

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 S60MC 機関適合手法の承認について -

ClassNK

テクニカル インフォメーション

No. TEC-0878
発行日 2011年11月25日

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、改正 MARPOL ANNEX VI では、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た、出力5,000kWを超え、1気筒の行程容積が90リットル以上の船用ディーゼル機関に対し、いずれかの主管庁が承認した規制適合手法が存在する場合、当該手法を適用してNOx 排出一次規制の基準に適合することが要求されています(ANNEX VI 第13 規則7.1)。

2011年10月5日に、デンマーク政府が、MAN B&W S60MC 機関に適用される規制適合手法を承認した旨をIMO に通知し、これに関する情報が10月10日にIMO よりMEPC.1/Circ.770として発行されましたので、次のとおりお知らせいたします。なお、これまで承認された規制適合手法につきましては、ClassNK テクニカル・インフォメーション No.TEC-0836 (MAN B&W S70MC 機関)、No.TEC-0848 (WÄRTSILÄ RTA 機関)及びNo.TEC-0867 (MAN B&W S70MC 及びS50MC 機関)をご参照下さい。

1. 規制適合手法の適用対象及び適用期限について

次表に示す条件に該当し、かつ燃料噴射ノズル型式及び陸上公試時の運転値が同 Circular 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	シリンダ当りのMCR 出力(kW/cyl)	定格回転数(rpm)
S60MC	1,650-2,040	94-105

規制適合手法は、原則としてIMO へ通知された後12ヶ月以降の最初の更新検査時までに適用することが要求されています。本規制適合手法の適用が要求されるMAN B&W S60MC 機関は、2012年10月6日以降最初の更新検査までに、当該規制適合手法を適用する必要があります。

(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。

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
規制適合手法の適用対象ディーゼル機関を特定するためには、ディーゼル機関の MCR 出力と定格回転数がIMO Circularの指定する範囲に含まれる事の確認だけでなく、燃料噴射ノズル型式や陸上公試における運転値(Pmax 及び Pmax-Pcomp)の確認も併せて必要となります。又、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可能性があります。従って、所有する船舶に搭載されたディーゼル機関の MCR 出力と定格回転数が IMO Circular に指定された範囲に含まれる場合、規制適合手法の適用可否について、エンジン製造者又は MAN Diesel & Turbo 社にご確認ください。なお、改造が行われているために当該規制適合手法を適用できないと判断された場合、エンジン製造者又は MAN Diesel & Turbo 社の見解に加え、当該規制適合手法を認証したデンマーク政府の了承を得る必要がありますので、デンマーク政府の見解を示す文書をご入手ください。
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 S60MC 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 ANNEX VI (IAPP)の定期的検査又は臨時検査が行われる場合、当該ディーゼル機関への規制適合手法の適用可否について検査時に確認いたします。予め上記 2.の要領にて適用可否をご確認の上、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エンジン製造者又は MAN Diesel & Turbo 社の見解書
 - 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)
 - 改造が行われている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
 - (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、エンジン製造者又は MAN Diesel & Turbo 社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。規制適合手法適用時に規制適合手法ファイルを入手し、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、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 機関部

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MEPC.1/Circ.770
10 October 2011

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 S60MC. 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 As the Administration of Denmark notified the certification of the approved method for engines specified in the annex to this circular on 5 October 2011, 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 6 October 2012, subject to commercial availability.

4 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 S60MC

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)			
S60MC	MAN B&W	1,650 – 2,040*	94-105*	Fuel nozzle	29085-11 HH	5 October 2011

* See attached Notice of Compliance for further details.



