate issues that may be applicable to a particular ship are considered in developing the Plan.

2.1.2 The issues that may require consideration include but are not limited to: type and size of ship, volume of ballast water carried and total capacity of tanks used for ballast water, ballast water pumping capacity, ship and crew safety issues, voyage type and length, the ship's typical operational requirements, and ballast water management techniques used on board.

#### **2.2 Concept of the Plan**

2.2.1 The Plan is required to be on board the ship and available to guide personnel in the safe operation of the ballast system employed on a particular ship. Effective planning ensures that the necessary actions are taken in a structured, logical, and safe manner.

2.2.2 For the Plan to accomplish its purpose, it must be:

- .1 realistic, practical and easy to use;
- .2 understood by ship's personnel engaged in ballast water management, both on board and ashore;
- .3 evaluated, reviewed, and updated as necessary; and
- .4 consistent with the operational ballasting requirements of the ship.

2.2.3 The Plan envisioned by regulation B-1 of the Annex to the Convention is intended to be a simple document. Inclusion of extensive background information on the ship, its structure, etc., should be avoided, as this is generally available elsewhere. If such information is relevant, it should be kept in annexes, or an existing document or manual reference should be made to the location of the information.

2.2.4 The Plan is a document to be used on board by the ship's personnel engaged in ballast water management. The Plan must therefore be available in a working language of the ship's personnel. A change in the personnel and/or the working language would require the issuance of the Plan in the new language(s).

2.2.5 The Plan should be readily available for inspection by officers authorized by a Party to the Convention.

## **2.3 Exemptions**

2.3.1 Regulation A-4 allows that an exemption may be granted to a ship from regulation B-3 or C-1.

2.3.2 Details of exemptions should be retained with the Plan.

2.3.3 Any exemption granted is to be recorded in the Ballast Water Record Book.

## **2.4 Additional measures**

2.4.1 The Convention, in regulation C-1 (Additional Measures), gives a Party, individually or jointly with other Parties, the right to introduce measures in addition to those in section B. Such additional measures are to be communicated to the Organization at least 6 months prior to the projected date of implementation.

2.4.2 The Plan should be accompanied by the most recent list of additional measures, as communicated by the Organization relevant to the ship's trade. The Plan should contain details and advice on the actions a ship must take to comply with any additional measures that may be required in accordance with regulation C-1 and for any emergency or epidemic situations.

## **2.5 Review of the Plan**

2.5.1 Regular review of the Plan by the owner, operator, or master should be conducted to ensure that the information contained is accurate and updated. A feedback system should be employed which will allow quick capture of changing information and incorporation of it into the Plan.

2.5.2 The Plan should be updated when any ballast water management system installed on the ship is upgraded or retrofitted.

2.5.3 Changes to the provisions of this Plan will need Administration approval.

### **3 MANDATORY PROVISIONS**

3.1 This section provides individual guidelines for the 12 mandatory provisions of regulation B-1 of the Annex to the Convention. In addition, it provides information to assist ships' personnel in managing ballast water and sediments.

3.2 Regulation B-1 of the Annex to the Convention provides that the Plan shall be specific to each ship and shall at least:

- .1 detail safety procedures for the ship and the crew associated with ballast water management as required by the Convention;
- .2 provide a detailed description of the actions to be taken to implement the ballast water management practices required by the Convention;
- .3 identify whether any ballast water management system installed on the ship was type approved in accordance with the BWMS Code or taking into account the Guidelines (G8), or is being operated in accordance with regulation D-4;
- .4 include high-level information on maintenance procedures and schedules necessary to keep any ballast water management system installed on the ship operating in good working order, and refer to the operation, maintenance and safety manual for the detailed procedures;
- .5 detail the procedures for the disposal of sediments at sea and to shore;
- .6 include the procedures for co-ordinating shipboard ballast water management that involves discharge to the sea with the authorities of the State into whose waters such discharge will take place;
- .7 include a procedure for safe ballast water exchange, including for partially treated and/or non-neutralized ballast water, taking into account the Guidelines developed by the Organization;
- .8 detail how the ship will plan for contingency measures, taking into account the Guidelines developed by the Organization;
- .9 include, if applicable, a procedure for the temporary storage of treated sewage and/or grey water in ballast water tanks, taking into account the Guidelines developed by the Organization;
- .10 designate the officer on board in charge of ensuring that the Plan is properly implemented;
- .11 contain the reporting requirements for ships provided for under the Convention; and

- .12 be written in the working language of the ship. If the language used is not English, French or Spanish, a translation into one of these languages should be provided.

3.3 The Ballast Water Management Plan should give guidance on the ballast handling procedures to be followed, including:

- .1 uptake of ballast water;
- .2 step-by-step procedures and sequences for the ballast system used;
- .3 detailed procedures for contingency measures;
- .4 procedures for the temporary storage of treated sewage and/or grey water in ballast water tanks, if applicable; and
- .5 any operational or safety restrictions including those associated with the ballast system used. This will also assist ship's personnel when responding to enquiries from inspection officers authorized by a Party.

3.4 Safety aspects of the ballast system used should include, as applicable, guidance on:

- .1 stability to be maintained at all times to values not less than those recommended by the Organization (or required by the Administration);
- .2 approved longitudinal stress and, where applicable, torsional stress values are to be maintained within permitted values;
- .3 transfer or exchange of ballast water that can generate significant structural loads by sloshing action in partially-filled tanks. If these operations include partially-filled tanks, consideration should be given to carrying out the operation in favourable sea and swell conditions such that the risk of structural damage is minimized;
- .4 wave-induced hull vibrations when carrying out ballast water exchange;
- .5 forward and aft draughts and trim, with particular reference to bridge visibility, slamming and minimum forward draft;
- .6 the effects of any potential hazards and occupational health that may affect the ship's personnel shall also be identified together with any safety precautions that need to be taken; and
- .7 the possible effects of tank over pressurization.

3.5 If a ship is able to complete at least 95 per cent volumetric exchange in less than three pumped volumes, documentation indicating that this ballast water exchange process has been approved under regulation D-1.2 should be provided in the Plan.

3.6 The Plan should also include procedures for the disposal of sediments and in particular:

- .1 on the sediment removal or reduction at sea, and when cleaning of the ballast tanks to remove sediments;

- .2 regarding the safety considerations to be taken if tank entry is required to remove sediments; and
- .3 regarding the use of port reception facilities for sediments.

3.7 The Plan should detail suitable contingency measures to be taken in the event that the ship is unable to manage ballast water in accordance with regulation D-2, taking into account the Guidelines<sup>1</sup> developed by the Organization.

3.8 The Plan should include ship-specific measures and procedures related to managing challenging water quality conditions, taking into account the Guidelines<sup>2</sup> developed by the Organization.

3.9 The Plan should include, if applicable, a procedure for the temporary storage of treated sewage and/or grey water in ballast water tanks, taking into account the Guidelines<sup>3</sup> developed by the Organization.

3.10 The Plan should clearly identify the officer in charge of ballast water management and outline his/her duties, which should include:

- .1 ensuring that the ballast water management performed follows the procedures in the Plan;
- .2 ensuring that the Ballast Water Record Book and any other necessary documentation are maintained; and
- .3 being available to assist the inspection officers authorized by a Party for any sampling that may need to be undertaken.

3.11 The Plan should contain guidance on the recording requirements according to the ship's Ballast Water Record Book provided for under this Convention, including details of exemptions granted to the ship.

3.12 In addition to the above, the Plan should include the following:

- .1 A foreword which should provide the ship's crew with explanations on the need for ballast water management and for record keeping. The foreword should include a statement that "This Plan must be kept available for inspection on request by an authorized authority".
- .2 Ship particulars, including at least:
  - .1 ships' name, flag, port of registry, gross tonnage, IMO number<sup>4</sup>, length (BP), beam, international call sign, and deepest ballast drafts (normal and heavy weather);

<sup>1</sup> Refer to the *Guidance on contingency measures under the BWM Convention* (BWM.2/Circ.62, as may be amended).

<sup>2</sup> Refer to the *Interim guidance on the application of the BWM Convention to ships operating in challenging water quality conditions* (resolution MEPC.387(81), as may be amended).

<sup>3</sup> Refer to the *Guidance for the temporary storage of treated sewage and/or grey water in ballast water tanks* (BWM.2/Circ.82, as may be amended).

<sup>4</sup> In accordance with resolution A.600(15) IMO Ship Identification Number Scheme.

- .2 the total ballast water capacity of the ship in cubic metres and other units if applicable to the ship;
  - .3 a brief description of the main ballast water management method(s) used on the ship; and
  - .4 identification (rank) of the officer in charge for implementing the Plan.
- .3 Information on the ballast system used on board, including:
- .1 ballast water tank arrangement;
  - .2 ballast water capacity plan;
  - .3 a ballast water piping and pumping arrangement, including air pipes and sounding arrangements;
  - .4 ballast water pump capacities;
  - .5 the ballast system used on board, including high-level information on operation and maintenance procedures and schedules necessary to keep any ballast water management system installed on the ship in good working order, with references to the operation, maintenance and safety manual (OMSM) held on board;
  - .6 any installed ballast water management systems and identification of whether any of these systems were type approved in accordance with the BWMS Code<sup>5</sup>, as may be amended, or taking into account the Guidelines developed by the Organization<sup>6</sup>, or are being operated in accordance with regulation D-4; and
  - .7 a plan and profile of the ship, or a schematic drawing of the ballast arrangement.
- .4 Information on ballast water sampling, including:
- .1 A list or diagrams indicating the location of sampling and access points in pipelines and ballast water tanks, to enable crew members to assist the authorized officers of a Party that have reason to obtain samples.
  - .2 Ship-specific guidance for conducting onboard sampling, which is sufficiently detailed to prevent improper sample collection (e.g. any ship and/or ballast water management system particulars that can impact the quality of discharge samples collected for sampling).

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<sup>5</sup> Refer to the *Code for Approval of Ballast Water Management Systems* (resolution MEPC.300(72), as may be amended).

<sup>6</sup> Refer to the *Guidelines for the approval of ballast water management systems* (G8) (resolutions MEPC.125(53), MEPC 174(58) or MEPC.279(70), as appropriate).

- .3 This section should make clear that sampling of ballast water is primarily a matter for the authorized inspection officers, and there is unlikely to be any need for crew members to take samples except at the express request, and under the supervision, of the authorized inspection officers.
- .4 The authorized inspection officers should be advised of all safety procedures to be observed when entering enclosed spaces.
- .5 Provisions for crew training and familiarization, including:
  - .1 requirements of a general nature regarding ballast water management;
  - .2 training and information on ballast water management practices;
  - .3 ballast water exchange;
  - .4 ballast water treatment systems;
  - .5 general safety considerations;
  - .6 the Ballast Water Record Book and maintenance of records;
  - .7 the operation and maintenance of installed ballast water management systems;
  - .8 safety aspects associated with the particular systems and procedures used on board the ship which affect the safety or human health of crew and passengers and/or the safety of the ship;
  - .9 precautions for entering tanks for sediment removal;
  - .10 procedures for the safe handling and packaging of sediment; and
  - .11 storage of sediment.

#### **4 NON-MANDATORY INFORMATION**

4.1 In addition to the provisions required by articles and regulations of the Convention, the owner/operator may include in the Plan, as appendices, additional information such as: provision of additional diagrams and drawings, shipboard equipment and reference materials. National or regional requirements that differ from the Convention may also be recorded for reference.

4.2 Non-mandatory information may also include manufacturer manuals (either as extracts or complete) or a reference to the location on board of such manuals and other relevant material.

## APPENDIX

### STANDARD FORMAT FOR THE BALLAST WATER MANAGEMENT PLAN

#### PREAMBLE

*The Ballast Water Management Plan should contain the information required by regulation B-1 of the Convention.*

*For guidance in preparing the Plan the following information is to be included. The Plan should be specific to each ship.*

#### INTRODUCTION

*At the beginning of each Plan, wording should be included to reflect the intent of the following text.*

1 This Plan is written in accordance with the requirements of regulation B-1 of the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (the Convention) and the associated Guidelines.

2 The purpose of the Plan is to meet the requirements for the control and management of ships' ballast water and sediments in accordance with the Guidelines for ballast water management and the Development of Ballast Water Management Plans (resolution MEPC.409(84)) ("the Guidelines"). It provides standard operational guidance for the planning and management of ships' ballast water and sediments and describes safe procedures to be followed.

3 This Plan has been approved by the Administration and no alteration or revision shall be made to any part of it without the prior approval of the Administration.

4 This Plan may be inspected on request by an authorized authority.

**Note: The Plan is to be written in the working language of the crew; if the text is not in English, French, or Spanish, the Plan is to include a translation into one of these languages.**

#### SHIP PARTICULARS

*At least the following details should be included:*

Ship's name;  
Flag;  
Port of registry;  
Gross tonnage;  
IMO number<sup>7</sup>;  
Length (BP);  
Beam;  
International call sign;  
Deepest ballast drafts (normal and heavy weather);

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<sup>7</sup> In accordance with resolution A.600(15), IMO Ship Identification Number Scheme.

Total ballast water capacity of the ship in cubic metres and other units if applicable to the ship;

A brief description of the main ballast water management method(s) used on the ship; and

Identification (rank) of the appointed ballast water management officer.

## **INDEX**

*An index of sections should be included to reference the content of the Plan.*

## **PURPOSE**

*Should contain a brief introduction for the ship's crew, explaining the need for ballast water management, and the importance of accurate record keeping.*

## **PLANS/DRAWINGS OF THE BALLAST SYSTEM**

*Plans or drawings of the ballast system, for example:*

- 1) ballast water tank arrangement;
- 2) ballast water capacity plan;
- 3) a ballast water piping and pumping arrangement, including air pipes and sounding arrangements;
- 4) ballast water pump capacities;
- 5) the ballast system used on board, with references to detailed operational and maintenance manuals held on board;
- 6) installed ballast water management systems; and
- 7) a plan and profile of the ship, or a schematic drawing of the ballast arrangement.

