Action code: WHEN CONVENIENT

Cylinder Lubrication Update

Guiding ACC Feed Rates for Alpha Lubricator and ME Lube

Replaces SL07-479/HRR for large bore engines

SL09-507/HRR
April 2009

Concerns

MAN B&W two-stroke 60-98 cm large bore engines.
Types: MC/MC-C, ME/ME-C with high top-land and Alpha Lubricator or ME Lube.

Summary

New cylinder lubrication recommendation 0.20 g/kWh × S%.
Absolute minimum: 0.60 g/kWh.

New ACC guidelines further emphasise the advantage of the Alpha Lubricator system

Dear Sirs

Based on experience and research, we have lowered our recommended ACC (Adaptive Cylinder oil Control) feed rate factors for plants equipped with Alpha Lubricator or ME Lube system. Consequently, our previous recommendation, announced in SL07-479/HRR, issued in June 2007, is only valid for engine types not covered by this service letter.

We now recommend the following feed rates:

Standard BN70 lubricating oil	
Fuel oil with sulphur content 3% and below	0.60 g/kWh
Fuel oil with sulphur content above 3%	0.20 g/kWh × sulphur%

This service letter specifies the recommended ACC feed rates for different types of lubricating oil during during running-in, low-sulphur fuel operation and standard engine operation.

A ready-to-print page, summarising feed rates for any lubrication situation is available on page 5, and selected ACC settings for BN70, BN50 and BN40 lubricating oils are listed on page 6.

Yours faithfully

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Contents

Cylinder lubrication

Four factors determine the lubricating oil feed rate:

- sulphur content in the fuel oil
- alkali content in the cylinder lube oil
- engine history
- engine load.

An Alpha Lubricator or ME Lube operating in ACC-mode (Adaptive Cylinder oil Control) adapts the lubricating oil feed rate to the fuel oil sulphur content and the engine load. The ACC-mode has been the standard on MAN B&W two-stroke engines since 2004.

The ACC factor is the determining factor in the feed rate equation: Feed rate = ACC factor × sulphur%. The recommended ACC factor is based on practical experiments performed on different types of engines under varying running conditions. When determining the recommended ACC factor, we consider engine performance, engine service life, environment and economy.

This service letter describes the cylinder feed rates in the following operation situations:

- standard
- low-sulphur fuel
- running-in.

Cylinder chemistry

The combustion process turns sulphur in the fuel oil into sulphuric acid. The higher the sulphur content in the fuel oil, the more sulphuric acid is created.

The alkaline content in the lubricating oil adds base to the chemical environment in the cylinder. The base in the lubricating oil will neutralise the sulphuric acid developed from the fuel sulphur.

The more base available, the more sulphuric acid can be neutralised. This is why lubricating oil with a high level of alkaline additives, i.e. high-BN (base number) oil, is particularly advantageous when operating on high-sulphur fuels.

The target BN-value in the cylinder drain oil is around 15–20.

A more acidic environment than recommended will increase the cold corrosion and, consequently, the wear on the cylinder liner.

In a more alkaline cylinder environment, surplus alkaline additives may accumulate as calcium deposits on the piston top land, possibly leading to mechanical bore polish. Lack of corrosive refreshment of the liner surface is another risk factor leading to chemical bore polish. Bore polish is one of the reasons for the most feared cylinder condition problem, i.e. scuffing.

Standard operation

We continuously perform lubrication feed rate tests on the different MAN B&W engines types, under varying running conditions and with varying fuel oil sulphur contents.

Our most recent research shows that the optimum lubrication feed rate is lower than our previous recommendations.

