

Rev. 4 –
Date: 31. January 2018

MERKEL seal materials in use with EAL - Oil and Grease

Rapidly biodegradable oils and greases and Environmentally Acceptable Lubricants (EAL) according to the definitions and requirements of the US EPA 2013 Vessel General Permit (VGP)

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1. General

Dear Customer,

this statement is a general recommendation for our most common seal materials, used in various maritime applications. The statement is listing lubricants which have been tested for seal material resistance.

The lubricant manufacturers have stated the listed lubricants as EALs per VGP 2013.

Note that not every rapidly biodegradable oil or grease is an EAL per VGP 2013.

In case that lubricants and/or seal materials are not listed below, we kindly ask to contact us, in order to test these lubricant against the seal material(s) in question.

Please note, that our recommendations are based on static seal material resistance tests performed for 28 days at 80 °C for oils and 60 °C for greases. The static seal material resistance tests have been performed with pure lubricants without any water content.

The lubricant performance, e.g. the seal material behavior under dynamic conditions, the lubrication, ageing and corrosion behavior etc., cannot be evaluated by us. The oil change intervals have to be defined by the lubricant manufacturers.

The following evaluation of the seal material grade is only valid, unless otherwise stated, under the described static conditions for swivel motion at low rotational speeds up to a work temperature of max. 80 °C for oils and of max. 60 °C for greases.

This statement is not valid for stern tube seal systems or propeller shaft seals operating under permanent rotating conditions. Please contact the stern tube seal system manufacturers directly for further information.

The mixture of different lubricant types can change the lubricant performance and the seal material resistance. The change of lubricant performance cannot be estimated by us. The change of seal material resistance has to be tested with a particular mixture, when in doubt.

In case NBR seal materials have been evaluated as non resistant to lubricants, the use of other seal materials such as HNBR or FKM should be verified. Please note, that the combination of seal material and seal style is limited and depends on the elastomer compound, mould design and production processes. We kindly ask to get in contact with us, if new combinations are required. This includes also other seal material types such as HNBR or FKM.

The given figures for the recommended max. water content have to be seen as an estimation, based on experiences and assumptions.

This information is based on our present knowledge and is given as a guide only. The evaluation of the seal material resistance grades are based on long term experiences with the stated applications in general and are also considering experiences with non-EAL rapidly biodegradable lubricants. However, no warranty or representation, express or implied, is made as to its accuracy or completeness, or the fitness of our products for a specific use.

Please note that long term experiences with EAL and/or long term seal material resistance tests are not yet given. Users are advised to ensure that they refer to the latest version of this data sheet.

Sincerely yours,

Freudenberg
Sealing Technologies GmbH

2. Oils for swivel motion at low rotational speed

| | |
|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Type of lubricant: | Oil |
| Application: | Swivel motion at low rotational speed |
| Application examples: | Rotary joints and/or oil distribution boxes Slewing bearings Steering gears Deck machinery, e.g. cranes, winches, stern roller |
| Merkel seal styles: | Rotomatic types ROI -1551 (M17 special) |
| - Examples - | Rotomatic ROI -1555 Rotomatic ROIS-0135 (M19 special) Radimatic TBM27R TBM21 |
| Merkel seal materials: | 70 NBR B209 |
| - Other on request - | 80 NBR B241 80 NBR B246 80 NBR B202 85 NBR B248 |
| Max. work temperature: | ≤ 80 °C |
| Recommended max. water content: | 0,1 % at 80 °C |
| - In view of seal material resistance - | |

