

標題

MARPOL 条約附属書 VI における既存ディーゼル
機関に適用される規制適合手法

- MAN B&W L50MC 機関適合手法の追加について -

ClassNK

テクニカル インフォメーション

No. TEC-1028

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各位

2009年5月13日発行の ClassNK テクニカル・インフォメーション No.TEC-0771 にてお知らせしておりますように、国際大気汚染防止原動機証書 (EIAPP 証書) の発行を受けていない既存のディーゼル機関が、規制適合手法を適用し NOx 排出一次規制の基準に適合すること可能な場合には、同手法を適用することが要求されています。今般、MAN B&W L50MC 機関に適用可能な規制適合手法が追加されましたので、次の通りお知らせいたします。詳細については、添付の MEPC.1/Circ.837 をご参照ください。

1. 規制適合手法の適用対象及び適用期限について

1990年1月1日以降かつ2000年1月1日より前に起工された船舶に搭載され、次表に示す条件に該当し、かつ燃料噴射ノズルの型式及び陸上公試時の運転値が MEPC.1/Circ.837 で指定された条件を満たすディーゼル機関は、当該規制適合手法の適用対象となります。

機関型式	テストサイクル (用途)	シリンダ当りの MCR 出力(kW/cyl)	定格回転数(rpm)
L50MC	E3 (固定ピッチプロペラ駆動)	1,075-1,330	133-148

本規制適合手法の適用が要求される MAN B&W L50MC 機関は、2015年6月5日以降最初の MARPOL 条約附属書 VI (IAPP) の更新検査までに適用する必要があります。

2. 規制適合手法適用対象ディーゼル機関の特定について

所有する船舶に搭載されたディーゼル機関の用途が固定ピッチプロペラ駆動かつ MCR 出力と定格回転数が IMO 回章に指定された範囲に含まれる場合、MAN Diesel & Turbo 社又はエンジン製造者に規制適合手法の適用可否についてご確認ください。なお、これまで承認された規制適合手法とは異なり、陸上公試における運転値のみが IMO 回章で指定されている範囲を外れているために適用不可と判断される場合には、その判断に関してデンマーク政府の了承を得る必要があります。MAN Diesel & Turbo 社又はエンジンメーカーを通して、デンマーク政府の見解が示された文書をご入手ください。

また、当該ディーゼル機関に対して改造が行われている場合、改造の内容によっては、規制適合手法を適用できないと判断される可能性があります。この場合も同様に、デンマーク政府の見解が必要となります。

(次頁に続く)

NOTES:

- ClassNK テクニカル・インフォメーションは、あくまで最新情報の提供のみを目的として発行しています。
- ClassNK 及びその役員、職員、代理もしくは委託事業者のいずれも、掲載情報の正確性及びその情報の利用あるいは依存により発生する、いかなる損失及び費用についても責任は負いかねます。
- バックナンバーは ClassNK インターネット・ホームページ(URL: www.classnk.or.jp)においてご覧いただけます。

3. 検査に関してのご連絡

(1) 規制適合手法適用前の定期的検査又は臨時検査

適用可能な規制適合手法が存在するディーゼル機関が搭載されている場合、IAPP 証書追補 2.2.1 の "Approved Method exists" 欄にチェックする必要があります。そのため、上記 1. の表に示した L50MC 機関が搭載されている船舶については、規制適合手法適用前に MARPOL 条約附属書 VI (IAPP) の定期的検査又は臨時検査が行われる場合、適宜当該ディーゼル機関への規制適合手法の適用要否について検査時に確認いたします。予め上記 2. の要領にて適用要否をご確認の上、受検の際には下記書類をご準備ください。

- 規制適合手法の適用可否に関する MAN Diesel & Turbo 社又はエンジン製造者の見解書
- 当該ディーゼル機関製造時の燃料噴射ノズルの型式を特定できる記録(本記録が無い場合、エンジン製造者又は MAN Diesel & Turbo 社の見解書に関連情報を含めることでも構いません。)
- 陸上公試時の運転データ、又は同等のデータ(Pmax 及び Pmax-Pcomp を含むもの)
- 以下の理由のために規制適合手法を適用できない場合は、デンマーク政府がその旨了承したことを示す文書
 - ・ 陸上公試時のデータのみが指定の範囲から外れている
 - ・ 就航後エンジンに改造が行われている

