MITSUI E&S

Mitsui E&S Machinery Co., Ltd.

SERVICE NOTE

for MITSUI－MAN B&W engines		No. 189	
Guidance of Cylinder Lubrication for Mark 7.1 / 8 and newer engines		APPROVED	N. Osako
		CHECKED	
		PREPARED	K. Harada
ENGINE TYPE	ME-C/ME-B/MC-C Mark8 and newer and S60 Mark7.1) (With Alpha lubricator)	DATE	2014.3.20

Rev.5 : Feed rate setting method for low S fuel is added, Cylinder oil ref list is removed (2020.07.22)

This Service Note describes the guidelines on cylinder lubrication for Mark8 and newer engine types.

We recommend you to follow this Service Note No.189 when you choice the cylinder oil and adjust the cylinder oil feed rates on S60Mark7.1 / all Mark8 and newer engine types.

In case of Mark7 and previous engines equipped with Alpha lubricator, we recommend you to adjust the cylinder oil feed rates in accordance with Service Note No.188.

In case of Mark7 and previous engines equipped with mechanical lubricator, we recommend you to adjust the cylinder oil feed rates in accordance with Service Note No.183.

The actual need for quantity of cylinder oil varies with the operational conditions such as load and fuel oil quality. Therefore, when the Alpha ACC principle is newly applied on engines in service, please contact us.

For contact addresses, please refer to Service Note No. 111.

PRIORITY							
IMMEDIATELY	☐	AT FIRST OPPORTUNITY	■	WHEN CONVENIENT	☐	OTHERS	☐

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1. Adjustment of cylinder oil feed rate according to Alpha ACC.

The cylinder oil dosage control principle, which adjust the Basic Feed Rate in proportion to the sulphur content in the fuel oil being burnt, is called Alpha Adaptive Cylinder oil Control or abbreviated Alpha ACC.

The Basic Feed Rate can be calculated in accordance with the following formula.

Basic Feed Rate [g/kWh] ＝ **ACC factor** [g/kWh S] **x** **S**[%]

Fig-1 shows the guiding cylinder oil feed rates [g/kWh] (Basic Feed Rate [g/kWh]) based on service hours in case of Alpha ACC. However, this is only the guidance, and the reduction schedule and actual CLO feed rates should be decided based on the actual cylinder condition.

2. Choice of cylinder oil

Generally, cylinder oil with high-alkalinity is used for high-sulphur fuel oil, and Cylinder oil with low-alkalinity is used for low-sulphur fuel oil, see Table-1 as guidance.

Table -1: Choice of cylinder oil

Low-sulphur fuel oil S% ≤ 1.5wt%	**BN15～BN40**
High-sulphur fuel oil 1.5wt% < 3.5wt%	**BN100**
Viscosity grade	**SAE 50**

When using cylinder oil with a different BN level from BN100, it is necessary to convert the ACC factor by multiplying the ACC factor with the fraction of 100/BN level of used cylinder oil and increase the feed rate.

（Example）
Using a BN40 and ACC factor(@BN100)=0.26
ACC Factor(@40BN) ＝ 0.26(@BN100) x 100/40 ＝ 0.65 [g/kWh S]

Fig -2 shows the relationship between sulphur content and Basic Feed Rate with cylinder oil with BN40 as an example.

Regarding the choice of cylinder oil, please refer to Service Note No.194.

3. Setting and guidance schedule of cylinder oil feed rate

Regarding the guideline for cylinder oil lubrication when operating with ≤ 0.5% Sulphur fuel, please refer to Service Note No.202.

1) Cylinder oil feed rate setting during breaking-in (0 – 500 running hours)

The initial running-in period after reconditioning or renewal of cylinder liners and/or piston rings is called the "Breaking-in". Cylinder liner and piston ring breaking-in takes maximum 500 running hours. During this breaking-in period, since the extra lubrication oil is required to flush

away the wear particles and assure a satisfactory oil film on the relatively rough running surface, we recommend to set ACC factor to 0.40 [g/kWh S @BN100], and set the minimum feed rate according to Table- 2.

