WÄRTSILÄ

WÄRTSILÄ **Engines**

Service Bulletin

RT-18.4
09.06.2009
Supersedes Bulletin RTA-18.3

Technical Information to all Owners / Operators of Wärtsilä RTA and RT-flex engines

Running-in of Cylinder Liners and Piston Rings

Contents

Wärtsilä Switzerland Ltd
Wärtsilä Schweiz AG
Wärtsilä Suisse SA

PO Box 414
CH-8401 Winterthur
Switzerland

Tel.: +41 52 262 23 30
Fax: +41 52 212 71 03
technicalsupport.chts@wartsila.com

1 Introduction

This Service Bulletin provides information regarding the updated running-in procedure for newly fitted piston rings after a piston overhaul or replacement of one or more cylinder liners on an engine in service. These running-in guidelines are based on our experience with material and machining specifications for cylinder liners or piston rings approved by Wärtsilä Switzerland Ltd. It is therefore of the utmost importance that spare cylinder liners and piston rings are genuine Wärtsilä spare parts.

In the Service Bulletin 18.3, only the CLU3 system is explained. This present edition will consider two additional systems, the Pulse Jet and Pulse (Retrofit and Feed) systems, which have a similar running-in procedure. Service Bulletin 60.1 may be referenced for older type lubrication systems.

This document for running-in supersedes all relevant instructions provided in Bulletin 18.3 and Engine Operating Manuals.

2 General remarks

After fitting the new cylinder liners or even after replacing only the piston rings, these must be run-in. The purpose of running-in is to achieve good sealing of the rings as soon as possible and is especially important for non-Chrome-Ceramic rings. Under no circumstances must any seizing occur on the running surfaces of cylinder liner and piston rings.

3 Preparations and checks to be made before starting the engine

For preparation before taking into service please refer to the Operating Manual. Pay particular attention to:

Cylinder liner running surface	Check for abnormalities such as sharp edges in the area of the lube oil grooves. Scavenge ports and the top dead centre wear ridge must be ground according to the maintenance manual.
Scavenge air receiver	Check for contamination with lube oil or any kind of debris.
Scavenge air receiver drains	Check to confirm drain valves are in an open position, and the high level alarm is functioning properly.
Piston ring grooves	Check for abnormalities such as wear steps or broken out chrome layers.
Required cylinder lubricating oil feed rate	To be set as specified in this document.
Piston skirt	Check condition for hard areas caused by scuffing. These should be dressed up.

Table 1

4 Remarks on running-in

The engine has to be run-in according to the guidelines of the running-in programme. The load-up programme should not be completed faster than recommended.

For particular attention:

Fuel oil	Running-in should be done on HFO (Heavy Fuel Oil) HFO to be correctly treated and preheated to the recommended injection viscosity before the engine is started
Cylinder lube oil	Same cylinder lubricating oil as for normal operation
VIT / FQS	VIT system should be switched off, FQS set to zero
Cylinder cooling water	Check the stability and the level of the cylinder cooling water temperature frequently. Temperature fluctuations should be avoided as far as possible: +/-2°C at constant load +/-4°C during transient conditions
Liner wall temperature	The monitoring tool MAPEX PR is of great advantage as it allows close monitoring of the liner wall temperature for safe running-in

Table 2

4.1 Running-in during slow steaming

On vessels intending to slow steam, the running-in schedule may be postponed until the next load up such as for turbocharger cleaning or boiler soot blowing. In that case, the procedure must then be followed up to 75% load. Having reached this load and completed the 75% operation, the load can be reduced again to the slow steaming level.

