Dear customers,

Talusia Universal is an unique and patented cylinder oil. It is fully approved by the engine designer for use on MAN engines for the whole range of the sulphur contents in heavy fuel oils. You will find herein some information about this product and the best way to use it on MAN engines.

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- Which cylinder oil applies with Talusia Universal?
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PRESENTATION OF TALUSIA UNIVERSAL

The Talusia Universal concept, reflects the ability to control the corrosive wear of liner surface whatever the sulphur content in the heavy fuel oil (HFO) used, was born more than 10 years ago. Thanks to years of work on the neutralization reaction, Total Lubmarine finally invented and patented a new design of marine cylinder lubricant (MCL) where a reduced BN reserve is able to work with about 20% more efficiency than a conventional BN70 MCL.

This explains why Talusia Universal should not be thought of as a down treated MCL and must not be considered as a “lower BN value” product either.

The choice and the balance between the components of the Talusia Universal formulation is the reason for the huge improvement in neutralization efficiency. It results in the capability to neutralize and to control the corrosive action of the acids produced during the combustion of high sulfur HFO in the same way as the conventional BN70 MCL.

A side-effect is the ability of Talusia Universal to minimize deposit accumulation when operating the engine with low sulfur HFO (between 0.5% and 1.5%) by applying the minimum recommended cylinder oil dosage either with mechanical or electronically controlled lubricators, which is a very important practical aspect for the customer.
TALUSIA UNIVERSAL APPROVALS

The first approval tests were carried out in 2007/2008, concurrently on two vessels fitted with K98 MC-C engines. For the first time, each engine was split in two sets of cylinders respectively lubricated with Talusia Universal and, a conventional BN 70 MCL, Talusia HR70, which gave the possibility to compare the two lubricants under exactly the same conditions on the same engine. It resulted in a full validation of Talusia Universal’s performance, when used as a BN70 conventional lubricant – that is to say the same Alpha Lubricator ACC settings.

In the period 2008/2009, MAN asked Lubmarine to run another approval field test to confirm the ability of Talusia Universal to assure the reliability of the big bore engines when the lube oil feed rate (LOFR) is reduced below the recommendation that was actually applied during the initial tests. The test with K98 MC-C was successful after more than 3800 h run at a flat rate of 0.60 g/kWh and therefore Talusia Universal was considered capable to be used when applying the latest recommendation for LOFR now in force for the big bore engines, that is to say 0.20 g/kWh x S%.

In the period 2009/2010, we had two reasons to do a last approval test to clearly validate the Talusia Universal concept and to demonstrate the extraordinary potential of a unique newly designed lubricant compared to conventional MCLs:

- to show that Talusia Universal can be used continuously with very low sulfur fuels on MAN engines without generating deposits that should result in bore polishing and scuffing patterns.

- to show to the market that Lubmarine had designed a MCL perfectly adapted to the new constraints for HFO sulfur content in Emission Controlled Areas (Sulphur content ≤ 1%).

It was successfully completed after more than 4200 h of test on a K98 ME-C continuously operating on a low sulphur fuel and monitored very carefully by MAN’s engineers.

MAN has issued different official documents that explain the Talusia Universal performance. These documents are the following:

- **No objection letter LSP/KEA/TGL/41549-2007** issued in November 2007 stating that Talusia Universal can be used in MAN 2-stroke engines;

- **Testimony letter LDF4/CXR/CEN/33691-2008** issued in May 2008 stating that Talusia Universal can be used with heavy fuel oils with high sulfur contents as BN 70 cylinder oil;

- **Testimony letter LDF4/CXR/CEN/32094-2009** issued in May 2009 stating that Talusia Universal can be used as a BN70 cylinder oil, with Alpha ACC factor of 0.20 g/kWh, in accordance with the recommendation issued in the Service Letter SL09-507/HRR;

- **No objection letter LDF4/DOJA/BAN/87374-2010** issued in October 2010 stating that Talusia Universal can be used also in MAN 2-stroke engines running with low sulphur fuel in the range 0.5 – 1.5 % Sulphur.

*Note: These documents are available upon request from your Lubmarine technical correspondent.*
Moreover, according to the MAN Guidelines for Fuels and Lubes purchasing (Ed 2009) Talusia Universal is categorized in the BN60-BN80 category.

<table>
<thead>
<tr>
<th>Lubricating oils - Low speed main engines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
</tr>
<tr>
<td>Requirement</td>
</tr>
</tbody>
</table>

BP
Energol OE-HT 30
Energol CLO-50M/CL 605
Energol CL 505/CL-EX 405

Castrol
CDX 30
Cytech 70/80 AW
Cytech 40 SX/50 S

Chevron
Veritas 800 Marine 30
Taro Special HT 70
Taro Special HT LS 40

Total
Atlanta Marine D 3005
Talusia HR 70/Talusia Universal
Talusia LS 40

Exxon Mobil
Mobilgard 300
Mobilgard 570
Mobilgard LS40

Shell
Melina 30/30S
Alexia 50
Alexia LS

Ref: MAN paper - Guidelines for Fuels and Lubes Purchasing Operation on Heavy Residual Fuels (pg 16)

Talusia Universal has been launched on the market January 1st, 2008 and today, more than 900 MAN engines, with various designs, are lubricated with this cylinder oil (1700 including the all engine designers).