International Maritime organization
4 Albert Embankment
London SE1 7SR
United Kingdom

October 5, 2011
Our reference:
Case 201010593/13
File 30.80.01

Centre for Maritime Regula-
tion/PK

**Certification of an approved method under the revised marpol An-
nexVI regulation 13.7.5. Engine type MAN BW S60MC**

DANISH MARITIME AUTHORITY
Vermundsgade 38 C
DK-2100 Copenhagen Ø

Dear Sirs,

Tel. +45 39 17 44 00
Fax +45 39 17 44 01

In accordance with the revised MARPOL Annex VI, the Danish Maritime Authority hereby informs that Denmark has certified the enclosed approved method.

dma@dma.dk
www.dma.dk

The certification of the approved method for the NOx reduction for engine type MAN B&W S60MC is attached for circulation in accordance with the revised MARPOL Annex VI, regulation 13.7.1.

The certification is based on the attached *Notice of compliance* Revised MARPOL 73/78, Annex VI Regulation 13 "Approved Method" for the Reduction of NOx Engine Type MAN B&W S60MC AM no. 29085-11 HH by Germanischer Lloyds Issued at Hamburg, 2011-08-31/Rev.1.

CVR-no. 29 83 16 10
EAN-nr. 5798000023000

MINISTRY OF ECONOMIC AND
BUSINESS AFFAIRS

An example of the approved method file and the On-board Survey Procedure is attached together with Enclosure 3 which include more detailed information's by the manufacturer on the lay-out areas of the engines for which the Approved Method AM no. 29085-11 HH is applicable.

The approved method file required to accompany the specific engine will be issued based on the on board verification carried out after installation of the approved method.

The approved method complies with the requirements in the revised MARPOL Annex VI regulation 13.7.5.1 and 13.7.5.2.

Yours sincerely,



Palle Kristensen
Ship Surveyor
E-mail 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 S60MC

AM no. 29085-11 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

1. That this Revised Notice of Compliance is valid only for the combination of engine type, fuel valve nozzles and lay-out area mentioned below.
2. That this Revised Notice of Compliance does not replace the Approved Method File of the individual engine.
3. That this Revised 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.
4. That this Revised Notice of Compliance includes a Lay-out area graph for which the Approved Method with AM no. 29085-11 HH is applicable.

Specification of “Approved Method”

Manufacturer	:	MAN Diesel & Turbo
GL approval no.	:	29085-11 HH
Date of primary issue	:	2011-06-22

AM	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) ⁱⁱ	P _{max} at max tolerance (barabs) ⁱⁱⁱ		P _{max} -P _{comp} at max tolerance (bar) ⁱⁱⁱ	
				100%	75%	100%	75%
MD-C-S60-1#1 5116821-1 (AM-1)	1756126-6 or M5-1 1268760-2, 3187610-9 or M6-7 1268787-8 or M6-8	1840-2040	100-105	143	132	16	31
MD-C-S60-2#1 5116799-5 (AM-2)	as AM-1	1650-2040	94-105	143	132	19	33
MD-C-S60-2#2 5116799-5 (AM-2)	as AM-1	1840-2040	100-105	143	132	18	33