New recommendations for standard operation with standard BN70 lubricating oil:

BN70 lubricating oil	
Fuel oil with sulphur content 3% and below	0.60 g/kWh
Fuel oil with sulphur content above 3%	0.20 g/kWh × S%

Low-sulphur fuel oils call for less alkaline lubricating oil (see page 3). Below is given the recommendations for selected types of less alkaline lubricating oils:

BN60 lubricating oil	
Fuel oil with sulphur content 2.6% and below	0.60 g/kWh
Fuel oil with sulphur content above 2.6%	0.23 g/kWh × S%

BN50 lubricating oil	
Fuel oil with sulphur content 2.1% and below	0.60 g/kWh
Fuel oil with sulphur content above 2.1%	0.28 g/kWh × S%

BN40 lubricating oil	
Fuel oil with sulphur content 1.7% and below	0.60 g/kWh
Fuel oil with sulphur content above 1.7%	0.35 g/kWh × S%

ACC Cylinder Lubrication

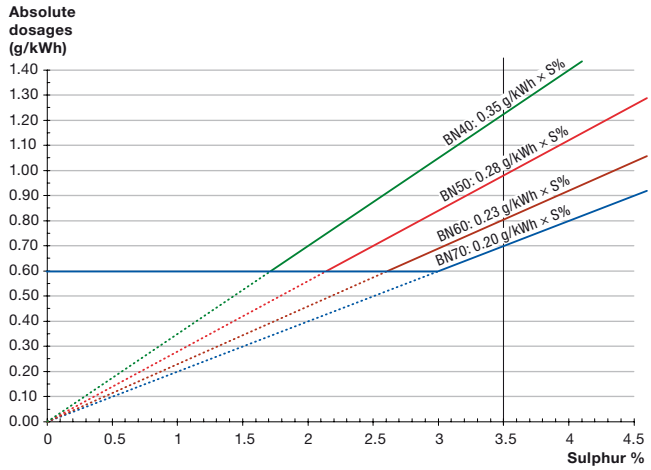

Fig. 1: Recommended cylinder lubrication feed rate as a function of the fuel oil sulphur content for selected lubricating oils (BN40-BN70)

Based on calculations of the average worldwide sulphur content used on MAN B&W two-stroke engines, the average cylinder oil consumption will be less than 0.65 g/kWh when these new recommendations become effective.

Low-sulphur fuel operation

Low-sulphur fuel oil is necessary when operating in sulphur emission control areas (SECA).

Operation on fuel oil with around 1.5% sulphur should preferably be done in combination with a low-BN cylinder oil. However, continuing on BN70 cylinder oil is possible for a limited period of 7-14 days without any serious risks of over-alkalinity.

We recommend using a lower-BN cylinder oil, when operating on low-sulphur fuels for extended periods (more than 14 days).

BN and low-sulphur fuel

MAN Diesel recommends a minimum oil feed rate of 0.60 g/kWh for any lubricating oil for hydrodynamic purposes.

However, to avoid surplus alkaline additives in the cylinder, we generally recommend that the alkaline content in the lubricating oil match the sulphur content in the fuel oil. This is particularly crucial when operating on low-sulphur fuel for extended periods (more than 14 days).

Low-BN oils should be chosen for low-sulphur fuels, and high-BN oils for high-sulphur fuels.

BN	Sulphur
40 - 50	< 3.5%
60 - 70	> 2.5%

Running-in operation

A MAN B&W two-stroke engine requires extra attention and extra lubricating oil during its first 2,500 running hours, the first 500 hours being the most demanding period.

We classify the running-in period in three categories:
1. breaking-in (0-500 hours)
2. running-in, phase 1 (500-1,500 hours)
3. running-in, phase 2 (1,500-2,500 hours).

The purpose of extra lubricating oil during the running-in period is to:
- help flush away wear particles
- build up oil film in a not yet run in cylinder.

The running-in process has been eased and shortened considerably by our alu-bronze running-in coating on all 4 piston rings (standard on all MAN B&W two-stroke engines). Cylinder liner run-in is facilitated by our semi-honed liner surface.

We recommend frequent scavenge air port inspections during the first 2,500 running hours (see Fig. 2).

Breaking-in (0-500 hours)

Piston ring and liner breaking-in takes 500 running hours, maximum. We recommend a fixed, relatively high lubrication feed rate during the breaking-in period.

During breaking-in, the running-in coating on the piston rings will gradually wear off, and the wave shape of the cylinder liner surface will smoothen. During this process, extra lubricating oil is required to flush away wear particles and build a satisfactory oil film between the still relatively rough sliding surfaces.