During breaking-in, we recommend to check the condition of piston rings and cylinder liners trough the scavenge air port every 100 hours. **Do not proceed to the next lubrication step (Changing of minimum feed rate) if the inspection reveals seizures or other irregularities.**

Table -2: Feed rate setting during the breaking-in period

Service hours [hour]	**ACC factor** [g/kWh S]	**Minimum feed rate** [g/kWh]
0 ～ 15	**0.40× 100/BN (*1)** (*1)BN:BN level of used cylinder oil	**1.70 (*1) (*2)**
15 ～ 100		**1.50 (*2)**
100 ～ 200		**1.30 (*2)**
200 ～ 300		**1.10 (*2)**
300 ～ 400		**0.90 (*2)**
400 ～ 500		**0.70 (*2)**

(Note)

(*1) ● For Mark9 type with cylinder bore 50cm and smaller engine ; 1.50 is applied

(*2) ● In case if the minimum feed rate is higher than ACC dependent feed rate (ACC factor x S%), the feed rate is set at the minimum feed rate.

● Engine load during the initial breaking-in period (0-15 hours) should be increased carefully in accordance with Fig-6. However, engine load during the breaking-in period is not specified.

2) Feed rate adjustment after the breaking-in period

First of all, knowledge of the correct sulphur content of the fuel oil being burnt at any time is a condition for Alpha ACC. When starting the Alpha ACC control and/or changing the used fuel oil, the Basic Feed Rate should be calculated in accordance with a following formula, and set the value on HMI panel of Alpha lubricator system (MC engine) or MOP screen (ME engine)

Basic Feed Rate [g/kWh] =

ACC factor [g/kWh S@BN100] **x Sulphur content** [%] **x 100/BN(*1)**

(*1):BN level of used cylinder oil

（Example）Sulphur content in fuel: 2.5%, ACC factor=0.32

- BN100CLO: Basic Feed Rate = 0.32 x 2.5 x (100/100) = 0.80g/kWh
- BN70CLO: Basic Feed Rate = 0.32 x 2.5 x (100/70) = 1.14g/kWh

① Guiding value for S60Mark7.1 / Mark8 and newer engine type.

Table- 3: Guiding values

Base number（BN level）	**100**
Guiding minimum feed rate	0.60g/kWh
ACC factor range (@BN100)	**0.40 - 0.20** [g/kWh S @BN100]

② Familiarization of ACC factor

We recommend to start out with an ACC factor in the upper end of the range, i.e., 0.4 [g/kWh S@BN100]. ACC factor can be reduced over a period of steps of 600 hours as shown in Table-4. Before reducing ACC factor to the next step, inspection should be carried out, and the cylinder condition should be proved satisfactory. **Do not proceed to the next step if the inspection reveals seizures or other irregularities and/or increased corrosive level.**

Table- 4: ACC factor @BN100

Service hours [hour]	**ACC factor** [g/kWh S @BN100]	**Min. Feed Rate** [g/kWh]
500 ～ 1100	**0.40**	**0.60**
1100 ～ 1700	**0.36**	
1700 ～ 2300	**0.32**	
2300 ～ 2900	**0.28**	
2900 ～ 3500	**0.24**	
3500 ～	**0.20**	

- ACC factor should be assessed based on the actual cylinder condition. The cylinder condition can only be evaluated when the fuel sulphur level has been enough high to ensure that the lubrication has been in the ACC active area (the hatched area in blue marked in fig-3)

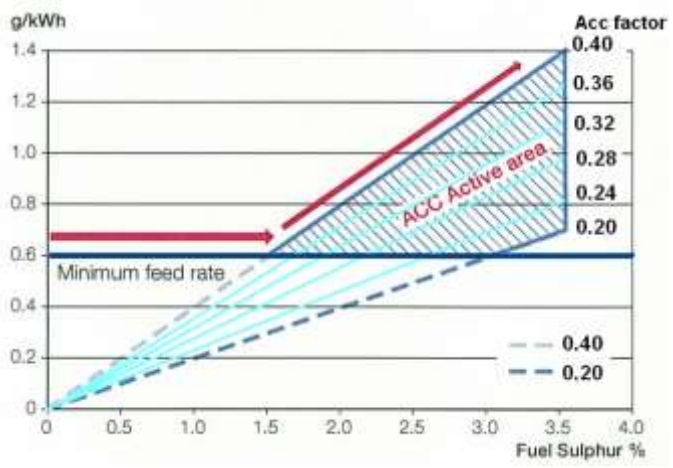

Fig- 3: Relationship between feed rate and fuel sulphur content

- In case if abnormal cylinder condition is confirmed, increase the Basic Feed Rate to 1.4g/kWh until the recovery of cylinder condition is confirmed.

- During starting and maneuvering, the feed rate is automatically increased by means of the "LCD" by 25%. Therefore, no special operation is required.

We recommend to find the optimal ACC factor by reducing ACC factor over a period of steps of 600 hours based on the actual inspection results.

