

Amendments to the NOx Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles

Object of Amendment

Rules/Guidance for Marine Pollution Prevention Systems
Rules/Guidance for Marine Engine Emission Verification

Reason for Amendment

The procedures for verifying compliance with regulation 13 of MARPOL Annex VI, which regulates emissions of nitrogen oxides (NOx) from marine diesel engines installed on ships, are specified in the NOx Technical Code. The Society has established procedures for the verification of emissions based on the NOx Technical Code in its Rules for Marine Engine Emission Verification.

With the widespread adoption of electronically controlled engines, it has become technically feasible for engines to switch between engine operational profiles during operation and to optimise combustion characteristics depending on operating conditions. However, since NOx emissions and fuel consumption are generally in a trade-off relationship, it has been recognised that, where engine operational profiles are switched for the purpose of improving fuel efficiency, NOx emissions under actual operating conditions may increase compared to those measured during emission verification.

In addition, the previous NOx Technical Code did not include specific requirements regarding the handling of switching between multiple engine operational profiles, the methods to be applied during emission verification, or requirements for recording such switching, leaving these matters to the discretion of the Administration. As a result, concerns were raised that the use of multiple engine operational profiles could be interpreted as constituting an irrational emission control strategy prohibited under the NOx Technical Code and that reliance on the Administration's discretion could lead to a lack of consistency.

In light of these issues, amendments to the NOx Technical Code were discussed at the IMO with the aim of introducing verification procedures for engines using multiple engine operational profiles. In addition, discussions were held to clarify requirements related to emission control strategies, which had previously been ambiguous, and to strengthen requirements for ensuring that such strategies are maintained under actual operating conditions. This included a requirement for engine manufacturers to provide information to demonstrate to the satisfaction of the Administration that the emission control strategy is maintained under operating conditions outside the applicable test cycles.

As a result, at the 83rd session of the Marine Environment Protection Committee (MEPC 83), held in April 2025, amendments to the NOx Technical Code reflecting these matters were adopted as IMO resolution MEPC.397(83). Furthermore, at the 84th session (MEPC 84), held from April to May 2026, amendments to MARPOL Annex VI incorporating the above amendments were adopted as IMO resolution MEPC.408(84).

Accordingly, relevant requirements are amended based on IMO resolutions MEPC.397(83) and MEPC.408(84).

Outline of the Amendment

The main contents of this amendment are as follows:

- (1) Addition of information to be included in the engine technical file
- (2) Addition of the NOx certification pack in the Rules for Marine Engine Emission Verification as documentation subject to approval by the Society
- (3) Revision of the definition of test cycles to be applied for the verification of engine emissions
- (4) Incorporation of Chapter 8 “Multiple Engine Operational Profiles” newly added to the NOx Technical Code

Effective Date and Application

This amendment applies as follows on or after 1 January 2028:

- (1) To a new individual engine or a parent engine of an engine family or engine group that has not been previously certified, with an International Air Pollution Prevention Engine (EIAPP) Certificate issued on or after 1 January 2028
- (2) To a new member engine of an engine family or engine group for which the parent engine was certified before 1 January 2028, where the EIAPP Certificate is issued on or after 1 January 2030
- (3) This amendment does not apply to a marine diesel engine which already has an EIAPP Certificate, except in the following cases:
 - (a) Where the engine is subject to a substantial modification on or after 1 January 2028, in which case this amendment applies in accordance with the definition of “substantial modification” as set out in amended paragraph 1.3.2 of the NOx Technical Code 2008
 - (b) Where an identical replacement engine is installed on or after 1 January 2028 on a ship, and the replaced engine is equipped with multiple engine operational profiles

An asterisk (*) after the title of a requirement indicates that there is also relevant information in the corresponding Guidance.

ID:DD26-07

Amended-Original Requirements Comparison Table (Amendments to the NO_x Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
RULES FOR MARINE POLLUTION PREVENTION SYSTEMS Part 8 EQUIPMENT FOR THE PREVENTION OF AIR POLLUTION FROM SHIPS Chapter 1 GENERAL 1.1 General 1.1.2 Terminology (<i>Regulation 2, 13, 14 and 16 of Annex VI and 1.3, 4.1, 4.3.9 and 4.4.8 of NO_x Technical Code</i>)* ((1) to (11) are omitted.) (12) “Substantial modification” of a diesel engine means as follows. (a) For diesel engines installed on ships at beginning stage of construction on or after 1 January 2000 (19 May 2005 for ships not engaged in international voyages), substantial modification means any modification to an engine that could potentially cause the NO_x emission from the engine to exceed the limits specified in 2.1.2-1. Routine replacement of components of a diesel engine by parts specified in the Technical File that do not alter NO_x emission characteristics is not considered a “substantial modification”. <u>For the recertification of such an engine following a substantial modification, the version of the NO_x</u>	RULES FOR MARINE POLLUTION PREVENTION SYSTEMS Part 8 EQUIPMENT FOR THE PREVENTION OF AIR POLLUTION FROM SHIPS Chapter 1 GENERAL 1.1 General 1.1.2 Terminology (<i>Regulation 2, 13, 14 and 16 of Annex VI and 1.3, 4.1, 4.3.9 and 4.4.8 of NO_x Technical Code</i>)* ((1) to (11) are omitted.) (12) “Substantial modification” of a diesel engine means as follows. (a) For diesel engines installed on ships at beginning stage of construction on or after 1 January 2000 (19 May 2005 for ships not engaged in international voyages), substantial modification means any modification to an engine that could potentially cause the NO_x emission from the engine to exceed the limits specified in 2.1.2-1. Routine replacement of components of a diesel engine by parts specified in the Technical File that do not alter NO_x emission characteristics is not <u>be</u> considered a “substantial modification”.	MEPC.397(83) 1.3.2

Amended-Original Requirements Comparison Table (Amendments to the NO_x Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
<u>Technical Code that was used for the original certification applies except if the engine was or is now equipped with an auxiliary control device or has multiple engine operational profiles. Where an auxiliary control device is fitted, the requirements of 2.5 and 3.3 of the <i>NO_x Technical Code</i> apply. Where there are multiple engine operating profiles, the requirements of Chapter 8 of the <i>NO_x Technical Code</i> apply.</u> (b) For diesel engines installed on ships at beginning stage of construction before 1 January 2000 (19 May 2005 for ships not engaged in international voyages), substantial modification means any modification made to an engine which increases its existing NO_x emission characteristics in excess of the limits established by the <u>onboard</u> simplified measurement method referred to in 2.1.2-2(2)(b). These changes include, but are not limited to, changes in its operations or in its technical parameters (e.g. changing camshafts, fuel injection systems, air systems, combustion chamber configuration, or timing calibration of the engine). However, the installation of a certified approved method pursuant to 2.1.1-3 or certification pursuant to 2.1.2(1)(a) to (c) is not considered to be a substantial modification for the purpose of the application of (13) and 2.1.2-1(2). <u>For recertification of such an engine following a substantial modification, 2.5 and 3.3 apply and, where that engine has multiple engine operating profiles, Chapter 8 of the <i>NO_x Technical Code</i> also applies.</u>	(b) For diesel engines installed on ships at beginning stage of construction before 1 January 2000 (19 May 2005 for ships not engaged in international voyages), substantial modification means any modification made to an engine which increases its existing NO_x emission characteristics in excess of the limits established by the <u>on-board</u> simplified measurement method referred to in 2.1.2-2(2)(b). These changes include, but are not limited to, changes in its operations or in its technical parameters (e.g., changing camshafts, fuel injection systems, air systems, combustion chamber configuration, or timing calibration of the engine). However, the installation of a certified approved method pursuant to 2.1.1-3 or certification pursuant to 2.1.2(1)(a) to (c) is not considered to be a substantial modification for the purpose of the application of (13) and 2.1.2-1(2).	