Germanischer Lloyd
Issued at Hamburg, 2011-08-31 / Rev. 1


Hans-Joachim Götz

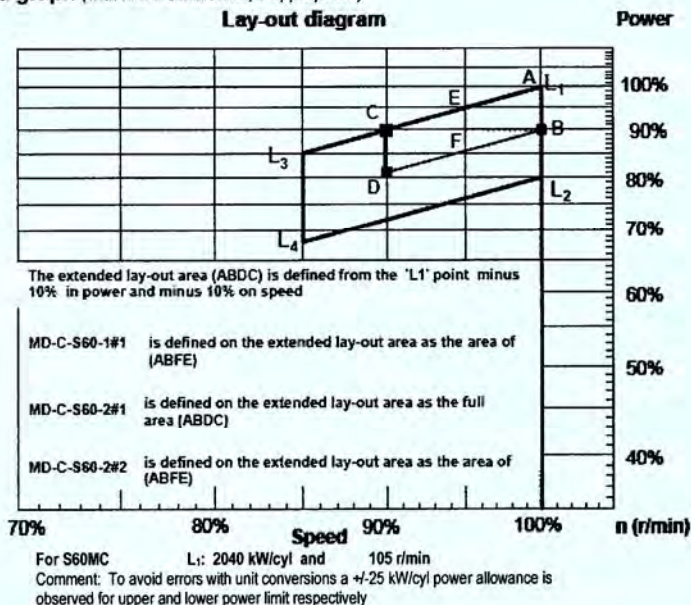

Dr. Fabian Kock



“Approved Method” for the Reduction of NO_x Engine Type MAN B&W S60MC, AM no. 29085-11 HH

- 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)
- ⁱⁱⁱ at ISO ambient conditions based on original test-bed data at 75 & 100% loads (or interpolated from adjacent loads, if not available)
- ^{iv} exemptions may be introduced on approval by the Administration

Lay-out area graph (with AM-#'s indicated, if appropriate)



This is to Confirm

1. That the a.-m. “Approved Method” has been verified and approved in accordance with all provisions and requirements as applicable.
2. In particular the a.-m. “Approved Method” fulfils the following requirements:
 - The cost of the Approved Method does not exceed 375 Special Drawing Rights per metric tonne NO_x.
 - The power of the engine is not reduced by more than 1.0%.
 - The specific fuel consumption (SFOC) as calculated following ISO standard conditions for the appropriate E3 or E2 cycle is not increased by more than 2.0%.



Germanischer Lloyd
Issued at Hamburg, 2011-08-31 / Rev. 1

Hans-Joachim Götze
Hans-Joachim Götze

Dr. Fabian Kock
Dr. Fabian Kock



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 – S70MC

MD-C-S70-2#2

Engine group

Engine type	Test cycle	Rated power (kW/cyl)	Rated speed (r/min)
S70MC	E3	2250-2810*	81-91

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

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) 17.0
 Estimated NOx emission value: at reference conditions (g/kWh): 14.6
 at maximum tolerances (g/kWh): 16.7

MAN Diesel, PrimeServ dept. DR-CPH

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

place and date of issueCopenhagen, 21 Jan. 2011.....



MAN Diesel & Turbo

Engine Description – Design and Performance Values

Engine type: **MAN B&W – S70MC**

Engine group: **MD-C-S70-2#2**

Table 1 – NOx Components*

Component (parameter)	Specification	MAN B&W IMO ID	Other IMO ID
Fuel valve nozzle	2 fuel valves pr. cylinder	3062364-9	
Fuel pump plunger (diameter)	ø73 mm	not applicable (N/A)	
Fuel cam (rise)	1.953 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	132	96	68	144	135	99	71
	Cylinder pressure rise – bar (Pmax - Pcomp)	4	24	20	21	12	32	28	29
	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'.)

