MITSUI E&S

Mitsui E&S Machinery Co., Ltd.

SERVICE NOTE

for MITSUI－MAN B&W engines,		No. 188	
Guidance for Cylinder oil consumption in case of Alpha ACC for Mark7 and previous engine		APPROVED	N. Osako
		CHECKED	
		PREPARED	K. Harada
ENGINE TYPE	ME/ME-C/MC/MC-C(Mark7 and previous) (With Alpha lubricator)	DATE	2013.10.30

Rev.4: : Feed rate setting method for low S fuel is added, Cylinder oil ref list is removed (2020.07.22)

The guidance for cylinder oil dosage control depending on Alpha ACC principle has been explained in our Service Note No.184. However, the licensor, MAN Diesel & Turbo, has updated their guidelines on cylinder lubrication in response to recent changes in operational pattern towards low-load operation, development of new cylinder oil and the general development of engines. Therefore, we have also updated our guidelines on cylinder lubrication, and new guidance is explained in this Service Note No.188.

Since this Service Note No.188 replaces the previous Service Note No.184, we recommend you to follow the guideline described on this Service Note No.188 when you adjust the cylinder oil dosage on Mark7 and previous engine.

In case of Mark8 and newer engine types, please refer to Service Note No.189 when you choice the cylinder oil and adjust the cylinder oil dosage.

In case if the mechanical lubricators are applied on your engines and/or if you do not intend to adjust the cylinder oil dosage according to Alpha ACC even if Alpha lubricator system is applied, we recommend you to adjust the Basic Feed Rates in accordance with Service Note No.183.

The actual need for cylinder oil quantity 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 our MES TECHNOSERVICE CO. LTD.

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 cylinder oil 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 S% 1.5～3.5wt%	**BN70 ～ 100**
Viscosity grade	**SAE50**

When using cylinder oil with a different BN level from BN70, it is necessary to convert the ACC factor by multiplying the ACC factor with the fraction of 70/BN level of used cylinder oil

（Example）
Using a BN40 and ACC factor (@BN70) = 0.26
ACC factor (@40BN) ＝ 0.26(@70BN) x 70/40 ＝ 0.455

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

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 0.34 [g/kWh S @BN70], and set the minimum feed rate according to Table- 3.

During breaking-in, we recommend to check the condition of piston rings and cylinder liners trough the scavenge air ports 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	**0.34× 70/BN (*1)** (*1)BN:BN level of used cylinder oil	**1.70**
15 ～ 100		**1.50**
100 ～ 200		**1.30**
200 ～ 300		**1.10**
300 ～ 400		**0.90**
400 ～ 500		**0.70**

(Note)

- 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-7. 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@70BN] **x Sulphur content** [%] **x 70/BN(*1)**

(*1):BN level of used cylinder oil

（Example）Sulphur content in fuel: 3.2%, ACC factor=0.34

- BN70CLO: Basic Feed Rate = 0.34 x 3.2 x (70/70) = 1.09g/kWh
- BN100CLO: Basic Feed Rate = 0.34 x 3.2 x (70/100) = 0.76g/kWh

① Guiding value for Mark7 and previous engine type.

Table- 3: Guiding values

Base number（BN level）	**70 ～ 100**
Guiding minimum feed rate	0.60g/kWh
ACC factor range (@BN70)	**0.34 ～ 0.20** [g/kWh S@BN70]

② Familiarization of ACC factor

We recommend to start out with an ACC factor in the upper end of the range, i.e., 0.34 [g/kWh S @BN70]and then 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.

If High corrosive level is found with ACC factor [0.34g/kWh S @BN70], we recommend to increase an ACC factor to 0.40g/kWh S@BN70

Service hours [hour]	**ACC factor** [g/kWhS@BN70]	**Min. Feed Rate** [g/kWh]
500 ～ 1100	**0.34**	**0.60**
1100 ～ 1700	**0.30**	
1700 ～ 2300	**0.26**	
2300 ～ 2900	**0.22**	
2900 ～	**0.20**	

Table-4: ACC factor @BN70

- 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 shown in blue in fig-4)