## **DESCRIPTION OF THE BALLAST SYSTEM**

*A description of the ballast system.*

## **BALLAST WATER SAMPLING POINTS**

*Lists and/or diagrams indicating the location of sampling and access points in pipelines and ballast water tanks.*

*A note that sampling of ballast water is primarily a matter for the authorized authority, and there is unlikely to be any need for crew members to take samples except at the express request, and under the supervision, of the authorized authority.*

## **OPERATION OF THE BALLAST SYSTEM**

*A detailed description of the operation of the ballast system(s) used on board.*

*Information on general ballast water management precautionary practices, including:*

- *high-level information on operation and maintenance procedures and schedules necessary to keep any ballast water management system installed on the ship in good working order, with references to the operation, maintenance and safety manual (OMSM) held on board;*
- *a procedure for safe ballast water exchange, including partially treated and/or non-neutralized ballast water, taking into account the Guidelines developed by the Organization<sup>8</sup>;*
- *a detailed plan for contingency measures, taking into account the Guidelines developed by the Organization<sup>9</sup>; and*
- *procedures for the temporary storage of treated sewage and/or grey water in ballast water tanks, if applicable, taking into account the Guidelines developed by the Organization<sup>10</sup>.*

## **SAFETY PROCEDURES FOR THE SHIP AND THE CREW**

*Details of specific safety aspects of the ballast system used.*

## **OPERATIONAL OR SAFETY RESTRICTIONS**

*Details of specific operational or safety restrictions including those associated with the management system which affects the ship and or the crew including reference to procedures for safe tank entry.*

## **DESCRIPTION OF THE METHOD(S) USED ON BOARD FOR BALLAST WATER MANAGEMENT AND SEDIMENT CONTROL**

*Details of the method(s) used on board for the management of ballast water and for sediment control including step-by-step operational procedures, including identification of whether any ballast water management system installed on the ship was type approved in accordance with the BWMS Code<sup>11</sup>, as may be amended, or taking into account the Guidelines developed by the Organization<sup>12</sup>, or is being operated in accordance with regulation D-4.*

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<sup>8</sup> Refer to the 2017 *Guidelines for ballast water exchange* (G6) (resolution MEPC.288(71), amended by resolution MEPC.371(80)), the *Interim guidance on the application of the BWM Convention to ships operating in challenging water quality conditions* (resolution MEPC.387(81)), or the *Guidance on contingency measures under the BWM Convention* (BWM.2/Circ.62), as may be amended.

<sup>9</sup> Refer to the *Guidance on contingency measures under the BWM Convention* (BWM.2/Circ.62, as may be amended).

<sup>10</sup> Refer to the *Guidance for the temporary storage of treated sewage and/or grey water in ballast water tanks* (BWM.2/Circ.82, as may be amended).

<sup>11</sup> Refer to the *Code for Approval of Ballast Water Management Systems* (resolution MEPC.300(72), as may be amended).

<sup>12</sup> Refer to the *Guidelines for the approval of ballast water management systems* (G8) (resolutions MEPC.125(53), MEPC 174(58) or MEPC.279(70), as appropriate).

## **PROCEDURES FOR THE DISPOSAL OF SEDIMENTS**

*Procedures for the disposal of sediments at sea and to shore.*

## **METHODS OF COMMUNICATION**

*Details of the procedures for co-ordinating the discharge of ballast in waters of a coastal State.*

## **DUTIES OF THE BALLAST WATER MANAGEMENT OFFICER**

*Outline of the duties of the designated officer.*

## **RECORDING REQUIREMENTS**

*Details of the record-keeping requirements of the Convention.*

## **CREW TRAINING AND FAMILIARIZATION**

*Information on the provision of crew training and familiarization.*

## **EXEMPTIONS**

*Details of any exemptions granted to the ship under regulation A-4.*

## **APPROVING AUTHORITY**

Details and stamp of approving authority.

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## ANNEX 7

### UNIFIED INTERPRETATION TO REGULATION D-3 OF THE BWM CONVENTION

**Installation date provisions applicable to ballast water management systems approved taking into account the 2016 Guidelines (G8) (resolution MEPC.279(70))**

#### **Regulation D-3**

*Approval requirements for ballast water management systems*

Regulation D-3.1 reads as follows:

"1 Except as specified in paragraph 2, ballast water management systems used to comply with this Convention shall be approved by the Administration as follows:

- .1 ballast water management systems installed<sup>1</sup> on or after 28 October 2020 shall be approved in accordance with the BWMS Code, as may be amended; and
- .2 ballast water management systems installed<sup>1</sup> before 28 October 2020 shall be approved taking into account the guidelines<sup>2</sup> developed by the Organization or the BWMS Code, as may be amended.

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<sup>1</sup> Refer to paragraph 2 of the unified interpretation of appendix I (Form of the International Ballast Water Management Certificate) of the BMW Convention related to "date installed" contained in BWM.2/Circ.66.

<sup>2</sup> Refer to resolutions MEPC.125(53), MEPC.174(58) or MEPC.279(70), as appropriate."

#### ***Interpretation:***

1.1 In accordance with paragraph 1.13 of the BWMS Code (resolution MEPC.300(72)), ballast water management systems (BWMS) approved taking into account the 2016 Guidelines (G8), adopted by resolution MEPC.279(70), shall be deemed to be in accordance with the BWMS Code. In light of this, BWMS approved taking into account the 2016 Guidelines (G8) may remain installed on board ships on or after 28 October 2020.

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## ANNEX 8

### UNIFIED INTERPRETATION TO REGULATIONS 13.2.2 AND 13.2.3 OF MARPOL ANNEX VI

#### 10 Time of replacement of an engine<sup>1</sup>

##### Regulation 13

##### *Nitrogen oxides (NO<sub>x</sub>)*

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:**

10.1 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;<sup>2</sup> or
- .2 in the absence of a contractual delivery date, the actual delivery date of the engine to the ship,<sup>3</sup> 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<sup>4</sup> specified in sub-paragraphs of regulations 13.5.1.2 or 13.5.1.3, 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.

<sup>1</sup> Existing section 10 of MEPC.1/Circ.795/Rev.9 is to be replaced by this unified interpretation in the next revision of the circular.

<sup>2</sup> 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.

<sup>3</sup> For engines without EIAPP Certification there will not be the defining NO<sub>x</sub> critical component markings or setting values as usually given in the approved Technical File. Consequently, in these instances, the assessment of "... same NO<sub>x</sub> 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).

<sup>4</sup> For an emission control area using the three dates application criteria based on the building contract date, or the keel laying date, or the delivery date, the date referred to in paragraph 10.1.3 and 10.3 is the building contract date or the keel laying date as applicable.

10.2 Entry of the date in paragraph 10.1 above, provided the conditions associated with those dates apply, should be made in item 8.a "Major conversion – According to regulations 13.2.1.1 and 13.2.2" of the Supplement of IAPP Certificate.

10.3 If the engine is not tested within six months after the date<sup>†</sup> specified in the sub-paragraphs of regulations 13.5.1.2 or 13.5.1.3, as appropriate owing 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. **Application dates for major conversion using the criteria based on "three dates"**<sup>2</sup>

### **Regulation 13**

#### *Nitrogen oxides (NO<sub>x</sub>)*

Regulation 13.2.3 reads as follows:

"A marine diesel engine referred to in paragraph 2.1.2 or 2.1.3 of this regulation shall meet the following standards:

- .1 for a ship constructed prior to 1 January 2000, the standards set forth in paragraph 3 of this regulation shall apply; and
- .2 for a ship constructed on or after 1 January 2000, the standards in force at the time the ship was constructed shall apply."

#### ***Interpretation:***

For the application of regulation 13.2.3.2:

For a ship constructed on or after 1 March 2026 and operating in the Norwegian Sea Emission Control Area defined in regulation 13.5.1.2.3 or for a ship constructed on or after 1 January 2027 and operating in the North-East Atlantic Emission Control Area defined in regulation 13.5.1.3.2, the three dates application criteria based on the building contract date, or in absence of a building contract the keel laying date, or the delivery date should be used to determine "the time the ship was constructed", without prejudice to the definition of "ship constructed" as set out in regulation 2.1.28.

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<sup>2</sup> This new section is to be added to the next revision of MEPC.1/Circ.795/Rev.9.

## ANNEX 9

### DRAFT AMENDMENTS TO MARPOL ANNEX VI

#### (Installation of pressure-vacuum devices on tankers carrying crude oil)

#### **Regulation 15**

##### *Volatile organic compounds*

- 1 A new paragraph 8 is added after the existing paragraph 7 as follows:

"8 For a tanker carrying crude oil constructed on or after [date of entry into force of the amendments], where pressure-vacuum devices are installed in accordance with regulation 11.6.1 of SOLAS chapter II-2, such devices shall have an opening pressure of not less than 0.20 bar gauge."

#### **Appendix I**

##### *Form of International Air Pollution Prevention (IAPP) Certificate (regulation 8)*

##### *Supplement to the International Air Pollution Prevention Certificate (IAPP Certificate)*

- 2 A new paragraph 2.4.2.3 is added after paragraph 2.4.2.2 as follows:

"2.4.2.3 For a tanker carrying crude oil constructed on or after [date of entry into force of the amendments], pressure-vacuum devices that are fitted in accordance with regulation 15.8 ..... □  
"

\*\*\*



## ANNEX 10

### UNIFIED INTERPRETATION TO REGULATION 16.9 OF MARPOL ANNEX VI

#### 14 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:***

14.1 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.

14.2 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 shall be designed so that the temperature in the actual combustion space where solid waste is combusted reaches 600°C within five minutes after start-up. This is a design requirement to be verified during type approval testing only. The onboard monitoring of combustion chamber flue gas outlet temperature is intended for safe operation and continuous compliance and should not be used for verification of this design requirement.

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\* Existing section 14 of MEPC.1/Circ.795/Rev.9 to be replaced by this unified interpretation in the next revision of the circular.



## ANNEX 11

### DRAFT AMENDMENTS TO THE NO<sub>x</sub> TECHNICAL CODE 2008

(Certification of engines that operate on non-carbon-containing fuel or mixtures of carbon-containing and non-carbon-containing fuels)

#### Abbreviations, subscripts and symbols

**Table 1** – Symbols and abbreviations for the chemical components

1 New rows are added to table 1 as follows:

"

| Symbol           | Definition    |
|------------------|---------------|
| C                | Carbon        |
| H <sub>2</sub>   | Hydrogen      |
| NH <sub>3</sub>  | Ammonia       |
| N <sub>2</sub> O | Nitrous oxide |

"

**Table 2** – Abbreviations for analysers for measurement of marine diesel engine gaseous emissions (refer to appendix III of this Code)

2 New rows are added to table 2 as follows:

"

| Symbol | Definition                 |
|--------|----------------------------|
| FTIR   | Fourier transform infrared |
| LIA    | Laser infrared analyser    |
| MS     | Mass spectrometer          |
| NDUV   | Non-dispersive ultraviolet |
| RS     | Raman spectrometer         |

"

**Table 3** – Symbols and subscripts for terms and variables  
(refer to chapter 5, chapter 6, appendix IV and appendix VI of this Code)

3 In table 3, the row on symbol "c<sub>x</sub>" is replaced with the following:

"

| Symbol         | Term                                                                                                        | Unit           |
|----------------|-------------------------------------------------------------------------------------------------------------|----------------|
| c <sub>x</sub> | Concentration in the exhaust (with subscript of the component nominating, d = dry, w = wet or m = measured) | ppm/%<br>(V/V) |

"

4 New rows are added to table 3 as follows:

"

| Symbol       | Term                                                       | Unit              |
|--------------|------------------------------------------------------------|-------------------|
| $M_e$        | Molar mass of the wet raw exhaust gas from measured values | g/mol             |
| $M_{gas}$    | Molar mass of gaseous components                           | g/mol             |
| $\rho_{gas}$ | Density of the gas component                               | kg/m <sup>3</sup> |
| $\rho_e$     | Density of the wet raw exhaust gas from measured values    | kg/m <sup>3</sup> |

"

5 Table 4 is replaced with the following:

**Table 4 – Symbols for fuel oil composition**

| Symbol        | Definition                           | Unit  |
|---------------|--------------------------------------|-------|
| $W_{ALF}^*$   | H content of fuel                    | % m/m |
| $W_{BET}^*$   | C content of fuel                    | % m/m |
| $W_{GAM}^*$   | S content of fuel                    | % m/m |
| $W_{DEL}^*$   | N content of fuel                    | % m/m |
| $W_{EPS}^*$   | O content of fuel                    | % m/m |
| $\alpha^{**}$ | Molar hydrogen-to-carbon ratio (H/C) | 1     |
| $\gamma$      | Molar sulphur-to-carbon ratio (S/C)  | 1     |
| $\varepsilon$ | Molar oxygen-to-carbon ratio (O/C)   | 1     |

\* "<sub>1</sub>" denotes fuel fraction for fuel oil type 1 in dual fuel applications.

"<sub>2</sub>" denotes fuel fraction for fuel oil type 2 in dual fuel applications.

$$^{**}\alpha = 11.9164 \cdot \frac{W_{ALF}}{W_{BET}}$$

"

6 A new table 5 is added after the existing table 4 as follows:

"

**Table 5 – Chemical components, molar masses and densities**  
(refer to appendix VI of this Code)

| Chemical component             | Molar Mass (g/mol) | Density* (kg/m <sup>3</sup> ) |
|--------------------------------|--------------------|-------------------------------|
| CO                             | 28.0101            | 1.2497                        |
| CO <sub>2</sub>                | 44.0095            | 1.9636                        |
| H <sub>2</sub>                 | 2.01588            | 0.08994                       |
| H <sub>2</sub> O               | 18.0153            | 0.80375                       |
| HC <sup>**</sup>               | 13.8754            | 0.61905                       |
| N <sub>2</sub> O               | 44.0128            | 1.9636                        |
| NH <sub>3</sub>                | 17.0305            | 0.75982                       |
| NO <sub>x</sub> <sup>***</sup> | 46.0055            | 2.0525                        |
| O <sub>2</sub>                 | 31.9988            | 1.4277                        |

\*At 273.15 K and 101.325 kPa.