During breaking-in, we recommend checking the piston rings and the cylinder liner through the scavenge air ports every 100 hours. Do not proceed to the next lubrication step if the scavenge air port inspection reveals seizures or other irregularities!

Breaking-in	Feed rate, BN70 lubricating oil
0 - 5 hours	1.70 g/kWh
5 - 100 hours	1.50 g/kWh
100 - 200 hours	1.30 g/kWh
200 - 300 hours	1.10 g/kWh
300 - 400 hours	0.90 g/kWh
400 - 500 hours	0.70 g/kWh

To avoid a high torque during breaking-in, we recommend a 16-hours stepwise load increase from 50% load to max. load.

When running in new piston rings in well running liners, we recommend a 5-hour load-up from 50% load to max. load. This load limitation can be set for a single cylinder unit by adjusting the individual fuel pump index.

Running-in, phase 1 (500-1,500 hours)
After the first 500 running hours, standard sulphur-dependent lubrication can be applied. Hence, ACC can take over lubrication.

For a BN70 oil, MAN Diesel recommends a running-in, phase 1 dosage of 0.26 g/kWh x sulphur %.

Running-in, phase 1	Feed rate, BN70 lubricating oil
500 - 1,500 hours	0.26 g/kWh × S%

Running-in, phase 2 (1,500-2,500 hours)
After 1,500 hours, the running-in piston ring alu-coating is usually worn through, and the base material or the cermet coating on the top and bottom rings is visible.

When reaching 1,500 running hours, carefully check the piston rings and the cylinder liner through the scavenge air ports. If the alu-coating is worn through, proceed to running-in, phase 2.

For a BN70 oil, MAN Diesel recommends a running-in, phase 2 dosage of 0.23 g/kWh × sulphur %.

Running-in, phase 2	Feed rate, BN70 lubricating oil
1,500 - 2,500 hours	0.23 g/kWh × S%

Inspect the piston rings and the cylinder liner through the scavenge air ports after 2,500 running hours. If no micro seizures or other irregularities are found, we recommend switching to the standard operation feed rate of **0.20 g/kWh × sulphur%.**

Table I: Guiding Cylinder Oil Feed Rates for all Operation Situations

MC/MC-C, ME/ME-C and ME-B engines with high topland and Alpha Lubricator or ME Lube					
		Standard BN70 cylinder oil	BN60 cylinder oil	BN50 cylinder oil	BN40 cylinder oil
Basic setting		0.20 g/kWh × S%	0.23 g/kWh × S%	0.28 g/kWh × S%	0.35 g/kWh × S%
Minimum feed rate		0.60 g/kWh			
Maximum feed rate during running-in		1.7 g/kWh			
Part-load control		100% to 25% load: proportional to indicated engine load 25% load and lower: proportional to rpm			
Running-in new or reconditioned liners and new piston rings based on standard BN70 cylinder oil	Feed rate	First 5 hours 1.7 g/kWh 5 - 500 hours: stepwise reduction from 1.5 to 0.6 g/kWh 500 - 1,500 hours: 0.26 g/kWh × S% (absolute min. 0.60 g/kWh) 1,500 - 2,500 hours: 0.23 g/kWh × S% (absolute min. 0.60 g/kWh) From 2,500 hours: 0.20 g/kWh × S% (absolute min. 0.60 g/kWh)			
	Engine load	Testbed: stepwise increase to max. load over 5 hours In service: from 50% to max. load over 16 hours			
Running-in new rings in already run-in and well running liners (standard BN70 cylinder oil)		From 50% to max. load in 5 hours Feed rate: +25% for 24 hours			
Manoeuvring and load change situations		During starting, manoeuvring and load changes, increase feed rate by means of the “LCD” by 25% of the actual figure. Keep this level for ½ hour after the load has stabilised.			
Lubrication of cylinders that show abnormal conditions		Frequent scavenge air port inspections of piston rings and cylinder liners are very important for maintaining a safe cylinder condition. If irregularities are observed, consider adjustments of the lube oil rate. In case of scuffing, sticking piston rings or high liner temperature fluctuations, raise the feed rate to 1.2 g/kWh and lower p_{max} and mep. As soon as the situation has been stabilised, set the lubrication feed rate and the pressures back to normal.			