However, there is another method to find the optimal ACC factor quickly based on the content of iron (Fe) and residual BN in the scavenge drain oil. Fig-4 shows the criteria of the scavenge drain oil analysis. It is important to get a valid test result. Therefore, the drain samples should be ashore to a certified laboratory.

The fastest way to evaluate the corrosive behavior of an engine from the scavenge drain oil analysis is to do a stress test, a so called Feed Rate Sweep. It can also be used in the ACC familiarization period in order to find the suitable lube oil feed rate for your particular engine, operating pattern and lube oil used. Please refer to Service Note No.190 for procedure of Sweep Test.

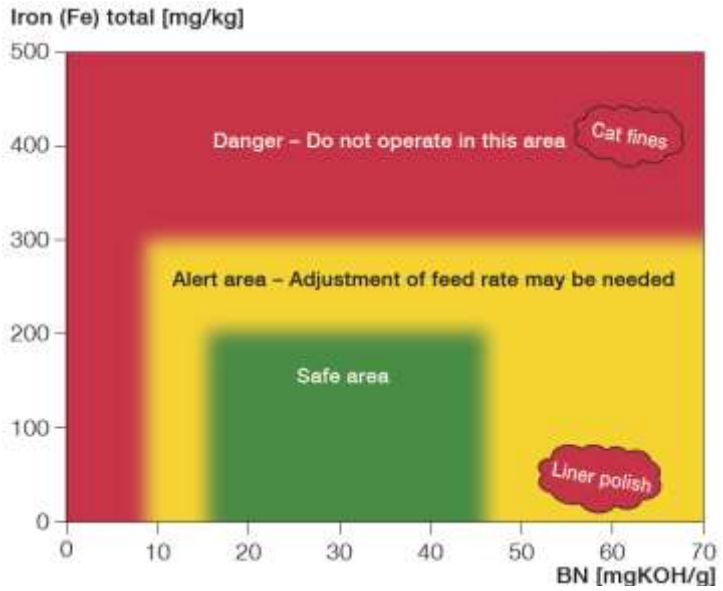

Fig-4: Drain oil BN vs. iron (Fe)

4. Cylinder oil dosage at part load

In case of Alpha ACC control principle, LOAD dependent regulation, where the cylinder oil dosage at part load is decreased in proportion to the ratio between engine output at part load and M.C.O., is applied. However, the LOAD dependent regulation mode is automatically taken over to SPEED dependent regulation mode at 25% load on the nominal propeller curve. Fig -5 shows the ratio of cylinder oil consumption based on engine-load.

When operating the engine at low-load, the liner surface will become cooler, and therefore, the risk of corrosion in the cylinder will be increased. The risk of corrosion on the engines equipped with the Waste Heat Recovery (WHR) and the engines applied on the various part-load optimization possibilities e.g. TC cut-out operation, operating of variable turbine area (VTA) and the exhaust gas by-pass (EGB), tends to be increased. Therefore, it is necessary to find the optimal ACC factor to accommodate the corrosion level on each

condition/engine.

5. Running-in schedule after the maintenance

After renewal of cylinder liners and piston rings, the breaking-in/running-in schedule which is shown in Fig -1 should be followed. And the engine load during the initial breaking-in period (0-15 hours) should be increased carefully in accordance with Fig -6

However, when assembling new piston rings in already run-in cylinder liner, if the special piston ring package for running-in (Alu-coat) is used, the running-in period can be shortened.

In case if the Alu-coat ring package is used in already run-in liner, the Basic Feed Rate shall be increased to 0.9g/kWh and keep at 0.9g/kWh for 24 hours only. If the Basic Feed Rate which is calculated by "ACC factor x S%" is higher than 0.9g/kWh, no extra lubrication is needed.

For any inquiries and questions regarding the Alu-coat piston ring, please refer to Techno News No.083.

6. Setting method

Please refer to the instruction book and the attached "Appendix".

