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DATA & SPECIFICATIONS

Wärtsilä 2-stroke
Technical Services

Final, 21.02.2014: RT-138
Issue 3, 21 February 2014

Lubricating oils

Information to all Owners and Operators of Wärtsilä 2-stroke diesel engines

At your convenience

Concerned products
All Wärtsilä 2-stroke diesel engines.

Preventive action
To ensure trouble-free operation of Wärtsilä 2-stroke engines, it is important to read the information and follow the recommendations about lubricating oils stated in this bulletin.

Note
This Data & Specifications bulletin Issue 3 supersedes Data & Specifications bulletin RT-138, Issue 2, dated 29.10.2013.
Reasons:

- Appendix 1 to RT-138 is updated.
- The content of Service Letter RT-148, entitled “Cylinder lubrication at low load operation – use of intermediate BN lubricating oils” has been included and thus RT-148 is superseded.
- In service FZG FLS requirements are introduced for system oils.
- A chapter for Environmentally Acceptable Lubricants (EAL) has been added.

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Contents

1 Introduction

NOTE:
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- In service FZG[1] FLS requirements are introduced for system oils.
- A chapter for environmentally acceptable lubricants (EAL) has been added. Wärtsilä 2-stroke engines have separate lubricants for system and cylinder lubrication.

2 System oil

The system oil provides lubrication for the bearings, the running parts of the engine and for the crosshead assembly. In addition, it is used as hydraulic fluid in the servo oil system of the engine and also cools the pistons. In the first generation of RTA engines and in even older 2-stroke engines, the piston cooling system was designed for water cooling.

System oil requirements:

- An additive-type crankcase oil of the SAE 30 viscosity grade must be used as system oil.
- It must have a minimum BN of 5.0 mgKOH/g and detergent properties.
- It must meet load carrying performance in the FZG gear machine test method A/8, 3/90 according to ISO 14635-1, Failure Load Stage (FLS) 11 as a minimum.
- Good thermal stability, anti-corrosion and antifoam properties and good demulsifying performance are further requirements.

[1] *The FZG gear machines located at the FZG Institute, Munich/Germany, shall be the reference test apparatus and will be used in the event of any uncertainty about test repeatability and reproducibility.*

NOTE:
Validated lubricating oils for Wärtsilä two-stroke engines are listed in:

- Appendix 1 “Validated cylinder and system oils”.

For other or new lubricants, please contact Wärtsilä. The contact details are mentioned in Chapter 9 “Contacts”.

2.1 Oil care

2.1.1 System oil

In order to always maintain the lubricating oil in good condition for a long period of time, effective oil treatment is necessary. This is achieved by using a self-cleaning, centrifugal separator working as purifier in by-pass, by circulating the oil from the oil tank through the separator. The system oil volume should be centrifuged at least three times a day through the separator. The purifier throughput shall be set according to the recommendation of the separator manufacturer. However it is recommended to maintain the oil temperature between 90 to 95 °C for this treatment unless it is otherwise advised by the separator supplier.
Solid contaminants (dirt) and water must be removed from the oil as completely as possible. There is always the risk that water can enter the system and cause corrosive attack on engine parts, particularly with sea water. Water contamination can also lead to bacterial infection of the oil resulting in loss of lubrication capability and heavy corrosion of the system. Good maintenance is the most effective precaution to keep water out of the oil. The water content of the lubricating oil should not exceed 0.2% by mass over an extended period of time. If higher water contamination is observed, special measures such as intensified treatment in the separator or in a renovating tank must be considered.

2.1.2 Servo oil system of RT-flex and specific W-X engines

In order to prolong the lifetime of the sliding parts, fine filtered oil is used in this system. Branched off from the system oil it passes through an additional automatic filter with a fine mesh size, which flushes back to the system oil. The filter mesh size is according to the particular engine specifications.
The function of the flushing process and the low differential pressure shall be monitored during operation of the automatic filter; see documentation of the automatic filter manufacturer.
The bypass filter element may be used temporarily for inspecting and cleaning the regular elements, or if these have to be removed for any reason.

2.2 Attention limits for selected system oil parameters

The condition of the lubricating system oil charge can be assessed by analysing selected parameters. With regular checks deterioration can be detected at an early stage and remedial measures taken.