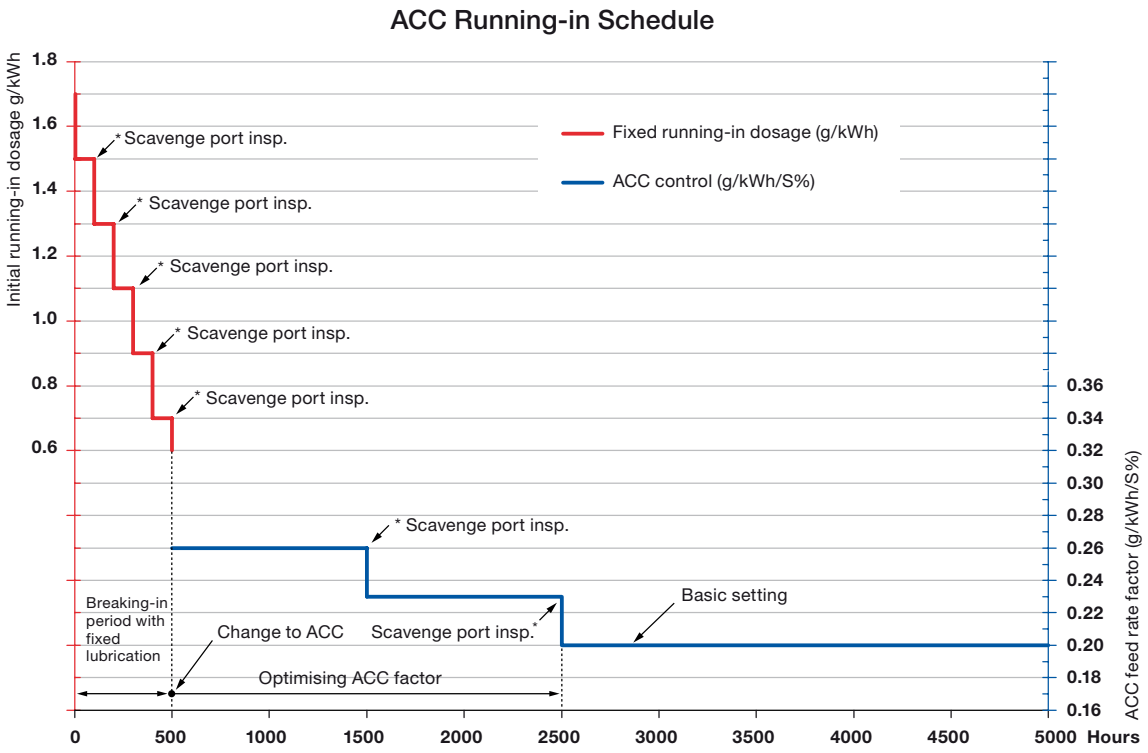

Fig. 2: New ACC running-in schedule (liner and rings)

Table II: ACC settings for BN70, BN50 and BN40 lubricating oils for MC/MC-C engines

Alpha Lube ACC BN70 Cylinder Oil				
ACC factor			Dosage (ACC factor × S%)	HMI setting
Standard	Running-in			
0.20	Phase 2 0.23	Phase 1 0.26		
Sulphur %			g/kWh	
0-3.0	0-2.6	0-2.3	0.60*	55
3.1	2.7	2.4	0.62	57
3.2	2.8	2.5	0.64	58
3.3	2.8	2.5	0.65	59
3.4	2.9	2.6	0.68	61
3.5	3.1	2.7	0.70	64
3.6	3.2	2.8	0.73	66
3.7	3.2	2.9	0.74	67
3.8	3.3	2.9	0.75	69
3.9	3.4	3.0	0.78	71
4.0	3.5	3.1	0.81	73
4.1	3.6	3.2	0.82	74
4.2	3.6	3.2	0.83	76
4.3	3.7	3.3	0.86	78
4.4	3.8	3.4	0.88	80
4.5	3.9	3.5	0.90	82
	4.0	3.5	0.91	83
	4.1	3.6	0.94	85
	4.2	3.7	0.96	87
	4.3	3.8	0.99	90
	4.4	3.9	1.01	92
	4.5	4.0	1.04	95
		4.1	1.07	97
		4.2	1.10	100
		4.3	1.12	102
		4.4	1.14	104
		4.5	1.17	106
			1.30	118
			1.50	136
			1.70	155