(2) 規制適合手法適用後の確認検査

規制適合手法適用後の確認検査は、MAN Diesel & Turbo 社又はエンジン製造者から個品毎に支給される規制適合手法ファイルに記載された方法に従って行われます。MAN Diesel & Turbo 社又はエンジン製造者にご相談の上、デンマーク政府の代行として DNV-GL 殿によって承認された規制適合手法ファイルをご入手いただき、受検の際に検査員にご提示ください。同検査では、指定された部品が装備されていること、又、当該ディーゼル機関の 75%MCR における運転値が指定する範囲内に含まれること等を確認します。詳細は規制適合手法ファイルをご参照ください。なお、確認のために必要なディーゼル機関の運転値につきましては、規制適合手法の適用後、受検に先立って本船にて予め取得していただく必要があります。受検の際には、機関長等の責任者により確認された運転値データをご準備ください*。

* この運転値データが未取得の場合、検査を完了することができません。規制適合手法を適用した後、本船にて運転値データを取得した上で、適用期限までに受検していただく必要がありますので、規制適合手法の適用時期には十分ご注意ください。

(次頁に続く)

なお、これまで IMO に通知された規制適合手法の一覧は添付 MEPC.1/Circ.845 をご参照ください。
MAN B&W L50MC 機関以外で既に当該手法が適用可能なディーゼル機関については、以下の ClassNK テクニカル・インフォメーションをご参照ください。

- ・TEC-0836 (MAN B&W S70MC 機関)
- ・TEC-0848 (WÄRTSILÄ RTA 機関)
- ・TEC-0867 (MAN B&W S70MC 及び S50MC 機関)
- ・TEC-0878 (MAN B&W S60MC 機関)

なお、本件に関してご不明な点は、以下の部署にお問い合わせください。

一般財団法人 日本海事協会 (ClassNK)

本部 管理センター別館 機関部

住所: 東京都千代田区紀尾井町 3-3 (郵便番号 102-0094)

Tel.: 03-5226-2022 / 2023

Fax: 03-5226-2024

E-mail: mcd@classnk.or.jp

添付:

1. MEPC.1/Circ.837
2. MEPC.1/Circ.845

4 ALBERT EMBANKMENT
LONDON SE1 7SR
Telephone: +44 (0)20 7735 7611 Fax: +44 (0)20 7587 3210

MEPC.1/Circ.837
10 June 2014

INFORMATION ON AN APPROVED METHOD UNDER MARPOL ANNEX VI

Communication received from the Administration of Denmark

1 In accordance with the provisions of regulation 13.7.1 of MARPOL Annex VI, a communication has been received from the Administration of Denmark concerning certification of an approved method for marine diesel engine MAN B&W L50MC. The details are annexed hereto, and hereby circulated to Parties to MARPOL Annex VI and Member States of the Organization for information and appropriate action.

2 It should be noted that, for marine diesel engines with a power output of more than 5,000 kW and a per cylinder displacement at or above 90 litres installed on a ship constructed on or after 1 January 1990 but prior to 1 January 2000, installation of an approved method is required if the approved method for that engine has been certified by an Administration of a Party, or alternatively, certification as provided for under regulation 13.7.1.2 of MARPOL Annex VI.

3 It should be also noted that the Marine Environment Protection Committee, as its sixty-sixth session, adopted the *2014 Guidelines in respect of the information to be submitted by an Administration to the Organization covering the certification of an Approved Method as required under regulation 13.7.1 of MARPOL Annex VI* (resolution MEPC.242(66)).

4 As the Administration of Denmark notified the certification of the approved method for engines specified in the annex to this circular on 4 June 2014, installation of the method for such engines will be mandatory no later than the first renewal survey for the International Air Pollution Prevention Certificate, which occurs on or after 5 June 2015, subject to commercial availability.

5 Member Governments are invited to bring this circular to the attention of their Administrations, relevant shipping organizations, recognized organizations, shipping companies and other stakeholders, and encourage them to take action as appropriate.

ANNEX

APPROVED METHOD FOR MAN B&W L50MC

Specification of the Engine Type				Type of Approved Method	Approved Method Number	Date of notification
Engine type	Manufacturer	MCR per cylinder (kW/cyl)	Rated speed (rpm)			
L50MC	MAN B&W	1,075 – 1,330*	133-148*	Fuel nozzle	94988-14 HH	4 June 2014

* See attached Notice of Compliance for further details.