Postponing of the running-in procedure is only possible if both conditions are met:

- A full set of CC rings (Chrome Ceramic) is installed
- A new, fully honed or previously run-in liner are in use according to the latest specifications as set by Bulletin 43.3

5 Running-in with CLU3 system

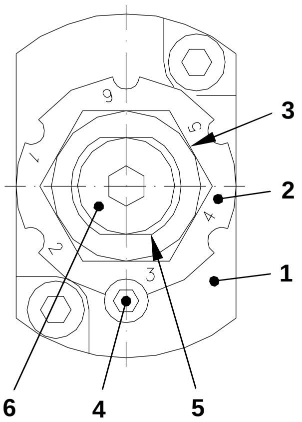
5.1 Cylinder oil feed rate adjustment and calculation

The CLU3 system is applied for cylinder liners with both single and multi-level lubrication and assembled upper and lower quills. For multi-level assemblies, the distribution of cylinder lubricating oil on cylinder liners should be adjusted as follows:

Lubrication level	Distribution setting
Upper quills	30 – 40 %
Lower quills	70 – 60 %

Table 3

Distribution between the upper and lower quills is adjusted with the **cylinder lubricating pump setting disc** (setting position 1 to 6 will change the pump stroke).



1 Pump element
2 Adjustment disc
3 Hexagonal nut
4 Fixing screw
5 AF24 for turning adjustment disc
6 Screw plug

Figure 1

The volume of cylinder oil discharged by each pump stroke to a particular cylinder liner depends on the upper and lower quill's adjustment setting. It should be noted that adjustments can be made on a running lubricator pump.

Setting disc position	1	2	3	4	5	6
Old design* [ml/stroke]	0.212	0.290	0.397	0.544	0.736	0.941
New design** [ml/stroke]	0.27	0.36	0.47	0.63	0.83	1.10

* Old lubricating pump design is before week 28 / 2002

** New lubricating pump design is from week 28 / 2002

Table 4

Note: See Service Bulletin RTA-60.1 for further details on CLU3 lubrication oil pumps.

The total pump volume depends on the number of pump elements and the pump shaft rotating speed, i.e. number of strokes. The Remote Control System (RCS) will send a signal dependent upon the engine load (known as the “H” signal. Please refer to the shop test report) to the frequency converter. The pump’s electric motor will then turn the pump shaft proportionally to both the frequency output from the converter and the pump gear ratio. The user has the possibility to proportionally vary the output signal from the RCS with the adjustable **Pump Speed Factor** (PSF). This adjustment can be made on a running engine. The PSF should be limited to the range of **0.85** to **1.15** to prevent over/under lubrication in case of emergency operation. The PSF limit should provide a safe margin of the cylinder oil feed rate at full load, although a setting close to 1.0 is advised.

Note: When the remote control is not functioning, the frequency converter switches to emergency lubrication. With supply at mains frequency (i.e. 50 or 60 Hz), the frequency convertor speed is then constant at all engine loads.

The ratio of the lubricating pump shaft speed to the motor frequency is known as the Frequency Ratio (FR). This ratio depends on the engine bore and the necessary pump capacity:

RTA / RT-flex cylinder bore [cm]	Frequency Ratio [Pump shaft speed / motor supplied frequency]
48T-B, 52	0.57
58T-B, 60, 62	0.763
50, 68T-B, 72	1
84T-B	1.53
96C	2

Table 5

To obtain the lubricating pump shaft rotational speed and essentially the stroke rate of the pump, the motor input frequency read-out from the converter display must be multiplied by the frequency ratio.

5.2 Example of the cylinder oil feed rate calculation

Considering a 10RT-flex96C engine with the new lubricating pump design and operating at 40.0 MW with the following parameters set:

- The upper quill set to position 1 with a discharge capacity of 0.27 ml/stroke (Table 4)
- The lower quills set to position 3, with a volume discharged 0.47 ml/stroke (Table 4)
- The cylinder oil density known to be 0.90 kg/l at 40°C

- The pump speed factor (PSF) adjusted to 1.0

  If the output frequency read out from the frequency converter is 50.0 Hz, the lubricator pump shaft speed can be calculated:

```
Frequency * Frequency Ratio
= 50.0 * 2 (from Table 5)
= 100 rpm  (or strokes/min)
```

It thus follows that:

(EQN 1) $$((q_u + q_l) * i * n * \rho * 60) / P = \text{feed rate } [g/kWh]$$

where:

- q_u: upper quill discharged volume [ml/stroke]
- q_l: lower quill discharged volume [ml/stroke]
- i: number of units (cylinders)
- n: horizontal shaft speed [rpm]
- ρ: cylinder oil density [kg/m^3]
- 60: conversion of hour to minutes
- P: engine load [kW]

Based on (EQN 1) the cylinder oil feed rate for the detailed engine will be:

```
((0.27 + 0.47) * 10 * 100 * 0.92 * 60) / 40000
= 1.02 g/kWh
```

If the PSF is changed to 0.95 for example, the output frequency will be proportional:

```
50 Hz * 0.95 PSF = 47.5 Hz,
```

and so the feed rate can subsequently be recalculated.