Amended-Original Requirements Comparison Table (Amendments to the NOx Technical Code to Allow the Use of
Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
((13) to (28) are omitted.)	((13) to (28) are omitted.)	
The effective date of the amendment is according to EFFECTIVE DATE AND APPLICATION (A)		

Amended-Original Requirements Comparison Table (Amendments to the NO_x Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
Chapter 2 EQUIPMENT FOR THE PREVENTION OF AIR POLLUTION FROM SHIPS 2.1 Nitrogen Oxides (NO_x) (<i>Regulation 13 of Annex VI</i>) 2.1.2 Requirements for Installation* 2 Measurement and calculation <u>are</u> to be in accordance with the following: (1) NO_x emissions are to be measured and calculated applying a test cycle in accordance with the following (a) to (d). (a) <u>For a fixed pitch propeller propulsion engine or a propeller-law operated non-propulsion engine, test cycle E3 is to be applied in accordance with Table 8-2.</u> (b) <u>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 is to be applied in accordance with Table 8-3.</u> (c) <u>For a non-propulsion engine that is a constant-speed engine, test cycle D2 is to be applied in accordance with Table 8-4.</u> (d) <u>For a non-propulsion engine that operates as a variable-speed engine, not included above, test cycle C1 is to be applied in accordance with Table 8-5.</u> ((2) to (4) are omitted.) (5) <u>In the case of a marine diesel engine to be certified in</u>	Chapter 2 EQUIPMENT FOR THE PREVENTION OF AIR POLLUTION FROM SHIPS 2.1 Nitrogen Oxides (NO_x) (<i>Regulation 13 of Annex VI</i>) 2.1.2 Requirements for Installation* 2 Measurement and calculation <u>is</u> to be in accordance with the following: (1) NO_x emissions are to be measured and calculated applying a test cycle in accordance with the following (a) to (e). (a) <u>For constant-speed diesel engines for ship main propulsion, including diesel-electric drive, test cycle E2 specified in Table 8-2 is to be applied.</u> (b) <u>For controllable-pitch propeller sets test cycle E2 specified in Table 8-2 is to be applied.</u> (c) <u>For propeller-law-operated main and propeller-law-operated auxiliary diesel engines test cycle E3 specified in Table 8-3 is to be applied.</u> (d) <u>For constant-speed auxiliary diesel engines, the test cycle D2 specified in Table 8-4 is to be applied.</u> (e) <u>For variable-speed, variable-load auxiliary diesel engines, not included in (a) to (d) above, the test cycle C1 specified in Table 8-5 is to be applied.</u> ((2) to (4) are omitted.) (Newly added)	MEPC84/3/1/Annex Para 3 MEPC84/3/1/Annex

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Amended	Original	Remarks																																																																																																
accordance with Table 8-1(c), the specific emission at each individual mode point is not to exceed the applicable NOx emission limit value by more than 50 % except as follows: (a) The 10 % mode point in the D2 test cycle. (b) The 10 % mode point in the C1 test cycle. (c) The idle mode point in the C1 test cycle. Table 8-2 Test Cycle Type E3 <table><tr><td>Number of revolutions</td><td>100 %</td><td>91 %</td><td>80 %</td><td>63 %</td></tr><tr><td>Output</td><td>100 %</td><td>75 %</td><td>50 %</td><td>25 %</td></tr><tr><td>Weighting factor^{*(1)}</td><td>0.2</td><td>0.5</td><td>0.15</td><td>0.15</td></tr></table> Table 8-3 Test Cycle Type E2 <table><tr><td>Number of revolutions</td><td>100 %</td><td>100 %</td><td>100 %</td><td>100 %^{*(2)}</td></tr><tr><td>Output</td><td>100 %</td><td>75 %</td><td>50 %</td><td>25 %</td></tr><tr><td>Weighting factor^{*(1)}</td><td>0.2</td><td>0.5</td><td>0.15</td><td>0.15</td></tr></table> Table 8-4 Test Cycle Type D2 <table><tr><td>Number of revolutions</td><td>100 %</td><td>100 %</td><td>100 %</td><td>100 %</td><td>100 %</td></tr><tr><td>Output</td><td>100 %</td><td>75 %</td><td>50 %</td><td>25 %</td><td>10 %</td></tr><tr><td>Weighting factor^{*(1)}</td><td>0.05</td><td>0.25</td><td>0.3</td><td>0.3</td><td>0.1</td></tr></table>	Number of revolutions	100 %	91 %	80 %	63 %	Output	100 %	75 %	50 %	25 %	Weighting factor ^{*(1)}	0.2	0.5	0.15	0.15	Number of revolutions	100 %	100 %	100 %	100 % ^{*(2)}	Output	100 %	75 %	50 %	25 %	Weighting factor ^{*(1)}	0.2	0.5	0.15	0.15	Number of revolutions	100 %	100 %	100 %	100 %	100 %	Output	100 %	75 %	50 %	25 %	10 %	Weighting factor ^{*(1)}	0.05	0.25	0.3	0.3	0.1	Table 8-2 Test Cycle Type E2 <table><tr><td>Number of revolutions</td><td>100%</td><td>100%</td><td>100%</td><td>100%^{*(2)}</td></tr><tr><td>Output</td><td>100%</td><td>75%</td><td>50%</td><td>25%</td></tr><tr><td>Weighting factor^{*(1)}</td><td>0.2</td><td>0.5</td><td>0.15</td><td>0.15</td></tr></table> Table 8-3 Test Cycle Type E3 <table><tr><td>Number of revolutions</td><td>100%</td><td>91%</td><td>80%</td><td>63%</td></tr><tr><td>Output</td><td>100%</td><td>75%</td><td>50%</td><td>25%</td></tr><tr><td>Weighting factor^{*(1)}</td><td>0.2</td><td>0.5</td><td>0.15</td><td>0.15</td></tr></table> Table 8-4 Test Cycle Type D2 <table><tr><td>Number of revolutions</td><td>100%</td><td>100%</td><td>100%</td><td>100%</td><td>100%</td></tr><tr><td>Output</td><td>100%</td><td>75%</td><td>50%</td><td>25%</td><td>10%</td></tr><tr><td>Weighting factor^{*(1)}</td><td>0.05</td><td>0.25</td><td>0.3</td><td>0.3</td><td>0.1</td></tr></table>	Number of revolutions	100%	100%	100%	100% ^{*(2)}	Output	100%	75%	50%	25%	Weighting factor ^{*(1)}	0.2	0.5	0.15	0.15	Number of revolutions	100%	91%	80%	63%	Output	100%	75%	50%	25%	Weighting factor ^{*(1)}	0.2	0.5	0.15	0.15	Number of revolutions	100%	100%	100%	100%	100%	Output	100%	75%	50%	25%	10%	Weighting factor ^{*(1)}	0.05	0.25	0.3	0.3	0.1	Para 3/Table 4 MEPC84/3/1/Annex Para 3/Table 1 MEPC84/3/1/Annex Para 3/Table 2 MEPC84/3/1/Annex Para 3/Table 3
Number of revolutions	100 %	91 %	80 %	63 %																																																																																														
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Amended-Original Requirements Comparison Table (Amendments to the NOx Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended									Original									Remarks
Table 8-5 Test Cycle Type C1									Table 8-5 Test Cycle Type C1									MEPC84/3/1/Annex Para 3/Table 4
Number of revolutions	Number of maximum continuous revolutions				Intermediate ^{*(4)}			Idle	Number of revolutions	Number of maximum continuous revolutions				Intermediate ^{*(4)}			Idle	
Torque ^{*(3)}	100 %	75 %	50 %	10 %	100 %	75 %	50 %	0 %	Torque ^{*(3)}	100%	75%	50%	10%	100%	75%	50%	0%	
Weighting factor ^{*(1)}	0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.15	Weighting factor ^{*(1)}	0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.15	
Notes: *(1) (Omitted) *(2) There are exceptional cases, including large bore diesel engines intended for E2 applications, in which, due to their oscillating masses and construction, diesel engines cannot be run at low load at nominal speed without the risk of damaging essential components. In such cases, the diesel engine manufacturer is to make application to the Administration that the test cycle as given in Table 8-3 may be modified for the 25 % power mode with regard to the diesel engine speed. The adjusted diesel engine speed at 25% power, however, is to be as close as possible to the rated diesel engine speed, as recommended by the diesel engine manufacturer and approved by the Administration. The applicable weighting factors for the test cycle are to remain unchanged. ((3) and (4) are omitted.)									Notes: *(1) (Omitted) *(2) There are exceptional cases, including large bore diesel engines intended for E2 applications, in which, due to their oscillating masses and construction, diesel engines cannot be run at low load at nominal speed without the risk of damaging essential components. In such cases, the diesel engine manufacturer is to make application to the Administration that the test cycle as given in Table 8-2 may be modified for the 25% power mode with regard to the diesel engine speed. The adjusted diesel engine speed at 25% power, however, is to be as close as possible to the rated diesel engine speed, as recommended by the diesel engine manufacturer and approved by the Administration. The applicable weighting factors for the test cycle are to remain unchanged. ((3) and (4) are omitted.)									
The effective date of the amendment is according to EFFECTIVE DATE AND APPLICATION (B)																		