The International Maritime Organization
4 Albert Embankment
London SE1 7SR
United Kingdom

4. juni 2014
Our reference:
Case 2014012876/4

Regulation, Manning and
Certification/PK

**Notification of the Certification of an Approved Method as required
under Regulation 13.7.1 of MARPOL Annex VI**

Dear Sirs,

In accordance with the revised MARPOL Annex VI and Resolution MEPC 242(66) "2014 Guidelines in respect of the information to be submitted by an Administration to the Organization covering the certification of an Approved Method as required under regulation 13.7.1 of MARPOL Annex VI" the Danish Maritime Authority hereby informs that Denmark has certified the enclosed Approved Method for the NOx reduction for engine type MAN B&W L50MC.

DANISH MARITIME AUTHORITY

Carl Jacobsens Vej 31
2500 Valby
Danmark

Tel. +45 91376000
CVR-no. 29 83 16 10
EAN-no. 5798000023000
dma@dma.dk
www.dma.dk

The certification is based on the Notice of Compliance Revised MARPOL 73/78, Annex VI Regulation 13 "Approved Method" for the Reduction of NOx Engine Type MAN B&W L50MC AM no. 94988.14 HH, issued by Germanischer Lloyd at Hamburg, 2014-04-15, enclosed, and Documentation for an Approved Method for MAN B&W L50MC GL approval No. 94988-14 HH.

MINISTRY OF BUSINESS AND GROWTH

An example of the Approved Method File and an example of the On-board Survey Procedure is included in the enclosed documentation. The Approved Method file required to accompany the specific engine will be issued based on the onboard verification carried out after installation of the Approved Method.

The Approved Method applies to:

Manufacturer	Engine type	MCR per cylinder (kW/cyl)	Rated speed (rpm)	Application cycle
MAN B&W	L50MC	1075-1330	133-148	E3

More detailed information of the identification of engines to which the Approved Method applies is specified in the diagrams in the enclosed Notice of Compliance

The Approved Method contact point (CP) is:

MDT Copenhagen, PrimeServ Dept DR (DR-cph@mandieselturbo.com)

The Approved Method complies with the requirement in the revised
MARPOL Annex VI, regulation 13.7.5.1 and 13.7.5.2.

Yours sincerely



Palle Kristensen
Principal Ship Surveyor
Special Adviser

Direct phone: 91376372

E-post: PK@dma.dk

Notice of Compliance



Revised MARPOL 73/78, Annex VI Regulation 13
"Approved Method" for the Reduction of NO_x
Engine Type MAN B&W L50MC
AM no. 94988-14 HH

This is to State

That a.-m. "Approved Method" (AM) has been verified under the provisions of the IMO Revised MARPOL Annex VI, Regulation 13, Paragraph 7.1, whereby a marine diesel engine with a power output of more than 5,000 kW and a per cylinder displacement at or above 90 litres installed on a ship constructed on or after 1 January 1990 but prior to 1 January 2000 shall comply with the emission limits set forth in subparagraph 7.4 of this regulation, provided that an "Approved Method" for that engine has been certified by an Administration of a Party and notification of such certification has been submitted to the Organization by the certifying Administration.

This is to Note

- That this Notice of Compliance is valid only for the combination of engine type, fuel valve nozzles and lay-out area mentioned below.
- That this Notice of Compliance does not replace the Approved Method file of the individual engine.
- That this Notice of Compliance includes a specification of allowed 'existing' fuel nozzles with IMO marking numbers, engine rating and max. performance values. The performance values should be taken from the test-bed report, or similar documentation.
- That this Notice of Compliance includes a lay-out area graph for which the Approved Method with AM no. 94988-14 HH is applicable.

Specification of "Approved Method"

Manufacturer : MAN Diesel & Turbo

GL approval no. : 94988-14 HH

Date of primary issue : 2014-04-15

AM	Load Cycle	Specification of engine type ^{iv}			Specification of performance ^{iv}			
		'Existing' fuel nozzles drawing number/ IMO ID number ⁱ	MCR per cylinder (kW/cyl) ⁱⁱ	Rated speed (rpm) ⁱⁱⁱ	Pmax at max tolerance (barabs) ⁱⁱⁱ		Pmax-Pcomp at max tolerance (bar) ⁱⁱⁱ	
					100%	75%	100%	75%
MD-C-L50-1#1 1144789-3 (AM-1)	E3	1242912-0 (M1)	1075-1330	133-148	144	134	29	49