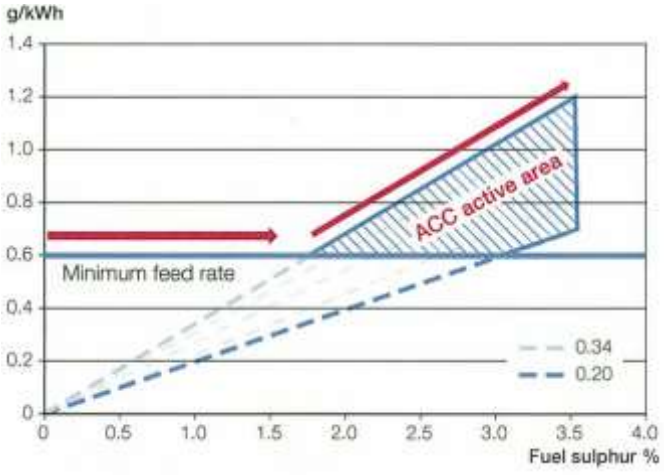

Fig-4: Relationship between feed rate and fuel sulphur content

- In case if abnormal cylinder condition is confirmed, increase the Basic Feed Rate to 1.2g/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 results of the inspection.

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-5 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.

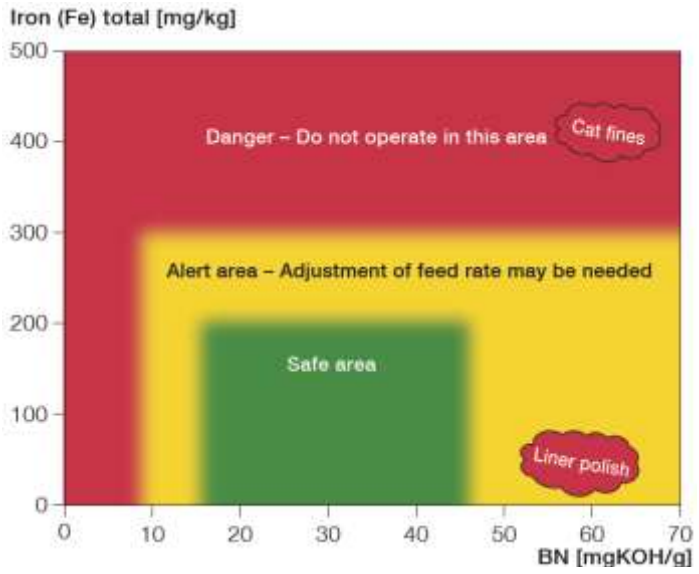

Fig-5: Drain oil BN vs. iron (Fe)

4. Minimum feed rate

The minimum feed rate is specified at 0.6[g/kWh] for oil film formation on the sliding surface.

Wear rates of cylinder liners and/or piston rings may be increased in proportion to the reduction of the feed rate. In case of Alpha ACC control, the feed rate will decrease to the specified minimum feed rate when using the fuel oil with low-sulphur. Therefore, we recommend to carry out the periodical scavenge port inspection at least once a month to keep the monitoring of cylinder condition.

5. 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-6 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.

6. 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-7

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 for running-in 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.

7. 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)