GENERAL CONSIDERATIONS ABOUT THE CYLINDER OIL DOSAGE

Talusia Universal is a « non conventional » MCL. So this lubricant has raised questions from users about the feed rate to apply. Total Lubmarine has demonstrated, through laboratory tests results, an extensive field test program and the lubrication of more than 1700 vessels for 3 years that Talusia Universal can be used with the same feed rate as a conventional BN 70 MCL. This has been agreed in a testimony letter issued by MAN (ref LDF4/CXR/CEN/32094-2009 issued in May 2009).

However the implementation of this recommendation, through the lubricator settings, requires good knowledge of the engine technology and which MAN Service Letter has to be applied. The cylinder oil dosage depends on the engine type, the lubricator technology, the bore size and the piston design.

- **Lubricator**

Depending on the engine licensee and the customer’s choice, MAN engines can be fitted with mechanical lubricator (H Jensen) or electronically controlled lubricator (Alpha ACC Lubricator or ME Lube). With an electronically controlled lubricator, the cylinder oil dosage is proportional to the sulphur level in the fuel. The cylinder oil feed rate is higher with the mechanical lubricator and does not depend on S% in the fuel.

- **Bore size**

MAN recommends different cylinder oil dosages depending on the bore size of the engine. The MAN engines are divided in two categories:

<table>
<thead>
<tr>
<th>Engine</th>
<th>Bore size (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big bore engines</td>
<td>60 - 98</td>
</tr>
<tr>
<td>Small bore engines</td>
<td>26 - 50</td>
</tr>
</tbody>
</table>
- **Piston Top-land**

MAN engines are fitted with different piston types depending on the engine design features (year of build, engine type...). It is possible to find 3 main piston types.

- Piston with ‘Low Top-land’
- Piston with ‘Semi-high Top-land’
- Piston with ‘High Top-land’

The description of the piston top-lands is given in Attachment 1.

The low top-land piston design has been used until the beginning of 2000s decade. The date of withdrawal of this design has been variable depending on the MAN licensees. Due to a higher sulphuric acid condensation in these engines, the cylinder oil dosage is significantly higher in these engines than in the newest ones.

The high top-land piston design has been introduced on big bore ME engines with the Oros combustion chamber, at the end of 1990s and then on other ME & MC engine types. According to MAN, the high top-land piston designs leads to a significant reduction of the sulphuric acid condensation and then to a lower cylinder oil dosage.

The ‘semi-high top-land’ piston design is used on specific engine types: S70 ME-C, L70 ME-C, S65 ME-C, S60 ME-C, L60 ME-C, S50 ME-B, S40 ME-B, S35 ME-B...

According to MAN’s latest experience (1), using a too low cylinder oil feed rate in regards to the sulphur content in the fuel results in a too little sulphuric acid compensation, and thereby a risk of high corrosive wear. Therefore the recommended cylinder oil dosage is higher than with ‘high top-land’ engines.

MAN states that all engines, both MC and ME types, built after 2002, are equipped with high or semi-high top-land pistons. Depending on the piston top-land design, MAN recommends different cylinder oil dosages which are in turn dependant on the sulphur content in the fuel (feed rate factor) for the engines fitted with electronically controlled lubricators.

(1): feed back from MAN during the year 2010

**WHICH FEED RATE APPLIES WITH TALUSIA UNIVERSAL?**

Lubmarine recommends applying Talusia Universal with the same feed rate as a conventional BN70 MCL. The current MAN recommendations about cylinder oil dosage, for standard operation with BN70 lubricating oil, are given for information in Attachment 2.

These recommendations are subject to change by MAN without notice. It is the users responsibility to verify with the engine designer or builder that these recommendations are still in force.

- **HMI setting for engines fitted with Alpha ACC Lubricator**

The feed rate to apply is converted in HMI settings depending on the S% in the fuel. The HMI setting can be found in tables given in the Annex of the relevant MAN service letter. Lubmarine recommends using the BN70 lubricating oil tables with Talusia Universal.
Important notice about the feed rate recommendations

Lowering the feed rate towards the basic feed rate or the minimum feed rate should be done stepwise. Any reduction should always be based on careful evaluation of the actual liner and piston ring condition. The overall cylinder condition should be checked through the scavenge ports at least once a month according to the recommendations from MAN.

Moreover, Total Lubmarine is not responsible for determining the most appropriate feed rate to the actual engine condition. The user remains responsible for the correct cylinder oil dosage. In any case, the specific engine designer/builder recommendations should be followed.