The following guiding limits should not be exceeded for a long period in service; these are the oil alert limits:

Table 1, Alert limits of system oil parameters for RT-flex and W-X engines

Parameter	Unit	Limit	Test method
Viscosity at 40 °C	mm^2/s [cSt]	max. 140	ASTM D 445
Flash point (PMCC)	°C	min. 200	ASTM D 92
Total insolubles	% m/m^2	max. 0.70	ASTM D 893b
Base Number (BN)	mgKOH/g	max. 12	ASTM D 2896
Water content	% m/m	max. 0.20	ASTM D 95 or ASTM D 1744
FZG gear machine test	Failure load stage	min. 9	ISO 14635-1 A8, 3/90

Table 2, Alert limits of system oil parameters for RTA engines

Parameter	Unit	Limit	Test method
Viscosity at 40 °C	mm^2/s [cSt]	max. 140	ASTM D 445
Flash point (PMCC)	°C	min. 200	ASTM D 92
Total insolubles	% m/m	max. 0.70	ASTM D 893b
Base Number (BN)	mgKOH/g	max. 12	ASTM D 2896
Water content	% m/m	max. 0.50	ASTM D 95 or ASTM D 1744
FZG gear machine test	Failure load stage	min. 8	ISO 14635-1 A8, 3/90

If one of the limits is reached, appropriate remedial action should be considered to correct the situation. Such action may be intensified purification (reduction of throughput, adjustment of temperatures), treating in a renovating tank (settling tank) or partial exchange of the oil charge. It is advisable to consult the oil supplier in such a case.

The oil condemnation limits are listed in Table 3 and Table 4, depending on the 2-stroke engine type. If the oil condition has deteriorated so far that it cannot be improved by the purifier and filters, a part of the oil charge must be replaced in order to return the oil charge to an acceptable performance level.

[2] *% m/m: Mass percent*

Table 3, Oil condemnation limits for RT-flex and W-X engines

Parameter	Unit	Limit	Test method
Viscosity at 40 °C	mm^2/s [cSt]	max. 150	ASTM D 445
Flash point (PMCC)	°C	min. 180	ASTM D 92
Total insolubles	% m/m	max. 1.0	ASTM D 893b
Base Number (BN)	mgKOH/g	max. 15	ASTM D 2896
Water content	% m/m	max. 0.30	ASTM D 95
SAN	—	nil	ASTM D 95 or ASTM D 1744
Calcium	mm/kg [ppm]	max. 6000	ICP
Zinc	mm/kg [ppm]	min. 100	ICP
Phosphorus	mm/kg [ppm]	min. 100	ICP
FZG gear machine test	Failure load stage	min. 8	ISO 14635-1 A8, 3/90

Table 4, Oil condemnation limits for RTA and older 2-stroke engines

Parameter	Unit	Limit	Test method
Viscosity at 40 °C	mm^2/s [cSt]	max. 160	ASTM D 445
Flash point (PMCC)	°C	min. 190	ASTM D 92
Total insolubles	% m/m	max. 2.0	ASTM D 893b
Base Number (BN)	mgKOH/g	max. 30	ASTM D 2896
Water content	% m/m	max. 0.50	ASTM D 95
SAN	—	nil	ASTM D 95 or ASTM D 1744
Calcium	mm/kg [ppm]	max. 6000	ICP
Zinc	mm/kg [ppm]	min. 100	ICP
Phosphorus	mm/kg [ppm]	min. 100	ICP
FZG gear machine test	Failure load stage	min. 7	ISO 14635-1 A8, 3/90

These limits are set out as guidance. The quality condition of the oil in circulation, however, cannot be fully judged by a single parameter. Other oil parameters must be used in context to be able to find the cause of the problem and the appropriate remedy for correction.

If the Base Number (BN) of the system oil rises sharply, check the piston rod gland box and piston rod condition.

A certain consumption and replenishment of system oil is required to keep the system oil in good condition.
A significant decrease of the flash point below the recommended value shown above should trigger a replenishment of the oil charge.

The replenishment prevents a rise in system oil BN. A small rise in BN is often an indication that the system oil consumption is low.

The open cup type of flash point determination (e.g. COC) should be used to decide if a partial or complete change of oil charge is necessary.
The closed cup flash point determination (e.g. PMCC) can be used to monitor the system oil condition, but not for oil change.

The FZG gear machine performance to method A/8, 3/90, ISO 14635-1 of the oil charge is particularly important if a new gear wheel, camshaft or fuel pump follower is fitted or has been polished, in order to provide protection against scuffing during the running-in of the gears, camshaft or follower. If the system oil has been in use for more than a year, the FZG performance of the oil should be determined to establish whether the performance is adequate for the new or polished gear(s), camshaft or follower.

Regular on board checks of BN and water content should be performed in order to obtain an early indication of oil degradation.