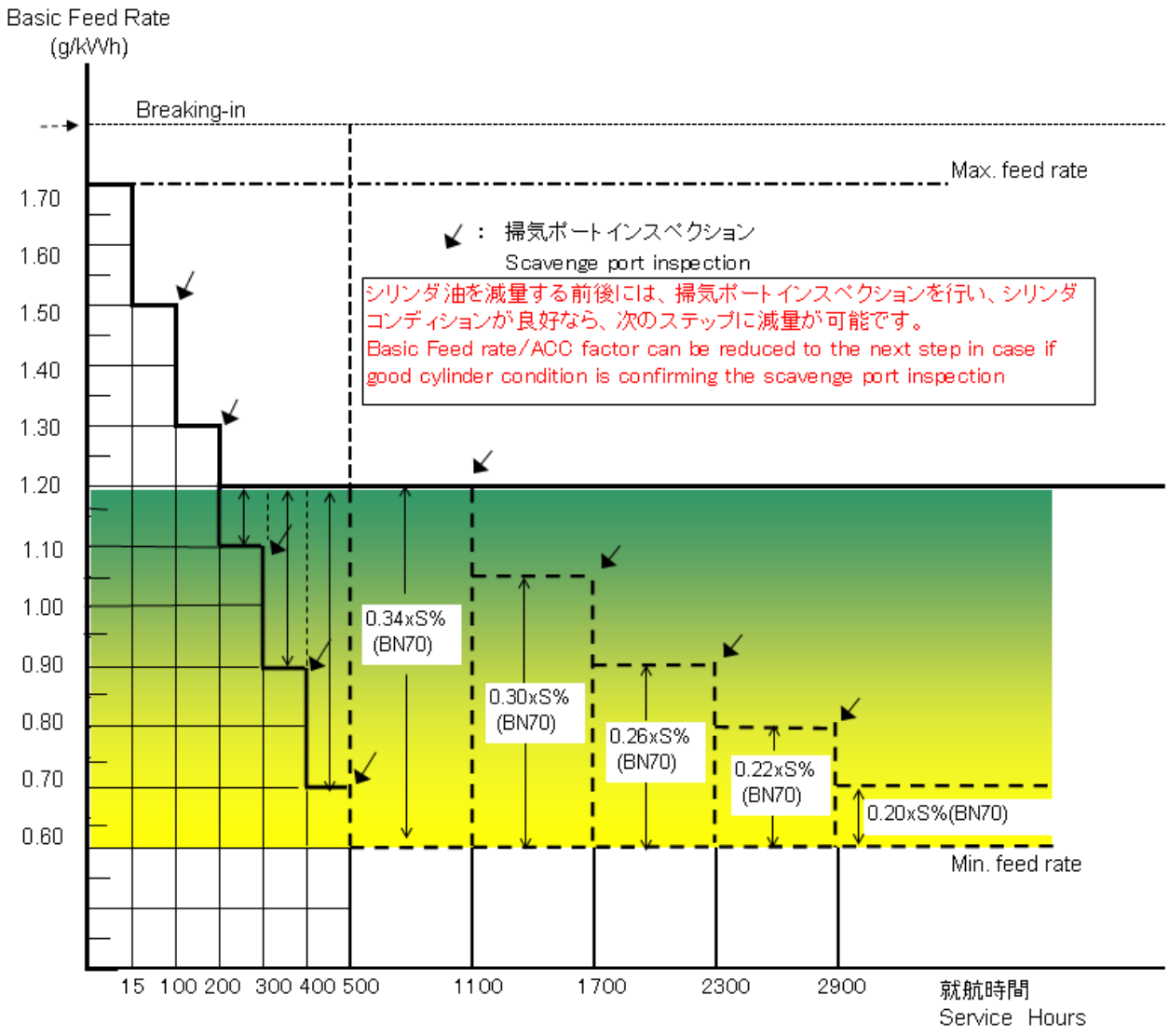

Fig-1：Guiding Basic Feed Rate and ACC factor (for BN70)

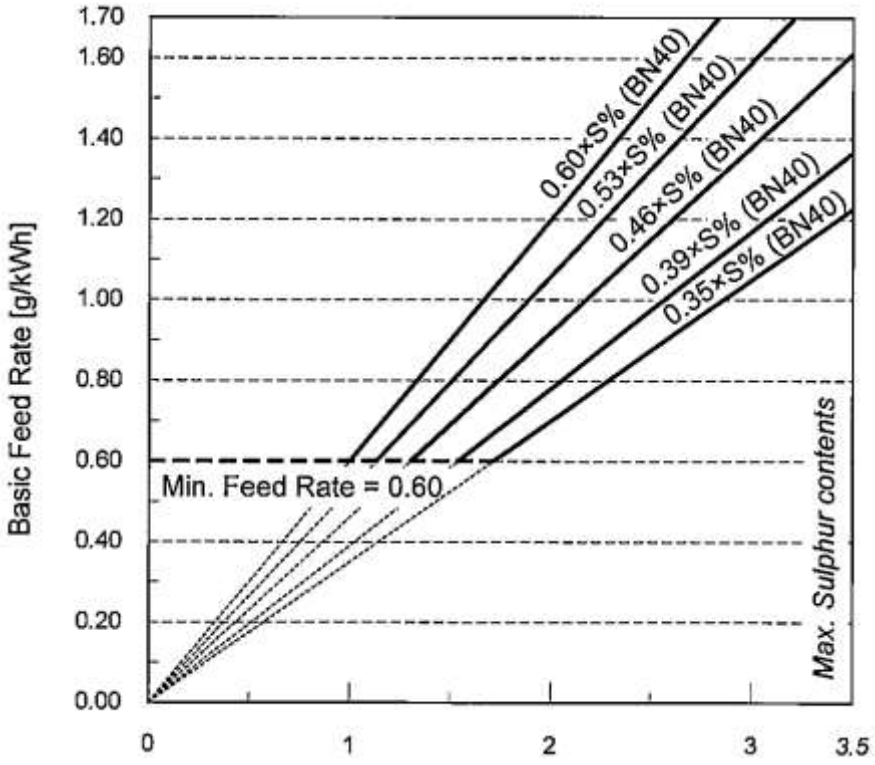

Fig-2: Sulphur content and Basic Feed Rate (for BN40)