Amended-Original Requirements Comparison Table (Amendments to the NOx Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
2.1.3 Technical File and Record Book of Engine Parameters* 1 Technical File Every diesel engine is to be accompanied with an approved Technical File prepared by the diesel engine manufacturer, etc. and containing the following information. (1) Identification of those components, including detailed information to enable to find out whether they are modified or not, settings and operating values of the diesel engine which influence its NOx emissions including any NOx-reducing device or system. (2) Identification of the full range of allowable adjustments or alternatives for the components of the diesel engine. (3) Full record of the relevant diesel engine's performance, including the number of maximum continuous revolutions and maximum continuous output of the diesel engine consistent with those specified on the nameplate. (4) At least one of the methods to verify NOx emissions, which is listed in 2.1.2-2(2) and applicable at the inspection specified in 3.2.2-4(2), Part 2, or the <u>onboard</u> diesel engine parameter check method otherwise specified by the Society. When <u>onboard</u> direct measurement and monitoring method are applied, procedures for calibration and operation of the measuring equipment specified by the diesel engine manufacturer, etc. are to be contained. In addition, when exhaust gas cleaning system to reduce NOx emissions is installed, <u>onboard</u> NOx verification procedures for the system to ensure it is operating	2.1.3 Technical File and Record Book of Engine Parameters* 1 Technical File Every diesel engine is to be accompanied with an approved Technical File prepared by the diesel engine manufacturer, etc. and containing the following information. (1) Identification of those components, including detailed information to enable to find out whether they are modified or not, settings and operating values of the diesel engine which influence its NOx emissions including any NOx-reducing device or system. (2) Identification of the full range of allowable adjustments or alternatives for the components of the diesel engine. (3) Full record of the relevant diesel engine's performance, including the number of maximum continuous revolutions and maximum continuous output of the diesel engine consistent with those specified on the nameplate. (4) At least one of the methods to verify NOx emissions, which is listed in 2.1.2-2(2) and applicable at the inspection specified in 3.2.2-4(2), Part 2, or the <u>on-board</u> diesel engine parameter check method otherwise specified by the Society. When <u>on-board</u> direct measurement and monitoring method <u>is</u> applied, procedures for calibration and operation of the measuring equipment specified by the diesel engine manufacturer, etc. are to be contained. In addition, when exhaust gas cleaning system to reduce NOx emissions is installed, <u>on-board</u> NOx verification procedures for the system to ensure it is	

Amended-Original Requirements Comparison Table (Amendments to the NO_x Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
correctly are also to be contained. (5) A copy of the test report on the testing in accordance with Section 2, Annex V of the <i>NO_x Technical Code</i>. (In the case where the <u>onboard</u> simplified measurement method applied in accordance with 2.2.5.2 of the <i>NO_x Technical Code</i> was conducted for emission verification, both the test reports are to be included.) For a Member Engine of an Engine Family or Engine Group, it may be substituted for that for the Parent Engine. (6) If applicable, the designation and restrictions for a diesel engine which is a member of an Engine Family or Engine Group in consistent with the requirement specified in Chapter 4 of the <i>NO_x Technical Code</i>. (7) Specifications of those spare parts/components of the diesel engine which, when used in the diesel engine, according to those specifications, will result in continued compliance of the NO_x emission with the limits specified in 2.1.2-1. (8) <i>EIAPP Certificate</i>, where it has been issued. (9) In case the exhaust gas cleaning system to reduce NO_x emissions is installed, record of the presence of the system as a component of the diesel engine. (10) Where an additional substance is introduced, such as ammonia, urea, steam, water, fuel additives, etc., a ready means of demonstrating that the consumption of such additional substances is consistent with achieving compliance with the applicable NO_x limit. (11) <u>Where (10) above applies, the means by which it is to be verified that the required quantities of additional substance used are consistent with achieving the engine's intended base emission control strategy is to be included as part of the onboard NO_x verification</u>	operating correctly are also to be contained. (5) A copy of the test report on the testing in accordance with Section 2, Annex V of the <i>NO_x Technical Code</i>. (In the case where the <u>on-board</u> simplified measurement method applied in accordance with 2.2.5.2 of the <i>NO_x Technical Code</i> was conducted for emission verification, both the test reports are to be included.) For a Member Engine of an Engine Family or Engine Group, it may be substituted for that for the Parent Engine. (6) If applicable, the designation and restrictions for a diesel engine which is a member of an Engine Family or Engine Group in consistent with the requirement specified in Chapter 4 of the <i>NO_x Technical Code</i>. (7) Specifications of those spare parts/components of the diesel engine which, when used in the diesel engine, according to those specifications, will result in continued compliance of the NO_x emission with the limits specified in 2.1.2-1. (8) <i>EIAPP Certificate</i>, where it has been issued. (9) In case the exhaust gas cleaning system to reduce NO_x emissions is installed, record of the presence of the system as a component of the diesel engine. (10) Where an additional substance is introduced, such as ammonia, urea, steam, water, fuel additives, etc., a ready means of demonstrating that the consumption of such additional substances is consistent with achieving compliance with the applicable NO_x limit. (Newly added)	MEPC.397(83) 2.5.6.4

Amended-Original Requirements Comparison Table (Amendments to the NO_x Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
<u>procedure.</u> (12) <u>Identification of all auxiliary control devices, irrespective of whether they operate under steady-state or transient conditions.</u> (13) <u>For those auxiliary control devices which may operate under steady-state conditions, the operating conditions which will cause those devices to function.</u> (14) <u>The means by which the operation of those auxiliary control devices which may operate under steady-state conditions, the operating conditions may be verified as part of the onboard NO_x verification procedure.</u> (15) <u>The power (or torque) and speed boundaries of the not-to-exceed zone</u> (16) <u>The onboard NO_x verification procedure is to include means to verify that the engine only operates within not-to-exceed zone</u> (17) Other information considered necessary by the Society.	(11) Other information considered necessary by the Society.	MEPC.397(83) 2.5.6.1 to 2.5.6.3 MEPC.397(83) 3.3.2 Renumbering
The effective date of the amendment is according to EFFECTIVE DATE AND APPLICATION (A)		