2.3 Particle size and count for RT-flex and W-X engines

Particle size analysis can provide a useful insight into wear in an engine. Abrasive particles in the oil can cause wear, thus the requirements should be closely followed. The requirements for particle size refer only to the oil in the RT-flex and W-X hydraulic oil system which operates the exhaust valve and the fuel and cylinder oil injection systems, i.e. the servo oil after the fine filter which is normally 10 µm maximum sphere passing size. Some engines are equipped with a 25 µm maximum or other fine filter. The ISO 4406 particle count requirement does not apply to the bulk system oil which is used to cool the pistons and lubricate the bearings, gears, crosshead slides, etc in RTA and RT-flex engines.
However, the particle count requirements are valid for the system oil after the filter in W-X engines.

The NAS 1638 particle count requirements were previously specified as per Table 5, Table 6 and Table 7, but this method has been superseded by the ISO 4406 method (see Table 8) and thus the NAS data is provided for reference only.

Table 5, Recommended limits in NAS classes for RT-flex engines

	Particle size (µm or microns)				
	5–15	15–25	25–50	50–100	100–150
Lubricating oil	13	12	11	10	8
	Lubricating oil separator				
Servo oil	13	12	9	7	4
			Servo oil filter		

Table 6, Recommended limits in NAS classes for W-X engines

	Particle size (µm or microns)				
	5–15	15–25	25–50	50–100	100–150
Lubricating oil	13	12	11	10	8
	Lubricating oil separator				
Servo oil	13	11	10	8	3
			Servo oil filter		

Table 7, NAS 1638 and SAE AS 4059 cleanliness classes

Contamination (particles/100 ml)		**Particle size (µm or microns)**				
		5–15	**15–25**	**25–50**	**50–100**	**100–150**
Classes: Up to class maximum	**(14)**	4,096,000	729,600	129,600	23,040	4096
	(13)	2,048,000	364,800	64,800	11,520	2048
	12	1,024,000	182,400	32,400	5760	1024
	11	512,000	91,200	16,200	2880	512
	10	256,000	45,600	8100	1440	256
	9	128,000	22,800	4050	720	128
	8	64,000	11,400	2025	360	64
	7	32,000	5700	1012	180	32
	6	16,000	2850	506	90	16
	5	8000	1425	253	45	8
	4	4000	712	126	22	4
	3	2000	356	63	11	2
	2	1000	178	32	6	1
	1	500	89	16	3	1
	0	250	44	8	2	0
	00	125	22	4	1	0

NOTES:

- Particle counting has poor repeatability and reproducibility.
- A tolerance of ± 2 NAS classes is acceptable to Wärtsilä.
- The method does not determine the nature, hardness or shape of the particle.
- Check the used oil analysis and particle count data to form a full picture.

Table 8, ISO 4406 particle count and size classes

	Number of particles per 100 ml		
	More than	**Up to and including**	**Class**
	250,000,000	—	<28
	130,000,000	250,000,000	28
	64,000,000	130,000,000	27
	32,000,000	64,000,000	26
	16,000,000	32,000,000	25
	8,000,000	16,000,000	24
	4,000,000	8,000,000	23
	2,000,000	4,000,000	22
	1,000,000	2,000,000	21
	500,000	1,000,000	20
> 4 µm max.	250,000	500,000	19
	130,000	250,000	18
> 6 µm max.	64,000	130,000	17
	32,000	64,000	16
	16,000	32,000	15
> 14 µm max.	8000	16,000	14
	4000	8000	13
	2000	4000	12
	1000	2000	11
	500	1000	10
	250	500	9
	130	250	8
	64	130	7
	32	64	6
	16	32	5
	8	16	4
	4	8	3
	2	4	2
	1	2	1
	0	1	0

The ISO 4406 particle count system operates with 3 size classes based on a 100 ml oil sample, which are:

- R_4 = Number of particles equal to or larger than 4 µm
- R_6 = Number of particles equal to or larger than 6 µm
- R_{14} = Number of particles equal to or larger than 14 µm

2.3.1 Recommended limits for ISO 4406 particle count

The requirement for 100 ml of oil sample is therefore:

ISO 4406 19/17/14 maximum

- in the servo oil of RT-flex engines
- in the system oil after the filter of W-X engines

which means:

- **A maximum of 500,000 particles of size > 4**
- **A maximum of 130,000 particles of size > 6**
- **A maximum of 16,000 particles of size > 14**

This is equivalent to the previous requirement for a maximum of NAS Class 8 particle count.