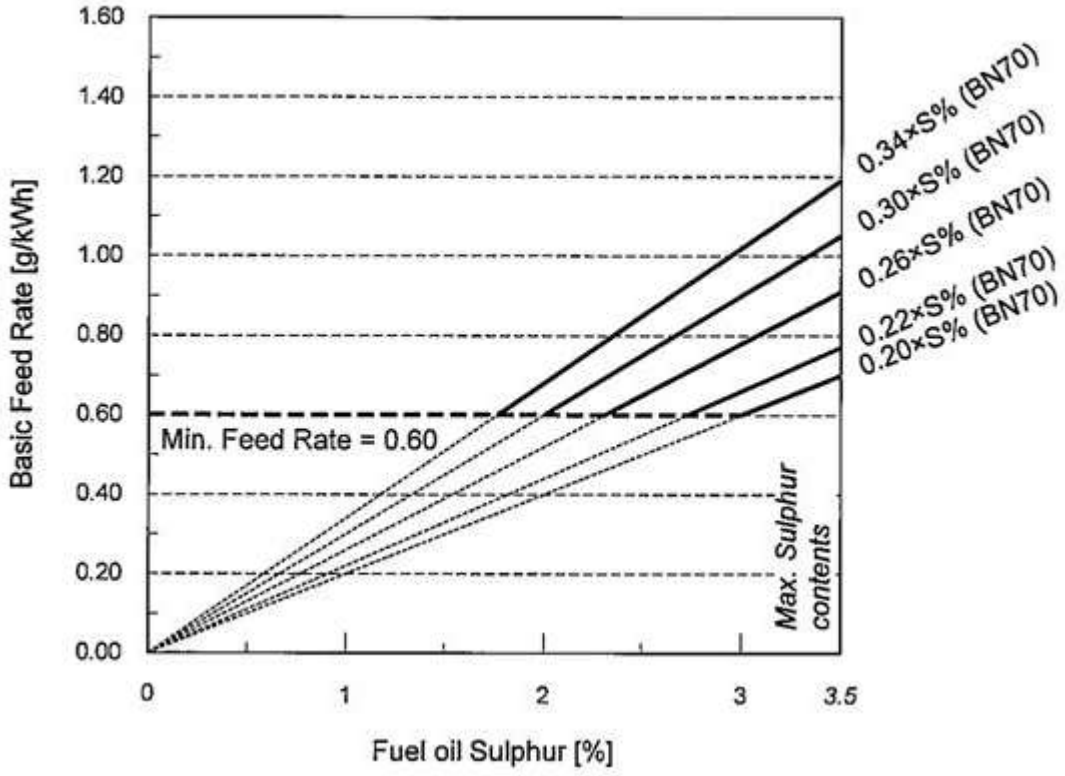

Fig-3 : Sulphur content and Basic Feed Rate (for BN70)