ⁱ not all fuel nozzles are marked, but if drawings are referenced to original MAN B&W (drilling) drawings (i.e. identical nozzles) these engines are also included in the AM

ⁱⁱ within the range bounded by MCR per cylinder and rated speed as defined in attached lay-out graph (a +/- 25 kW tolerance shall be allowed on the power limits, respectively, to allow for minor conversion errors)
(a metric conversion factor: 0.7355 kW/bHp is used)

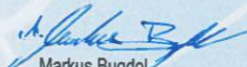
ⁱⁱⁱ at ISO ambient conditions based on original test-bed data at 75 & 100% loads (or interpolated from adjacent loads, if not available)

^{iv} (performance data to be specified with one decimal, Pmax rounded up & Pcomp rounded down)

exemptions may be introduced on approval by the Administration after evaluation by the Contact Point


Germanischer Lloyd
 Issued at Hamburg, 2014-04-15


 Dr. Fabian Kock


 Markus Bugdol



MAN Diesel & Turbo

Approved Method File **(‘Existing’ engine emission document)**

issued under the provisions of the Protocol of 2008 to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 related thereto (MARPOL 73/78 Annex VI.)

for

MAN B&W – L50MC

MD-C-L50-1#1 (VIT, CC-F)

Engine group

Engine type	Test cycle	Rated power (kW/cyl)	Rated speed (r/min)
L50MC	E3	1075-1330*	133-148

*a +/- 25 kW/cyl allowance is given on upper and lower power limits, respectively

B&W engine #nnnn (vessel IMO #yyyyyy,) zL50MC, rating 1330 kW/cyl at 148 r/min
Specific member engine:

THIS IS TO CERTIFY that engines specified in this engine group, when complying with the given description in Table 1 and 2 (requirements for design and performance,) fully satisfies the requirements as amended in the Revised MARPOL Annex VI and the NOx Technical Code 2008.

Applicable NOx emission limit (IMO Tier I) (g/kWh) **16.6**
Estimated NOx emission value: at reference conditions (g/kWh): **14.2**
at maximum tolerances (g/kWh): **16.3**

prepared by..... **MAN Diesel, PrimeServ dept. DR-CPH**
(full designation of the competent person or organization authorized under the provisions of the Convention)

place and date of issue..... **Copenhagen, 14 June 2013**

Approved by.....
(Seal or Stamp of the authority, as appropriate)



MAN Diesel & Turbo

Engine Description – Design and Performance Values

Engine type: **MAN B&W – L50MC**

Engine group: **MD-C-L50-1#1 (VIT, CC-F)**

Table 1 – NOx Components*

Component (parameter)	Specification	MAN B&W IMO ID	Other IMO ID
Fuel valve nozzle	2 fuel valves pr. cylinder	1144789-3	
Fuel pump plunger (diameter)	Ø47 mm	not applicable (N/A)	
Fuel cam (rise)	1.268 mm/deg	not applicable (N/A)	

*) A cross reference table for all 'IMO' components of less importance for the NOx emission has been submitted to the Administration to define the engine group

Table 2 – Reference and maximum allowed operating values

	Parameter (ISO ambient conditions)	Reference value				Maximum allowed **)			
		100	75	50	25	100	75	50	25
	Power – %	100	75	50	25	100	75	50	25
Engine parameters	Maximum combustion pressure – barabs	141	130	98	70	144	133	101	73
	Cylinder pressure rise – bar (Pmax - Pcomp)	21	40	37	29	28	48	45	37
	Scavenging-air temperature – °C	48	43	39	44	54	46	42	47
	Turbine back pressure – mmWC	300	179	86	25	450	340	225	115
	VIT load break point (if applicable):	85 %				Reference value			
Ambient conditions (ISO ambient conditions)	Ambient pressure – mbar	1000							
	Ambient temperature – °C	25							
	Humidity – rel. %	30							
	Sea-water (inlet) temperature – °C	25							
	Central sea-water-cooler fresh-water-outlet temperature (for central-cooling system) – °C *)	36							

*) Based on 25°C sea-water temperature (but depending on cooling strategy, (see also Instruction book 'Operation'))

**) Additionally, common MAN B&W engine instructions shall always be followed.



MAN Diesel & Turbo

On-board survey

In order to ensure compliance, the following must be checked:

1. The design must correspond with the above description (Table 1 – NOx components.)
2. A standard performance check must provide performance data (corrected to ISO ambient conditions) within the tolerances as specified in Table 2 – Reference and maximum allowed operating values.