The following samples would be acceptable:

- ISO 4406 19/15/11, ISO 4406 16/13/12, ISO 4406 15/12/10

The following samples would not be acceptable:

- ISO4406 20/17/13, ISO 4406 19/16/15, ISO 4406 20/18/16

2.3.2 Particle counts in the servo oil of RT-flex and W-X engines

If it is found that the particle count is exceeded, the coarse and fine filters must be checked to ensure that all the filter elements, gaskets and seals are intact and not damaged. If high particle counts persist and the filters are in order, then there is probably an area of excessive wear in the engine generating an excessive number of particles. Excessive numbers of particles can also enter the system oil if the piston rod gland boxes are not sealing correctly and used cylinder oil is getting into the system oil. The purifier also removes particles, and care must be taken to ensure that it is operated at the correct temperature according to the manufacturers recommendations and that the throughput is adjusted to suit optimum operation.

2.4 Taking system oil samples

At regular intervals, i.e. about every 3000 operating hours, it is recommended that a sample of the system oil shall be taken and forwarded to a laboratory for analysis. The analysis should include ISO 4406 particle counting for samples taken after the coarse or fine filter. The sample should be taken after the filter prior to the oil entering the engine main oil gallery or the servo system.

With the oil pump running and the engine oil at operating temperature, drain a small quantity of oil from a cock in the lubricating system to flush out any dirt accumulated in this cock and rinse the clean sample container with some oil.

Subsequently take an oil sample in the sample bottle marked with the following information for the laboratory:

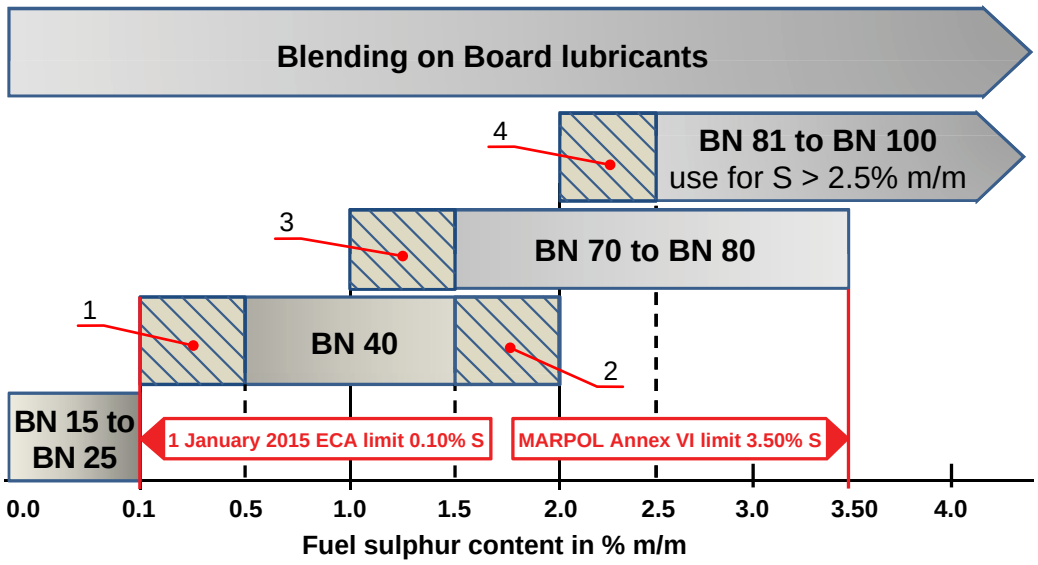
- Ship’s name or name of plant
- Engine type
- Engine serial number
- Date of sampling
- Operating hours of oil and of engine
- Sampling point location
- Oil brand and type

3 Cylinder lubricating oil

A high-alkaline cylinder lubricating oil of the SAE 50 viscosity grade with a minimum kinematic viscosity of 18.5 cSt at 100 °C is recommended. However, cylinder oils of the viscosity grades SAE 40 and SAE 60 may be used under certain circumstances. The alkalinity of the oil is indicated by its Base Number (BN) measured in mgKOH/g according to method ASTM D 2896. The base number of cylinder lubricants is not an index for detergency, but a direct measure of alkalinity. The alkalinity of the lubricating oil must be chosen with regard to the sulphur content of the fuel, engine operating condition and lubricating oil feed rate. The higher the sulphur content, the higher the lubricating oil's BN must be, see Chapter 8 "Appendix 1 – list of "Validated cylinder and system oils" and Appendix 2" – list of Lubricants for flywheel and pinion gear teeth".

The choice between BN 40 and BN 70 and other BN cylinder lubricants depends on the fuel sulphur content. Intermediate and wide range BN lubricants are now also being marketed, see Chapter 8 "Appendix". The general cylinder oil BN recommendations, dependent on the fuel sulphur content, are explained in the next Chapter 3.1 and shown in Figure 1.