\*\*Molar mass used for HC based on a hydrogen-to-carbon ratio of 1.85.

\*\*\*Molar mass based on molecular weight of NO<sub>2</sub>.

"

## Chapter 1 – General

### 1.3 Definitions

7 New paragraphs 1.3.38 and 1.3.39 are added after existing paragraph 1.3.37<sup>1</sup> as follows:

"1.3.38 *Dual fuel* means relating to a marine diesel engine designed for concurrent operation with two or more different types of fuel oil. In such cases, one of the fuel oils is used as a pilot fuel or balance fuel.

1.3.39 *Gas fuel* means a fuel oil with a vapour pressure exceeding 0.28 MPa absolute at a temperature of 37.8°C.<sup>1</sup>

<sup>1</sup> Refer to paragraph 2.2.18 of the International Code of Safety for Ships Using Gases or other Low-flashpoint Fuels (IGF Code).

"

## Chapter 5 – Procedures for NO<sub>x</sub> emission measurements on a test bed

### 5.3 Test fuel oils

8 Paragraph 5.3.2 is replaced with the following:

"5.3.2 The selection of the fuel oil for the test depends on the purpose of the test. In the case of an engine which is to operate on petroleum-derived fuel oils and a suitable reference fuel oil is not available, it is recommended to use a DM-grade (distillate) marine fuel specified in ISO 8217:2005, with properties suitable for the engine type. In case a DM-grade fuel oil is not available, an RM-grade (residual) fuel oil according to ISO 8217:2005 shall be used. The fuel oil shall be analysed for its composition of all components necessary for a clear specification and determination of DM or RM grade. The nitrogen content shall also be determined. The fuel oil used during the parent engine test shall be sampled during the test."

9 Paragraph 5.3.4 is replaced with the following:

"5.3.4 The gas fuel as used for the test shall be representative of the gas fuel composition to be used in service. A gas fuel sample shall be collected during the test of the parent engine, except for ammonia fuel and hydrogen fuel where manufacturer's certificates of analysis obtained at fuel procurement may be substituted. The gas fuel shall be analysed to give fuel composition and fuel specification as required by the Administration."

10 Paragraph 5.3.6 is replaced with the following:

"5.3.6 In the case of a dual fuel engine, the engine shall be tested at each mode point with the fuel mix ratio which results in the highest NO<sub>x</sub> value (g/kWh), which shall then be the certified limit value for that fuel mix and parameter."

<sup>1</sup> Paragraphs 1.3.21 to 1.3.37, added by resolution MEPC.397(83), are expected to enter into force on 1 March 2027.

## **5.5 Determination of exhaust gas flow**

11 Paragraph 5.5.1 is replaced with the following:

"5.5.1 The exhaust gas flow shall be determined by one of the methods specified in 5.5.2, 5.5.3, 5.5.4, 5.5.5 or 5.5.6."

12 Section 5.5.4 is replaced with the following:

*"5.5.4 Fuel flow and carbon balance method for carbon-containing fuels, or fuel mixtures, with  $\alpha \leq 6.0$*

5.5.4.1 This involves exhaust mass flow rate calculation from fuel consumption, fuel composition and exhaust gas concentrations, if the actual hydrogen-to-carbon ratio of the fuel,  $\alpha$ , over the test mode is less than or equal to 6.0 according to equation (12) of this Code, using the carbon balance method, as specified in section 3 of appendix VI of this Code."

13 New sections 5.5.5 and 5.5.6 are added after section 5.5.4 as follows:

*"5.5.5 Fuel flow and hydrogen balance method for non-carbon-containing fuels, or fuel mixtures, with  $\alpha > 6.0$*

5.5.5.1 This involves exhaust mass flow rate calculation from fuel consumption, fuel composition and exhaust gas concentrations, if the actual hydrogen-to-carbon ratio of the fuel,  $\alpha$ , over the test mode is greater than 6.0 according to equation (12) of this Code, using the hydrogen balance method, as specified in section 4 of appendix VI of this Code.

*5.5.6 Fuel flow and oxygen balance method for non-carbon-containing fuels, or fuel mixtures, with  $\alpha > 6.0$*

5.5.6.1 This involves exhaust mass flow rate calculation from fuel consumption, fuel composition and exhaust gas concentrations, if the actual hydrogen-to-carbon ratio of the fuel,  $\alpha$ , over the test mode is greater than 6.0 according to equation (12) of this Code, using the oxygen balance method, as specified in section 5 of appendix VI of this Code."

## **5.9 Test run**

14 The title of section 5.9.2 is replaced with the following:

*"5.9.2 Main exhaust components (if applicable, based on fuel type/mixture): CO, CO<sub>2</sub>, HC, NO<sub>x</sub>, O<sub>2</sub>, H<sub>2</sub>, NH<sub>3</sub>, N<sub>2</sub>O and H<sub>2</sub>O"*

15 Paragraph 5.9.2.1 is replaced with the following:

"5.9.2.1 An analytical system for the determination of the gaseous emissions in the raw exhaust gas shall be based on the use of analysers given in 5.4. Note that the gaseous emissions measured, with the exception of NO<sub>x</sub>, are dependent on the fuel type and method used to determine exhaust gas flow in 5.5. "

16 Paragraph 5.9.3.2 is replaced with the following:

"5.9.3.2 The exhaust gas temperature shall be at least 191°C at the HC sample probe. The exhaust gas temperature at the sample probe for gas types other than those measured by HC sampling probes must be high enough to prevent water condensation at the expected maximum water vapour concentration. For example, this can be achieved at 70°C for diesel fuel and 85°C for pure hydrogen fuel."

17 Section 5.9.7 is replaced with the following:

**"5.9.7 Analyser response**

5.9.7.1 When stabilized, the output of the analysers shall be recorded both during the test and during all zero and span response checks, using a data acquisition system or a strip chart recorder. The recording period shall not be less than 10 minutes when analysing exhaust gas or not less than 3 minutes for each zero and span response check. For data acquisition systems, a minimum sampling frequency of 3 per minute shall be used. Measured concentrations of CO, HC, H<sub>2</sub>, NH<sub>3</sub>, N<sub>2</sub>O and NO<sub>x</sub> are to be recorded in terms of, or equivalent to, ppm to at least the nearest whole number. Measured concentrations of CO<sub>2</sub>, H<sub>2</sub>O and O<sub>2</sub> are to be recorded in terms of, or equivalent to, % to not fewer than two decimal places."

**5.12 Calculation of the gaseous emissions**

**5.12.2 Determination of the exhaust gas flow**

18 Paragraph 5.12.2.1 is replaced with the following:

"5.12.2.1 The exhaust gas flow rate ( $q_{mew}$ ) shall be determined for each mode in accordance with one of the methods described in 5.5.2 to 5.5.6."

**5.12.3 Dry/wet correction**

19 In paragraph 5.12.3.2, new sub-paragraphs 5.12.3.2.3 and 5.12.3.2.4 are added after existing sub-paragraph 5.12.3.2.2 as follows:

".3 Incomplete combustion, in all cases where the hydrogen balance method in 5.5.5 is used - calculate  $k_{wr3}$  as described in section 4 of appendix VI of this Code.

.4 Incomplete combustion, in all cases where the oxygen balance method in 5.5.6 is used - calculate  $k_{wr4}$  as described in section 5 of appendix VI of this Code."

20 In the same paragraph, existing sub-paragraph 5.12.3.2.3 is renumbered to 5.12.3.2.5 and replaced with the following:

".5 Where two fuel oils, fuel oil type 1/fuel oil type 2, are concurrently used, the parameters  $q_{mf}$ ,  $w_{ALF}$ ,  $w_{BET}$ ,  $w_{DEL}$ ,  $w_{EPS}$  for use in the calculations in paragraphs 5.12.3.1 to 5.12.3.2 shall be calculated using table 5.

**Table 5 – Determination of dual fuel parameters for raw exhaust gas**

| Factors in formula (6) (7) (8) |   | Formula for factors                                                                     |
|--------------------------------|---|-----------------------------------------------------------------------------------------|
| $q_{mf}$                       | = | $q_{mf\ 1} + q_{mf\ 2}$                                                                 |
| $W_{ALF}$                      | = | $\frac{q_{mf\ 1} \cdot W_{ALF\ 1} + q_{mf\ 2} \cdot W_{ALF\ 2}}{q_{mf\ 1} + q_{mf\ 2}}$ |
| $W_{BET}$                      | = | $\frac{q_{mf\ 1} \cdot W_{BET\ 1} + q_{mf\ 2} \cdot W_{BET\ 2}}{q_{mf\ 1} + q_{mf\ 2}}$ |
| $W_{DEL}$                      | = | $\frac{q_{mf\ 1} \cdot W_{DEL\ 1} + q_{mf\ 2} \cdot W_{DEL\ 2}}{q_{mf\ 1} + q_{mf\ 2}}$ |
| $W_{EPS}$                      | = | $\frac{q_{mf\ 1} \cdot W_{EPS\ 1} + q_{mf\ 2} \cdot W_{EPS\ 2}}{q_{mf\ 1} + q_{mf\ 2}}$ |

"

#### 5.12.5 Calculation of the emission mass flow rates

21 Section 5.12.5.1 is replaced with the following:

"5.12.5.1 The emission mass flow rate of the respective component in the raw exhaust gas for each mode shall be calculated in accordance with 5.12.5.2 from the measured concentration as obtained in accordance with 5.11.1, the applicable  $u_{gas}$  value and the exhaust gas mass flow rate in accordance with 5.5.

5.12.5.1.1 For carbon-containing fuels, or fuel mixtures, where the hydrogen-to-carbon ratio of the fuel,  $\alpha$ , over the test mode is less than or equal to 4.0, use the applicable  $u_{gas}$  values from table 6.

**Table 6 – Coefficient  $u_{gas}$  and fuel-specific parameters for raw exhaust gas**

| Gas                                    |                  | NO <sub>x</sub>                | CO       | HC       | CO <sub>2</sub> | O <sub>2</sub> | NH <sub>3</sub> <sup>***</sup> | H <sub>2</sub> <sup>***</sup> |
|----------------------------------------|------------------|--------------------------------|----------|----------|-----------------|----------------|--------------------------------|-------------------------------|
| $\rho_{gas}$ kg/m <sup>3</sup>         |                  | 2.053                          | 1.250    | *        | 1.9636          | 1.4277         | 0.771                          | 0.0899                        |
|                                        | $\rho_e^\dagger$ | Coefficient $u_{gas}^\ddagger$ |          |          |                 |                |                                |                               |
| Liquid fuel <sup>**</sup>              | 1.2943           | 0.001586                       | 0.000966 | 0.000479 | 0.001517        | 0.001103       | -                              | -                             |
| Rapeseed Methyl Ester                  | 1.2950           | 0.001585                       | 0.000965 | 0.000536 | 0.001516        | 0.001102       | -                              | -                             |
| Methanol                               | 1.2610           | 0.001628                       | 0.000911 | 0.001133 | 0.001557        | 0.001132       | -                              | -                             |
| Ethanol                                | 1.2757           | 0.001609                       | 0.000980 | 0.000805 | 0.001539        | 0.001119       | -                              | -                             |
| Natural gas, bio-methane and e-methane | 1.2661           | 0.001621                       | 0.000987 | 0.000558 | 0.001551        | 0.001128       | -                              | -                             |
| Propane                                | 1.2805           | 0.001603                       | 0.000976 | 0.000512 | 0.001533        | 0.001115       | -                              | -                             |
| Butane                                 | 1.2832           | 0.001600                       | 0.000974 | 0.000505 | 0.001530        | 0.001113       | -                              | -                             |
| Ammonia                                | 1.1912           | 0.001723                       | 0.001049 | n/a      | 0.001648        | 0.001199       | 0.000647                       | -                             |
| Hydrogen                               | 1.1872           | 0.001729                       | 0.001053 | n/a      | 0.001654        | 0.001203       | -                              | 0.000076                      |

\* Depending on fuel.

\*\* Petroleum derived.

\*\*\* For reference only.

<sup>†</sup>  $\rho_e$  is the nominal density of the exhaust gas.

<sup>‡</sup> At " $\lambda$ " = 2, wet air, 273.15 K, 101.325 kPa.

Values for  $u$  given in table 6 are based on ideal gas properties.

In multiple fuel type operation, the  $u_{\text{gas}}$  value used shall be determined from the values applicable to those fuels in the table set out above proportioned in accordance with the fuel mass ratio used.

5.12.5.1.2 For non-carbon-containing fuels, or fuel mixtures, where the hydrogen-to-carbon ratio of the fuel,  $\alpha$ , over the test mode is greater than 4.0, calculate  $u_{\text{gas}}$  as described in section 6 of appendix VI of this Code."

22 In section 5.12.5.2, the description of  $u_{\text{gas}}$  is replaced with the following:

" $u_{\text{gas}}$  = ratio between density of exhaust component and density of exhaust gas, see table 6"

## **Chapter 6 – Procedures for demonstrating compliance with NO<sub>x</sub> emission limits on board**

### **6.3 Simplified measurement method**

#### **6.3.1 General**

23 Paragraph 6.3.1.2 is replaced with the following:

"6.3.1.2 To gain meaningful results for onboard confirmation tests and onboard renewal, annual and intermediate surveys, as an absolute minimum, the gaseous emission concentrations of NO<sub>x</sub> and CO<sub>2</sub> shall be measured in accordance with the appropriate test cycle. If the engine operates on fuel with  $\alpha > 6.0$ , then H<sub>2</sub> (only required for hydrogen fuel and mixtures containing hydrogen fuel), NH<sub>3</sub> (only required for ammonia fuel and mixtures containing ammonia fuel), N<sub>2</sub>O (only required for ammonia fuel and mixtures containing ammonia fuel) and H<sub>2</sub>O shall be measured in addition to CO<sub>2</sub> (only required if one of the fuel types contains carbon). The weighting factors ( $W_F$ ) and the number of modes ( $n$ ) used in the calculation shall be in accordance with 3.2."