The attached flow chart describes the procedure for an on-board survey and Appendix A provides a complete on-board survey based on the original test-bed report.

It is required to perform an on-board survey within one-month period from a called (or anticipated) survey. Further, soonest after docking (or performance adjustment or repair on-board,) a survey shall be performed to verify setting values and ensure continuing compliance.

Survey code

A dedicated survey code issued for the engine group (following the AMF specifications) can be used to demonstrate compliance and print out a new Appendix A for the initial and later on-board surveys.

The survey code adjusts automatically Pmax and Pcomp to ISO ambient conditions with input of the specified performance parameters (*yellow fields in the tables.*) However, it is possible to check compliance manually, using the equations stated in Appendix A.

Actual date for the survey and actual member engine# shall be stated in the Appendix to ensure that the correct survey is carried out and all surveys shall be signed by the Chief Engineer and added to the record book.

Performance data

Performance data shall be obtained following a standard performance-observation check as described in the MAN B&W engine 'operation instructions.' Pmi measurements or indicator cards will provide Pmax and Pcomp. The data should be specified with one decimal where possible (especially Pmax and Pcomp,) and Pcomp rounded down as being the 'worst' condition.

Usually three or four load points are measured in a standard performance check, but only data from 75% load (and a load point above the VIT break point for engines with VIT) are then filled in the survey code 'input fields' to verify compliance.

If compliance is not obtained the first time, the engine needs to be adjusted for compliance, and data obtained again. Please observe that measuring equipment must be calibrated according the IMO Regulation before the scheduled survey.

Record book

An engine record book can be created by collecting all future survey print outs and add description on the performed maintenance (date for installation or renovation of new IMO components and performance adjustments.)