5.3 Feed rate for running-in and normal service

At the start of the running-in process, it is necessary to increase the cylinder lubricator settings of the respective unit(s) to a maximum feed rate of 1.6 g/kWh (at CMCR). The calculated cylinder oil feed rate has to be verified with measurements.

A feed rate reduction should take place at the intervals detailed by the running-in programme, but by no more than 0.1 g/kWh per adjustment. The minimum period to reach the guide feed rate, 1.1 g/kWh, should not be shorter than that shown in the running-in programme.

6 Running-in with Pulse Jet, Retrofit Pulse or Pulse Feed lubrication system

In all systems there is a common principle with regard to the vertical oil distribution: above – into – below the ring pack. The installation specific oil distribution can be viewed in the flexView software. The running-in procedure for all systems is similar.

6.1 Adjusting the feed rate of lubricating oil

The adjustment of the cylinder oil feed rate can be carried out by means of flexView user parameters ('LUB' card → 'Feed Rate') individually for each cylinder, or globally for all cylinders (Example shown in Figure 2).

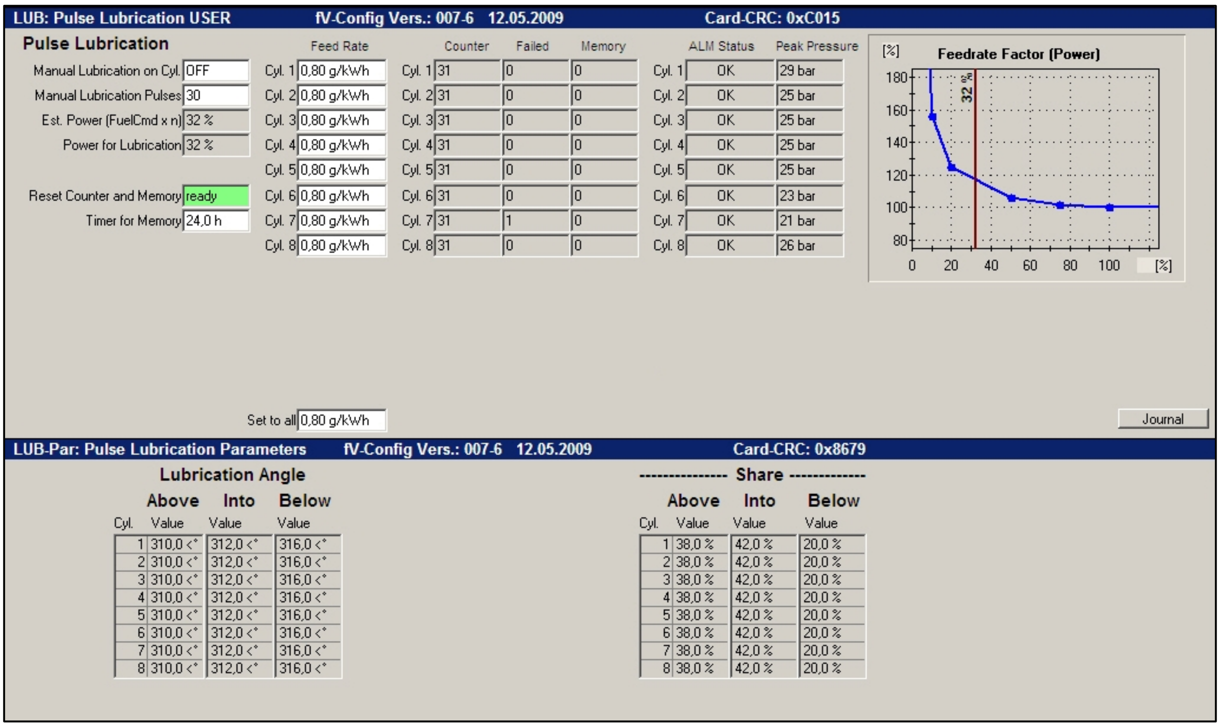


Figure 2

6.2 Measurement and calculation of the specific cylinder oil consumption

The following procedure describes how to measure the specific cylinder oil consumption.

