Subject

Application of "Approved Method" to existing diesel engines under the provisions of MARPOL ANNEX VI
- Certification of an Approved Method for MAN B&W S60MC engines -

ClassNK
Technical Information

No. TEC-0878
Date 25 November 2011

To whom it may concern

As already advised in ClassNK Technical Information No. TEC-0771 dated 13 May 2009, marine diesel engines with a power output of more than 5,000 kW and a per cylinder displacement at or above 90 liters installed onboard ships constructed on or after 1 January 1990 but prior to 1 January 2000 are to comply with Tier I emission limits using an Approved Method, provided that an Approved Method for that engine has been certified by an Administration (Reg. 13.7.1 of ANNEX VI).

Since the Administration of Denmark notified that they had certified an Approved Method for MAN B&W S60MC engines on 5 October 2011 and the IMO published the relevant information on 10 October 2011 in MEPC.1/Circ.770 as attached, this ClassNK Technical Information provides the relevant information on the Approved Method and their confirmation during survey, as described below. As for the information on the Approved Methods that were previously certified, please refer to ClassNK Technical Information No. TEC-0836 (MAN B&W S70MC engines), No. TEC-0848 (WÄRTSILÄ RTA engines) and No. TEC-0867 (MAN B&W S70MC and S50MC engines).

1. Diesel engine to which the Approved Method is to be applied and deadline for the application
Diesel engines that correspond to the following table are required to apply the Approved Methods provided that the fuel nozzle type and shop test performance values satisfy the conditions specified in the MEPC Circular.

Engine Type	MCR per cylinder (kW/cyl)	Rated Speed (rpm)
S60MC	1,650-2,040	94-105

The Approved Method is to be applied, in principle, by no later than the first renewal survey that occurs 12 months or more after the Approved Method has been submitted to the IMO once it has been certified by the Administration. Therefore, for the MAN B&W S60MC engines to which the Approved Method is to be applied, application of the Approved Method will become mandatory by no later than the first renewal survey for IAPP Certification that occurs on or after 6 October 2012.

(To be continued)

2. Identification of the diesel engine to which the Approved Method is to be applied
In order to identify the diesel engines to which the Approved Method is to be applied, it is necessary to confirm fuel nozzle type and shop test performance values (Pmax and Pmax-Pcomp) as well as confirm that the MCR and rated speed are within the ranges specified in the MEPC Circulars. Also, in cases where some modification is made to the diesel engine, there is a possibility that the Approved Method cannot be applied to the modified diesel engine depending on the type of modification made. Therefore, in cases where the MCR and rated speed of the diesel engine installed onboard the ship are within the range specified in the MEPC Circulars, please contact the engine manufacturer or MAN Diesel & Turbo for confirmation of the applicability of the Approved Methods. In cases where the engine manufacturer or MAN Diesel & Turbo determine that the Approved Methods cannot be applied due to the nature of the modifications made to the diesel engine, the applicability of the Approved Method needs to be authorized by the Administration of Denmark. In this case, the shipowner is to obtain an authorization letter issued by the Administration of Denmark.

3. Information on relevant surveys
(1) Periodical Survey and Occasional Survey before application of the Approved Method
In cases where a diesel engine to which an applicable Approved Method exists is installed, the check box in 2.2.1, "Approved Method exists" of the Supplement to the IAPP Certificate needs to be ticked off. Therefore, in cases where ships onboard which MAN B&W S60MC engines specified in the tables mentioned in sections 1. above are installed, and the Periodical Survey or Occasional Survey for MARPOL ANNEX VI (IAPP) certification is carried out before application of the Approved Method, the shipowners are to confirm the applicability of the Approved Method in the manner described in section 2 above. Prior to the survey, the shipowners are to prepare the following documents in order to show the appropriate applicability of the Approved Method at the time of the survey.
- View report on the applicability of the Approved Method issued by the engine manufacturer or MAN Diesel & Turbo.
- Record of the fuel nozzles type at the time of manufacture (If there is no available record, the relevant information may be included in the view report issued by the engine manufacturer or MAN Diesel & Turbo.)
- Shop test report, or similar documentation (including data on Pmax and Pmax-Pcomp)
- Authorization letter issued by the Administration of Denmark, if the Approved Methods cannot be applied due to modifications made to the diesel engine.