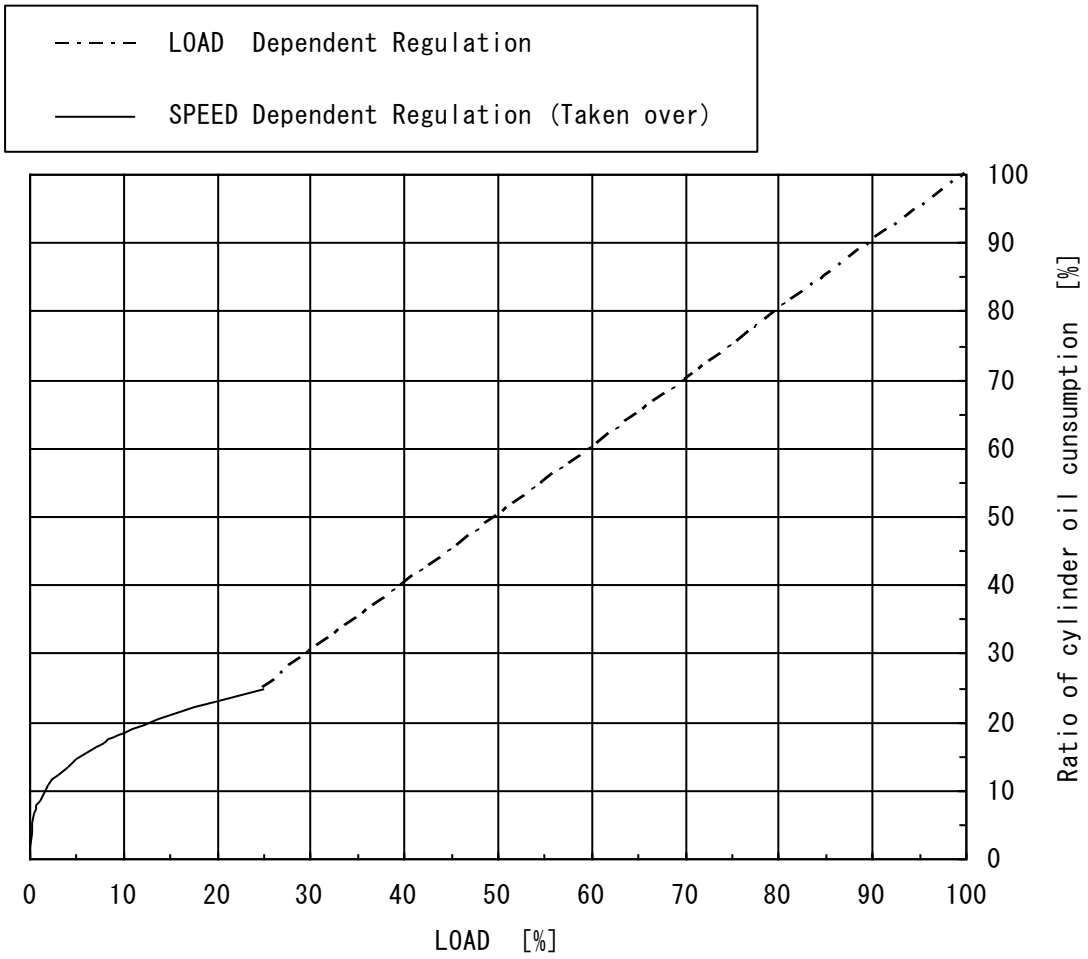

Fig-6: Cylinder oil consumption rate at part load

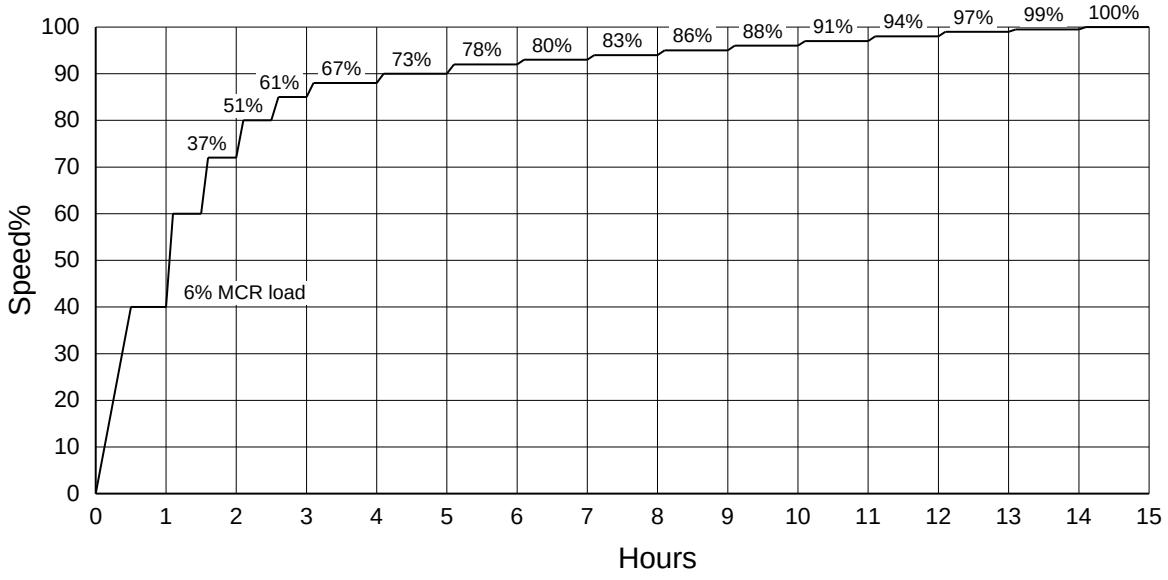

Fig-7: Load-up schedule during initial breaking-in

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 above table(ACC factor)**	[g/kWhS]
S%	:	Sulphur content in fuel oil	[wt%]
Min. Feed Rate	:	**See above 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. BN70	ACC factor e.g.BN40	Min. Feed Rate [g/kWh]
0 ～ 15	**0.34** × 70/BN	0.34	0.60	**1.70**
15 ～ 100				**1.50**
100 ～ 200				**1.30**
200 ～ 300				**1.10**
300 ～ 400				**0.90**
400 ～ 500				**0.70**
500 ～ 1100	**0.34** × 70/BN	0.34	0.60	**0.60**
1100 ～ 1700	**0.30** × 70/BN	0.30	0.53	
1700 ～ 2300	**0.26** × 70/BN	0.26	0.46	
2300 ～ 2900	**0.22** × 70/BN	0.22	0.39	
2900 ～	**0.20** × 70/BN	0.20	0.35	

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"

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. BN70	ACC factor e.g.BN40	Min. Feed Rate [g/kWh]
0 ～ 15	**0.34** × 70/BN	0.34	0.60	**1.70**
15 ～ 100				**1.50**
100 ～ 200				**1.30**
200 ～ 300				**1.10**
300 ～ 400				**0.90**
400 ～ 500				**0.70**
500 ～ 1100	**0.34** × 70/BN	0.34	0.60	**0.60**
1100 ～ 1700	**0.30** × 70/BN	0.30	0.53	
1700 ～ 2300	**0.26** × 70/BN	0.26	0.46	
2300 ～ 2900	**0.22** × 70/BN	0.22	0.39	
2900 ～	**0.20** × 70/BN	0.20	0.35	

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 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

*) In case of S70MC/-C S80MC/-C, please contact TECHNOSERVICE Div., since the different formula for calculation of HMI setting(%) is applied on some of S70/S80 engines.