Amended-Original Requirements Comparison Table (Amendments to the NO_x Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
RULES FOR MARINE ENGINE EMISSION VERIFICATION Chapter 1 GENERAL RULES 1.2 Definition 1.2.1 Terms* Terms used in the Rules are defined as follows: ((1) to (14) are omitted.) (15) “Substantial modification” of an engine means as follows. (a) For engines installed on ships at beginning stage of construction on or after 1 January 2000 (19 May 2005 for ships not engaged in international voyages), substantial modification means any modification to an engine that could potentially cause the NO_x emission from the engine to exceed the limits specified in 2.2.2-1. Routine replacement of components of an engine by parts specified in the Technical File that do not alter NO_x emission characteristics is not be considered a “substantial modification”. <u>For the recertification of such an engine following a substantial modification, the version of the NO_x Technical Code that was used for the original certification applies except if the engine was or is now equipped with an auxiliary control device or has multiple engine operational profiles. Where an auxiliary control device is fitted, the</u>	RULES FOR MARINE ENGINE EMISSION VERIFICATION Chapter 1 GENERAL RULES 1.2 Definition 1.2.1 Terms* Terms used in the Rules are defined as follows: ((1) to (14) are omitted.) (15) “Substantial modification” of an engine means as follows. (a) For engines installed on ships at beginning stage of construction on or after 1 January 2000 (19 May 2005 for ships not engaged in international voyages), substantial modification means any modification to an engine that could potentially cause the NO_x emission from the engine to exceed the limits specified in 2.2.2-1. Routine replacement of components of an engine by parts specified in the Technical File that do not alter NO_x emission characteristics is not be considered a “substantial modification”.	MEPC.397(83) 1.3.2

Amended-Original Requirements Comparison Table (Amendments to the NO_x Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
<u>requirements of 2.5 and 3.3 of the <i>NO_x Technical Code</i> apply. Where there are multiple engine operating profiles, the requirements of Chapter 8 of the <i>NO_x Technical Code</i> apply.</u> (b) For engines installed on ships at beginning stage of construction before 1 January 2000 (19 May 2005 for ships not engaged in international voyages), substantial modification means any modification made to an engine which increases its existing NO_x emission characteristics in excess of the limits established by the on-board simplified measurement method. These changes include, but are not limited to, changes in its operations or in its technical parameters (e.g., changing camshafts, fuel injection systems, air systems, combustion chamber configuration, or timing calibration of the engine). However, the installation of a certified approved method pursuant to <i>Regulation 13.7.1.1 of Annex VI</i> or certification pursuant to <i>Regulation 13.7.1.2 of Annex VI</i> is not considered to be a substantial modification for the purpose of the application of (16) and 2.2.2-1(2). <u>For recertification of such an engine following a substantial modification, 2.5 and 3.3 apply and, where that engine has multiple engine operating profiles, Chapter 8 of the <i>NO_x Technical Code</i> also applies.</u> ((16) to (20) are omitted.) (21) <u>“Engine operational profile” means a particular set of NO_x influencing settings applied in the base emission control strategy which influences the NO_x emission performance. Those settings may relate to, but are not limited to, fuel injection, inlet and exhaust valve</u>	(b) For engines installed on ships at beginning stage of construction before 1 January 2000 (19 May 2005 for ships not engaged in international voyages), substantial modification means any modification made to an engine which increases its existing NO_x emission characteristics in excess of the limits established by the on-board simplified measurement method. These changes include, but are not limited to, changes in its operations or in its technical parameters (e.g., changing camshafts, fuel injection systems, air systems, combustion chamber configuration, or timing calibration of the engine). However, the installation of a certified approved method pursuant to <i>Regulation 13.7.1.1 of Annex VI</i> or certification pursuant to <i>Regulation 13.7.1.2 of Annex VI</i> is not considered to be a substantial modification for the purpose of the application of (16) and 2.2.2-1(2). ((16) to (20) are omitted.) (Newly added)	MEPC.397(83) 1.3.21

Amended-Original Requirements Comparison Table (Amendments to the NOx Technical Code to Allow the Use of
Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
<u>operation, charge air management, exhaust bypass/wastegate or exhaust after-treatment controls and auxiliary control devices.</u> (22) <u>“Multiple engine operational profiles” means that more than one engine operational profile is available for selection on a marine diesel engine.</u> (23) <u>“Auxiliary control device” means a system, function or control strategy installed on a marine diesel engine that is used to protect the engine and/or its ancillary equipment against operating conditions that could result in damage or failure, or that is used to facilitate the starting of the engine. An auxiliary control device may also be a strategy or measure that has been satisfactorily demonstrated not to be a defeat device. An auxiliary control device includes any element of design that includes sensors, or other arrangements which, by an action of the control system, can activate, modulate, delay or deactivate the operation of any part of the base emission control system. Any device or strategy the activation of which causes a non-progressive change in emissions is also an auxiliary control device. An auxiliary control device not declared at the time of the first certification of a marine diesel engine is to be considered a defeat device.</u> (24) <u>“Defeat device” means a device that measures, senses or responds to operating variables (e.g. engine speed, temperature, intake pressure or any other parameter) for the purpose of activating, modulating, delaying or deactivating the operation of any component or the function of the emission control system such that the effectiveness of the emission control system is reduced under conditions encountered during normal</u>		MEPC.397(83) 1.3.22 MEPC.397(83) 1.3.23 MEPC.397(83) 1.3.24

Amended-Original Requirements Comparison Table (Amendments to the NO_x Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
operation, unless the use of such a device is substantially included in the applied emission certification test procedures. An auxiliary control device accepted as part of the Administration's review of the NO_x certification pack is not a defeat device. (25) <u>"Base emission control strategy" means the emission control strategy active at any time an auxiliary control device is not active. It consists of any parameter, element of design, or operating control that is designed to modulate as a function of engine load and/or speed in a manner that affects the emission performance of the engine. The modulation of parameters is to be progressive and not to result in a disproportionate change in emissions.</u> (26) <u>"Rational emission control strategy" means the base emission control strategy applied to a marine diesel engine which ensures that the emission values at the individual mode points as used to give the weighted specific emission value are representative of the emission values during normal operation of the engine.</u> (27) <u>"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.</u> (28) <u>"Not-to-exceed emission limit value" means the maximum permitted NO_x emission value at a given operating condition as determined in accordance with 3.3 of the <i>NO_x Technical Code</i> within the not-to-exceed zone of the engine.</u> (29) <u>"Not-to-exceed zone" means the power or torque and</u>		MEPC.397(83) 1.3.25 MEPC.397(83) 1.3.26 MEPC.397(83) 1.3.27 MEPC.397(83) 1.3.28 MEPC.397(83) 1.3.29

Amended-Original Requirements Comparison Table (Amendments to the NO_x Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
<u>speed area of a marine diesel engine within the limit area of the not-to-exceed zone as declared by the applicant that the engine is certified to operate within under steady-state conditions. In the case of the C1 cycle, as given by 2.2.2-2, the not-to-exceed zone corresponds to the whole of the limit area of the not-to-exceed zone.</u> (30) <u>“Limit area of the not-to-exceed zone” means the power or torque and speed boundaries of the not-to-exceed zone at and above 25% rated power for all test cycles as given by 2.2.2-2 except for the C1 cycle where it is at and above 50% engine load.</u> (31) <u>“Point emission value” means the NO_x emission value expressed in terms of g/kWh at the reference conditions of humidity and temperature given by NO_x Technical Code at a particular power or load and speed point.</u> (32) <u>“NO_x certification pack” means the package of information supplied by the applicant to the Administration as required to be submitted by 2.5 and 3.3 of the <i>NO_x Technical Code</i>.</u> (33) <u>“Propulsion engine” means a marine diesel engine that is used for direct or indirect propulsion. A propulsion engine may additionally perform non-propulsion duties during or separately to propulsion duties.</u> (34) <u>“Non-propulsion engine” means a marine diesel engine that is not a propulsion engine. An engine that solely or in part provides athwartships movement of a ship is not a propulsion engine.</u> (35) <u>“Constant-speed engine” means a marine diesel engine that is limited to constant-speed operation.</u> (36) <u>“Constant-speed engine” operation means a marine</u>		MEPC.397(83) 1.3.30 MEPC.397(83) 1.3.31 MEPC.397(83) 1.3.32 MEPC.397(83) 1.3.33 MEPC.397(83) 1.3.34 MEPC.397(83) 1.3.35 MEPC.397(83) 1.3.36