#### **6.3.2 Engine parameters to be measured and recorded**

24 In paragraph 6.3.2.1, "table 6" is replaced with "table 7".

25 Existing table 6 is renumbered to table 7.

### **6.4 Direct measurement and monitoring method**

#### **6.4.2 Emission species measurement**

26 New paragraphs 6.4.2.3 and 6.4.2.4 are added after existing paragraph 6.4.2.2 as follows:

"6.4.2.3 If exhaust gas mass flow is to be determined in accordance with the hydrogen balance method in 5.5.5, determine the additional exhaust gas constituents to be measured based on the requirements in section 4 of appendix VI of this Code.

6.4.2.4 If exhaust gas mass flow is to be determined in accordance with the oxygen balance method in 5.5.6, determine the additional exhaust gas constituents to be measured based on the requirements in section 5 of appendix VI of this Code."

6.4.3 *Engine performance measurements*

27 In paragraph 6.4.3.1, "table 7" is replaced with "table 8".

28 Existing table 7 is renumbered to table 8.

6.4.4 *Ambient condition measurements*

29 In paragraph 6.4.4.1, "table 8" is replaced with "table 9".

30 Existing table 8 is renumbered to table 9.

6.4.9 *Data for emission calculation*

31 Paragraph 6.4.9.2 is replaced with the following:

"6.4.9.2 For the evaluation of the gaseous emissions, a 1-Hertz minimum chart reading of a stable 10-minute sampling interval of each load point shall be averaged. The average concentrations of NO<sub>x</sub>, and, if required, CO<sub>2</sub> and, optionally, CO, HC and O<sub>2</sub> for the carbon balance method, or based on the requirements in section 4 of appendix VI of this Code for the hydrogen balance method, or based on the requirements in section 5 of appendix VI of this Code for the oxygen balance method shall be determined from the averaged chart readings and the corresponding calibration data."

6.4.10 *Exhaust gas flow rate*

32 In paragraph 6.4.10, sub-paragraph 6.4.10.1.2 is replaced with the following:

".2 in accordance with 5.5.4, 5.5.5 or 5.5.6 and appendix VI of this Code, with not measured species set to zero and  $c_{CO_2d}$  set to 0.0375% or measure the actual concentration in the ambient air."

6.4.11 *Fuel oil composition*

33 Section 6.4.11.1 is replaced with the following:

"6.4.11.1 Fuel oil composition, to calculate gas mass flow wet,  $q_{mf}$ , shall be provided by one of the following:

- .1 fuel oil composition, carbon, hydrogen, nitrogen and oxygen, by analysis (default oxygen value of 0.0% may be adopted for petroleum-derived fuel oils, natural gas, hydrogen and ammonia); or
- .2 default values as given in table 10."

34 Existing table 9 is renumbered to table 10 and is replaced with the following:

"

**Table 10 – Default fuel oil parameters**

|                                                      | <b>Carbon</b>          | <b>Hydrogen</b>        | <b>Nitrogen</b>        | <b>Oxygen</b>          |
|------------------------------------------------------|------------------------|------------------------|------------------------|------------------------|
|                                                      | <i>W<sub>BET</sub></i> | <i>W<sub>ALF</sub></i> | <i>W<sub>DEL</sub></i> | <i>W<sub>EPS</sub></i> |
| Liquid, petroleum-derived fuel oils sulphur content: |                        |                        |                        |                        |
| ≤ 0.10%                                              | 87.5%                  | 12.44%                 | 0.0%                   | 0.0%                   |
| > 0.10 - ≤ 0.50%                                     | 87.0%                  | 12.35%                 | 0.2%                   | 0.0%                   |
| > 0.50%                                              | 85.0%                  | 11.90%                 | 0.4%                   | 0.0%                   |
| Natural gas, bio-methane and e-methane               | 75.0%                  | 25.0%                  | 0.0%                   | 0.0%                   |
| Hydrogen                                             | 0.0%                   | 100.0%                 | 0.0%                   | 0.0%                   |
| Ammonia                                              | 0.0%                   | 17.8%                  | 82.2%                  | 0.0%                   |

For other fuel oils, default values as approved by the Administration or as given in the onboard monitoring manual.

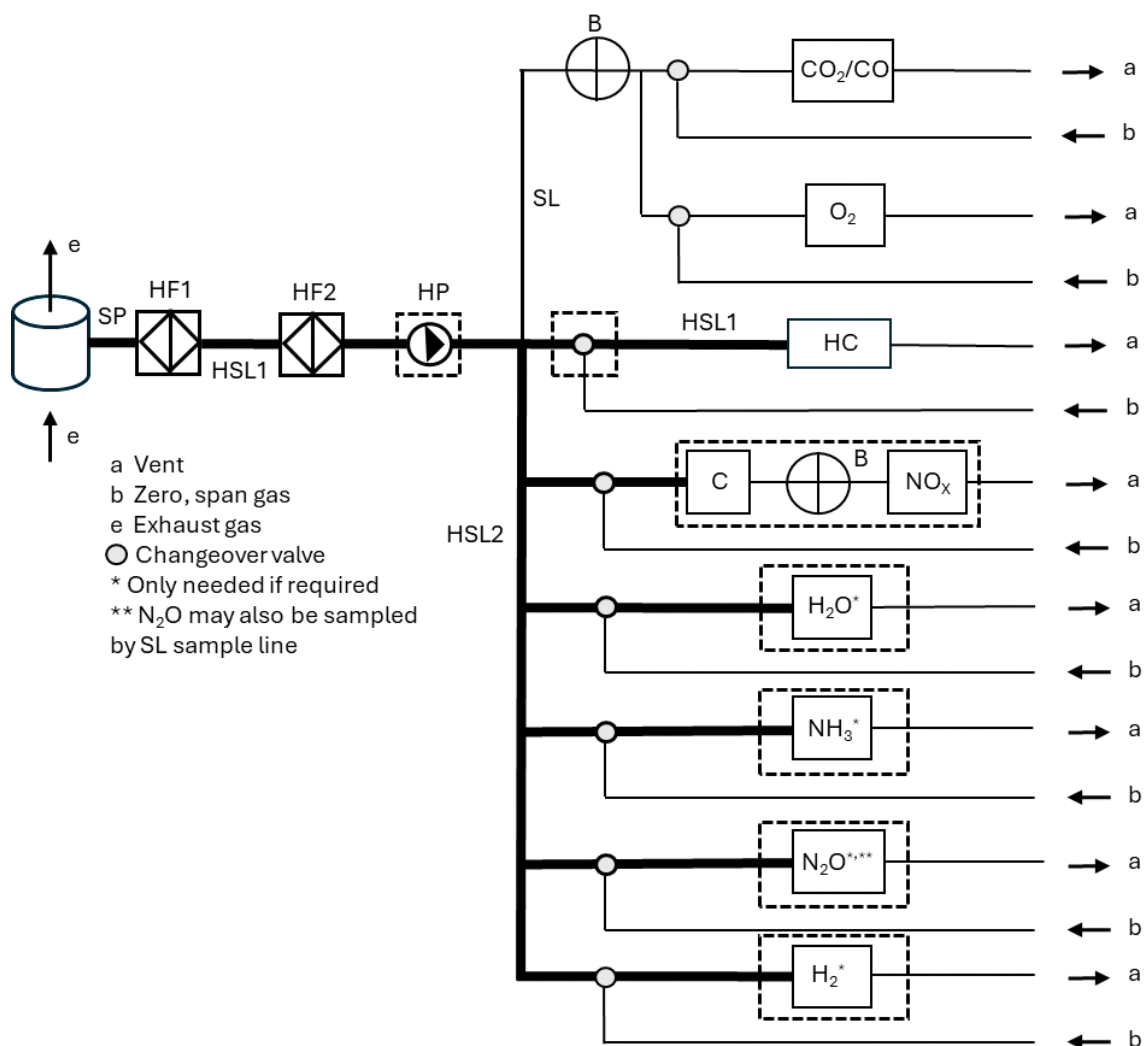
"

### **Appendix III – Specifications for analysers to be used in the determination of gaseous components of marine diesel engine emissions**

#### **1 General**

35 Section 1.1 including figure 1 is replaced with the following:

"1.1 The components included in an exhaust gas analysis system for the determination of the concentrations of CO, CO<sub>2</sub>, NO<sub>x</sub>, HC, H<sub>2</sub>, NH<sub>3</sub>, N<sub>2</sub>O, H<sub>2</sub>O and O<sub>2</sub> are shown in figure 1, which provides an example of an exhaust gas analysis system. All components in the sampling gas path must be maintained at the temperatures specified for the respective systems.



**Figure 1 - Arrangement of exhaust gas analysis system**

36 In paragraph 1.2, sub-paragraph 1.2.2 is replaced with the following:

"2 HSL1 – Heated sampling line

The sampling line provides a gas sample from a single probe to the split point(s) and the HC analyser. The sampling line shall be made of stainless steel or PTFE and have a 4 mm minimum and a 13.5 mm maximum inside diameter.

- .1 For non-methanol- and non-ethanol-fuelled engines, if the temperature of the exhaust gas at the sampling probe is equal to or below 191°C, a wall temperature of 191°C ± 11°C as measured at every separately controlled heated section.

If the temperature of the exhaust gas at the sampling probe is above 191°C, a wall temperature greater than 180°C shall be maintained.

Immediately before the heated filter HF2 and the HFID, a gas temperature of  $191^{\circ}\text{C} \pm 11^{\circ}\text{C}$  shall be maintained.

- .2 For methanol- and ethanol-fuelled engines, maintain a wall temperature between  $110^{\circ}\text{C}$  and  $202^{\circ}\text{C}$ , as measured at every separately controlled heated section."

37 In the same paragraph, sub-paragraph 1.2.3 is replaced with the following:

- ".3 HSL2 – Heated  $\text{NO}_x$ ,  $\text{H}_2\text{O}$ ,  $\text{NH}_3$ ,  $\text{H}_2$  and  $\text{N}_2\text{O}$  sampling line

The sampling line shall be made of stainless steel or PTFE and maintain a wall temperature to prevent water condensation, up to the converter C when using a cooling unit B, and up to the analyser when a cooling unit B is not used. For example, for raw exhaust, this can be achieved at  $70^{\circ}\text{C}$  for diesel fuel and  $85^{\circ}\text{C}$  for pure hydrogen fuel."

38 In the same paragraph, sub-paragraph 1.2.10 is replaced with the following:

- ".10  $\text{NO}_x$  - Nitrogen oxides analyser

Chemiluminescent detector (CLD) or heated chemiluminescent detector (HCLD). It shall be kept at a temperature to prevent water condensation. For example, for raw exhaust, this can be achieved at  $70^{\circ}\text{C}$  for diesel fuel and  $85^{\circ}\text{C}$  for pure hydrogen fuel."

39 In the same paragraph, new sub-paragraphs 1.2.14 to 1.2.17 are added after existing sub-paragraph 1.2.13 as follows:

- ".14  $\text{H}_2$  - Hydrogen analyser

Mass spectrometer (MS) or raman spectrometer (RS). The sample stream and analyser shall be designed to prevent water condensation.

- .15  $\text{NH}_3$  - Ammonia analyser

Fourier transform infrared (FTIR), non-dispersive ultraviolet (NDUV) or laser infrared analyser (LIA). The sample stream and analyser shall be designed to prevent water condensation. The sample path (sampling line, pre-filter(s) and valves) shall be made of stainless steel or PTFE and shall be heated at a temperature between  $110^{\circ}\text{C}$  and  $202^{\circ}\text{C}$  in order to minimize losses and sampling artefacts. For  $\text{NH}_3$  measurement, the sampling line shall be as short as practically possible. Alternatively, analysers can be installed in situ to avoid sample loss.

- .16  $\text{H}_2\text{O}$  - Water analyser

Fourier transform infrared (FTIR), mass spectrometer (MS) or laser infrared analyser (LIA). The sample stream and analyser shall be designed to prevent water condensation.

- .17  $\text{N}_2\text{O}$  – Nitrous oxide analyser

Fourier transform infrared (FTIR), non-dispersive infrared (NDIR), non-dispersive ultraviolet (NDUV) or laser infrared analyser (LIA). If the analyser measures wet-based concentration, the sample stream and analyser shall be designed to prevent water condensation."

### **3      Analysers**

40      The chapeau of section 3 is replaced with the following:

"Sections 3.1 to 3.9 describe the measurement principles to be used. The gases to be measured shall be analysed with the following instruments. For non-linear analysers, the use of linearizing circuits is permitted."

41      Section 3.3 is replaced with the following:

#### **"3.3      Hydrocarbon (HC) analysis**

The hydrocarbon analyser shall be of the heated flame ionization detector (HFID) type with detector, valves, pipework and associated components heated so as to maintain a gas temperature of  $191^{\circ}\text{C} \pm 11^{\circ}\text{C}$ . For methanol- or ethanol-fuelled engines, maintain a gas temperature between  $110^{\circ}\text{C}$  and  $202^{\circ}\text{C}$ . Optionally, for gas-fuelled engines (without liquid pilot injection), the hydrocarbon analyser may be of the non-heated flame ionization detector (FID) type."