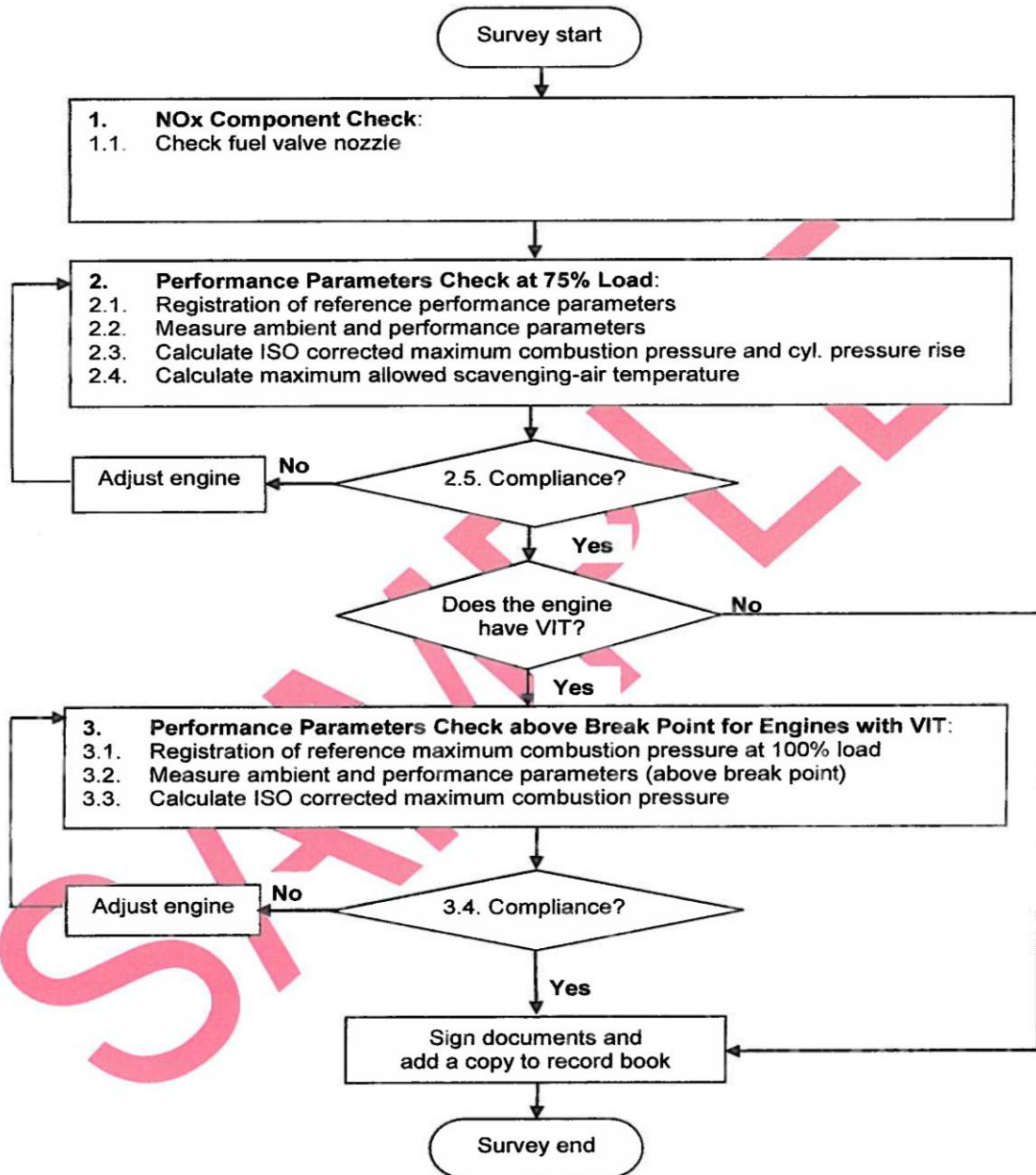
Procedure

1. On-board surveys are carried out following the above description based on standard MAN B&W engine performance observations and in agreement with performance measurements in the NOx Technical Code
2. Add, as part of the AMF (page 5,) the filled-out survey code (Appendix A) with original test-bed data for pre approval (initial approval) of the 'individual' AMF and, as an example for an on-board survey *)
3. Following the AM installation, a new survey shall be performed on board to show compliance before renewal of the IAPP certificate. Similarly, on-board surveys shall be performed before future annual or intermediate surveys
4. Add future on-board surveys to show continued compliance as part of the engine record book

*) The scavenging-air temperature may not show compliance on test bed due to the different cooling set up on the test facilities. Non compliance of other parameters on test bed requires the Administration approval.



MAN Diesel & Turbo



Appendix A: On-board Survey Procedure

For onboard survey fill out and print the following form (yellow fields)

Engine group MD-C-L50-1
Engine No M1 T14-T17
Date 24-03-2003

Engine group MD-C-L50-1
Engine No M1 T14-T17
Date 24-03-2003

1. NOx Component check (AMF Table 1)

	check	IMO ID#
Fuel valve nozzle		1144789-3

2. Performance parameter check at 75% load

2.1 Registration of reference performance parameters (AMF Table 2)

Performance parameters	Reference			Max. allowed		
	Units	Symbol	Values	Units	Symbol	Values
Max combustion pressure	barabs	A	131	barabs	E	134
Cylinder pressure rise	bar	B	41	bar	F	49
Turbine back pressure	mmWC	C	179	mmWC	G	340
Scavenging-air temperature	°C	D	43	°C	H	46

2.2 Measure ambient and performance parameters (at 75% load ± 5%)

Performance parameters	Measured			ISO Corrected (see 2.3.2.4)		
	Units	Symbol	Values	Units	Symbol	Values
Max combustion pressure	bar	I	132	barabs	Q	131,04
Max cyl compr. pressure	bar	J	91	barabs	R	90,66
Turbine back pressure	mmWC	K	123	mmWC		
Scavenging-air temperature	°C	L	31	°C		
Ambient pressure	mbar	M	1018	mbar		
T/C inlet temperature	°C	N	16,5	°C		
Sea-water inlet temperature	°C	O	9,8	°C		
Set point coolant outlet temp.	°C	P	36	°C		

2.3 Calculate ISO corrected max. combustion pressure and max. cyl. compression pressure

$$Q = (I + M/1000) * (1 + 0.002198 * (N - 25) - 0.00081 * (L - D) - 0.00022 * (M - 1000) + 0.75 + 0.00005278 * (K - C)) \quad (1)$$

$$R = (J + M/1000) * (1 + 0.002954 * (N - 25) - 0.00153 * (L - D) - 0.000301 * (M - 1000) + 0.75 + 0.00007021 * (K - C)) \quad (2)$$