3.1 Fuel sulphur content and cylinder oil BN



1. ***0.1% < Sulphur < 0.5% m/m:*** *Inject cylinder oil at guide feed rate to prevent excess piston crown and top land deposits.*
2. ***1.5% < Sulphur < 2.0% m/m:*** *Permitted for engine operation of less than 48 hours only. Increase cylinder oil feed rate if required for safe BN to prevent liner and piston ring corrosion. If this mode is often used, check scrapedown BN and check rings to ensure adequate alkalinity.*
3. ***1% < Sulphur < 1.5% m/m:*** *Permitted for engine operation of less than 48 hours only. Inject cylinder oil at guide feed rate to minimise piston crown and top land deposits.*
4. ***2.0% < Sulphur < 2.5% m/m:*** *Inject cylinder oil at guide feed rate to prevent excess piston crown and top land deposits.*

Figure 1, Relationship between fuel sulphur content and cylinder oil BN

NOTES:

- From 1st January 2015 only fuel with less than 0.1% m/m sulphur may be used in the ECA's (Scrubbers can be used to reduce the effective exhaust sulphur content).
- Use BN 70 or higher cylinder oil if fuel sulphur content is above 2.5% m/m.
- Monitor piston underside residual BN of the oil and inspect rings and liners to select the appropriate BN oil, optimise feed rate and avoid corrosion and excessive piston crown and top land deposits.

Cylinder oils of excessively high BN for the fuel sulphur can lead to excessive piston crown deposit accumulation. Piston crown deposits need to be carefully monitored through scavenge port inspections as they can lead to lubricant film breakdown and excessive liner, piston and ring wear.

BN 40 lubricants are formulated with neutral additives (low BN contribution) to boost the detergency level and thermal stability back to the level of a BN 70 lubricant. No significant increase in corrosive cylinder liner and piston ring wear is to be expected when using BN 40 lubricants, at least up to 2.0% sulphur, provided that the lubricant feed rate is kept high.

BN 40 lubricants tend to form fewer and softer deposits on the piston crown land and in the exhaust regions, e.g. on the turbocharger nozzle ring, relative to the BN 70 and other higher BN products at the same feed rate.

NOTE:

The BN 40 products can safely be used with heavy fuel oil with sulphur content in the range 1.5% to 2.0% m/m as well. The feed rate will probably have to be increased depending on remaining BN measured in the piston underside drain oil or scrape down samples. Intermediate and other BN cylinder oils are available. These cylinder oils may be used provided that performance is regularly monitored and the lubricating oil feed rate is adjusted to avoid piston underside BN which is too low. Incorrectly adjusted piston underside BN can lead to excessive corrosive wear and scuffing, see the limits and recommendations in the next Chapter 3.2.

ATTENTION:

Only the validated cylinder and system oils as listed in Appendix 1 should be used.

The supplying oil company assumes all responsibility for the performance of the lubricating oils in service of all Wärtsilä 2-stroke engines to the exclusion of any liability of any Wärtsilä company belonging to the Wärtsilä group. The oil company along with other possible manufacturers and distributors of the products in question shall indemnify, compensate and hold harmless Wärtsilä and companies belonging to the Wärtsilä group from and against any claims, damages and losses caused by the lubricating oils in question.

To avoid problems with fuel sulphur content, it is good practice to keep enough of the previous bunker. This can be used until an analysis of the sulphur content of the new bunker has been received. The Bunker Delivery Note (BDN) and bunker analysis can show inaccuracy in measuring the sulphur content and possible different HFO composition. The sulphur content used to set the correct feed rate must be the higher value of the BDN or the bunker analysis to ensure safe operation.

3.2 Oil analysis of the piston underside drain or scrape down samples

Wärtsilä recommends that Piston Under-Side (PUS) drain oil (also known as scrape down or drip oil) samples are regularly taken from each cylinder and analysed to monitor the engine condition. These analyses are conducted to assess cylinder liner and ring wear rates and to optimise the cylinder oil feed rate. Wear metals, residual BN, viscosity, fuel components and water are measured. Additional benefits are that the piston rod gland box condition can be monitored by considering the amount of system oil additive metals in the sample. It is important to monitor trends and not absolute values, and to consider the actual amount of oil that is being drained in relation to the analysis results. Corrosion of the liners and steel parts is determined by measuring the total iron content of the piston underside or scrape down oil. There can be a significant amount of system oil which is mixed with the old cylinder oil in the piston underside space. In order to get an accurate view of the used cylinder oil, a correction needs to be made to remove the impact of the system oil on results. This is done by correcting the iron and residual BN values by taking account of the system oil contributing phosphorous and/or zinc to the old oil. Care must be taken in performing this correction analysis as some cylinder oils also contain phosphorous and/or zinc.