For questions regarding feed rate setting method for running-in after maintenance, please contact our Technoservice Division at tech_de@mes.co.jp. (For contact address, please refer to Service Note No.111)

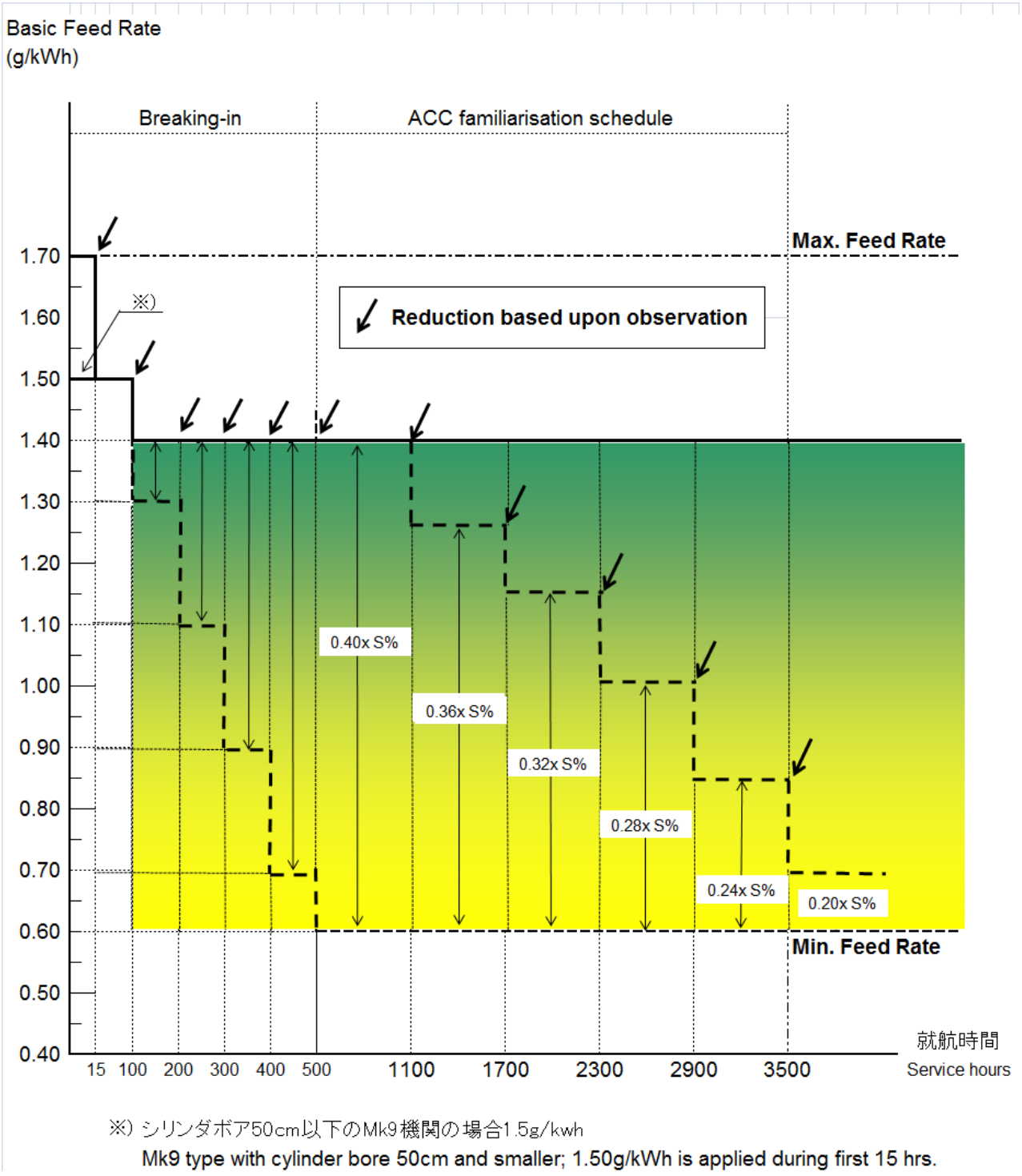

Fig-1：Guiding Basic Feed Rate and ACC factor (for BN100)