Amended-Original Requirements Comparison Table (Amendments to the NOx Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
<u>diesel engine regulated by a speed control device that automatically controls the operator demand to maintain engine's nominal speed across the load range. Additionally, an idle speed setting may be provided that can be used during start-up or shutdown.</u> (37) <u>"Variable-speed engine" means an engine that is not a constant-speed engine.</u> Chapter 2 EMISSION VERIFICATION, ETC. 2.1 Application for Emission Verification, etc. 2.1.1 Application for Emission Verification, etc.* 4 The following drawings and documents are to be submitted to the Society together with the application. (1) Specifications of the engine (excluding cases where submitted separately) (2) Drawings showing the construction and layout of the engine (excluding cases where submitted separately) (3) Documents showing the materials used for the engine (excluding cases where submitted separately) (4) Documents showing the scope of the target engine (5) Documents showing the criteria for selection (for parent engine only) (6) Technical File <u>(7) NOx certification pack (for parent engine only)</u> <u>(8) NOx measuring plans (for parent engine only)</u> <u>(9) Other documents considered necessary by the Society</u>	Chapter 2 EMISSION VERIFICATION, ETC. 2.1 Application for Emission Verification, etc. 2.1.1 Application for Emission Verification, etc.* 4 <u>Three copies each</u> of the following drawings and documents are to be submitted to the Society together with the application. (1) Specifications of the engine (excluding cases where submitted separately) (2) Drawings showing the construction and layout of the engine (excluding cases where submitted separately) (3) Documents showing the materials used for the engine (excluding cases where submitted separately) (4) Documents showing the scope of the target engine (5) Documents showing the criteria for selection (for parent engine only) (6) Technical File (Newly added) <u>(7) NOx measuring plans (for parent engine only)</u> <u>(8) Other documents considered necessary by the Society</u>	MEPC.397(83) 1.3.37 This requirement is amended in view of the practice that submissions are mainly made in an electronic format, such as PDF files. MEPC.397(83) 2.5.2

Amended-Original Requirements Comparison Table (Amendments to the NOx Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
6 Technical File is to include at least the information in the following (1) to (17). (1) Identification of those components, including detailed information to enable to find out whether they are modified or not, settings and operating values of the engine which influence its NOx emissions including any NOx-reducing device or system. (2) Identification of the full range of allowable adjustments or alternatives for the components of the engine. (3) Full record of the relevant engine's performance, including the number of maximum continuous revolutions and maximum continuous output of the engine consistent with those specified on the nameplate. (4) At least one of the following methods to verify NOx emissions: the on-board simplified measurement method, the on-board direct measurement and monitoring method, or an on-board engine parameter check method specified otherwise by the Society. When on-board direct measurement and monitoring method is applied, procedures for calibration and operation of the measuring equipment specified by the engine manufacturer, etc. are to be contained. In addition, when exhaust gas cleaning system to reduce NOx emissions is installed, on-board NOx verification procedures for the system to ensure it is operating correctly are also to be contained. (5) A copy of the test report on the testing required in 2.2.1(2)(a). (In the case where the method in 2.2.1(2)(d)ii) applied in accordance with 2.2.1(2)(a)iv)2) was conducted for emission verification, both the test reports are to be included.)	6 Technical File is to include at least the information in the following (1) to (11). (1) Identification of those components, including detailed information to enable to find out whether they are modified or not, settings and operating values of the engine which influence its NOx emissions including any NOx-reducing device or system. (2) Identification of the full range of allowable adjustments or alternatives for the components of the engine. (3) Full record of the relevant engine's performance, including the number of maximum continuous revolutions and maximum continuous output of the engine consistent with those specified on the nameplate. (4) At least one of the following methods to verify NOx emissions: the on-board simplified measurement method, the on-board direct measurement and monitoring method, or an on-board engine parameter check method specified otherwise by the Society. When on-board direct measurement and monitoring method is applied, procedures for calibration and operation of the measuring equipment specified by the engine manufacturer, etc. are to be contained. In addition, when exhaust gas cleaning system to reduce NOx emissions is installed, on-board NOx verification procedures for the system to ensure it is operating correctly are also to be contained. (5) A copy of the test report on the testing required in 2.2.1(2)(a). (In the case where the method in 2.2.1(2)(d)ii) applied in accordance with 2.2.1(2)(a)iv)2) was conducted for emission verification, both the test reports are to be included.)	

Amended-Original Requirements Comparison Table (Amendments to the NO_x Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
For a Member Engine of an Engine Family or Engine Group, it may be substituted for that for the Parent Engine. (6) If applicable, the designation and restrictions for an engine which is a member of an Engine Family or Engine Group in consistent with the requirement specified in Chapter 4 of the <i>NO_x Technical Code</i>. (7) Specifications of those spare parts/components of the engine which, when used in the engine, according to those specifications, will result in continued compliance of the NO_x emission with the limits specified in 2.2.2-1. (8) <i>EIAPP Certificate</i>, where it has been issued. (9) In case the exhaust gas cleaning system to reduce NO_x emissions is installed, record of the presence of the system as an essential component of the engine. (10) Where an additional substance is introduced, such as ammonia, urea, steam, water, fuel additives, etc., sufficient information to allow a ready means of demonstrating that the consumption of such additional substances is consistent with achieving compliance with the applicable NO_x limit. (11) <u>Where (10) above applies, the means by which it is to be verified that the required quantities of additional substance used are consistent with achieving the engine's intended base emission control strategy is to be included as part of the onboard NO_x verification procedure.</u> (12) <u>Identification of all auxiliary control devices, irrespective of whether they operate under steady-state or transient conditions.</u> (13) <u>For those auxiliary control devices which may operate under steady-state conditions, the operating</u>	For a Member Engine of an Engine Family or Engine Group, it may be substituted for that for the Parent Engine. (6) If applicable, the designation and restrictions for an engine which is a member of an Engine Family or Engine Group in consistent with the requirement specified in Chapter 4 of the <i>NO_x Technical Code</i>. (7) Specifications of those spare parts/components of the engine which, when used in the engine, according to those specifications, will result in continued compliance of the NO_x emission with the limits specified in 2.2.2-1. (8) <i>EIAPP certificate</i>, where it has been issued. (9) In case the exhaust gas cleaning system to reduce NO_x emissions is installed, record of the presence of the system as an essential component of the engine. (10) Where an additional substance is introduced, such as ammonia, urea, steam, water, fuel additives, etc., sufficient information to allow a ready means of demonstrating that the consumption of such additional substances is consistent with achieving compliance with the applicable NO_x limit. (Newly added)	MEPC.397(83) 2.5.6.4 MEPC.397(83) 2.5.6.1 to 2.5.6.3