Long-term experience and the analysis of hundreds of piston underside samples drawn from a wide range of engines operating on high sulphur fuel (1.5 < Sulphur < 4.5% m/m) shows that:

1. The **safe** corrected piston underside residual BN to avoid piston ring and liner corrosion is greater than **25 mgKOH/g.**
2. The **alert** corrected limit for piston underside residual BN to avoid excessive corrosion is about **15 mgKOH/g.**
3. The **danger** corrected limit is less than **10 mgKOH/g** piston underside residual BN and is likely to lead to excessive corrosion and rapid piston ring and liner wear if not corrected. It often leads to scuffing and the rapid failure of piston rings and very rapid corrosive liner wear.

The safe value for continuous operation on low sulphur fuel oil (0.0% < Sulphur < 1.5% m/m) and using a low BN cylinder oil needs to be determined for each engine by monitoring piston underside samples and regularly checking pistons, piston rings and cylinder liners for excessive deposits, corrosion and wear.

Fuel sulphur in the range 1.5 < Sulphur % < 3.5 m/m and cylinder oil with 50 < BN < 100

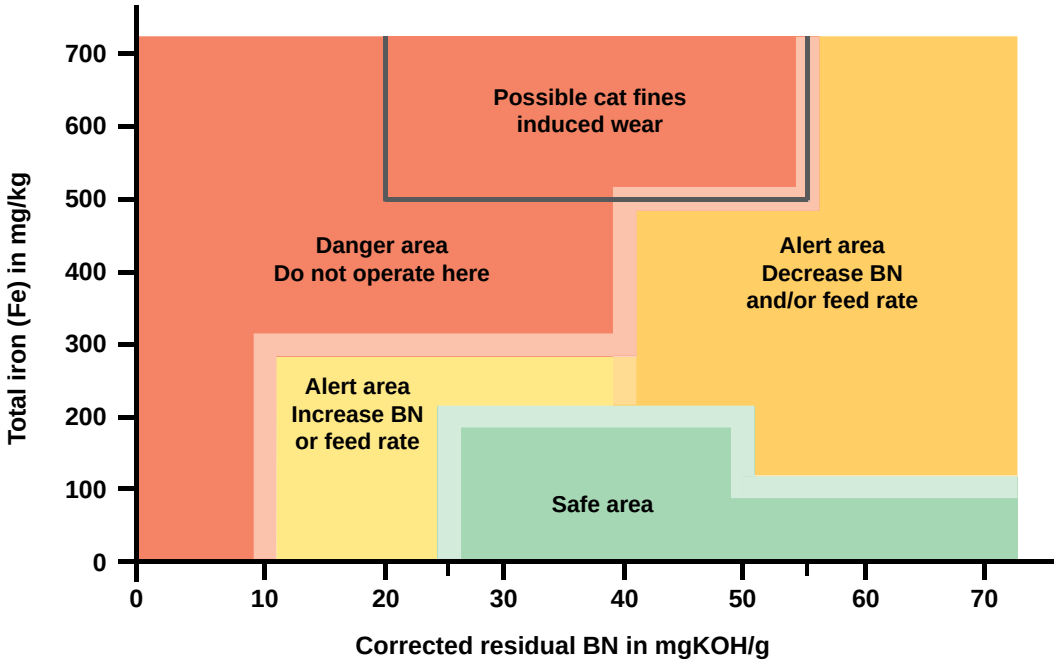


Figure 2, PUS, Scrapedown or drip oil analysis interpretation

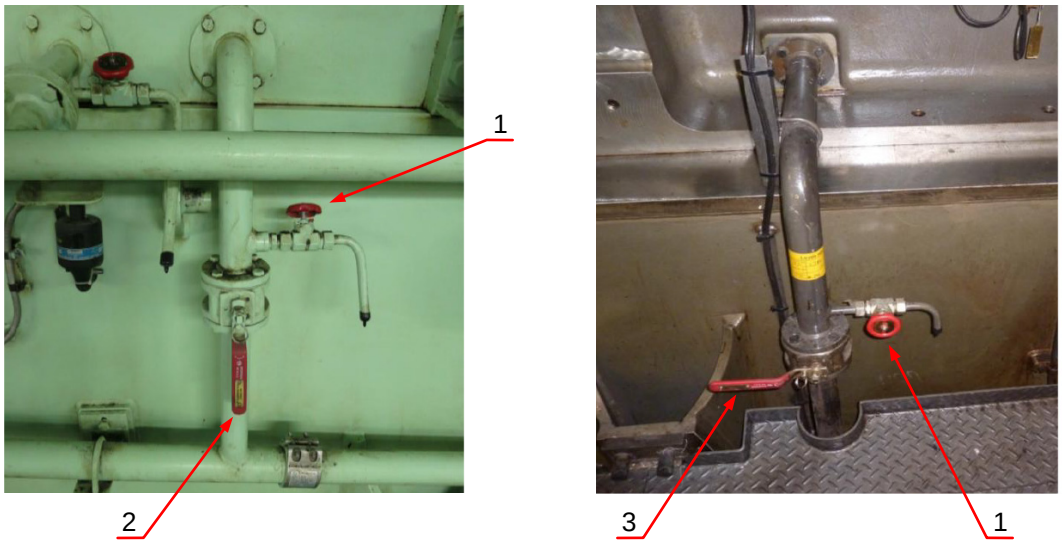
NOTE:
There are smooth transitions between the various areas as shown in Figure 2.