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

Service hours [hour]	ACC factor Formula	ACC factor e.g. BN70	ACC factor e.g.BN40	Min. Feed Rate [g/kWh]
0 ～ 15	**0.34** × 70/BN	0.34	0.60	**1.70**
15 ～ 100				**1.50**
100 ～ 200				**1.30**
200 ～ 300				**1.10**
300 ～ 400				**0.90**
400 ～ 500				**0.70**
500 ～ 1100	**0.34** × 70/BN	0.34	0.60	**0.60**
1100 ～ 1700	**0.30** × 70/BN	0.30	0.53	
1700 ～ 2300	**0.26** × 70/BN	0.26	0.46	
2300 ～ 2900	**0.22** × 70/BN	0.22	0.39	
2900 ～	**0.20** × 70/BN	0.20	0.35	

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)

Alpha Lube ACC BN70 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		
Sulphur content %								
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	0.62	56
3.2	2.7	2.5	2.3	2.1	2.0	1.9	0.64	58
3.3	2.8	2.5	2.4	2.2	2.1	1.9	0.66	60
3.4	2.8	2.6	2.4	2.3	2.1	2.0	0.68	62
	2.9	2.7	2.5	2.3	2.2	2.1	0.70	64
	3.0	2.8	2.6	2.4	2.3	2.1	0.73	66
	3.1	2.9	2.7	2.5	2.3	2.2	0.75	68
	3.2	3.0	2.8	2.6	2.4	2.3	0.77	70
	3.3	3.0	2.8	2.6	2.5	2.3	0.79	72
	3.4	3.1	2.9	2.7	2.5	2.4	0.81	74
	3.5	3.2	3.0	2.8	2.6	2.5	0.84	76
		3.3	3.1	2.9	2.7	2.5	0.86	78
		3.4	3.1	2.9	2.8	2.6	0.88	80
		3.5	3.2	3.0	2.8	2.7	0.90	82
			3.3	3.1	2.9	2.7	0.92	84
			3.4	3.2	3.0	2.8	0.95	86
			3.5	3.2	3.0	2.8	0.97	88
				3.3	3.1	2.9	0.99	90
				3.4	3.2	3.0	1.01	92
				3.4	3.2	3.0	1.03	94
					3.3	3.1	1.06	96
					3.4	3.2	1.08	98
					3.4	3.2	1.10	100
						3.3	1.12	102
						3.4	1.14	104
						3.4	1.17	106
						3.5	1.19	108

Example）Using a BN70 cylinder oil,　ACC factor=0.34 and sulphur content = 2.9 [wt%]

From the above table, HMI setting [%] = **90**