Amended-Original Requirements Comparison Table (Amendments to the NOx Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
<u>conditions which will cause those devices to function.</u> (14) <u>The means by which the operation of those auxiliary control devices which may operate under steady-state conditions, the operating conditions may be verified as part of the onboard NOx verification procedure.</u> (15) <u>The power (or torque) and speed boundaries of the not-to-exceed zone.</u> (16) <u>The onboard NOx verification procedure is to include means to verify that the engine only operates within not-to-exceed zone.</u> (17) Other information considered necessary by the Society. <u>7 The applicant is to demonstrate, using a NOx certification pack, that a rational emission control strategy is applied to the engine subject to emission verification across the whole range of its operating load and speed. In order to enable the Society to confirm that a rational emission control strategy is applied during normal operation of the engine, the NOx certification pack is to include the information in (1) to (4) below.</u> (1) <u>Information relating to the base emission control strategy as specified in the following (a) to (g).</u> (a) <u>A list of all NOx emission influencing setting and operating values controlled by an engine's base emission control strategy; for example fuel injection, inlet and exhaust valve operation, charge air management, exhaust bypass/wastegate or exhaust after-treatment controls.</u> (b) <u>A record of the reference values for the settings and operating values identified in (a) at each of the mode points of the applicable test cycle.</u> (c) <u>Documentation that whenever the engine is</u>	(11) Other information considered necessary by the Society. (Newly added)	MEPC.397(83) 3.3.2 Renumbering MEPC.397(83) 2.5.2 MEPC.397(83) 2.5.4

Amended-Original Requirements Comparison Table (Amendments to the NOx Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
<u>operating between two mode points as identified in (b), the emission control strategy interpolates progressively between the mode points.</u> <u>(d) Documentation to show that, along lines of constant power and varying speed from the line between the mode points to the limit area of the not-to-exceed zone of the engine, the base emission control strategy is to ensure that any variation in the point emission values is progressive and justified from the value at that power on the line between the mode points, unless rationalised by an auxiliary control device or explained by a physical limitation of the engine.</u> <u>(e) A declaration that the engine's base emission control strategy only reacts to changes in engine load and speed.</u> <u>(f) Any other information the applicant considers relevant.</u> <u>(g) Any other information the Society requests.</u> <u>(2) A declaration of all auxiliary control devices installed on the engine, irrespective of whether they operate under steady-state or transient conditions. Any auxiliary control device not so declared is to be considered a defeat device.</u> <u>(3) Information relating to auxiliary control devices which may operate under steady-state conditions, as specified in the following (a) and (b).</u> <u>(a) A justification of the need for that device.</u> <u>(b) A description for that device, as specified in the following i) to viii).</u> <u>i) Details of the conditions under which that device will operate and the functioning of</u>		MEPC.397(83) 2.5.3 MEPC.397(83) 2.5.5

Amended-Original Requirements Comparison Table (Amendments to the NO_x Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
<u>that device.</u> ii) <u>How each modulated parameter of the emission control system achieves the stated purpose of the base emission control strategy.</u> iii) <u>The process used to ensure that the modulation is limited to the conditions where the stated purpose of the auxiliary control device operational strategy arises and to set the modulation to be the minimum necessary to achieve that stated purpose.</u> iv) <u>The effect of the application of that device on the engine's base emission control strategy.</u> v) <u>For auxiliary control devices that operate above 25% engine power, the effect on the point emission values is to be documented.</u> vi) <u>For auxiliary control devices that operate within the declared not-to-exceed zone, an estimate of the effect on the point emission values is to be documented.</u> vii) <u>Any other information the applicant considers relevant.</u> viii) <u>Any other information the Society requests.</u> (4) <u>Information relating to the not-to-exceed zone as specified in the following (a) and (b).</u> (a) <u>The boundaries of the not-to-exceed zone at or above 25% power, defined in terms of power (or torque) and speed, are to be declared by the applicant to the Society as part of the NO_x certification pack. Operation outside these not-to-exceed zone boundaries, within the limit area of the not-to-exceed zone, is to be permitted only during starting, stopping, acceleration,</u>		MEPC.397(83) 3.3.1

Amended-Original Requirements Comparison Table (Amendments to the NO_x Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
<u>deceleration, load pick-up or load rejection. However, operation below 25% power and at or above 63% speed for the E3, E2 and D2 test cycles, and operation below 50% load for the C1 test cycle, is to be permitted only where it is demonstrated, in accordance with the requirements of 2.5 of the <i>NO_x Technical Code</i>, that a rational emission control strategy continues to be applied.</u> (b) <u>In addition to the emission verification specified in 2.2.1, the Society may, where it deems necessary, require that up to three emission values be determined at load points within the not-to-exceed zone, as agreed between the applicant and the Society.</u> 2.2 Emission Verification and Approval of Technical File of the Engine 2.2.2 Maximum Allowable NO_x Emission Limits* 2 Measurement and calculation is to be in accordance with the following: (1) NO_x emissions are to be measured and calculated applying a test cycle in accordance with the following (a) to (d). (a) <u>For a fixed pitch propeller propulsion engine or a propeller-law operated non-propulsion engine, test cycle E3 is to be applied in accordance with Table 1.2.</u> (b) <u>For a propulsion engine that does not operate with a fixed pitch propeller, including an engine</u>	2.2 Emission Verification and Approval of Technical File of the Engine 2.2.2 Maximum Allowable NO_x Emission Limits* 2 Measurement and calculation is to be in accordance with the following: (1) NO_x emissions are to be measured and calculated applying a test cycle in accordance with the following (a) to (e). (a) <u>For constant-speed engines for ship main propulsion, including diesel electric drive, test cycle E2 specified in Table 1.2 is to be applied.</u> (b) <u>For controllable-pitch propeller sets test cycle E2 specified in Table 1.2 is to be applied, irrespective of combinatory curve.</u>	MEPC.397(83) 3.3.3 MEPC.397(83) 3.2

Amended-Original Requirements Comparison Table (Amendments to the NOx Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks																														
<u>fitted as part of a diesel-electric installation or an engine operated with a controllable-pitch propeller, test cycle E2 is to be applied in accordance with Table 1.3.</u> (c) <u>For a non-propulsion engine that is a constant-speed engine, test cycle D2 is to be applied in accordance with Table 1.4.</u> (d) <u>For a non-propulsion engine that operates as a variable-speed engine, not included in (a) to (c) above, test cycle C1 is to be applied in accordance with Table 1.5.</u> ((2) and (3) are omitted.) (4) <u>In the case of a marine diesel engine to be certified in accordance with Table 1.1(c), the specific emission at each individual mode point is not to exceed the applicable NOx emission limit value by more than 50% except as follows:</u> (a) <u>The 10% mode point in the D2 test cycle.</u> (b) <u>The 10% mode point in the C1 test cycle.</u> (c) <u>The idle mode point in the C1 test cycle.</u>	(c) <u>For propeller-law-operated main and propeller-law-operated auxiliary engines test cycle E3 specified in Table 1.3 is to be applied.</u> (d) <u>For constant-speed auxiliary engines, test cycle D2 specified in Table 1.4 is to be applied.</u> (e) <u>For variable-speed, variable-load auxiliary engines, not included in (a) to (d) above, test cycle C1 specified in Table 1.5 is to be applied.</u> ((2) and (3) are omitted.) (Newly added)																															
Table 1.2 Test Cycle Type E3 <table><tr><td>Number of revolutions</td><td>100 %</td><td>91 %</td><td>80 %</td><td>63 %</td></tr><tr><td>Output</td><td>100 %</td><td>75 %</td><td>50 %</td><td>25 %</td></tr><tr><td>Weighting factor^{*(1)}</td><td>0.2</td><td>0.5</td><td>0.15</td><td>0.15</td></tr></table>	Number of revolutions	100 %	91 %	80 %	63 %	Output	100 %	75 %	50 %	25 %	Weighting factor ^{*(1)}	0.2	0.5	0.15	0.15	Table 1.2 Test Cycle Type E2 <table><tr><td>Number of revolutions</td><td>100%</td><td>100%</td><td>100%</td><td>100%^{*(2)}</td></tr><tr><td>Output</td><td>100%</td><td>75%</td><td>50%</td><td>25%</td></tr><tr><td>Weighting factor^{*(1)}</td><td>0.2</td><td>0.5</td><td>0.15</td><td>0.15</td></tr></table>	Number of revolutions	100%	100%	100%	100% ^{*(2)}	Output	100%	75%	50%	25%	Weighting factor ^{*(1)}	0.2	0.5	0.15	0.15	MEPC.397(83) 3.1.4 MEPC.397(83) 3.2 Table 1
Number of revolutions	100 %	91 %	80 %	63 %																												
Output	100 %	75 %	50 %	25 %																												
Weighting factor ^{*(1)}	0.2	0.5	0.15	0.15																												
Number of revolutions	100%	100%	100%	100% ^{*(2)}																												
Output	100%	75%	50%	25%																												
Weighting factor ^{*(1)}	0.2	0.5	0.15	0.15																												