Figure 2 shows where engines fitted with chrome ceramic piston rings and fully honed liners should be operated in regard to piston underside total oil iron content and residual BN. The cylinder oil BN and/or lubricant feed rate must be changed to ensure that there is not excessive corrosive or magnetic iron in the piston underside oil.

The piston underside oil chromium content is also an important indicator of corrosion or wear in the engine, if chrome ceramic piston rings are fitted. Chromium values less than 5 mg/kg indicate that there is little corrosion and wear in the engine. Values above about 5 mg/kg indicate that corrosion and/or wear are occurring which may reduce piston ring and liner life. The chrome content of the piston underside oil should not exceed 10 mg/kg for long periods of time.

ATTENTION:
Engines fitted with cast iron or non chrome ceramic rings tend to have significantly higher total iron levels than those stated above under normal operating conditions.

3.3 Taking piston underside (PUS), scrapedown or drip oil samples



1. *Sampling cock*
2. *Oil drain valve in normal position*
3. *Oil drain valve in sampling position*

Figure 3, PUS, Scrapedown or drip oil sampling

Oil sampling should only be done when the engine has been in a stable operating condition on a known fuel with the same cylinder oil feed rate, engine load and other variable factors for at least 12 hours. Further samples should be taken under similar conditions to improve data trending information.
The procedure how to take oil samples is described in Chapters 3.3.1 and 0.

3.3.1 Flushing

The system should be flushed to prevent non representative accumulated debris from entering the sample bottle.

1. Close the oil drain valve to allow oil to accumulate for about 30 to 60 minutes, depending on engine load, oil feed rate, etc.
2. After enough oil has accumulated, open the sampling cock slowly and carefully to blow any old oil into a bucket. When the sampling cock and sample pipe are thoroughly flushed, close the sampling cock.
3. Open the drain valve to allow the remaining oil to be blown down the drain pipe, this only takes a few seconds.
4. When this is completed, close the oil drain valve again.
5. Record the engine operating conditions, fuel parameters, cylinder oil feed rate and other data required on the used oil analysis form.

3.3.2 Sampling

Complete this procedure for every cylinder of the engine.

1. Wait for 10 to 60 minutes for enough oil to accumulate to fill the sample bottle. These are normally 100 ml but may vary.
2. Open the sampling cock slowly and carefully fill the sample bottle. Ensure that the sample bottle has the cylinder number and references marked so that it can be clearly identified.
3. Close the sampling cock.
4. Open the oil drain valve into the normal position again so that surplus oil can drain away.
5. Proceed to the next cylinder and perform the same procedure.
6. It is good practice to also submit a sample of fresh cylinder oil taken at the engine inlet pipe after the filter for analysis. There are sometimes contaminations, because wrong oil may have been delivered or placed in the wrong tank. This is important to ensure that cylinder oil change over has been correctly performed and the appropriate oil is in the system.
7. Ensure that the sample bottle tops are closed securely and the bottles accurately marked before submitting them for analysis. The sample bottles must be securely packed to prevent leakage when dispatching the parcel by postal or courier service to the laboratory.

3.4 General recommendations

Service experience has shown that when operating below 60% CMCR, the engine corrosion behaviour can vary significantly. Therefore Wärtsilä recommends the following:

If the engine is to be operated at continuous low load (i.e. more than 24 hours of operation below 60% CMCR) and use HFO with sulphur content above 2.5% m/m, **Wärtsilä strongly recommends the use of cylinder lubricating oil with a minimum BN of 70, but preferably higher, as the cylinder oil feed rate cannot be adjusted to adequately compensate for the lower alkalinity.** BN 70 lubricants as well as higher BN lubricants are available with most of the lubrication oil suppliers (see Data & Specification bulletin RT-138, Appendix 1). A high BN lubricant adapted to the piston running and corrosion condition of the engine can also be achieved by using the Blending on Board package. This product allows the flexible onboard production of a “fit for purpose” cylinder lubricant when it comes to the BN needed to overcome corrosion or to operate with low sulphur residual fuels.