6.2.1 Required tools

- Stopwatch
- Beaker
- Cloth to wipe up escaping oil

6.2.2 Procedure

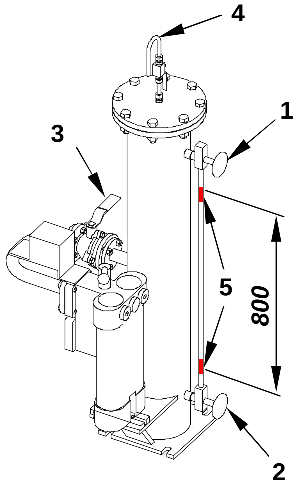


Figure 3

⇒ Open the upper and lower isolating valves (1/2) for the sight glass (these valves should be kept closed during normal operation). Ensure that drain valve is closed.

⇒ Shut the inlet valve (3) to the measuring vessel, open the vent valve (4) immediately once the valve (3) has been closed (leave valve (4) open for the duration of the measurement procedure).

⇒ The oil level in gauge glass shall start to drop as the consumption is now from the measuring vessel only. Once the level has reached the lower edge of the upper marker commence with time measurement with help of stop watch.

⇒ Once the oil level has reached the upper edge of the lower marker (5) note the time taken to consume the fixed volume.

⇒ Open the inlet valve (3) to the measuring vessel and allow the oil to flow from the vent valve (4). Once bubble free oil starts flowing form the vent valve (4), close it. Clean the spilled oil if any.

⇒ Shut the upper and lower isolating valves (1/2) on the measuring vessel and open the drain valve collecting the drained oil in the beaker.

The volume of oil consumed in the measured time is 26 litres. This is for a measuring height of 800mm marked on the gauge glass prior to measurement.

6.2.3 Calculating the total oil consumption

1. Divide the consumed amount of oil (26 litres) by the measurement period (seconds). The result is the total oil consumption in litres per second.
2. Multiply the result of the last step by 3600. The result is the total oil consumption in litres per hour
3. Multiply the result of the last step with the oil density. The result is the total oil consumption in kilograms per hour

The entire calculation can be put into one formula:

(EQN 2) $$C = 3600 * \rho * (\Delta V / \Delta t)$$

where:

C: Total oil consumption [kg/h]

ρ: Density of oil [kg/l]; typically 0.92 kg/l

ΔV: Volume of oil consumed during measurement [l]

Δt: Measurement time [s]

6.2.4 Calculating the specific oil consumption

Based on EQN 2 the total oil consumption as follows:

4. Divide the result of the last step by the current engine power output (kW). The result is the specific oil consumption in kilograms per kilowatt hour

   The engine power can be seen at the flexView screen as a relative value. (100% is corresponding to full power). Other values can be calculated by the rule of proportion.

5. Multiply the result of the last step by 1000. The result is the specific oil consumption in grams per kilowatt hour

6. Divide the result of the last step by the correction factor. See below. The result is the specific oil consumption in grams per kilowatt hour

   We can put the entire calculation for specific oil consumption into one formula:

(EQN 3) $$R = 3.6 * 10^6 * (\rho / fP) * (\Delta V / \Delta t)$$

where:

R: Specific oil consumption [g/kWh]

ρ: Density of oil [kg/l]; typically 0.92 kg/l

ΔV: Volume of oil consumed during the measurement [l]

Δt: Measurement time [s]

P: Engine power during the measurement [kW]

f: Correction factor

The correction with the factor (f) is necessary if the engine does not run at full speed. See below (Table 6).