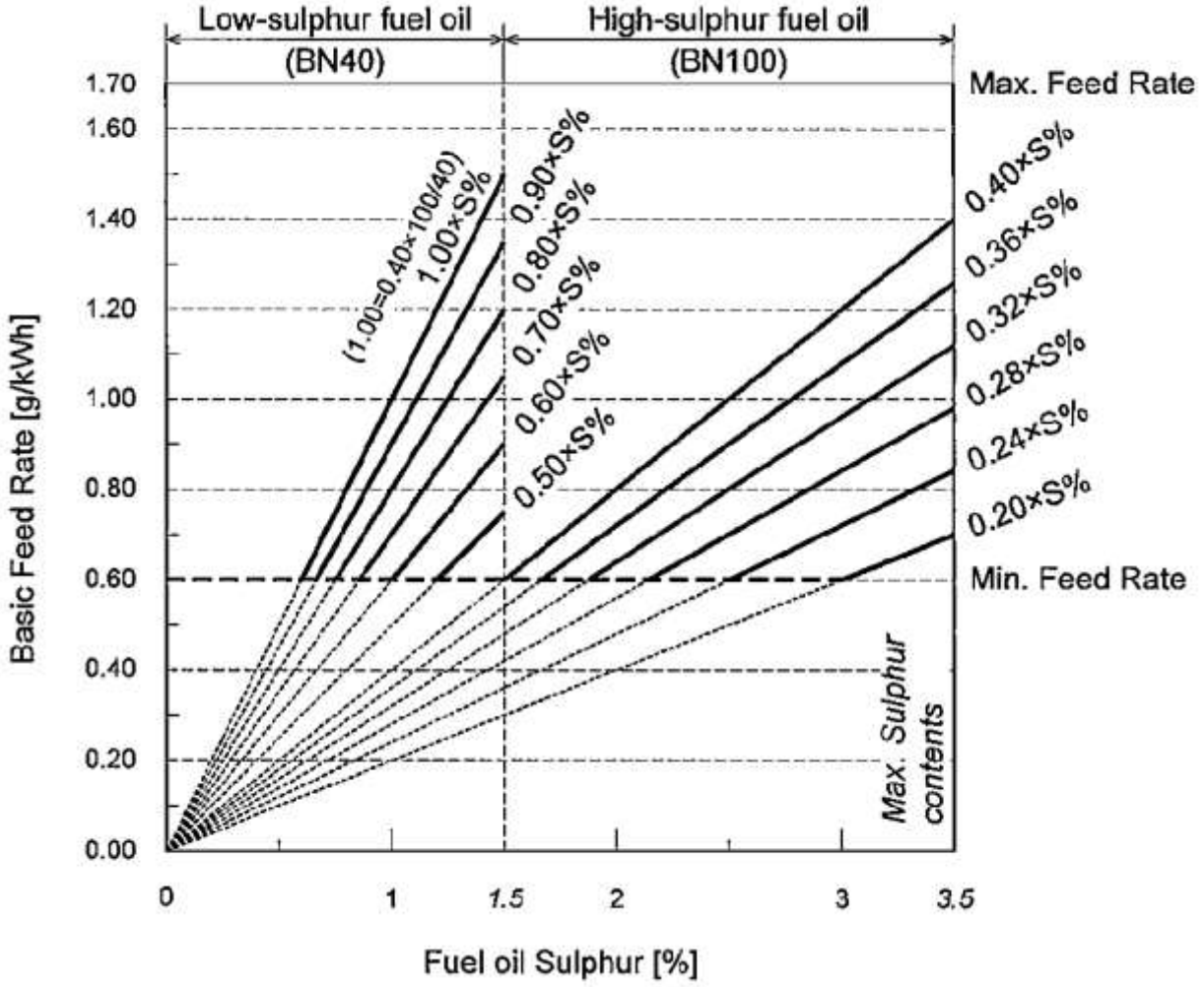

Fig 2: Relationship between feed rate and fuel sulphur content

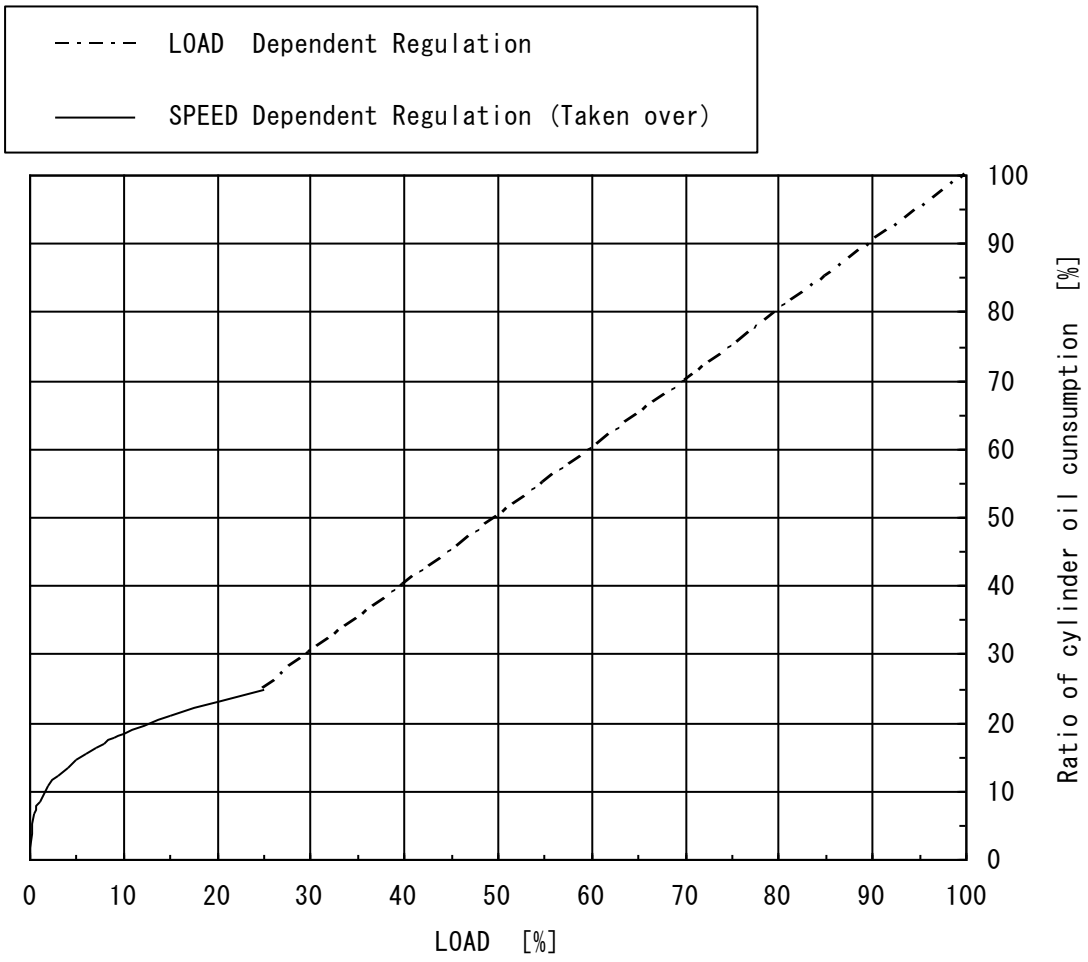

Fig-5: Cylinder oil consumption rate at part load