As the operating conditions can be more severe than anticipated by the sulphur adjustment factors, it is important to monitor the corrected residual BN on a regular basis and to ensure that the value is met as stated in Figure 2.
An onboard monitoring programme should at least permit the assessment of the residual BN from piston underside drain oil. The measurement of total iron and chromium in the piston underside oil is also recommended. A sudden increase of the values of iron or chromium would indicate the occurrence of significant cold corrosion and appropriate countermeasures should be applied (see also Technical Bulletin RT-161, entitled “Cylinder lubrication”).

3.5 Use of intermediate BN lubricating oils

Field experience showed when operating engines using intermediate BN oils and running permanently at low load requires that other recommendations have to be reviewed. As a consequence the “No Objection Letters” to the lubricant suppliers were re-issued during May 2013.

Conditions for use of intermediate BN lubricating oils:

- When using intermediate BN oils Wärtsilä strongly recommends the application of an **onboard** monitoring programme for piston underside drain oil in order to assess at least the residual BN of the piston underside drain oil. The recommended frequency of piston underside drain oil sampling is:
  - At every bunker change, especially when using HFO with sulphur content above 2.5% m/m
  - At change of the average load (24 hours) of 10% CMCR or higher
  - At least once per week

- If an onboard monitoring programme is in place, then any of the lubricants that have been validated and are listed in the Data & Specification bulletin RT-138, Appendix 1 can be used. However, Wärtsilä wants to reinforce the sulphur dependency principle for the intermediate BN oils in accordance with Technical Bulletin RT-161. **The intermediate BN oil has to be considered in the sulphur dependency guideline according to its nominal BN level.**
  If the residual BN value is below the alert limit, then the recommendations of Technical Bulletin RT-161 apply and consideration as to the change of lubricant for a higher BN lubricant should be made.

- Alternatively, if there is no onboard monitoring, Wärtsilä has to impose the following restrictions:

ATTENTION:
For all RTA, RT-flex and W-X engines, the intermediate BN oils (BN higher than 40 and BN lower than 70) may only be used with HFO in the sulphur range 0.5% to **2.5% m/m** if the engine is going to be continuously operated at low load (i.e. more than 24 hours of operation below 60% CMCR).

4 Turbocharger oil

To select and maintain the turbocharger lubricating oil, the recommendations given in the turbocharger supplier’s instruction manual must be observed.
The turbocharger oil is normally system oil or turbine oil depending on the turbocharger supplier’s recommendations.

5 Turning gear oil

For the choice and maintenance of the lubricant, the recommendations given in the turning gear supplier’s instruction manual must be observed.

6 Lubricant for flywheel and pinion gear teeth

The selection and application of the lubricant must be in compliance with the specification published in the Maintenance Manual Group 3, Chapter 3206–1 “Turning gear” and the recommendations by the engine manufacturer. In addition, the lubricant suppliers are listed in:

- Appendix 2 “Lubricants for flywheel and pinion gear teeth”.

7 Environmentally acceptable lubricants

Environmentally Acceptable Lubricants (EAL) are currently required for ships operating in USA waters, and this area may be extended in future. These lubricants which are required for all ‘oil to sea interfaces’ which include stern tubes, thrusters, rudders, stabilisers, variable pitch propellers, underwater ropes and machinery and underwater transmissions are made with base oils and additives which are significantly different to those used for system and cylinder oil. Consequently EAL’s should not be mixed into system or cylinder oils where they are to be used in engine applications. Even small contaminations of EAL (depending on base oil quality) into system and cylinder oil can lead to elastomer compatibility, water emulsification and high temperature deposit formation issues.

8 Appendix

1. Validated cylinder and system oils (Appendix 1).
2. Lubricants for flywheel and pinion gear teeth (Appendix 2).

9 Contacts

9.1 How to contact Wärtsilä

For questions about the content of this Data & Specifications bulletin, or if you need Wärtsilä assistance, services, spare parts and/or tools, please contact your nearest Wärtsilä representative.
If you don't have the contact details at hand, please follow the link "Contact us" – "24h Services" on the Wärtsilä webpage:
www.wartsila.com

9.2 Contact details for emergency issues

9.2.1 Operational support

For questions concerning operational issues, please send your enquiry to:
technicalsupport.chts@wartsila.com
or phone 24hrs support: +41 52 262 80 10.

9.2.2 Field service

If you need Wärtsilä Field Service, please send your enquiry to:
Ch.Fieldservice@wartsila.com
or phone 24hrs support: +41 79 255 68 80.

9.2.3 Spare parts

If you need Wärtsilä spare parts and/or tools, please contact your nearest Wärtsilä representative or your key account manager.