Relative engine power output P/P_{max}	**Correction factor f**
100%	1.00
75%	1.02
50%	1.06
20%	1.25
10%	1.56

Table 6

6.3 Adjusting the feed rate for running-in and normal service

At the beginning of the running-in process, it is necessary to increase the cylinder lubricator settings of the respective unit(s) to a maximum feed rate of 1.4 g/kWh as shown in the running-in programme.

Based on the nominal power, the lubricating oil feed rate can be reduced as follows:

Reduction to feed rate	**after**
1.2 g/kWh	Approximately 15 running hours
1.0 g/kWh	50 running hours
0.9 g/kWh	200 running hours and after inspection of the piston rings and cylinder liners

Table 7

With regular checks of the piston rings and cylinder liners in the course of the next 500 to 1000 operating hours, the feed rate can be reduced in small steps until the guide feed rate is reached according to the running-in programme.

7 Reduction of the feed rate below recommended or guide value

A feed rate reduction below the recommended value after 1000 running hours can be envisaged after confirmation that satisfactory piston running conditions have been established.

The feed rate reduction should take place in steps of approximately 0.1 g/kWh, with periods of 500 to 1000 running hours between each step.

Any decision to reduce the feed rate should be based on the inspection results of the running surface of the piston rings and cylinder liner through the scavenge ports.

The guide feed rate is 1.1 g/kWh for CLU3, and 0.8 g/kWh for Pulse system for normal service. Any reduction below this is therefore dependant upon:

- The operating conditions of engine
- The heavy fuel oil sulphur content
- The operator's considerations: Cylinder lubricating oil costs versus cylinder liner and maintenance costs
- The lubricant selection
- The piston underside drain oil analysis if available

8 Cylinder oil

A high detergency, high base number cylinder lubricant chosen from the attached list should be used with high sulphur heavy fuel oil. Latest engine designs with high MEP benefit from the use of approved lubricants. The Base Number (BN) selection depends on fuel Sulphur content.

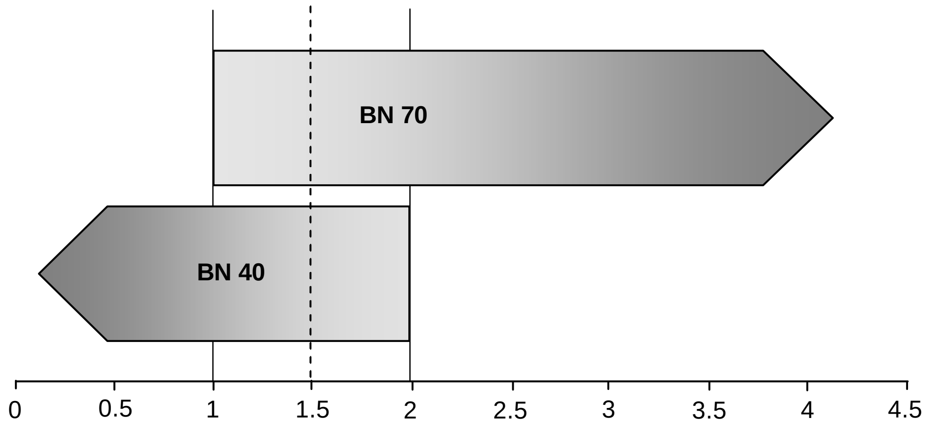


Figure 4

The following recommendations are made for normal service:

Fuel sulphur content	Recommended Base Number
>1.5%	BN 70
<1.5%	BN 40

Table 8

Attention: If BN 70 is to be used with fuel sulphur content down to 1.0%, it is of the utmost importance not to over lubricate and adhere to the recommended nominal feed rate of 1.1 g/kWh for CLU3 systems, and 0.8 g/kWh for Pulse systems.