Amended-Original Requirements Comparison Table (Amendments to the NOx Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended					Original					Remarks
Table 1.3 Test Cycle Type E2					Table 1.3 Test Cycle Type E3					MEPC.397(83) 3.2 Table 2
Number of revolutions	100 %	100 %	100 %	100 % ^{*(2)}	Number of revolutions	100%	91%	80%	63%	
Output	100 %	75 %	50 %	25 %	Output	100%	75%	50%	25%	
Weighting factor ^{*(1)}	0.2	0.5	0.15	0.15	Weighting factor ^{*(1)}	0.2	0.5	0.15	0.15	
Table 1.4 Test Cycle Type D2					Table 1.4 Test Cycle Type D2					MEPC.397(83) 3.2 Table 3
Number of revolutions	100 %	100 %	100 %	100 %	100 %	100%	100%	100%	100%	
Output	100 %	75 %	50 %	25 %	10 %	100%	75%	50%	25%	
Weighting factor ^{*(1)}	0.05	0.25	0.3	0.3	0.1	0.05	0.25	0.3	0.3	
Table 1.5 Test Cycle Type C1					Table 1.5 Test Cycle Type C1					MEPC.397(83) 3.2 Table 4
Number of revolutions	Number of maximum continuous revolutions				Intermediate ^{*(4)}				Idle	
Torque ^{*(3)}	100 %	75 %	50 %	10 %	100 %	75 %	50 %	0 %		
Weighting factor ^{*(1)}	0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.15		
Notes:					Notes:					
*(1) (Omitted)					*(1) (Omitted)					
*(2) There are exceptional cases, including large bore engines intended for E2 applications, in which, due to their oscillating masses and construction, engines cannot be run at low load at nominal speed without the risk of damaging essential components. In such cases, the engine manufacturer is to make application to the Administration that the test cycle as given in Table 1.3 may be modified for the 25 % power mode with regard to the engine speed. The adjusted engine speed at 25 % power, however, is to be as close as possible to the rated engine speed, as recommended by the engine manufacturer and approved by the Administration. The applicable weighting factors for the test cycle are to remain unchanged.					*(2) There are exceptional cases, including large bore engines intended for E2 applications, in which, due to their oscillating masses and construction, engines cannot be run at low load at nominal speed without the risk of damaging essential components. In such cases, the engine manufacturer is to make application to the Administration that the test cycle as given in Table 1.2 may be modified for the 25% power mode with regard to the engine speed. The adjusted engine speed at 25% power, however, is to be as close as possible to the rated engine speed, as recommended by the engine manufacturer and approved by the Administration. The applicable weighting factors for the test cycle are to remain unchanged.					
((3) and (4) are omitted.)					((3) and (4) are omitted.)					

Amended-Original Requirements Comparison Table (Amendments to the NO_x Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
3 The Society may, where it deems necessary, require that up to three point emission values be determined at load points, other than those specified in Tables 1.2 to 1.5, within the not-to-exceed zone, in order to verify compliance with the not-to-exceed zone requirements. The load points at which emission measurements are to be carried out are to be agreed between the applicant and the Society as part of the review of the NO_x certification pack. Point emission values are to be determined in accordance with the procedures given in Chapter 5 and Appendix X of the <i>NO_x Technical Code</i>. To be acceptable, each point emission value so determined is not to exceed the respective not-to-exceed emission limit value, as determined using the procedure in Appendix X of the <i>NO_x Technical Code</i>. 4 Where an additional substance is introduced, such as ammonia, urea, steam, water, fuel additives, etc., a means of monitoring the consumption of such substance is to be provided. 5 When a new test cycle is applied to an engine already verified using a different test cycle listed in -2(1)(a) to (e), the verification may be carried out by recalculation, by applying the measurement results from the specific modes of the first verification to the calculation of the total weighted emissions for the new test cycle application, using the corresponding weighting factors from the new test cycle. 6 Engines to which multiple engine operational profiles are applied are to undergo emission verification, in addition to complying with the requirements of Chapter 8 of the <i>NO_x Technical Code</i>, in the following cases: (1) A marine diesel engine that is in-service switchable between different NO_x emission limit tiers; (2) A marine diesel engine certified to more than one test cycle application in accordance with 3.2 of the <i>NO_x</i>	(Newly added) 3 Where an additional substance is introduced, such as ammonia, urea, steam, water, fuel additives, etc., a means of monitoring the consumption of such substance is to be provided. 4 When a new test cycle is applied to an engine already verified using a different test cycle listed in -2(1)(a) to (e), the verification may be carried out by recalculation, by applying the measurement results from the specific modes of the first verification to the calculation of the total weighted emissions for the new test cycle application, using the corresponding weighting factors from the new test cycle. (Newly added)	MEPC.397(83) 3.3.3 MEPC.397(83) 8.1.1

Amended-Original Requirements Comparison Table (Amendments to the NOx Technical Code to Allow the Use of
Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
<u>Technical Code</u>, where the engine operational profile is in-service switchable based on the duty the engine is performing (e.g. load or operating condition); or (3) A marine diesel engine certified to the same NOx emission standard, the same rated power, the same rated speed and the same test cycle, which is in-service switchable between multiple engine operational profiles.		

Amended-Original Requirements Comparison Table (Amendments to the NOx Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
GUIDANCE FOR MARINE POLLUTION PREVENTION SYSTEMS Part 8 EQUIPMENT FOR THE PREVENTION OF AIR POLLUTION FROM SHIPS Chapter 2 EQUIPMENT FOR THE PREVENTION OF AIR POLLUTION FROM SHIPS 2.1 Nitrogen Oxides (NOx) (<i>Regulation13 of Annex VI</i>) 2.1.3 Technical File and Record Book of Engine Parameters 3 The wording “Other information considered necessary by the Society” includes, but is not limited to, the following types of information: (1) <u>For marine diesel engines using multiple engine operational profiles, the information specified in Chapter 8 of the <i>NOx Technical Code</i>.</u> (2) If the engine has more than one mode of operation, details of the control guidelines for selecting the different modes of operation and recording the modes of operation, along with the method used for switching between modes. (Deleted)	GUIDANCE FOR MARINE POLLUTION PREVENTION SYSTEMS Part 8 EQUIPMENT FOR THE PREVENTION OF AIR POLLUTION FROM SHIPS Chapter 2 EQUIPMENT FOR THE PREVENTION OF AIR POLLUTION FROM SHIPS 2.1 Nitrogen Oxides (NOx) (<i>Regulation13 of Annex VI</i>) 2.1.3 Technical File and Record Book of Engine Parameters 3 The wording “Other information considered necessary by the Society” includes, but is not limited to, the following types of information: (Newly added) (1) If the engine has more than one mode of operation, details of the control guidelines for selecting the different modes of operation and recording the modes of operation, along with the method used for switching between modes. (2) <u>Auxiliary control device (if applicable).</u>	MEPC.397(83) Chapter 8 Deleted: covered by 2.1.1-6, Part 8 of the Rules.