(To be continued)

(2) Confirmation survey after application of the Approved Method
Once the Approved Method is applied, a confirmation survey of the Approved Method is to be carried out in accordance with the Approved Method File, which is to be distributed to each ship by the engine manufacturer or MAN Diesel & Turbo. The shipowner is to present the Approved Method File to the surveyor at the confirmation survey. During the Survey, a check will also be made to confirm that all designated components are installed in the subject diesel engine, and the operational data at 75% load is within the range specified by MAN Diesel & Turbo. For more details, please confirm the Approved Method File. Operational data that is mandatory for the confirmation survey is to be obtained prior to the confirmation survey after application of the Approved Method. For the confirmation survey, please prepare the operational data obtained by the responsible person, e.g. chief engineer, etc.*

* The confirmation survey cannot be completed unless the operational data has been obtained. Please give due attention to the timing of the Approved Method application, because the survey needs to be completed by the deadline upon obtaining the operational data onboard after application of the Approved Method.

For any questions about the above, please contact:

NIPPON KAIJI KYOKAI (ClassNK)
Machinery Department, Administration Center, Head Office
Address: 4-7 Kioi-cho, Chiyoda-ku, Tokyo 102-8567, Japan
Tel.: +81-3-5226-2022 / 2023
Fax: +81-3-5226-2024
E-mail: mcd@classnk.or.jp

Attachment:

1. MEPC.1/Circ.770

INTERNATIONAL MARITIME ORGANIZATION

E

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

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.

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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.

SØFARTSSTYRELSEN

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 Regulation/PK

DANISH MARITIME AUTHORITY
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DK-2100 Copenhagen Ø

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

MINISTRY OF ECONOMIC AND BUSINESS AFFAIRS

Certification of an approved method under the revised marpol AnnexVI regulation 13.7.5. Engine type MAN BW S60MC

Dear Sirs,

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

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.

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]	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

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

Hans- Joachim Götze

Dr. Fabian Kock

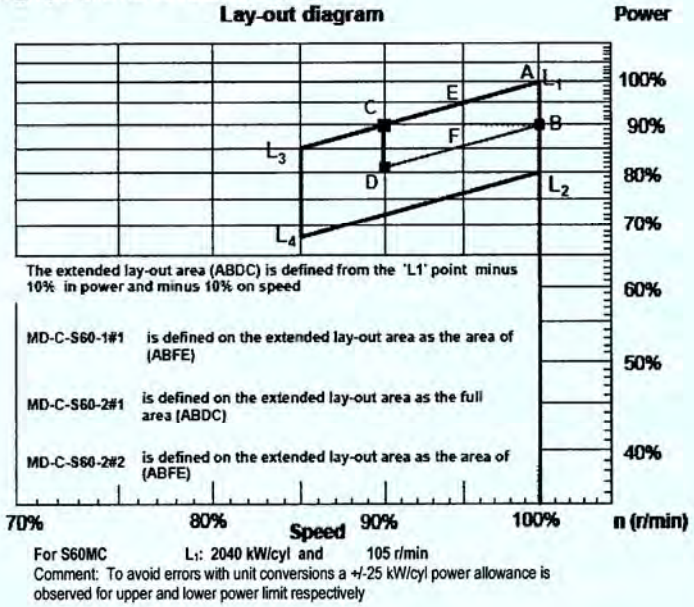
Page 1 of 2

"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)*



For S60MC L_1: 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

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

Dr. Fabian Kock

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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 issue .....Copenhagen, 21 Jan. 2011.....

1

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			
	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'.)*