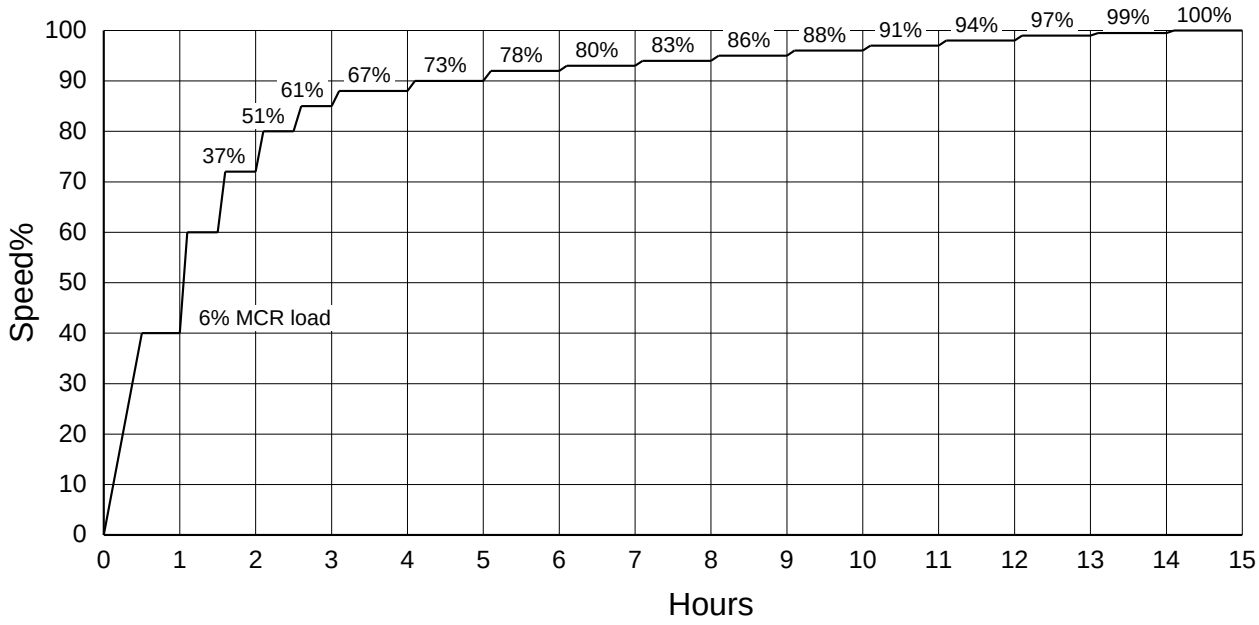

Fig-6: Load-up schedule during initial breaking-in

ME-C/ME-B engine

For fuel with Sulphur content of more than 0.5wt%

Set the value in below fields on MOP screen "Cylinder Lubrication"