Alpha Lube ACC BN50 Cylinder Oil				
ACC factor			Dosage (ACC factor × S%)	HMI setting
Standard	Running-in			
0.28	Phase 2 0.32	Phase 1 0.36		
Sulphur %			g/kWh	
0-2.1	0-1.9	0-1.7	0.60*	55
2.2	1.9	1.7	0.62	56
2.3	2.0	1.8	0.64	59
2.4	2.1	1.9	0.67	61
2.5	2.2	1.9	0.70	64
2.6	2.3	2.0	0.73	66
2.7	2.4	2.1	0.76	69
2.8	2.5	2.2	0.78	71
2.9	2.5	2.3	0.81	74
3.0	2.6	2.3	0.84	76
3.1	2.7	2.4	0.87	79
3.2	2.8	2.5	0.90	81
3.3	2.9	2.6	0.92	84
3.4	3.0	2.6	0.95	87
3.5	3.1	2.7	0.98	89
3.6	3.2	2.8	1.01	92
3.7	3.2	2.9	1.04	94
3.8	3.3	3.0	1.06	97
3.9	3.4	3.0	1.09	99
4.0	3.5	3.1	1.12	102
4.1	3.6	3.2	1.15	104
4.2	3.7	3.3	1.18	107
4.3	3.8	3.3	1.20	109
4.4	3.9	3.4	1.23	112
4.5	4.0	3.5	1.26	115
	4.1	3.6	1.28	116
	4.2	3.6	1.31	119
	4.3	3.7	1.34	122
	4.4	3.8	1.38	125
	4.5	3.9	1.41	128
		4.0	1.44	131
		4.1	1.48	134
		4.2	1.51	137
		4.3	1.55	141
		4.4	1.58	144
		4.5	1.62	147

Alpha Lube ACC BN40 Cylinder Oil				
ACC factor			Dosage (ACC factor × S%)	HMI setting
Standard	Running-in			
0.35	Phase 2 0.40	Phase 1 0.46		
Sulphur %			g/kWh	
0-1.7	0-1.5	0-1.5	0.60*	55
1.8	1.6	1.4	0.63	57
1.9	1.7	1.5	0.67	60
2.0	1.8	1.5	0.70	64
2.1	1.8	1.6	0.74	67
2.2	1.9	1.7	0.77	70
2.3	2.0	1.8	0.81	73
2.4	2.1	1.8	0.84	76
2.5	2.2	1.9	0.88	80
2.6	2.3	2.0	0.91	83
2.7	2.4	2.1	0.95	86
2.8	2.4	2.2	0.98	89
2.9	2.5	2.2	1.02	92
3.0	2.6	2.3	1.05	95
3.1	2.7	2.4	1.09	99
3.2	2.8	2.5	1.12	102
3.3	2.9	2.5	1.16	105
3.4	3.0	2.6	1.19	108
3.5	3.1	2.7	1.23	111
3.6	3.2	2.8	1.26	115
3.7	3.3	2.8	1.30	118
3.8	3.3	2.9	1.33	121
3.9	3.4	3.0	1.37	124
4.0	3.5	3.1	1.40	127
4.1	3.6	3.2	1.44	130
4.2	3.7	3.2	1.47	134
4.3	3.8	3.3	1.50	136
4.4	3.9	3.4	1.54	140
4.5	4.0	3.5	1.61	146
	4.1	3.6	1.65	150
	4.2	3.7	1.70	155

** Absolute minimum dosage*