On-board survey

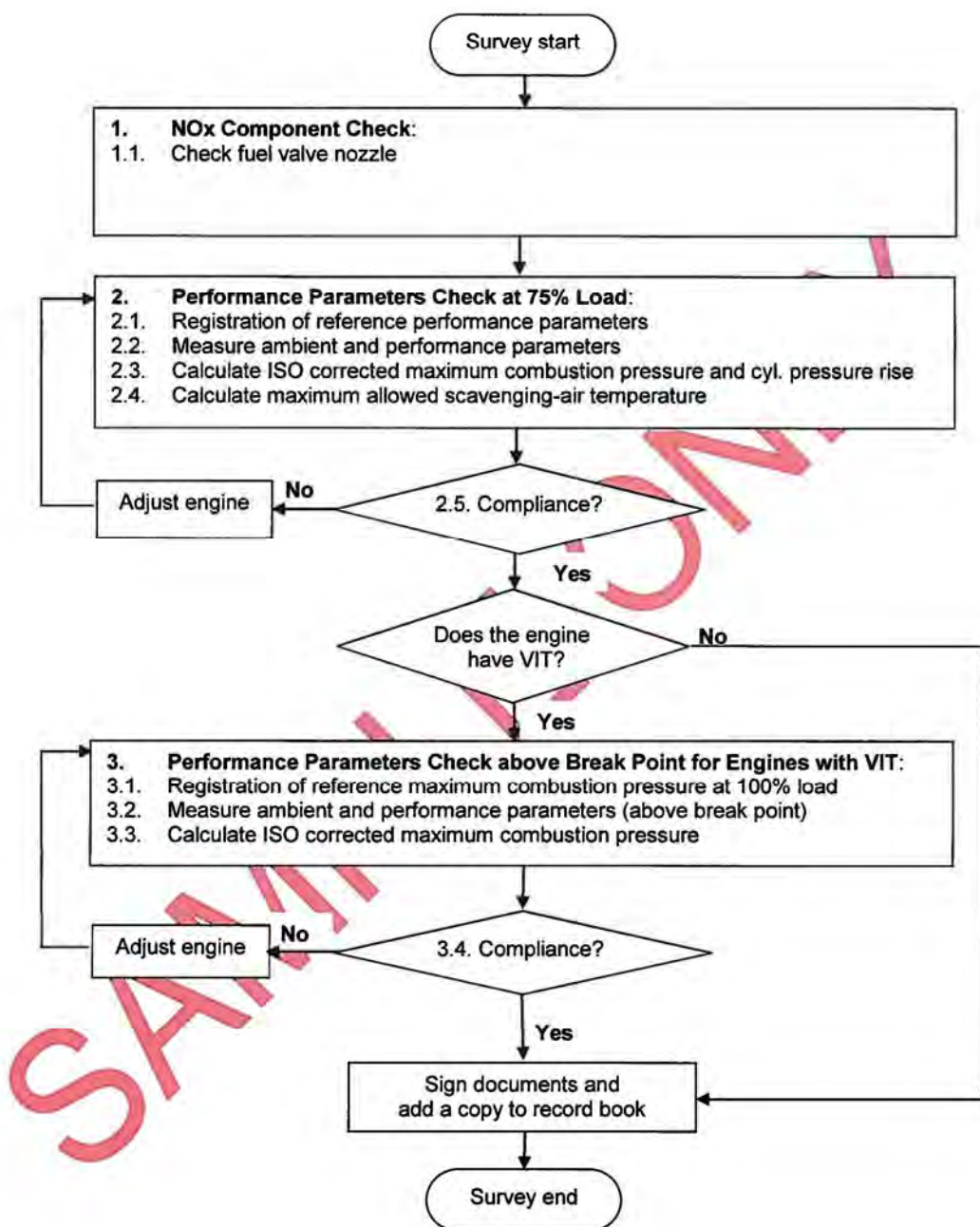
In order to ensure compliance, the following must be checked:

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 on-board survey and Appendix A provides a complete (manually handled) on-board survey. (A dedicated survey code for the group can be used to demonstrate compliance.)



MAN Diesel & Turbo



Engine group: MD-C-S70-2
 Engine No.: 5623
 Date: 2011-02-18

Appendix A: On-board Survey Procedure

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

1. NOx Component check (AMF Table 1)

Fuel valve nozzle	check	IMO ID#
		3062364-9

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	132	barabs	E	135
Cylinder pressure rise	bar	B	24	bar	F	32
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	130,8	barabs	Q	132,92
Max. cyl. compr. pressure	bar	J	105,3	barabs	R	107,54
Turbine back pressure	mmWC	K	194	mmWC		
Scavenging-air temperature	°C	L	42,3	°C		
Ambient pressure	mbar	M	1012	mbar		
T/C inlet temperature	°C	N	29,1	°C		
Sea-water inlet temperature	°C	O	32,5	°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):