42      Section 3.4 is replaced with the following:

#### **"3.4      Nitrogen oxides (NO<sub>x</sub>) analysis**

The nitrogen oxides analyser shall be of the chemiluminescent detector (CLD) or heated chemiluminescent detector (HCLD) type with an NO<sub>2</sub>/NO converter, if measured on a dry basis. If measured on a wet basis, an HCLD with converter maintained above  $55^{\circ}\text{C}$  shall be used, provided the water quench check (see section 9.2.2 of appendix IV of this Code) is satisfied. For both CLD and HCLD, the sampling path shall be maintained at a wall temperature to prevent water condensation up to the converter for dry measurement, and up to the analyser for wet measurement. For example, for raw exhaust, this can be achieved at  $70^{\circ}\text{C}$  for diesel fuel and  $85^{\circ}\text{C}$  for pure hydrogen fuel. "

43      New sections 3.6 to 3.9 are added after the existing section 3.5 as follows:

#### **"3.6      Hydrogen (H<sub>2</sub>) analysis**

The hydrogen analyser shall be of the mass spectrometer (MS) or raman spectrometer (RS) type.

#### **3.7      Water (H<sub>2</sub>O) analysis**

The water analyser shall be of the Fourier transform infrared (FTIR), mass spectrometer (MS) or laser infrared analyser (LIA) type. Water content may alternatively be determined by measurement of the oxygen concentration upstream and downstream of a sample dryer and determining the water content based on the difference in the two measurements.

### 3.8 Ammonia (NH<sub>3</sub>) analysis

The ammonia analyser shall be of the Fourier transform infrared (FTIR), non-dispersive ultraviolet (NDUV) or laser infrared analyser (LIA) type. The sample stream and analyser shall be designed to prevent water condensation. The sample path (sampling line, pre-filter(s) and valves) shall be made of stainless steel or PTFE and shall be heated at a temperature between 110°C and 202°C in order to minimize losses and sampling artefacts. For NH<sub>3</sub> measurement, the sampling line shall be as short as practically possible.

### 3.9 Nitrous oxide (N<sub>2</sub>O) analysis

The nitrous oxide analyser shall be of the Fourier transform infrared (FTIR), non-dispersive infrared (NDIR), non-dispersive ultraviolet (NDUV) or laser infrared analyser (LIA) type. "

## Appendix IV – Calibration of the analytical and measurement instruments

### 2 Calibration gases and zero and span check gases

#### 2.1 Pure gases (including zero check gases)

44 Section 2.1.1 is replaced with the following:

"2.1.1 The required purity of the gases is defined by the contamination limits given below. The following gases shall be available:

- .1 purified nitrogen (contamination  $\leq 1$  ppmC,  $\leq 1$  ppm CO,  $\leq 400$  ppm CO<sub>2</sub>,  $\leq 0.1$  ppm NO,  $\leq 1$  ppm H<sub>2</sub>,  $\leq 1$  ppm NH<sub>3</sub>,  $\leq 0.02$  ppm N<sub>2</sub>O,  $\leq 5$  ppm H<sub>2</sub>O);
- .2 purified oxygen (purity  $> 99.5\%$  volume O<sub>2</sub>);
- .3 hydrogen-helium mixture ( $40 \pm 2\%$  H<sub>2</sub>, balance He), (contamination  $\leq 1$  ppmC,  $\leq 400$  ppm CO<sub>2</sub>); and
- .4 purified synthetic air (contamination  $\leq 1$  ppmC,  $\leq 1$  ppm CO,  $\leq 400$  ppm CO<sub>2</sub>,  $\leq 0.1$  ppm NO,  $\leq 1$  ppm H<sub>2</sub>,  $\leq 1$  ppm NH<sub>3</sub>,  $\leq 0.02$  ppm N<sub>2</sub>O,  $\leq 5$  ppm H<sub>2</sub>O (oxygen content 18% - 21% volume)).

Note: Contamination for H<sub>2</sub>, NH<sub>3</sub>, N<sub>2</sub>O and H<sub>2</sub>O only applies if those are to be measured as part of the test programme. "

#### 2.2 Calibration and span gases

45 In paragraph 2.2.1, "and" in sub-paragraph 2.2.1.4 is deleted, "." in sub-paragraph 2.2.1.5 is replaced with ";", and new sub-paragraphs 2.2.1.6 to 2.2.1.9 are added after sub-paragraph 2.2.1.5 as follows:

- " .6 H<sub>2</sub> and purified nitrogen;
- .7 NH<sub>3</sub> and purified nitrogen;
- .8 N<sub>2</sub>O and purified nitrogen; and

- .9 H<sub>2</sub>O and purified synthetic air or nitrogen. (Humidified gas can be generated by using a heated bubbler or by injecting a known amount of water into the blending gas upstream of the analyser. Caution must be taken that no water condensation takes place upstream of the analyser. Traceability for the heated bubbler is done via dew point sensor calibration and for water injection via flow meter calibration.)"

- 46 Paragraph 2.2.2 is replaced with the following:

"2.2.2 The true concentration of a calibration and span gas must be within  $\pm 2\%$  of the nominal value except for NH<sub>3</sub> and H<sub>2</sub>O, which must be within  $\pm 3\%$  of the nominal value. All concentrations of calibration and span gases shall be given on a volume basis (volume per cent or volume ppm)."

## **5 Calibration procedure**

### **5.4 Calibration**

- 47 Paragraph 5.4.2 is replaced with the following:

"5.4.2 Using purified synthetic air (or nitrogen) the CO, CO<sub>2</sub>, NO, H<sub>2</sub>, NH<sub>3</sub>, N<sub>2</sub>O, H<sub>2</sub>O and O<sub>2</sub> analysers shall be set at zero. The (H)FID analyser shall be set to zero using purified synthetic air."

## **9 Interference effects with CO, CO<sub>2</sub>, NO<sub>x</sub> and O<sub>2</sub> analysers**

- 48 The title of section 9 and its chapeau are replaced with the following:

### **"9 Interference effects with CO, CO<sub>2</sub>, NH<sub>3</sub>, N<sub>2</sub>O, H<sub>2</sub>O, NO<sub>x</sub> and O<sub>2</sub> analysers**

Gases other than the one being analysed can interfere with the reading in several ways. Positive interference occurs in NDIR, NDUV, LIA, FTIR and PMD instruments where the interfering gas gives the same effect as the gas being measured, but to a lesser degree. Negative interference occurs in NDIR, NDUV, LIA, FTIR instruments by the interfering gas broadening the absorption band of the measured gas, and in CLD instruments by the interfering gas quenching the radiation. The interference checks in 9.1 through 9.7 shall be performed prior to an analyser's initial use and after major service intervals."

### **9.3 O<sub>2</sub> analyser interference**

- 49 Section 9.3 is replaced with the following with deletion of table 6 and equation (9):

#### **"9.3 O<sub>2</sub> analyser interference**

9.3.1 PMD analysers have a cross-sensitivity to several gases, like NO, NO<sub>2</sub>, CO, CO<sub>2</sub> and H<sub>2</sub>O. Cross-sensitivity corrections may be used to increase measurement accuracy, subject to the approval of the Administration. Base corrections on instrument manufacturer specified values, physical magnetic behaviour references or measured interference values. Note that cross-sensitivity can have a significant effect on the oxygen balance calculation method at high O<sub>2</sub> concentrations (high air/fuel ratios).

9.3.2 For ZRDO and ECS analysers, instrument interference caused by gases other than oxygen shall be compensated in accordance with the manufacturer's recommendations and with good engineering practice. Electrochemical sensors shall be compensated for CO<sub>2</sub> and NO<sub>x</sub> interference."

50 New sections 9.4 to 9.7 are added after section 9.3 as follows:

"9.4 *NH<sub>3</sub> analyser interference check*

9.4.1 LIA, FTIR, and NDUV measurement principles are specified for NH<sub>3</sub> measurement and either principle may be used provided it meets the interference criteria. Gas dryers shall not be permitted for NH<sub>3</sub> measurement. If the analyser uses compensation algorithms that utilize measurements of other gases to meet this interference verification, a correct result depends on simultaneously conducting these other measurements to test the compensation algorithms during the analyser interference verification. The amount of interference shall be verified after initial analyser installation and after major maintenance.

9.4.2 Determine interferent species for NDUV based on the instrument manufacturer's recommendation. For example, CO<sub>2</sub>, H<sub>2</sub>O, SO<sub>2</sub>, NO<sub>2</sub> or NO can interfere with the NDUV NH<sub>3</sub> analyser performance.

9.4.3 For LIA and FTIR, the instrument manufacturer shall declare, in an "analyser performance declaration", which exhaust gas components interfere with the NH<sub>3</sub> reading and the extent of that interference based on the fuel type, the combustion system in which that fuel type is being used and the resulting concentration ranges of the various exhaust gas components in each scenario. Analysers using FTIR and LIA measurement principles, may be tuned for individual fuel types (e.g. petroleum derived fuel oils, hydrogen, ammonia, or particular fuel mixtures) and combustion systems (e.g. marine diesel engines operating on either 2 or 4 stroke principles). The analyser performance declaration shall at least contain:

- .1 analyser type;
- .2 analyser accuracy, noise, drift, linearity and repeatability values;
- .3 required intervals between calibration and zero/span drift checks\*;
- .4 range of ambient conditions covered;
- .5 the cross-interference gases for the exhaust gas matrix for each fuel type and combustion system;
- .6 for each of the interference gases, or combinations thereof, the maximum interference to the NH<sub>3</sub> reading;
- .7 the concentrations of those interference check gases to be used to check for potential interferences;
- .8 types of fuels and fuel mixtures for which the analyser performance declaration applies;
- .9 types of combustion systems for which the analyser performance declaration applies; and

- .10 in cases, where different analytical evaluation methods are applied, which evaluation method shall be used, depending on the type of fuel used and the test application.

\* Irrespective of the given intervals the requirements of 5.9.9 and appendix III, section 6 are to be complied with.

9.4.4 A multicomponent interference span gas made up of concentrations at least as high as the maximum expected during testing shall be used to verify interference. Alternatively, interference procedures for individual interference gases may also be run separately. If H<sub>2</sub>O is one of the interferent species, a humidified gas can be generated by using a heated bubbler or by injecting a known amount of water into the blending gas upstream of the analyser. Generate an H<sub>2</sub>O level at least as high as the maximum expected during emission testing. Record the analyser response. The analyser shall have combined interference within  $\pm 2\%$  of the expected mean NH<sub>3</sub> concentration expected during testing, or  $0.0 \pm 2.0$  ppm NH<sub>3</sub>, whichever is larger.

#### 9.5 *N<sub>2</sub>O analyser interference check*

9.5.1 LIA, FTIR, NDIR, and NDUV measurement principles are specified for N<sub>2</sub>O measurement and either principle may be used provided it meets the interference criteria. If the analyser uses compensation algorithms that utilize measurements of other gases to meet this interference verification, a correct result depends on simultaneously conducting these other measurements to test the compensation algorithms during the analyser interference verification. The amount of interference shall be verified after initial analyser installation and after major maintenance.

9.5.2 Determine interferent species for NDIR and NDUV based on the instrument manufacturer's recommendation. For example, CO, CO<sub>2</sub>, H<sub>2</sub>O, CH<sub>4</sub>, and SO<sub>2</sub> can interfere with the NDIR or NDUV N<sub>2</sub>O analyser performance.

9.5.3 For LIA and FTIR, the instrument manufacturer shall declare, in an "analyser performance declaration", which exhaust gas components interfere with the N<sub>2</sub>O reading and the extent of that interference based on the fuel type, the combustion system in which that fuel type is being used and the resulting concentration ranges of the various exhaust gas components in each scenario. Analysers using FTIR and LIA measurement principles, may be tuned for individual fuel types (e.g. petroleum- derived fuel oils, hydrogen, ammonia, or particular fuel mixtures) and combustion systems (e.g. marine diesel engines operating on either 2 or 4 stroke principles). The analyser performance declaration shall at least contain:

- .1 analyser type;
- .2 analyser accuracy, noise, drift, linearity and repeatability values;
- .3 required intervals between calibration and zero/span drift checks\*;
- .4 range of ambient conditions covered;
- .5 the cross-interference gases for the exhaust gas matrix for each fuel type and combustion system;

- .6 for each of the interference gases, or combinations thereof, the maximum interference to the N<sub>2</sub>O reading;
- .7 the concentrations of those interference check gases to be used to check for potential interferences;
- .8 types of fuels and fuel mixtures for which the analyser performance declaration applies;
- .9 types of combustion systems for which the analyser performance declaration applies; and
- .10 in cases, where different analytical evaluation methods are applied, which evaluation method shall be used, depending on the type of fuel used and test application.

\* Irrespective of the given intervals the requirements of 5.9.9 and appendix III, section 6 are to be complied with.

9.5.4 A multicomponent interference span gas made up of concentrations at least as high as the maximum expected during testing shall be used to verify interference. Alternatively, interference procedures for individual interference gases may also be run separately. If H<sub>2</sub>O is one of the interferent species, a humidified gas can be generated by using a heated bubbler or by injecting a known amount of water into the blending gas upstream of the analyser. Generate an H<sub>2</sub>O level at least as high as the maximum expected during emission testing, or a level at or above the level at the cooling unit if one is used to dry the sample. Record the analyser response. The analyser shall have combined interference within  $0.0 \pm 1.0$  ppm.

#### 9.6 *H<sub>2</sub>O analyser interference check*

9.6.1 LIA and FTIR measurement principles are specified for H<sub>2</sub>O measurement and either principle may be used provided it meets the interference criteria. If the analyser uses compensation algorithms that utilize measurements of other gases to meet this interference verification, a correct result depends on simultaneously conducting these other measurements to test the compensation algorithms during the analyser interference verification. The amount of interference shall be verified after initial analyser installation and after major maintenance.