2.4 Calculate maximum allowed scavenging-air temperature

Sea Water (SW) or Central fresh-water Cooling system (CC)

$$S = H + (D - 25) \quad (3)$$

Central fresh water Cooling system with Fixed outlet temperature (CC-F)

$$\text{If } O \leq P - 2 \quad S = H \quad (4a)$$

Else

$$S = H + (O - (P - 2)) \quad (4b)$$

Where P is the central cooler set point for outlet coolant temperature

2.5 Compliance check

Performance parameters	Engine performance	Max allowed	Compliance
Max combustion pressure	Q 131,0	≤ 134 E	yes
Cylinder pressure rise	Q · R 40,4	≤ 49 F	yes
Turbine back pressure	K 123	≤ 340 G	yes
Scavenging-air temperature	L 31,0	≤ 46 S	yes

Only for engines with VIT:

3. Performance parameter check above break point for engines with VIT (if appropriate)

3.1 Registration of reference performance parameters at 100% (AMF Table 2)

Performance parameters	Reference			Max allowed		
	Units	Symbol	Values	Units	Symbol	Values
Max combustion pressure	barabs	A	141	barabs	E	144
Turbine back pressure	mmWC	C	300	mmWC	G	450
Scavenging-air temperature	°C	D	48	°C	H	54
Break point	%	T	85			

3.2 Measure ambient and performance parameters (above the break point)

Performance parameters	Measured			ISO Corrected (see 3.2)		
	Units	Symbol	Values	Units	Symbol	Values
Max combustion pressure	bar	I	141,6	barabs	Q	140,52
Turbine back pressure	mmWC	K	230	mmWC		
Scavenging-air temperature	°C	L	36	°C		
Ambient pressure	mbar	M	1019	mbar		
T/C inlet temperature	°C	N	17	°C		
Measured load	%	U	100			

3.3 Calculate ISO corrected maximum combustion pressure

Use equation (1)

3.4 Compliance check

Performance parameters	Engine performance	Max./Min. allowed	Compliance
Max combustion pressure	Q 140,5	≤ 144 E	yes
Measured load	U 100	≥ 85 T	yes



E

4 ALBERT EMBANKMENT
LONDON SE1 7SR
Telephone: +44 (0)20 7735 7611 Fax: +44 (0)20 7587 3210

MEPC.1/Circ.845
18 July 2014

INFORMATION ON AN APPROVED METHOD UNDER MARPOL ANNEX VI

List of notifications from Administrations

1 In accordance with the provisions of regulation 13.7.1 of MARPOL Annex VI, for marine diesel engines with a power output of more than 5,000 kW and a per cylinder displacement at or above 90 litres, installed on a ship constructed on or after 1 January 1990 but prior to 1 January 2000, installation of an approved method is required if the approved method for that engine has been certified by an Administration of a Party and notification of such certification has been submitted to the Organization or, alternatively, certification as provided for under regulation 13.7.1.2 of MARPOL Annex VI.

2 The notifications that the Organization has received to date are set out in the annex.

3 Member Governments are invited to bring this circular to the attention of their Administrations, relevant shipping organizations, recognized organizations, shipping companies and other stakeholders and encourage them to take action as appropriate.

ANNEX

LIST OF NOTIFICATIONS FROM ADMINISTRATIONS

Date of notification	Administration	Engine type	Manufacture	Type of approved method	MCR per cylinder (kW/cyl)	Rated speed (rpm)	IMO Circular No.
5 October 2010	Denmark	S70MC	MAN B&W	Fuel nozzle	2,530 – 2,810	81 – 91	MEPC.1/Circ.738 MEPC.1/Circ.738/Add.1 MEPC.1/Circ.738/Add.2 MEPC.1/Circ.738/Add.3/Rev.1
4 February 2011	Germany	RTA52 RTA52U RTA58T RTA62 RTA62U RTA72 RTA72U RTA84C RTA84CU RTA84M RTA84T-B RTA96C	Wärtsilä Switzerland Ltd.	NO _x optimized injection timing	---	---	MEPC.1/Circ.743
11 August 2011	Denmark	S70MC	MAN B&W	Fuel nozzle	2,250 – 2,810	81 – 91	MEPC.1/Circ.764 MEPC.1/Circ.764/Add.1
11 August 2011	Denmark	S50MC	MAN B&W	Fuel nozzle	1,160 – 1,430	114 – 127	MEPC.1/Circ.765
5 October 2011	Denmark	S60MC	MAN B&W	Fuel nozzle	1,650 – 2,040	94 – 105	MEPC.1/Circ.770
4 June 2014	Denmark	L50MC	MAN B&W	Fuel nozzle	1,075 – 1,330	133 – 148	MEPC.1/Circ.837