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|---|--|---|------------------------------------|-----------------------------|-------------------------------|-------------|-----|
|  | | © Wärtsilä Corporation Finland Technology | | INSTALLATION MANUAL | | | |
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| - | Wärtsilä 34SG Wärtsilä 34LPG Wärtsilä 50SG | Appd. | 15.01.1999 | U. Åstrand | 1 (4) | 4V92A0780 | k |
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REQUIREMENTS AND OIL QUALITY

LUBRICATING OIL REQUIREMENTS AND QUALITY FOR WÄRTSILÄ® 34SG, WÄRTSILÄ® 34LPG AND WÄRTSILÄ® 50SG ENGINES

Viscosity

Viscosity class SAE 40

Viscosity Index (VI)

Min. 95

Alkalinity (BN)

Lubricating oils with BN of 4 - 7 mg KOH/g have to be used.

Sulphated ash level

The content of sulphated ash in gas engine lubricating oils is a very important property. Too high ash content can cause preignition, knocking and spark plug fouling, while too low ash content can lead to increased valve wear. Low ash lubricating oils with sulphated ash level of max. 0,6 % m/m have to be used.

Additives

The oils shall contain additives that give good oxidation stability, corrosion protection, load carrying capacity, neutralisation of acid combustion and oxidation residues and should prevent deposit formation on internal engine parts.

Foaming characteristics

Fresh lubricating oil shall meet the following limits for foaming tendency and stability, according to the ASTM D 892-92 test method:

| | |
|---------------|----------|
| Sequence I: | 100/0 ml |
| Sequence II: | 100/0 ml |
| Sequence III: | 100/0 ml |

Base oils

Use of virgin base stocks is only allowed, i.e. recycled or re-refined base oils are not allowed.



CONDEMNING LIMITS FOR USED LUBRICATING OIL

When estimating the condition of used lubricating oil, the following properties along with the corresponding limit values must be noted. If the limits are exceeded, measures must be taken. Compare also with guidance values for fresh lubricating of the brand used.

| PROPERTY | UNIT | LIMIT | TEST METHOD |
|-------------------|--------------------|----------------------------|----------------------|
| Viscosity | cSt at 40 °C | max. 50% increase | ASTM D 445 |
| Viscosity | cSt at 100 °C | max. 25% increase | ASTM D 445 |
| Water | % v/v or % m/m | max. 0,30 | ASTM D 95 or D 6304C |
| Base Number | mg KOH/g | max. 50% depletion | ASTM D 2896 |
| Total Acid Number | mg KOH/g | max. 2,5 mg KOH/g increase | ASTM D 664 |
| Insolubles | % m/m in n-pentane | max. 1,0 | ASTM D 893b |
| Oxidation | Abs/cm | max. 25 | IR |
| Nitration | Abs/cm | max. 20 | IR |

CHANGE OF LUBRICATING OIL BRAND

Top-up with another lubricating oil brand than being filled to the system is not allowed, except if the both two lubricating oils originate from the same manufacturer and are based on same base oils and additive technology. Otherwise the lubricating oil system has to be drained and then filled with another brand by following the procedure described here below.

In order to minimize the risk of lubricating oil foaming, deposit formation, blocking of lubricating oil filters, damage of engine components, etc., the following procedure should be followed when lubricating oil brand is changed from one to another:

- If possible, change the lubricating oil brand in connection with an engine (piston) overhaul
- Drain old lubricating oil from the lubricating oil system
- Clean the lubricating oil system in case of an excessive amount of deposits on the surfaces of engine components, like crankcase, camshaft compartment, etc.
- Fill the lubricating oil system with fresh lubricating oil

If the procedure described above is not followed, responsibility of possible damage and malfunctions caused by lubricating oil change should always be agreed between the oil company and customer.



VALIDATED LUBRICATING OIL QUALITIES FOR WÄRTSILÄ® 34SG, WÄRTSILÄ® 34LPG AND WÄRTSILÄ® 50SG

NATURAL GAS AND LIQUEFIED PETROLEUM GAS OPERATION

There exists experience that lubricating oils manufactured from API Group II or IV base oils are able to offer better cleanliness of exhaust gas boiler / economizer compared to lubricating oils manufactured from API Group I base oils and are thus recommended in the first place for such applications. In some cases also longer change intervals may be achieved by using API Gp II or IV based products.