9.6.2 For LIA and FTIR, the instrument manufacturer shall declare, in an "analyser performance declaration", which exhaust gas components interfere with the H<sub>2</sub>O reading and the extent of that interference based on the fuel type, the combustion system in which that fuel type is being used and the resulting concentration ranges of the various exhaust gas components in each scenario. Analysers using FTIR and LIA measurement principles, may be tuned for individual fuel types (e.g. petroleum-derived fuel oils, hydrogen, ammonia, or particular fuel mixtures) and combustion systems (e.g. marine diesel engines operating on either 2 or 4 stroke principles). The analyser performance declaration shall at least contain:

- .1 analyser type;
- .2 analyser accuracy, noise, drift, linearity and repeatability values;
- .3 required intervals between calibration and zero/span drift checks\*;

- .4 range of ambient conditions covered;
- .5 the cross-interference gases for the exhaust gas matrix for each fuel type and combustion system;
- .6 for each of the interference gases, or combinations thereof, the maximum interference to the H<sub>2</sub>O reading;
- .7 the concentrations of those interference check gases to be used to check for potential interferences;
- .8 types of fuels and fuel mixtures for which the analyser performance declaration applies;
- .9 types of combustion systems for which the analyser performance declaration applies; and
- .10 in cases, where different analytical evaluation methods are applied, which evaluation method shall be used, depending on the type of fuel used and the test application.

\* Irrespective of the given intervals the requirements of 5.9.9 and appendix III, section 6 are to be complied with.

9.6.3 The analyser shall have combined interference within  $\pm 2\%$  of the mean H<sub>2</sub>O concentration expected during testing.

#### 9.7 CLD NH<sub>3</sub> interference check

9.7.1 NH<sub>3</sub> can interfere with the CLD NO<sub>x</sub> analyser performance. CLD NH<sub>3</sub> interference verification is only required for engines running on NH<sub>3</sub> fuels or fuel mixtures with NH<sub>3</sub>.

9.7.2 With the analyser in NO<sub>x</sub> mode and the test gas flowing through the NO<sub>2</sub> to NO converter, flow an NH<sub>3</sub> span gas having a concentration at least as high as the maximum expected during testing and record the analyser response. The analyser shall have interference within  $\pm 2\%$  of the expected mean NO<sub>x</sub> concentration expected during testing or  $\leq 1$  ppm NO<sub>x</sub>, whichever is larger."

## Appendix V – Parent engine test report, test data, and determination of the highest composite specific emission value<sup>2</sup>

### Section 1 – Parent engine test report (see 5.10 and 8.2 of the Code)

#### Sheet 1 of 5 of the emissions test report

51 In the row on "Fuel oil specification", the term "Fuel oil specification" is replaced with "Fuel oil type 1 specification", and a new row on "Fuel oil type 2 specification" is added after the row on "Fuel oil type 1 specification" as follows:

"

|                               |  |
|-------------------------------|--|
| Fuel oil type 2 specification |  |
|-------------------------------|--|

"

<sup>2</sup> The titles of appendix V and of its sections 1 and 2 were amended by resolution MEPC.397(83), expected to enter into force on 1 March 2027.

52 The row on "Fuel oil temperature" is deleted.

### Sheet 3 of 5 of the emissions test report

53 In the section on measurement equipment, the following rows are added after the existing row on "HC analyser":

"

|                           |  |  |     |  |   |
|---------------------------|--|--|-----|--|---|
| H <sub>2</sub> analyser   |  |  | ppm |  | % |
| NH <sub>3</sub> analyser  |  |  | ppm |  | % |
| N <sub>2</sub> O analyser |  |  | ppm |  | % |
| H <sub>2</sub> O analyser |  |  | %   |  | % |

"

54 In the same section, in the row on "Fuel flow", the term "Fuel flow" is replaced with "Fuel oil type 1 flow", and a new row on "Fuel oil type 2 flow" is added after the row on "Fuel oil type 1 flow" as follows:

"

|                      |  |  |  |  |   |
|----------------------|--|--|--|--|---|
| Fuel oil type 2 flow |  |  |  |  | % |
|----------------------|--|--|--|--|---|

"

### Liquid fuel characteristics

55 In the first row of the table on liquid fuel characteristics, the term "Fuel type" is replaced with "Fuel oil type 1", and the following rows are added after the last row of the table:

"

| Fuel oil type 2 |          |                    |                         |       |
|-----------------|----------|--------------------|-------------------------|-------|
| Fuel properties |          |                    | Fuel elemental analysis |       |
| Density         | ISO 3675 | kg/m <sup>3</sup>  | Carbon                  | % m/m |
| Viscosity       | ISO 3104 | mm <sup>2</sup> /s | Hydrogen                | % m/m |
| Water           | ISO 3733 | % V/V              | Nitrogen                | % m/m |
|                 |          |                    | Oxygen                  | % m/m |
|                 |          |                    | Sulphur                 | % m/m |
|                 |          |                    | LHV/Hu                  | MJ/kg |

"

### Gas fuel characteristics

56 The table on gas fuel characteristics is replaced with the following:

"

| Fuel oil type 1             |               |                   |                                                     |       |
|-----------------------------|---------------|-------------------|-----------------------------------------------------|-------|
| Fuel properties             |               |                   | Fuel elemental analysis                             |       |
| Methane number <sup>†</sup> | EN16276: 2015 |                   | Carbon                                              | % m/m |
| Lower heating value         |               | MJ/kg             | Hydrogen                                            | % m/m |
| Boiling point               |               | °C                | Nitrogen                                            | % m/m |
| Density at boiling point    |               | kg/m <sup>3</sup> | Oxygen                                              | % m/m |
| Pressure at boiling point   |               | bar (abs)         | Sulphur                                             | % m/m |
|                             |               |                   | Methane, CH <sub>4</sub> <sup>†</sup>               | mol%  |
|                             |               |                   | Ethane, C <sub>2</sub> H <sub>6</sub> <sup>†</sup>  | mol%  |
|                             |               |                   | Propane, C <sub>3</sub> H <sub>8</sub> <sup>†</sup> | mol%  |

"

| Fuel oil type 1           |               |                   |                                               |       |
|---------------------------|---------------|-------------------|-----------------------------------------------|-------|
|                           |               |                   | Isobutane, i C <sub>4</sub> H <sub>10</sub> † | mol%  |
|                           |               |                   | N-Butane, n C <sub>4</sub> H <sub>10</sub> †  | mol%  |
|                           |               |                   | Pentane, C <sub>5</sub> H <sub>12</sub> †     | mol%  |
|                           |               |                   | C6+ †                                         | mol%  |
|                           |               |                   | CO <sub>2</sub> †                             | mol%  |
| Fuel oil type 2           |               |                   |                                               |       |
| Fuel properties           |               |                   | Fuel elemental analysis                       |       |
| Methane number †          | EN16276: 2015 |                   | Carbon                                        | % m/m |
| Lower heating value       |               | MJ/kg             | Hydrogen                                      | % m/m |
| Boiling point             |               | °C                | Nitrogen                                      | % m/m |
| Density at boiling point  |               | kg/m <sup>3</sup> | Oxygen                                        | % m/m |
| Pressure at boiling point |               | bar (abs)         | Sulphur                                       | % m/m |
|                           |               |                   | Methane, CH <sub>4</sub> †                    | mol%  |
|                           |               |                   | Ethane, C <sub>2</sub> H <sub>6</sub> †       | mol%  |
|                           |               |                   | Propane, C <sub>3</sub> H <sub>8</sub> †      | mol%  |
|                           |               |                   | Isobutane, i C <sub>4</sub> H <sub>10</sub> † | mol%  |
|                           |               |                   | N-Butane, n C <sub>4</sub> H <sub>10</sub> †  | mol%  |
|                           |               |                   | Pentane, C <sub>5</sub> H <sub>12</sub> †     | mol%  |
|                           |               |                   | C6+ †                                         | mol%  |
|                           |               |                   | CO <sub>2</sub> †                             | mol%  |

† For natural gas fuel oil only. Other gas fuels as required by the Administration in order to adequately define the fuel oil type used.

"

#### Sheet 4 of 5 of the emissions test report

57 In the section on gaseous emissions data, the following rows are added after the existing row on "HC concentration ppmC":

"

|                                |     |  |  |  |  |  |  |  |  |  |  |
|--------------------------------|-----|--|--|--|--|--|--|--|--|--|--|
| H <sub>2</sub> concentration   | ppm |  |  |  |  |  |  |  |  |  |  |
| NH <sub>3</sub> concentration  | ppm |  |  |  |  |  |  |  |  |  |  |
| N <sub>2</sub> O concentration | ppm |  |  |  |  |  |  |  |  |  |  |
| H <sub>2</sub> O concentration | %   |  |  |  |  |  |  |  |  |  |  |

"

58 In the same section, the following rows are added after the existing row on "HC mass flow kg/h":

"

|                            |      |  |  |  |  |  |  |  |  |  |  |
|----------------------------|------|--|--|--|--|--|--|--|--|--|--|
| H <sub>2</sub> mass flow   | kg/h |  |  |  |  |  |  |  |  |  |  |
| NH <sub>3</sub> mass flow  | kg/h |  |  |  |  |  |  |  |  |  |  |
| N <sub>2</sub> O mass flow | kg/h |  |  |  |  |  |  |  |  |  |  |
| H <sub>2</sub> O mass flow | kg/h |  |  |  |  |  |  |  |  |  |  |

"

**Sheet 5 of 5 of the emissions test report**

59 A new row is added after the existing row on "Engine data" as follows:

"

|                                                        |  |  |  |  |  |  |  |  |  |  |  |
|--------------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|
| Molar hydrogen-to-carbon ratio ( $\alpha$ )<br>of fuel |  |  |  |  |  |  |  |  |  |  |  |
|--------------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|

"

60 The row on "Fuel flow kg/h or m<sup>3</sup>/h" is replaced with the following with deletion of footnote †:

"

|                      |      |  |  |  |  |  |  |  |  |  |  |
|----------------------|------|--|--|--|--|--|--|--|--|--|--|
| Fuel oil type 1 flow | kg/h |  |  |  |  |  |  |  |  |  |  |
|----------------------|------|--|--|--|--|--|--|--|--|--|--|

"

61 A new row is added after the row on "Fuel oil type 1 flow kg/h" as follows:

"

|                      |      |  |  |  |  |  |  |  |  |  |  |
|----------------------|------|--|--|--|--|--|--|--|--|--|--|
| Fuel oil type 2 flow | kg/h |  |  |  |  |  |  |  |  |  |  |
|----------------------|------|--|--|--|--|--|--|--|--|--|--|

"

**Section 2 – Parent engine test data to be included in the technical file, additionally, for marine diesel engines to which 8.1.1.3 applies, the relevant test data for all engine operational profiles for which the engine is certified, which are to be included in the technical file (see 2.4.1.5 and 8.2 of the Code)**

62 The title of the subsection on "Parent engine test liquid fuel" is replaced with "Parent engine test liquid fuel oil type 1", and new rows are added after the existing row on "Water" in the subsection on "Parent engine test liquid fuel oil type 1" as follows:

"

| Parent engine test liquid fuel oil type 2 |       |  |
|-------------------------------------------|-------|--|
| Carbon                                    | % m/m |  |
| Hydrogen                                  | % m/m |  |
| Sulphur                                   | % m/m |  |
| Nitrogen                                  | % m/m |  |
| Oxygen                                    | % m/m |  |
| Water                                     | % V/V |  |

"

63 The subsection on "Parent engine test gas fuel" is replaced with the following:

"

| Parent engine test gas fuel type 1       |       |  |
|------------------------------------------|-------|--|
| Carbon                                   | % m/m |  |
| Hydrogen                                 | % m/m |  |
| Nitrogen                                 | % m/m |  |
| Oxygen                                   | % m/m |  |
| Sulphur                                  | % m/m |  |
| Methane, CH <sub>4</sub> †               | mol%  |  |
| Ethane, C <sub>2</sub> H <sub>6</sub> †  | mol%  |  |
| Propane, C <sub>3</sub> H <sub>8</sub> † | mol%  |  |

"

| Parent engine test gas fuel type 1            |       |  |
|-----------------------------------------------|-------|--|
| Isobutane, i C <sub>4</sub> H <sub>10</sub> † | mol%  |  |
| N-Butane, n C <sub>4</sub> H <sub>10</sub> †  | mol%  |  |
| Pentane, C <sub>5</sub> H <sub>12</sub> †     | mol%  |  |
| C6+ †                                         | mol%  |  |
| CO <sub>2</sub> †                             | mol%  |  |
| Parent engine test gas fuel type 2            |       |  |
| Carbon                                        | % m/m |  |
| Hydrogen                                      | % m/m |  |
| Nitrogen                                      | % m/m |  |
| Oxygen                                        | % m/m |  |
| Sulphur                                       | % m/m |  |
| Methane, CH <sub>4</sub> †                    | mol%  |  |
| Ethane, C <sub>2</sub> H <sub>6</sub> †       | mol%  |  |
| Propane, C <sub>3</sub> H <sub>8</sub> †      | mol%  |  |
| Isobutane, i C <sub>4</sub> H <sub>10</sub> † | mol%  |  |
| N-Butane, n C <sub>4</sub> H <sub>10</sub> †  | mol%  |  |
| Pentane, C <sub>5</sub> H <sub>12</sub> †     | mol%  |  |
| C6+ †                                         | mol%  |  |
| CO <sub>2</sub> †                             | mol%  |  |

† For natural gas fuel only. Other gas fuels as required by the Administration, in order to adequately define the fuel oil type used.