LOW SULPHUR FUELS OPERATIONS

According to the MAN No Objection Letter for the cylinder oil Talusia Universal, for low sulphur fuel (ref: LDF4/DOJA/BAN/87374-2010 – Oct 2010) Talusia Universal can be used on MAN two-stroke engines operating on low sulphur fuel in the range 0.5-1.5% sulphur.

To avoid any calcium carbonate deposit build-up on the piston top-land and to ensure a good cylinder liner lubrication, we recommend to use Talusia Universal with the minimum feed rate during the low sulphur fuel operations (sulphur content < 1.5%):

<table>
<thead>
<tr>
<th>Lubricator type</th>
<th>Engine type</th>
<th>Feed rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha Lube ACC lubricator or ME lube</td>
<td>All</td>
<td>0.6 g/kWh</td>
</tr>
<tr>
<td>Mechanical lubricator</td>
<td>K &amp; L types</td>
<td>0.8 g/kWh (*)</td>
</tr>
<tr>
<td>Mechanical lubricator</td>
<td>S types</td>
<td>0.95 g/kWh (*)</td>
</tr>
</tbody>
</table>

(*) Lowering the feed rate is to be based on observations of the actual engine condition and may be done in steps of maximum 0.05 g/bhb.h (0.068 g/kWh), taking care that the actual feed rate is not less than the minimum feed rate (ref: MAN Service Letter SL00-385/HRJ - Dec 2000).

SWITCHING FROM A CONVENTIONAL CYLINDER OIL TO TALUSIA UNIVERSAL

Talusia Universal is miscible and compatible with most of the conventional cylinder oils (e.g. BN 40 or BN 70 MCL) manufactured by the international lubricating oil suppliers. Nevertheless, the performance level of a mixture of two cylinder oils should be considered carefully, especially depending on the sulphur content in the fuel. A good practice consists in decreasing the oil level in the tank as much as possible before to fill it with Talusia Universal. In any case, please contact your Lubmarine technical correspondent for further information.

Questions or comments regarding this Customer Information should be directed to the Lubmarine Technical department.

Yours Faithfully

J.P. ROMAN
Lubmarine Technical Director
DESCRIPTION OF the PISTON TOP-LANDS FITTED ON MAN ENGINES

High topland  Semi-high topland  Low topland

Non-binding document
### CURRENT MAN RECOMMENDATIONS ABOUT CYLINDER OIL DOSAGE,
FOR STANDARD OPERATION WITH BN70 LUBRICATING OIL

<table>
<thead>
<tr>
<th>Lubricator type</th>
<th>Bore size</th>
<th>Engine type</th>
<th>Piston top-land design</th>
<th>Basic feed rate</th>
<th>Absolute minimum feed rate</th>
<th>MAN Service letter applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronically controlled lubricator (Alpha or ME lube)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Big bore (80 - 98 cm)</td>
<td>Big bore</td>
<td>MC / MC-C</td>
<td>High top-land</td>
<td>0.20 g/kWh x S%</td>
<td>0.60 g/kWh</td>
<td>Service Letter SL09-507/HRR (June 2009)</td>
</tr>
<tr>
<td></td>
<td>S or L MC / MC-C</td>
<td>(K, L, S types)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S or L ME / ME-C</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>60, 65, 70 cm</td>
<td></td>
<td>Semi-high top-land</td>
<td>0.26 g/kWh x S%</td>
<td>0.60 g/kWh</td>
<td>None – Based on Circular letter dated April 16th 2010. Please contact MAN for further guidance</td>
</tr>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Small bore (35 – 50 cm)</td>
<td></td>
<td></td>
<td>High and Semi High top-land</td>
<td>0.26 g/kWh x S%</td>
<td>0.60 g/kWh</td>
<td>Service Letter SL07-479/HRR (June 2007)</td>
</tr>
<tr>
<td></td>
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<td></td>
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</tr>
<tr>
<td>All</td>
<td></td>
<td>MC / MC-C</td>
<td>Low top-land</td>
<td>0.25 g/bph x S% (0.34 g/kWh x S%)</td>
<td>0.50 g/bph (0.68 g/kWh)</td>
<td>Service Letter SL03-417/HRJ (Jan 2003)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ME / ME-C</td>
<td>(K, L, S types)</td>
<td></td>
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<td></td>
<td></td>
<td>ME-B (L, S types)</td>
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</tr>
<tr>
<td></td>
<td>All</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>S MC / S MC-C</td>
<td>All</td>
<td>1.1 g/bph (1.5 g/kWh)</td>
<td>0.7 g/bph (0.95 g/kWh)</td>
<td></td>
<td>Service Letter SL00-385/HRJ (Dec 2000)</td>
</tr>
<tr>
<td></td>
<td>K MC / K MC-C</td>
<td>All</td>
<td>0.9 g/bph (1.2 g/kWh)</td>
<td>0.6 g/bph (0.8 g/kWh)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L MC / L MC-C</td>
<td>All</td>
<td></td>
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</tbody>
</table>