Table 1: Validated gas engine oils based on API Gp II and IV base oils:

| SUPPLIER | BRAND NAME | VISCOSITY | BN | SULPHATED ASH (% m/m) |
|-----------------------------|---|-----------|-----|-----------------------|
| Bharat Petroleum Corp. Ltd. | MAK GES XLA 40 | SAE 40 | 5,3 | 0,48 |
| Chevron (Texaco + Caltex) | HDAX 5200 Low Ash Gas Engine Oil SAE 40 | SAE 40 | 4,2 | 0,50 |
| ExxonMobil | Pegasus 905 | SAE 40 | 6,2 | 0,49 |
| | Pegasus 1005 | SAE 40 | 5,0 | 0,50 |
| | Pegasus 1 | SAE 40 | 6,5 | 0,49 |
| Idemitsu Kosan Co. Ltd. | Apolloil GHP 40L | SAE 40 | 4,7 | 0,45 |
| MOL-LUB Ltd. | MOL GMO Longlife 40 | SAE 40 | 6,6 | 0,50 |
| Pakelo Motor Oil S.r.l. | Geoterm LA 4 | SAE 40 | 6,6 | 0,50 |
| Petro-Canada | Sentron LD 5000 | SAE 40 | 4,9 | 0,57 |
| Petronas | GEO S 40 | SAE 40 | 5,6 | 0,46 |
| Sasol | Gas Engine Oil LA 40 | SAE 40 | 5,5 | 0,50 |
| Shell | Mysella S5 N 40 | SAE 40 | 4,5 | 0,48 |
| Total | Nateria X 405 ^{*)} | SAE 40 | 5,2 | 0,45 |

Table 2: Validated gas engine oils based on API Gp I base oils:

| SUPPLIER | BRAND NAME | VISCOSITY | BN | SULPHATED ASH (% m/m) |
|---------------------------|-----------------|-----------|------|-----------------------|
| Castrol | Duratec L | SAE 40 | 4,5 | 0,45 |
| Chevron (Texaco + Caltex) | Geotex LA 40 | SAE 40 | 5,2 | 0,45 |
| ExxonMobil | Pegasus 705 | SAE 40 | 5,3 | 0,49 |
| | Pegasus 805 | SAE 40 | 6,2 | 0,50 |
| Lukoil | Efforse 4004 | SAE 40 | 5,56 | 0,49 |
| Petrogal | Galp GN 4005 | SAE 40 | 5,2 | 0,45 |
| Shell | Mysella S3 N 40 | SAE 40 | 5,0 | 0,45 |



USE OF NON-VALIDATED LUBRICATING OILS:

Before using a lubricating oil not listed in the tables above, the engine manufacturer must be contacted. Lubricating oils that are not validated have to be tested according to engine manufacturer's procedure.

Should a non-validated lubricating oil be used during the engine warranty period, and there exist no agreement with the engine manufacturer about testing, the engine guarantee does not hold.

Lubricating oil companies listed above along with other possible manufacturers and distributors undertake all responsibility for the performance of their validated lubricating oils in service to the exclusion of any liability of any Wärtsilä company belonging to Wärtsilä group.

Further, they shall indemnify, compensate and hold harmless Wärtsilä and companies belonging to Wärtsilä group from and against any claims, damages and losses caused by the lubricating oils in question.

LUBRICATING OILS FOR ENGINE TURNING DEVICE

Based on the turning device manufacturer's instructions EP-gear oils having viscosity of 414 - 506 cSt at 40 °C = ISO VG 460 are normally considered as suitable lubricating oils for turning device. The following products are fulfilling the requirements:

| LUBRICATING OILS FOR ENGINE TURNING DEVICE | | | | |
|---|-----------------------------|-----------------------------------|------------------------------------|---------------------------------|
| SUPPLIER | BRAND NAME | VISCOSITY cSt at 40 °C | VISCOSITY cSt at 100 °C | VISCOSITY INDEX (VI) |
| BP | Energol GR-XP 460 | 460 | 30,5 | 95 |
| Castrol | Alpha SP 460 | 460 | 30,5 | 95 |
| Chevron (Texaco + Caltex) | Meropa 460 | 460 | 31,2 | 97 |
| ENI S.p.A. | Blasia 320 | 300 | 23,0 | 95 |
| ExxonMobil | Mobilgear 600 XP 460 | 460 | 30,6 | 96 |
| Fuchs | Renolin CLP 460 | 460 | 30,4 | 95 |
| Petro-Canada | Enduratex EP 460 | 452 | 30,4 | 97 |
| Shell | Omala S2 G 460 | 460 | 30,8 | 97 |
| Total / Lubmarine | Carter EP 460 | 470 | 30,3 | 93 |