"

64 In the subsection on "Engine performance", in the row on "Fuel flow", the term "Fuel flow" is replaced with "Fuel type 1 flow", and new rows are added after the row on "Fuel type 1 flow" as follows:

"

|                                      |      |  |  |  |  |  |  |  |  |
|--------------------------------------|------|--|--|--|--|--|--|--|--|
| Fuel type 2 flow                     | kg/h |  |  |  |  |  |  |  |  |
| hydrogen-to-carbon ratio (α) of fuel |      |  |  |  |  |  |  |  |  |

"

65 In the subsection on "Emission concentrations", new rows are added after the existing row on "HC" as follows:

"

|                          |     |  |  |  |  |  |  |  |  |
|--------------------------|-----|--|--|--|--|--|--|--|--|
| H <sub>2</sub> wet/dry   | ppm |  |  |  |  |  |  |  |  |
| NH <sub>3</sub>          | ppm |  |  |  |  |  |  |  |  |
| N <sub>2</sub> O wet/dry | ppm |  |  |  |  |  |  |  |  |
| H <sub>2</sub> O         | %   |  |  |  |  |  |  |  |  |

"

#### **Appendix VI – Calculation of exhaust gas mass flow (carbon balance method)** (refer to chapter 5 of the NO<sub>x</sub> Technical Code 2008)

66 The title of appendix VI is replaced with the following:

**"Appendix VI – Calculation of exhaust gas mass flow (carbon, hydrogen and oxygen balance methods)**  
(refer to chapter 5 of the NO<sub>x</sub> Technical Code 2008)"

## 1 Introduction

67 Section 1 is replaced with the following:

### "1 Introduction

1.1 This appendix addresses the calculation of the exhaust gas mass flow based on exhaust gas concentration measurement, and on the knowledge of fuel consumption. Symbols and descriptions of terms and variables used in the formulae for the carbon, hydrogen and oxygen balance measurement methods are summarized in the introduction of this Code.

1.2 The carbon balance measurement method shall be used for a fuel mix where the actual hydrogen-to-carbon ratio of the fuel,  $\alpha$ , over the test mode is less than or equal to 6.0.

1.3 The hydrogen or oxygen balance measurement method shall be used for a fuel mix where the actual hydrogen-to-carbon ratio of the fuel,  $\alpha$ , over the test mode is greater than 6.0.

1.4 Except as otherwise specified, all results of calculations required by this appendix shall be reported in the engine's test report in accordance with 5.10 of this Code."

68 A new section 2 is added after section 1 as follows:

### "2 Dual fuel applications

2.1 Where two fuel oils, fuel oil type 1/fuel oil type 2, are concurrently used, the parameters  $q_{mf}$ ,  $W_{ALF}$ ,  $W_{BET}$ ,  $W_{GAM}$ ,  $W_{DEL}$ ,  $W_{EPS}$ , for use in the calculations in sections in this appendix VI, shall be calculated as follows:

**Table 1 – Determination of dual fuel parameters for raw exhaust gas**

| Factors in formula (1) |   | Formula for factors                                                                     |
|------------------------|---|-----------------------------------------------------------------------------------------|
| $q_{mf}$               | = | $q_{mf\ 1} + q_{mf\ 2}$                                                                 |
| $W_{ALF}$              | = | $\frac{q_{mf\ 1} \cdot W_{ALF\ 1} + q_{mf\ 2} \cdot W_{ALF\ 2}}{q_{mf\ 1} + q_{mf\ 2}}$ |
| $W_{BET}$              | = | $\frac{q_{mf\ 1} \cdot W_{BET\ 1} + q_{mf\ 2} \cdot W_{BET\ 2}}{q_{mf\ 1} + q_{mf\ 2}}$ |
| $W_{GAM}$              | = | $\frac{q_{mf\ 1} \cdot W_{GAM\ 1} + q_{mf\ 2} \cdot W_{GAM\ 2}}{q_{mf\ 1} + q_{mf\ 2}}$ |
| $W_{DEL}$              | = | $\frac{q_{mf\ 1} \cdot W_{DEL\ 1} + q_{mf\ 2} \cdot W_{DEL\ 2}}{q_{mf\ 1} + q_{mf\ 2}}$ |
| $W_{EPS}$              | = | $\frac{q_{mf\ 1} \cdot W_{EPS\ 1} + q_{mf\ 2} \cdot W_{EPS\ 2}}{q_{mf\ 1} + q_{mf\ 2}}$ |

"

## 2 Carbon balance method, 1-step calculation procedure

69 Existing section 2 is renumbered to section 3 and existing paragraphs 2.1 to 2.4 are renumbered to paragraphs 3.1 to 3.4.

70 Renumbered paragraph 3.4 is replaced with the following:

"3.4 Carbon factor  $f_c$  according to equation (3):

$$f_c = (c_{CO2d} - c_{CO2ad}) \cdot 0.5441 + \frac{c_{COd}}{18,522} + \frac{c_{HCw}}{17,355} \quad (3)$$

with

$c_{CO2d}$  = dry CO<sub>2</sub> concentration in the raw exhaust, %  
 $c_{CO2ad}$  = dry CO<sub>2</sub> concentration in the ambient air, % = 0.0375% or measure the actual concentration in the ambient air  
 $c_{COd}$  = dry CO concentration in the raw exhaust, ppm  
 $c_{HCw}$  = wet HC concentration in the raw exhaust, ppm

"

71 Existing paragraph 2.5 is deleted.

72 A new section 4 is added after section 3 as follows:

#### "4 Hydrogen balance method

4.1 This method involves exhaust mass calculation from fuel consumption, fuel composition and exhaust gas concentrations for incomplete combustion.

4.2 Exhaust gas mass flow rate on wet basis:

$$q_{mew} = q_{mf} \cdot \left( 1 + A/F_{st} \cdot \lambda \cdot (1 + H_a \cdot 10^{-3}) \right) \quad (4)$$

with

$$A/F_{st} = \frac{\left( \frac{w_{BET}}{12.0107} + \frac{w_{ALF}}{4.03176} - \frac{w_{EPS}}{31.9988} + \frac{w_{GAM}}{32.065} \right) \cdot 138.297}{w_{BET} + w_{ALF} + w_{EPS} + w_{DEL} + w_{GAM}} \quad (5)$$

$$\lambda = \frac{w_{ALF} \cdot 3.77321 \cdot f_3}{\left( \left( \frac{w_{BET}}{12.0107} + \frac{w_{ALF}}{4.03176} + \frac{w_{GAM}}{32.065} - \frac{w_{EPS}}{31.9988} \right) \cdot 2.01588 \cdot f_4 \right) \cdot \left( 18.01528 + 28.96559 \cdot \left( \frac{1}{2} - f_1 \right) \cdot H_a \cdot 10^{-3} \right)} \quad (6)$$

$$f_1 = \left( \frac{w_{EPS}}{15.9994} + \frac{w_{DEL}}{14.0067} + \frac{3.5 \cdot c_{H2w} \cdot 10^{-4}}{c_{H2Ow} + 3.5 \cdot c_{H2w} \cdot 10^{-4}} \cdot \frac{w_{BET}}{12.0107} \right) \cdot \frac{1.00794}{w_{ALF}} \quad (7)$$

$$f_2 = \frac{28.96559 \cdot H_a \cdot 10^{-3}}{18.01528 + \left( \frac{1}{2} - f_1 \right) \cdot 28.96559 \cdot H_a \cdot 10^{-3}} \quad (8)$$

$$f_3 = \begin{pmatrix} 1 - \left(\frac{1}{2} + f_1\right) \cdot c_{H_2Ow} \cdot 10^{-2} \\ -(1 + f_1) \cdot c_{H_2w} \cdot 10^{-6} \\ -\left(\frac{1 + 3 \cdot f_1}{2}\right) \cdot c_{NH_3w} \cdot 10^{-6} \end{pmatrix} \quad (9)$$

$$f_4 = \begin{pmatrix} -f_2 + \left(1 + f_2 \cdot \left(\frac{1}{2} + f_1\right)\right) \cdot c_{H_2Ow} \cdot 10^{-2} \\ +(1 + f_2 \cdot (1 + f_1)) \cdot c_{H_2w} \cdot 10^{-6} \\ +\left(\frac{3}{2} + f_2 \cdot \left(\frac{1 + 3 \cdot f_1}{2}\right)\right) \cdot c_{NH_3w} \cdot 10^{-6} \end{pmatrix} \quad (10)$$

4.3  $H_a$  is the absolute humidity of intake air, in gram water per kg dry air. However, if  $H_a \geq H_{SC}$ , then  $H_{SC}$  shall be used in place of  $H_a$  in formulae (4), (6) and (8).

$$H_a = 621.955 \cdot \frac{p_a \cdot \frac{R_a}{100}}{p_b - p_a \cdot \frac{R_a}{100}} \quad (11)$$

$$H_{SC} = \frac{6.22 \cdot p_{SC} \cdot 100}{p_c - p_{SC}} \quad (12)$$

4.3.1  $H_a$  may be derived from relative humidity measurement, dew point measurement, vapour pressure measurement or dry/wet bulb measurement using generally accepted formulae. The generally accepted equations for the intake air humidity  $H_a$  are calculated as a function of vapour pressure and relative humidity.

4.3.2 The following formula calculates the saturation vapour pressure,  $p_a$ , as a function of the temperature  $T_a$ .

$$p_a = 10^{\log_{10}(p_a)} \quad (13)$$

4.3.2.1 For humidity measurements made at ambient temperatures from 0°C to 100°C or humidity measurements made over super-cooled water at ambient temperatures from -50°C to 0°C:

$$\begin{aligned} \log_{10}(p_a) = & 10.79574 \cdot \left(1 - \frac{273.16}{T_a}\right) - 5.028 \cdot \log_{10}\left(\frac{T_a}{273.16}\right) + 1.50475 \cdot 10^{-4} \\ & \cdot \left(1 - 10^{-8.2969 \cdot \left(\frac{T_a}{273.16} - 1\right)}\right) + 0.42873 \cdot 10^{-3} \cdot \left(10^{4.76955 \cdot \left(1 - \frac{273.16}{T_a}\right)} - 1\right) \\ & - 0.2138602 \end{aligned} \quad (14)$$

4.3.2.2 For humidity measurements made over ice at ambient temperatures from -100°C to 0°C:

$$\log_{10}(p_a) = -9.096853 \cdot \left( \frac{273.16}{T_a} - 1 \right) - 3.566506 \cdot \log_{10} \left( \frac{273.16}{T_a} \right) + 0.876812 \cdot \left( 1 - \frac{T_a}{273.16} \right) - 0.2138602 \quad (15)$$

**Note:** Formulae (14) and (15) reference the triple point of water at 273.16 K.

4.4 The following exceptions apply for the purpose of calculating the hydrogen balance:

4.4.1  $C_{H2W}$  measurement is only required for hydrogen fuel and fuel mixtures containing hydrogen fuel.

4.4.2  $C_{NH3W}$  measurement is only required for ammonia fuel and fuel mixtures containing ammonia fuel.

4.5 To calculate the dry-to-wet correction factor, the following equation shall be used:

$$k_{wr3} = \left( 1 - \frac{C_{H2Ow}}{100} \right) \cdot 1.008 \quad (16)$$

4.6  $q_{mf}$ ,  $w_{ALF}$ ,  $w_{BET}$ ,  $w_{GAM}$ ,  $w_{DEL}$  and  $w_{EPS}$  parameters, in formulae (5), (6) and (7), shall be calculated as described in 2.1 of this appendix VI."

73 A new section 5 is added after section 4 as follows:

## "5 Oxygen balance method

5.1 This method involves exhaust mass calculation from fuel consumption, fuel composition and exhaust gas concentrations for incomplete combustion.

5.2 The calculations shall be solved iteratively. For the first iteration it is necessary to use initial estimates for the dry exhaust density  $\rho_{ed}$  and the dry-to-wet correction factor  $k_{wr4}$ . As an initial estimate for the first iteration, the following values may be used:

$$\rho_{ed} = 1.293 \text{ kg/m}^3$$

$$k_{wr4} = 0.95$$

5.3 After each iteration use the calculated mass flows of air and exhaust to calculate new values for  $\rho_{ed}$  and  $k_{wr4}$  for the next iteration using equations 17 and 18.  $f_{fw}$  and  $f_{fd}$  are calculated using equations 19 and 20. The calculations are repeated for an iteration until the calculated wet exhaust mass flow,  $q_{mew}$ , from equation 21 is within 0.1% of the calculated wet exhaust mass flow from the previous iteration.

$$\rho_{ed} = \frac{q_{mad} + q_{mf} \cdot \left( 1 - \frac{w_{ALF}}{w_{BET} + w_{ALF} + w_{EPS} + w_{DEL} + w_{GAM}} \cdot 8.93668 \right)}{\frac{q_{mad}}{1.29230} + f_{fd} \cdot q_{mf}} \quad (17)$$

$$k_{wr4} = \frac{1 - \frac{1.24417 \cdot H_a + 111.187 \cdot w_{ALF} \cdot \frac{q_{mf}}{q_{maw}} \cdot (1 + H_a \cdot 10^{-3})}{773.815 + 1.24417 \cdot H_a + \frac{q_{mf}}{q_{maw}} \cdot (1 + H_a \cdot 10^{-3}) \cdot f_{fw} \cdot 1,000}}{1 - \frac{p_r}{p_b}} \quad (18)$$

$$f_{fw} = \frac{5.55936 \cdot w_{ALF} + 0.800117 \cdot w_{DEL} + 0.700464 \cdot w_{EPS}}{w_{BET} + w_{ALF} + w_{GAM} + w_{DEL} + w_{EPS}} \quad (19)$$

$$f_{fd} = -0.055593 \cdot w_{ALF} + 0.008002 \cdot w_{DEL} + 0.0070046 \cdot w_{EPS} \quad (20)$$

5.4 Exhaust gas mass flow rate on a wet basis:

$$q_{mew} = q_{maw} + q_{mf} \quad (21)$$

with

$$q_{maw} = q_{mad} \cdot \left(1 + \frac{H_a}{1,000}\right) \quad (22)$$

$$q_{mad} = q_{med} - q_{mf} \cdot (1 - w_{ALF} \cdot 0.0893668) \quad (23)$$

$$q_{med} = q_{mf} \cdot \left( \frac{(1 - 0.0893668 \cdot w_{ALF}) \cdot 23.1378 + f_2 - w_{EPS}}{23.1378 - \frac{f_1}{10,000 \cdot \rho_{ed}}} \right) \quad (24)$$

and

$$f_1 = \frac{14,276.3 \cdot c_{O2d} + 1.42763 \cdot c_{NO2d} - 1.07072 \cdot c_{NH3d}}{+0.713813 \cdot (c_{NOd} + c_{N2Od} - c_{COd} - c_{H2d} - \left(\frac{\alpha}{2} + 2 + 2 \cdot \gamma - \varepsilon\right) \cdot c_{HCd})} \quad (25)$$

$$f_2 = (2.66419 \cdot w_{BET} + 7.93668 \cdot w_{ALF} + 0.997935 \cdot w_{GAM}) \quad (26)$$

where

For concentrations measured after a dryer:

$$c_{gasd} = c_{gasm} \cdot 1.008 \quad (27)$$

For concentrations measured from wet exhaust:

$$c_{gasd} = \frac{c_{gasm}}{k_{wr4}} \cdot 1.008 \quad (28)$$

5.5 The following exceptions apply for the calculation of  $f_1$  in equation (25):

5.5.1 The concentrations  $c_{COd}$ ,  $c_{HCd}$ ,  $c_{H2d}$ ,  $c_{NH3d}$ ,  $c_{NOd}$ ,  $c_{NO2d}$  and  $c_{N2Od}$  shall be measured unless otherwise noted.