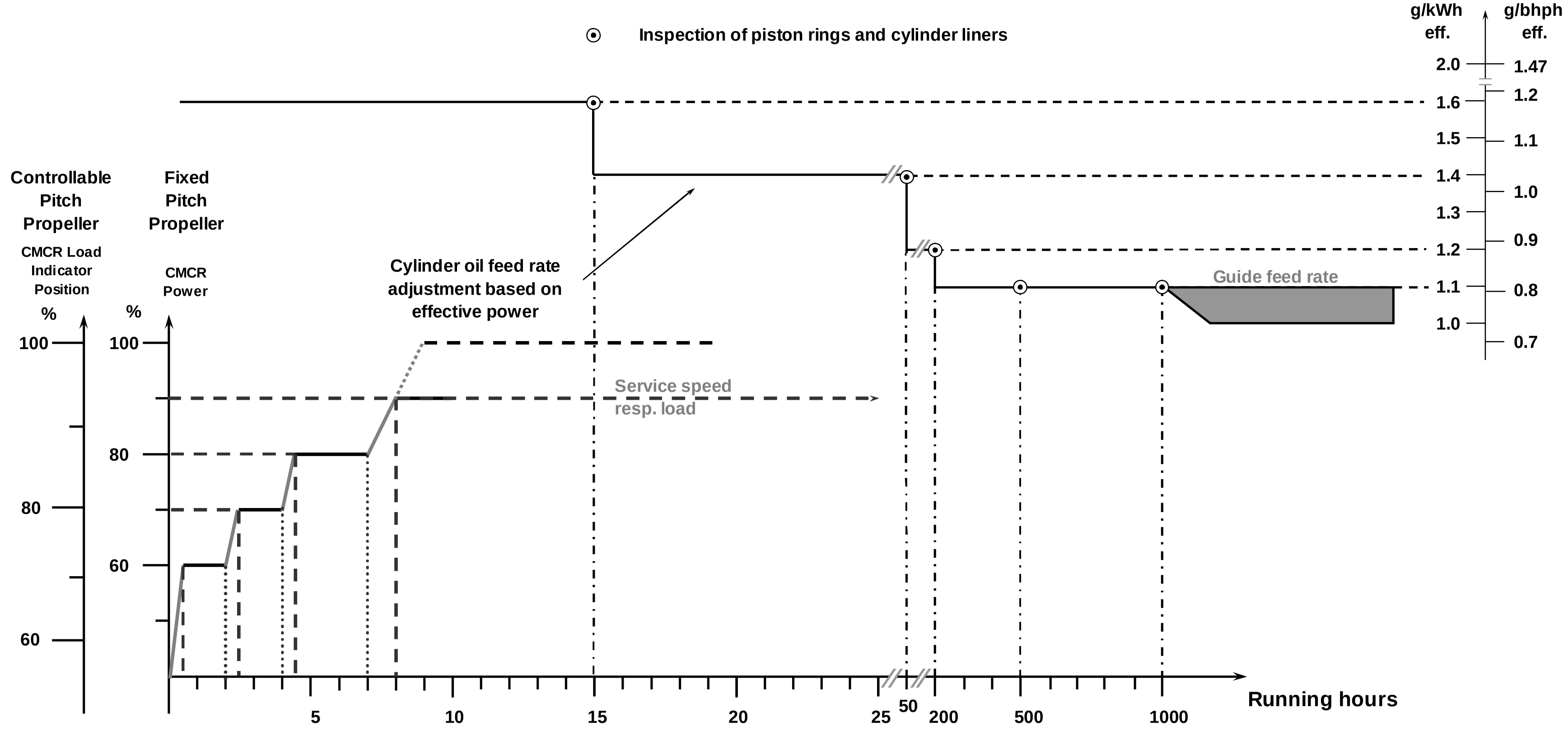
Note: Some oil companies have cylinder oil available which is suitable for both high- and low sulphur fuel.

For further information with regards to BN please refer to Service Bulletin RTA-66.