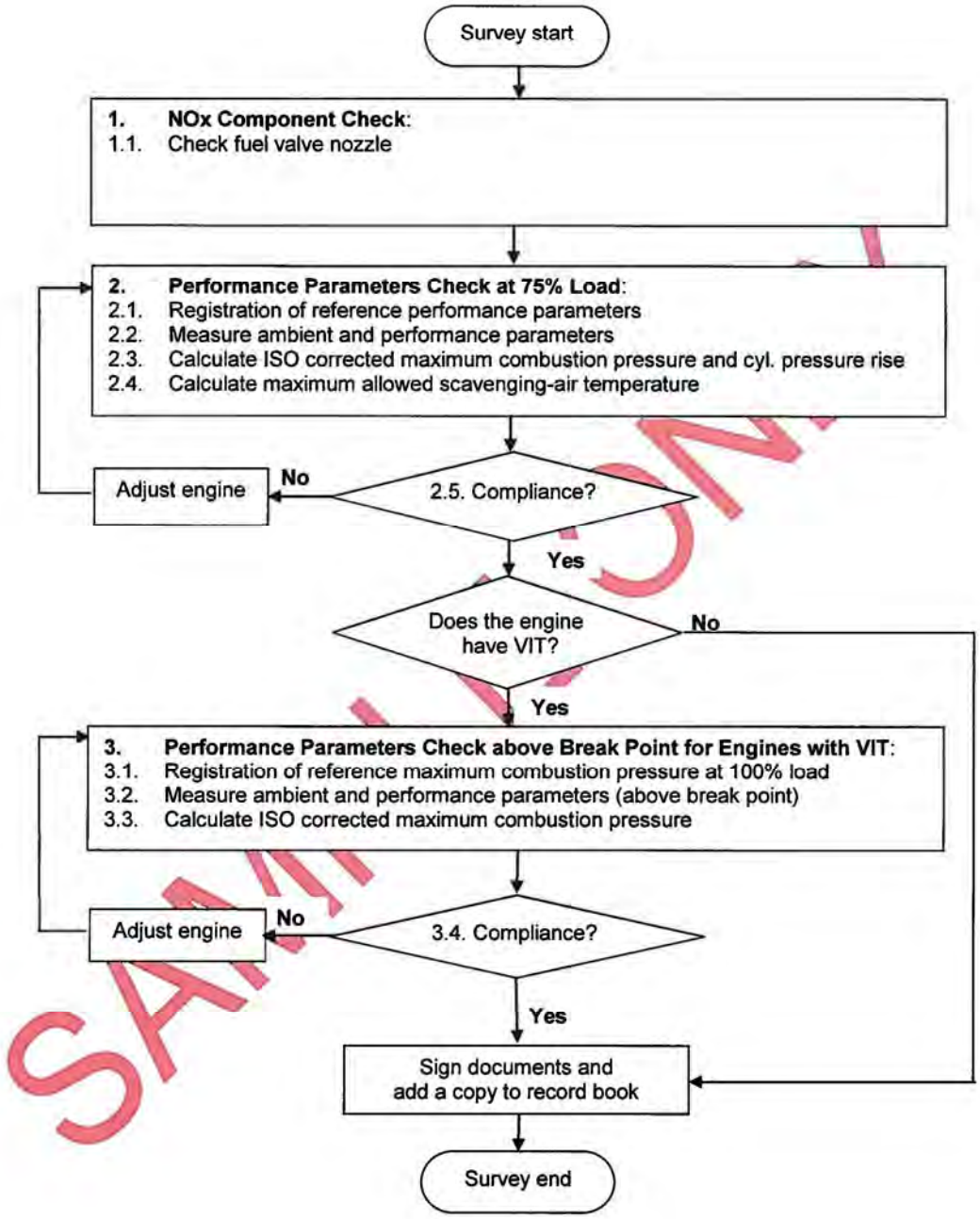
On-board survey

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



3

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)*

	check	IMO ID#
Fuel valve nozzle		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):

If O <= P-2 $S=H$ (4a)

Else $S=H+(O-(P-2))$ (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

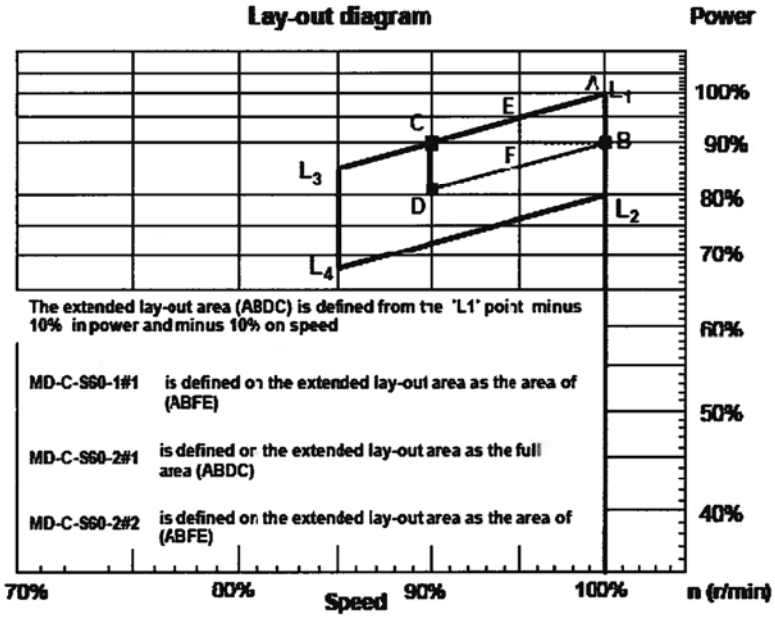
[i] not all fuel nozzles are marked, but if drawings are referenced to original MAN B&W (drilling) drawings (i.e. identical nozzles) these engines are also included in the AM