5.5.2 For mixtures of carbon-containing and non-carbon-containing fuels, in equation (25),  $\alpha$ ,  $\gamma$  and  $\varepsilon$  represent the properties of only the carbon-containing fuel. This is because unburned non-carbon-containing fuel does not contribute to HC emissions.

5.5.3  $c_{COd}$  measurement and  $c_{HCd}$  determination are required only for carbon-containing fuels and mixtures of carbon-containing and non-carbon-containing fuels. Otherwise, set these values to zero.

5.5.4  $c_{H2d}$  measurement is only required for hydrogen fuel and fuel mixtures containing hydrogen fuel. Otherwise, set this value to zero.

5.5.5  $c_{\text{NH}_3\text{d}}$  measurement is only required for ammonia fuel and fuel mixtures containing ammonia fuel. Otherwise, set this value to zero.

5.5.6 Separate values are required for  $c_{\text{NOd}}$  and  $c_{\text{NO}_2\text{d}}$ . The value of  $c_{\text{NOd}}$ , hence  $c_{\text{NO}_2\text{d}}$ , shall be determined by the temporary deactivation of the  $\text{NO}_x$  converter device. The measured value under that condition shall be recorded in accordance with 5.9.7.1.

5.5.7  $c_{\text{N}_2\text{Od}}$  measurement is required for ammonia fuel and fuel mixtures containing ammonia fuel or if an emission limit applies for  $\text{N}_2\text{O}$ . Otherwise, set this value to zero.

5.5.8 Table 2 provides an overview of the exhaust gas species measurement requirements by fuel type for the oxygen balance measurement method:

**Table 2 – Required exhaust gas concentration measurements by fuel oil type for the oxygen balance measurement method**

| Fuel oil type                          | Exhaust gas concentration measurement required* |                  |                          |                           |                  |                           |                           |
|----------------------------------------|-------------------------------------------------|------------------|--------------------------|---------------------------|------------------|---------------------------|---------------------------|
|                                        | $c_{\text{COd}}$                                | $c_{\text{HCd}}$ | $c_{\text{H}_2\text{d}}$ | $c_{\text{NH}_3\text{d}}$ | $c_{\text{NOd}}$ | $c_{\text{NO}_2\text{d}}$ | $c_{\text{N}_2\text{Od}}$ |
| Liquid fuel**                          | Yes                                             | Yes              |                          |                           | Yes              | Yes                       |                           |
| Natural gas, bio-methane and e-methane | Yes                                             | Yes              |                          |                           | Yes              | Yes                       |                           |
| Ammonia                                |                                                 |                  |                          | Yes                       | Yes              | Yes                       | Yes                       |
| Hydrogen                               |                                                 |                  | Yes                      |                           | Yes              | Yes                       |                           |

\* Where two or more fuel oil types are used concurrently, measurement requirements for exhaust gas concentrations shall be based on all fuel types used.

\*\* Petroleum-derived.

5.6  $q_{\text{mf}}$ ,  $w_{\text{ALF}}$ ,  $w_{\text{BET}}$ ,  $w_{\text{GAM}}$ ,  $w_{\text{DEL}}$  and  $w_{\text{EPS}}$  parameters in formulae (17), (18), (19), (20), (23), (24) and (26) shall be calculated as described in 2.1 of this appendix VI. "

74 A new section 6 is added after section 5 as follows:

## "6 Calculation for $u_{\text{gas}}$ coefficient when $\alpha > 4.0$

6.1 For fuels with  $\alpha > 4.0$  where the hydrogen balance method in 5.5.5 of this Code is used, the properties of raw exhaust gas change significantly with air to fuel ratio. For this method, calculate the applicable  $u_{\text{gas}}$  values for incomplete combustion from the molar masses of the exhaust gas components and raw exhaust as follows:

6.1.1 Calculate the molar mass of the exhaust,  $M_e$ , from measured wet concentrations  $c_{\text{H}_2\text{O}}$ ,  $c_{\text{H}_2}$  and  $c_{\text{NH}_3}$ , as follows:

$$M_e = \left( \begin{aligned} & f_3 - f_4 \cdot f_2 \\ & + \left( f_4 - (f_3 - f_4 \cdot f_2) \cdot \left( \frac{1}{2} + f_1 \right) \right) \cdot c_{\text{H}_2\text{Ow}} \cdot 10^{-2} \\ & + (f_4 - (f_3 - f_4 \cdot f_2) \cdot (1 + f_1)) \cdot c_{\text{H}_2\text{w}} \cdot 10^{-6} \\ & + \left( f_4 \cdot \frac{3}{2} - (f_3 - f_4 \cdot f_2) \cdot \left( \frac{1 + 3 \cdot f_1}{2} \right) \right) \cdot c_{\text{NH}_3\text{w}} \cdot 10^{-6} \end{aligned} \right) \quad (29)$$

with:

$$f_1 = \left( \frac{w_{EPS}}{15.9994} + \frac{w_{DEL}}{14.0067} + \frac{3.5 \cdot c_{H_2w} \cdot 10^{-4}}{c_{H_2Ow} + 3.5 \cdot c_{H_2w} \cdot 10^{-4}} \cdot \frac{w_{BET}}{12.0107} \right) \cdot \frac{1.00794}{w_{ALF}} \quad (30)$$

$$f_2 = \frac{28.96559 \cdot H_a \cdot 10^{-3}}{18.01528 + \left( \frac{1}{2} - f_1 \right) \cdot 28.96559 \cdot H_a \cdot 10^{-3}} \quad (31)$$

$$f_3 = \frac{(1 + H_a \cdot 10^{-3}) \cdot 521.823}{18.01528 + 28.96559 \cdot \left( \frac{1}{2} - f_1 \right) \cdot H_a \cdot 10^{-3}} \quad (32)$$

$$f_4 = (w_{BET} + w_{ALF} + w_{EPS} + w_{DEL} + w_{GAM}) \cdot \frac{2.01588}{w_{ALF}} \quad (33)$$

$c_{H_2w}$  measurement is only required for hydrogen fuel and fuel mixtures containing hydrogen fuel. Otherwise, set this value to zero.

$c_{NH_3}$  measurement is only required for ammonia fuel and fuel mixtures containing ammonia fuel. Otherwise, set this value to zero.

6.1.2 Calculate  $u_{gas}$  as follows:

$$u_{gas} = \frac{M_{gas}}{(M_e \cdot 1,000)} \quad (34)$$

6.2 For fuels with  $\alpha > 4.0$  where the direct measurement method of exhaust flow in 5.5.2 of this Code, the air and fuel measurement method in 5.5.3 of this Code, or the oxygen balance method in 5.5.6 of this Code is used, calculate the applicable  $u_{gas}$  values for incomplete combustion from either the densities of the exhaust gas components and wet raw exhaust or the molar masses of the exhaust gas components and raw exhaust using one of the following methods:

6.2.1 For the density method:

6.2.1.1 Calculate the density of wet raw exhaust,  $\rho_{ew}$ , from  $H_a$  from section 4.3 of this appendix VI,  $q_{mf}$ ,  $q_{mad}$  from equation (23) and  $f_{fw}$  from equation (19) as follows:

$$\rho_{ew} = \frac{1,000 + H_a + 1,000 \cdot \frac{q_{mf}}{q_{mad}}}{773.814 + 1.24417 \cdot H_a + 1,000 \cdot f_{fw} \cdot \frac{q_{mf}}{q_{mad}}} \quad (35)$$

6.2.1.2 Calculate  $u_{gas}$  as follows:

$$u_{gas} = \frac{\rho_{gas}}{(\rho_{ew} \cdot 1,000)} \quad (36)$$

6.2.2 For the molar mass method:

6.2.2.1 Calculate the molar mass of the exhaust,  $M_e$ , from  $q_{mf}$ ,  $q_{maw}$  from equation (22),  $f_{fw}$  from equation (19) and  $H_a$  from section 4.3 of this appendix VI as follows:

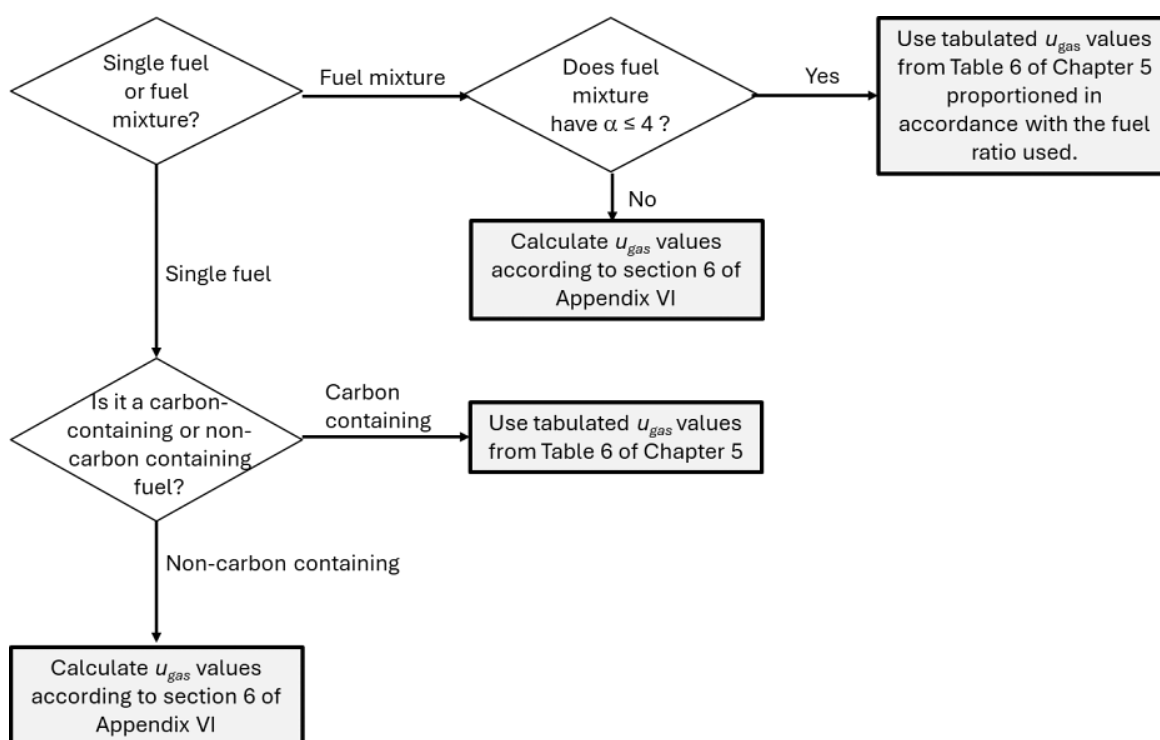
$$M_e = \frac{1 + \frac{q_{mf}}{q_{maw}}}{\frac{q_{mf}}{q_{maw}} \cdot \frac{f_{fw}}{22.414} + \frac{H_a \cdot 10^{-3}}{1 + H_a \cdot 10^{-3}} + \frac{1}{\frac{18.01528}{28.96559}}} \quad (37)$$

6.2.2.2 Calculate  $u_{gas}$  using equation (34) of this appendix VI. "

75 A new section 7 is added after section 6 as follows:

## "7 Flow chart for determination of $u_{gas}$ for fuels and fuel mixtures

7.1 The following flow chart is provided to guide the  $u_{gas}$  determination for fuels or fuel mixtures.



**Figure 1** – Flow chart for determination of  $u_{gas}$  for fuels and fuel mixtures

"

## Appendix VIII – Implementation of the direct measurement and monitoring method (refer to 6.4 of the NO<sub>x</sub> Technical Code 2008)

### 2 Analysing equipment

#### 2.1 Analysers

76 In paragraph 2.2.1, new sub-paragraphs 2.1.1.6 to 2.1.1.9 are added after existing sub-paragraph 2.1.1.5 as follows:

"6 Hydrogen (H<sub>2</sub>) analysis

When required, the hydrogen analyser shall be of the mass spectrometer (MS) or raman spectrometer (RS) type.

7 Ammonia (NH<sub>3</sub>) analysis

When required, the ammonia analyser shall be of the Fourier transform infrared (FTIR), non-dispersive ultraviolet (NDUV) or laser infrared analyser (LIA) type. The sample stream and analyser shall be designed to prevent water condensation.

8 Nitrous oxide (N<sub>2</sub>O) analysis

When required, the nitrous oxide analyser shall be of the Fourier transform infrared (FTIR), non-dispersive infrared (NDIR), non-dispersive ultraviolet (NDUV) or laser infrared analyser (LIA) type.

9 Water (H<sub>2</sub>O) analysis

When required, the water analyser shall be of the Fourier transform infrared (FTIR), mass spectrometer (MS) or laser infrared analyser (LIA) type."

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