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

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

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

$$\text{Else} \quad S = H + (O - (P - 2)) \quad (4b)$$

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	132,9	≤	135	E	yes
Cylinder pressure rise	Q - R	25,4	≤	32	F	yes
Turbine back pressure	K	194	≤	340	G	yes
Scavenging-air temperature 1)	L	42,3	≤	46	S	yes

Engine group: MD-C-S70-2
Engine No.: 5623
Date: 2011-02-18

75% Pres Rise (ISO corr) Q - R 25,38

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 3.3)		
	Units	Symbol	Values	Units	Symbol	Values
Max. combustion pressure	bar	I	140	barabs	Q	142,80
Turbine back pressure	mmWC	K	286	mmWC		
Scavenging-air temperature	°C	L	48	°C		
Ambient pressure	mbar	M	1012	mbar		
T/C inlet temperature	°C	N	32	°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	142,8	≤	144	E	yes
Measured load	U	100	≥	85	T	yes



MAN Diesel & Turbo

Enclosure 3 APPROVED METHOD(S) FOR MAN B&W S60MC

Date of notification: 05 October 2011

The AMs complies with the following requirements: Reg. 13.7.5.1 and Reg. 13.7.5.2

AM	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) ⁱⁱ	Pmax at max tolerance (barabs) ⁱⁱⁱ		Pmax-Pcomp at max tolerance (bar) ⁱⁱⁱ	
				100%	75%	100%	75%
MD-C-S60-1#1 5116821-1 (AM-1)	1756126-6 or M5-1 1268760-2, 3187610-9 or M6-7 1268787-8 or M6-8	1840-2040	100-105	143	132	16	31
MD-C-S60-2#1 5116799-5 (AM-2)	as AM-1	1650-2040	94-105	143	132	19	33
MD-C-S60-2#2 5116799-5 (AM-2)	as AM-1	1840-2040	100-105	143	132	18	33

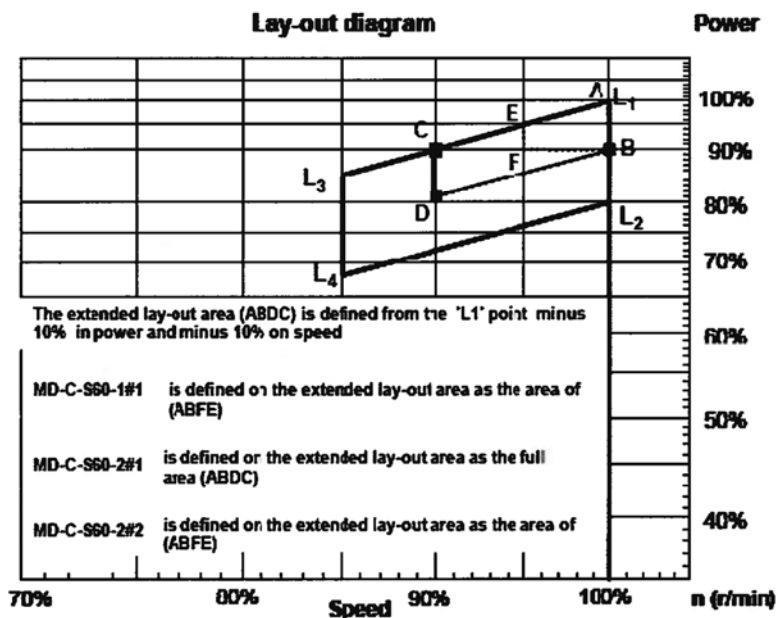
ⁱ not all fuel nozzles are marked, but if drawings are referenced to original MAN B&W (drilling) drawings (i.e. identical nozzles) these engines are also included in the AM

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)

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

^{iv} exemptions may be introduced on approval by the Administration

Lay-out area graph (with AM-#'s indicated, if appropriate)



For S60MC L₁: 2040 kW/cyl and 105 r/min

Comment: To avoid errors with unit conversions a +/-25 kW/cyl power allowance is observed for upper and lower power limit respectively

Enclosure 3