Feed Rate Factor	:	**See below table(ACC factor)**	[g/kWhS]
S%	:	Sulphur content in fuel oil	[wt%]
Min. Feed Rate	:	**See below table**	[g/kWh]
Feed Rate Adjust Factor	:	**1.0**	
Running In	:	"OFF" (or 0.00)	[g/kWh]

Service hours [hour]	ACC factor Formula	ACC factor e.g. BN100	ACC factor e.g. BN40	Min. Feed Rate [g/kWh]
0 ～ 15	**0.40** × 100/BN	0.40	1.00	**1.70(※)**
15 ～ 100				**1.50**
100 ～ 200				**1.30**
200 ～ 300				**1.10**
300 ～ 400				**0.90**
400 ～ 500				**0.70**
500 ～ 1100	**0.40** × 100/BN	0.40	1.00	**0.60**
1100 ～ 1700	**0.36** × 100/BN	0.36	0.90	
1700 ～ 2300	**0.32** × 100/BN	0.32	0.80	
2300 ～ 2900	**0.28** × 100/BN	0.28	0.70	
2900 ～ 3500	**0.24** × 100/BN	0.24	0.60	
3500 ～	**0.24** × 100/BN	0.20	0.50	

BN: Alkalinity (Base Number) of cylinder oil

※） For Mark9 type with cylinder bore 50cm and smaller engines; 1.50 is applied.

For fuel with sulphur content of up to 0.5wt%

Set the value in below fields on MOP screen "Cylinder Lubrication"

Feed Rate Factor	:	**Any value up to 1.00**	[g/kWhS]
S%	:	Sulphur content in fuel oil	[wt%]
Min. Feed Rate	:	**Desired feed rate**	[g/kWh]
Feed Rate Adjust Factor	:	**1.0**	
Running In	:	"OFF" (or 0.00)	[g/kWh]

MC-C engine

- MC-C engines with Alpha lubricator system and its control unit (ALCU) is ALCU1.
  （Shop test date of those engines: after July 2010）

For fuel with Sulphur content of more than 0.5wt%

Set the value in below fields on MOP screen "Cylinder Lubrication"

F.FACt	:	**See below table(ACC factor)**	[g/kWhS]
S-Pct	:	Sulphur content in fuel oil	[wt%]
F.Lo	:	**Min. Feed Rate (see below table)**	[g/kWh]
F.runI	:	**OFF**	

Service hours [hour]	ACC factor Formula	ACC factor e.g. BN100	ACC factor e.g.BN40	Min. Feed Rate [g/kWh]
0 ～ 15	**0.40** × 100/BN	0.40	1.00	**1.70**
15 ～ 100				**1.50**
100 ～ 200				**1.30**
200 ～ 300				**1.10**
300 ～ 400				**0.90**
400 ～ 500				**0.70**
500 ～ 1100	**0.40** × 100/BN	0.40	1.00	**0.60**
1100 ～ 1700	**0.36** × 100/BN	0.36	0.90	
1700 ～ 2300	**0.32** × 100/BN	0.32	0.80	
2300 ～ 2900	**0.28** × 100/BN	0.28	0.70	
2900 ～ 3500	**0.24** × 100/BN	0.24	0.60	
3500 ～	**0.20** × 100/BN	0.20	0.50	

BN: Alkalinity (Base Number) of cylinder oil

For fuel with Sulphur content of up to 0.5wt%

Set the value in below fields on MOP screen "Cylinder Lubrication"

F.FACt	:	**Any value up to 1.00**	[g/kWhS]
S-Pct	:	Sulphur content in fuel oil	[wt%]
F.Lo	:	**Desired feed rate**	[g/kWh]
F.runI	:	**OFF**	

MC-C engine

- MC-C engines (except for S70/S80) with Alpha lubricator system and its control unit is ALCU0. （Shop test date of those engines: before July 2010）