[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

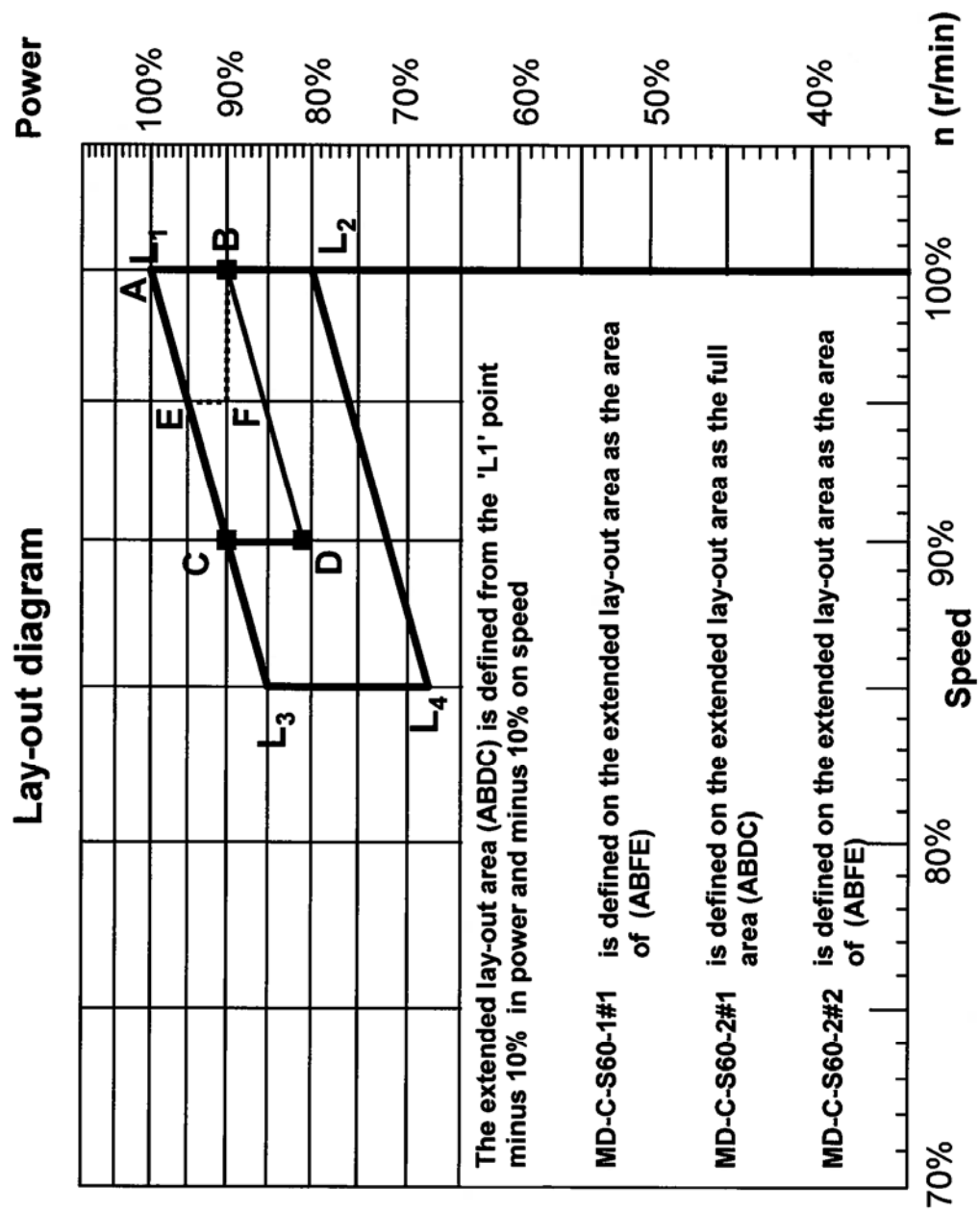
Lay-out area graph *(with AM-#'s indicated, if appropriate)*



For S60MC L_1: **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


Lay-out diagram
Power
100%
90%
80%
70%
60%
50%
40%
n (r/min)
70%
80%
90%
100%
Speed
A
B
C
D
E
F
L1
L2
L3
L4
The extended lay-out area (ABDC) is defined from the 'L1' point minus 10% in power and minus 10% on speed
MD-C-S60-1#1 is defined on the extended lay-out area as the area of (ABFE)
MD-C-S60-2#1 is defined on the extended lay-out area as the full area (ABDC)
MD-C-S60-2#2 is defined on the extended lay-out area as the area of (ABFE)