9 Running-in programme

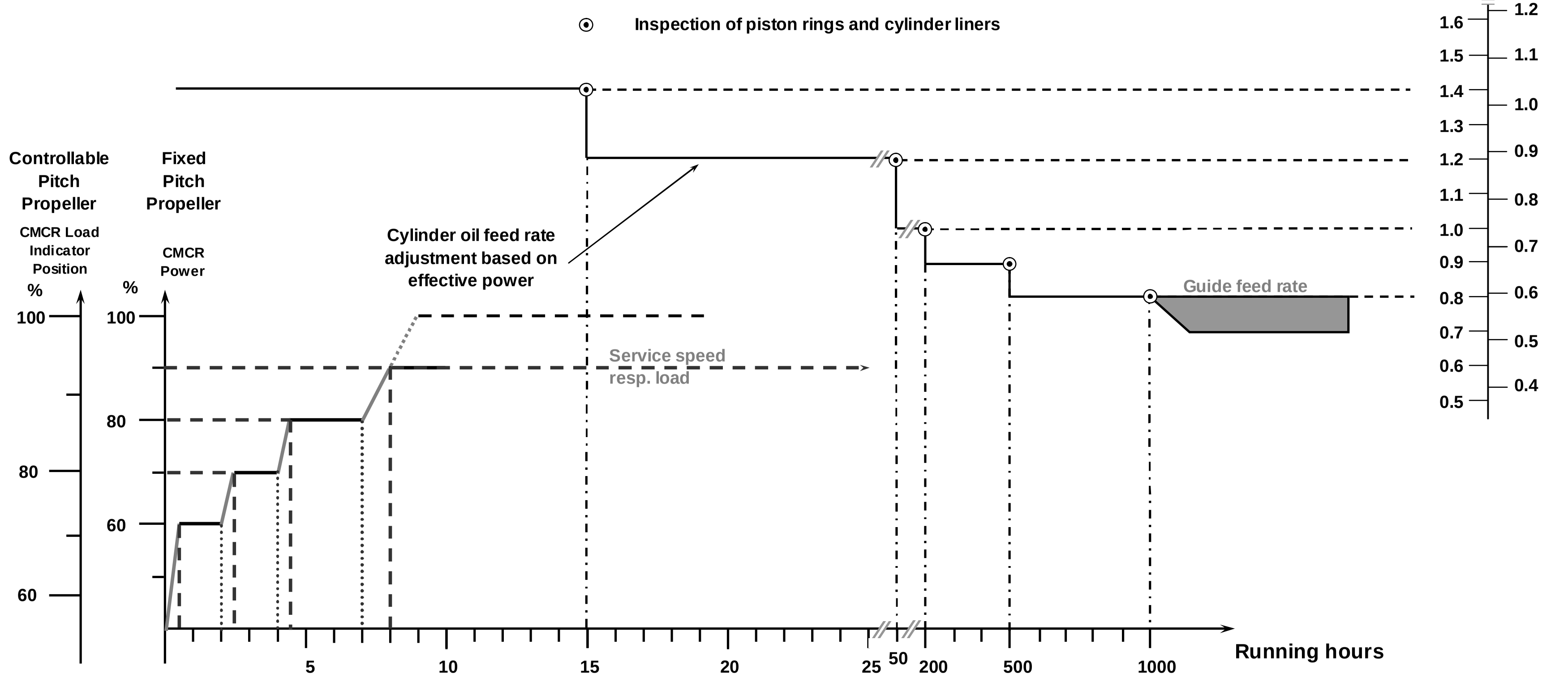
See next two pages for CLU3 and Pulse system running-in diagrams.

CLU3 system - running-in programme



On vessels intending to slow steam, the running-in schedule may be postponed provided both, a full set of CC rings (Chrome Ceramic), and a new fully honed or previously run-in liner are in use according to the latest specifications as set by Bulletin 43.3. At the next load up such as for turbocharger cleaning or boiler soot blowing, the running-in procedure must be completed up to 75% load before setting down to the slow steaming operation again.

Pulse system - running-in programme



On vessels intending to slow steam, the running-in schedule may be postponed provided both, a full set of CC rings (Chrome Ceramic), and a new fully honed or previously run-in liner are in use according to the latest specifications as set by Bulletin 43.3. At the next load up such as for turbocharger cleaning or boiler soot blowing, the running-in procedure must be completed up to 75% load before setting down to the slow steaming operation again.