For fuel with Sulphur content of more than 0.5wt%

Set the values in below fields of HMI panel

FrAtEt: (1) Set value calculated by following formula

HMI setting = ACC factor × S% / 1.1×100

"ACC factor": see below table
"S%": sulphur content in fuel oil

(2) or, set the reading value from the table in the next page

F.Lo : Min. Feed Rate (see above table) / 1.10 x 100

Service hours [hour]	ACC factor Formula	ACC factor e.g. BN100	ACC factor e.g. BN40	Min. Feed Rate [g/kWh]
0 ～ 15	**0.40** × 100/BN	0.40	1.00	**1.70**
15 ～ 100				**1.50**
100 ～ 200				**1.30**
200 ～ 300				**1.10**
300 ～ 400				**0.90**
400 ～ 500				**0.70**
500 ～ 1100	**0.40** × 100/BN	0.40	1.00	**0.60**
1100 ～ 1700	**0.36** × 100/BN	0.36	0.90	
1700 ～ 2300	**0.32** × 100/BN	0.32	0.80	
2300 ～ 2900	**0.28** × 100/BN	0.28	0.70	
2900 ～ 3500	**0.24** × 100/BN	0.24	0.60	
3500 ～	**0.20** × 100/BN	0.20	0.50	

BN: Alkalinity (Base Number) of cylinder oil

For fuel with Sulphur content of up to 0.5wt%

FrAtEt: 54

F.Lo: HMI setting value of desired feed rate (see table in next page)

HMI setting value

Alpha Lube ACC High BN Cylinder Oil											
ACC factor g/kWh × S%										g/kWh	HMI setting
0.20	0.24	0.26	0.28	0.30	0.32	0.34	0.36	0.38	0.40		
Sulphur content %											
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.59	54
3.1	2.6	2.4	2.2	2.1	1.9	1.8	1.7	1.6	1.5	0.62	56
3.2	2.7	2.5	2.3	2.1	2.0	1.9	1.8	1.7	1.6	0.64	58
3.3	2.8	2.5	2.4	2.2	2.1	1.9	1.8	1.7	1.7	0.66	60
3.4	2.8	2.6	2.4	2.3	2.1	2.0	1.9	1.8	1.7	0.68	62
	2.9	2.7	2.5	2.3	2.2	2.1	2.0	1.9	1.8	0.70	64
	3.0	2.8	2.6	2.4	2.3	2.1	2.0	1.9	1.8	0.73	66
	3.1	2.9	2.7	2.5	2.3	2.2	2.1	2.0	1.9	0.75	68
	3.2	3.0	2.8	2.6	2.4	2.3	2.1	2.0	1.9	0.77	70
	3.3	3.0	2.8	2.6	2.5	2.3	2.2	2.1	2.0	0.79	72
	3.4	3.1	2.9	2.7	2.5	2.4	2.3	2.1	2.0	0.81	74
	3.5	3.2	3.0	2.8	2.6	2.5	2.3	2.2	2.1	0.84	76
		3.3	3.1	2.9	2.7	2.5	2.4	2.3	2.1	0.86	78
		3.4	3.1	2.9	2.8	2.6	2.4	2.3	2.2	0.88	80
		3.5	3.2	3.0	2.8	2.7	2.5	2.4	2.3	0.90	82
			3.3	3.1	2.9	2.7	2.6	2.4	2.3	0.92	84
			3.4	3.2	3.0	2.8	2.6	2.5	2.4	0.95	86
			3.5	3.2	3.0	2.8	2.7	2.5	2.4	0.97	88
				3.3	3.1	2.9	2.8	2.6	2.5	0.99	90
				3.4	3.2	3.0	2.8	2.7	2.5	1.01	92
				3.4	3.2	3.0	2.9	2.7	2.6	1.03	94
					3.3	3.1	2.9	2.8	2.6	1.06	96
					3.4	3.2	3.0	2.8	2.7	1.08	98
					3.4	3.2	3.1	2.9	2.8	1.10	100
						3.3	3.1	3.0	2.8	1.12	102
						3.4	3.2	3.0	2.9	1.14	104
						3.4	3.2	3.1	2.9	1.17	106
						3.5	3.3	3.1	3.0	1.19	108
							3.4	3.2	3.0	1.21	110
							3.4	3.2	3.1	1.23	112
							3.5	3.3	3.1	1.25	114
								3.4	3.2	1.28	116
								3.4	3.2	1.30	118
								3.5	3.3	1.32	120
									3.3	1.33	121
									3.4	1.34	122
									3.4	1.35	123
									3.4	1.36	124
									3.4	1.38	125
									3.5	1.39	126
									3.5	1.40	127