Amended-Original Requirements Comparison Table (Amendments to the NO_x Technical Code to Allow the Use of
Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
(3) For engines fitted with selective catalytic reduction systems, the information specified in paragraph 3.2 of the Annex of <i>IMO</i> resolution <i>MEPC.399(83)</i> , as amended.	(3) For engines fitted with selective catalytic reduction systems, the information specified in paragraph 3.2 of the Annex of <i>IMO</i> resolution <i>MEPC.399(83)</i> , as amended.	

Amended-Original Requirements Comparison Table (Amendments to the NO_x Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
GUIDANCE FOR MARINE ENGINE EMISSION VERIFICATION Chapter 1 GENERAL RULES 1.2 Definition 1.2.1 Terms <u>4</u> The “speed control device” referred to in 1.2.1(36) of the Rules may, in service, either maintain a fixed speed or a load-dependent speed such that, at maximum load, the speed could be up to around 10 % lower than at zero load. Chapter 2 EMISSION VERIFICATION, ETC. 2.1 Application for Emission Verification, etc. 2.1.1 Application for Emission Verification, etc. 5 The wording “other information considered necessary by the Society” in 2.1.1-6(17) of the Rules include, but are not limited to, such information as the following: (1) <u>For marine diesel engines using multiple engine operational profiles, the information specified in Chapter 8 of the <i>NO_x Technical Code</i>.</u> (2) If the engine has more than one mode of operation (e.g. one mode to comply with the Tier II and another mode to comply with Tier III), details of the control	GUIDANCE FOR MARINE ENGINE EMISSION VERIFICATION Chapter 1 GENERAL RULES 1.2 Definition 1.2.1 Terms (Newly added) Chapter 2 EMISSION VERIFICATION, ETC. 2.1 Application for Emission Verification, etc. 2.1.1 Application for Emission Verification, etc. 5 The wording “other information considered necessary by the Society” in 2.1.1-6(11) of the Rules include, but are not limited to, such information as the following: (Newly added) (1) If the engine has more than one mode of operation (e.g., one mode to comply with the Tier II and another mode to comply with Tier III), details of the control	MEPC.397(83) 1.3.36 MEPC.397(83) Chapter 8

Amended-Original Requirements Comparison Table (Amendments to the NO_x Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
guidelines for the selection of the different modes of operation and the recording of the modes of operation along with the method of changing between the modes. (Deleted) (3) For engines fitted with selective catalytic reduction systems, the information specified in paragraph 3.2 of the Annex of <i>IMO</i> resolution <i>MEPC.399(83)</i>, as amended. <u>6 Where acceptable to the Administration, the documentation requirements of 2.1.1-7(1) and (2) of the Rules may alternatively be made by reference to that in respect of marine diesel engines comparable, in terms of NO_x emissions characteristics, to the engine to be certified.</u> <u>7 An identical replacement engine installed on a ship is to comply with 2.5 of the <i>NO_x Technical Code</i>, provided that those requirements applied at the time the relevant engine family or engine group was first certified.</u> 2.2 Emission Verification and Approval of Technical File of the Engine 2.2.2 Maximum Allowable NO_x Emission Limits <u>2 Fig. 2.2.2-1 may also be used as a reference for the selection of the test cycle specified in 2.2.2-2(1) of the Rules.</u>	guidelines for the selection of the different modes of operation and the recording of the modes of operation along with the method of changing between the modes. (2) <u>The auxiliary control device (if applicable) specified in Regulation 2.4 of Annex VI</u> (3) For engines fitted with selective catalytic reduction systems, the information specified in paragraph 3.2 of the Annex of <i>IMO</i> resolution <i>MEPC.399(83)</i>, as amended. (Newly added) 2.2 Emission Verification and Approval of Technical File of the Engine 2.2.2 Maximum Allowable NO_x Emission Limits (Newly added)	Deleted: covered by 2.1.1-6 of the Rules. MEPC.397(83) 2.5.7 MEPC.397(83) 2.5.8 MEPC.397(83) Appendix IX

Amended-Original Requirements Comparison Table (Amendments to the NO_x Technical Code to Allow the Use of Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
Fig. 2.2.2-1 Flow Chart for Engine Certification Test Cycle Determination <pre> graph TD A{Engine is a propulsion engine *} -- No --> B{Engine is propeller-law operated} A -- Yes --> C{Engine operated with fixed pitch propeller} B -- Yes --> E3_1[E3] B -- No --> D{Engine is constant speed} C -- Yes --> E3_2[E3] C -- No --> E2[E2] D -- Yes --> D2[D2] D -- No --> C1[C1] </pre> <u>Note</u> <u>* A propulsion engine may additionally perform non-propulsion duties during or separately to propulsion duties; however, engine that solely or in part provides athwartships movement of a ship is not a propulsion engine.</u> 3 The wording “fuel specified otherwise by the Society” in 2.2.2-2(2) of the Rules refers to a DM-grade marine fuel oil or RM-grade fuel oil (for the measurement procedures for emission verification on a test bed only in cases where a DM-grade fuel oil is not available) specified in <i>ISO 8217:2005</i>, or a gas fuel selected in accordance with the <i>NO_x Technical Code</i>. 4 <u>Alternative means by which it is to be shown that point emission values are determined or the not-to-exceed zone requirements specified in 2.2.2-3 of the Rules are complied with may be accepted, subject to their acceptability to the Administration.</u> 5 <u>For engines belonging to an engine family or engine group for which the emission certification was conducted prior to 1 January 2028, demonstration of compliance with requirements 3.3 of the <i>NO_x Technical Code</i> may be on the basis solely of documentation acceptable to the Administration.</u>	2 The wording “fuel specified otherwise by the Society” in 2.2.2-2(2) of the Rules refers to a DM-grade marine fuel oil or RM-grade fuel oil (for the measurement procedures for emission verification on a test bed only in cases where a DM-grade fuel oil is not available) specified in <i>ISO 8217:2005</i>, or a gas fuel selected in accordance with the <i>NO_x Technical Code</i>. (Newly added)	MEPC.397(83) 3.3.4 MEPC.397(83) 3.3.5
The effective date of the amendment is according to EFFECTIVE DATE AND APPLICATION (A)		

Amended-Original Requirements Comparison Table (Amendments to the NOx Technical Code to Allow the Use of
Multiple Engine Operational Profiles for Marine Diesel Engines and Clarify Engine Test Cycles)

Amended	Original	Remarks
EFFECTIVE DATE AND APPLICATION (A)		
1. The effective date of the amendments is 1 March 2027. 2. Notwithstanding the amendments, the current requirements may apply to member engines of engine families or engine groups for which the parent engine was first certified before 1 January 2028 and for which the EIAPP Certificate is issued before 1 January 2030. 3. Notwithstanding the preceding 2., the amendments apply to all engines for which the EIAPP Certificate is issued on and after 1 January 2030.		
EFFECTIVE DATE AND APPLICATION (B)		
1. The effective date of the amendments is 1 September 2027. 2. Notwithstanding the amendments, the current requirements may apply to member engines of engine families or engine groups for which the parent engine was first certified before 1 January 2028 and for which the EIAPP Certificate is issued before 1 January 2030. 3. Notwithstanding the preceding 2., the amendments apply to all engines for which the EIAPP Certificate is issued on and after 1 January 2030.		