| Oils | 70 NBR B209 | 80 NBR B241 | 80 NBR B246 | 80 NBR B202 | 85 NBR B248 |
|----------------------------------------|-------------|-------------|-------------|-------------|-------------|
| Seal materials | | | | | |
| Company name | | | | | |
| Product name | | | | | |
| BP / Castrol | | | | | |
| BioBar 68 | - | ✗ | - | ✗ | ✓ |
| Chevron | | | | | |
| Clarity Synthetic EA Hydraulic Oil 32 | ✓ | ✗ | ✓ | ✓ | ✓ |
| Clarity Synthetic EA Hydraulic Oil 46 | ✓ | ✗ | ✓ | ✓ | ✓ |
| Clarity Synthetic EA Hydraulic Oil 68 | ✓ | ✗ | ✓ | ✓ | ✓ |
| Clarity Synthetic EA Hydraulic Oil 100 | ✓ | ✗ | ✓ | ✓ | ✓ |
| Clarity Synthetic EA Gear Oil 100 | ✓ | ✗ | ✓ | ✗ | ✗ |
| Clarity Synthetic EA Gear Oil 150 | ✓ | ✗ | ✓ | ✗ | ✗ |
| ExxonMobil | | | | | |
| Mobil SHC Aware H 32 | ✓ | - | ✓ | - | - |
| Mobil SHC Aware ST 100 | ✓ | - | ✓ | - | - |
| Fuchs / Lukoil | | | | | |
| Plantogear 320 S | - | - | - | ✓ | ✓ |
| Plantosyn 46 HVI | - | ✓ | - | - | - |
| Klüber | | | | | |
| Klüberbio EG 2-68 | ✓ | - | ✓ | - | - |
| Klüberbio EG 2-100 | ✗ | ✓ | ✓ | - | - |
| Klüberbio EG 2-150 | ✗ | ✓ | ✓ | - | ✓ |
| Klüberbio LR9-32 | ✓ | - | ✓ | - | - |
| Klüberbio LR9-68 | - | - | - | - | ✓ |
| RSC BioSolutions | | | | | |
| Envirologic 3032 | ✓ | ✗ | ✓ | ✓ | ✓ |
| Envirologic 3046 | ✓ | ✗ | ✓ | ✓ | ✓ |
| Envirologic 3068 | ✓ | ✗ | ✓ | ✓ | ✓ |
| Envirologic 3100 | ✓ | ✗ | ✓ | ✓ | ✓ |
| Envirologic 200 | ✓ | ✗ | ✓ | ✗ | ✗ |
| Envirologic 210 | ✓ | ✗ | ✓ | ✗ | ✗ |
| Envirologic 215 | ✓ | ✗ | ✓ | ✗ | ✗ |

- ✓ : resistant
- ✓ : max. work temperature ≤ 60°C
- ✗ : not resistant, other seal materials recommended, see notes on page 2
- : not tested

| Seal materials | | | | | |
|-----------------------------|-------------|-------------|-------------|-------------|-------------|
| Oils | 70 NBR B209 | 80 NBR B241 | 80 NBR B246 | 80 NBR B202 | 85 NBR B248 |
| Company name | | | | | |
| Product name | | | | | |
| Shell | | | | | |
| Naturelle S4 Gear Fluid 68 | ✓ | - | ✓ | - | - |
| Naturelle S4 Gear Fluid 100 | ✗ | ✓ | ✓ | - | - |
| Naturelle S4 Gear Fluid 150 | ✗ | ✓ | ✓ | - | ✓ |
| Vickers | | | | | |
| Hydrox Bio 68 | ✓ | - | ✓ | - | - |
| Hydrox Bio 100 | ✓ | - | ✓ | - | - |
| Hydrox Bio 150 | ✓ | - | ✓ | - | - |
| Ecosure HSE 32 | ✓ | - | ✓ | - | - |
| Ecosure EAF 32 | ✓ | - | ✓ | - | - |

- ✓ : resistant
- ✓ : max. work temperature ≤ 60°C
- ✗ : not resistant, other seal materials recommended, see notes on page 2
- : not tested

3. Greases for swivel motion at low rotational speed

| | |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------|
| Type of lubricant: | Grease |
| Application: | Swivel motion at low rotational speed |
| Examples: | Slewing bearings Steering gears Rudder posts Deck machinery, e.g. cranes, winches, stern roller |
| Merkel seal styles: | Radiamatic |
| - Examples - | TBM27R TBM21 Rudder shaft seals |
| Merkel seal materials: | 70 NBR B209 |
| - Other on request - | 80 NBR B241 80 NBR B246 80 NBR B202 85 NBR B248 |
| Max. work temperature: | 60 °C |
| Recommended max. water content: | 10 % at 60 °C, also see following comments on grease |
| - In view of seal material resistance - | applications |

Please note: Do not use grease with solid particles for seal lubrication (e.g. MoS₂, Graphite etc.).

| Seal materials | | | | | | | |
|------------------------------------|-------------|-------------|-------------|-------------|--------------|-------------|------------|
| Greases | 80 NBR B241 | 80 NBR B202 | 85 NBR B248 | 85 NBR B203 | 85 HNBR U465 | 85 FKM K668 | 93 AU V167 |
| Company name | | | | | | | |
| Product name | | | | | | | |
| Castrol | | | | | | | |
| BioTac MP | ✘ | ✘ | ✘ | ✔ | ✔ | ✔ | ✔ |
| Chevron | | | | | | | |
| Clarity Synthetic EA Grease | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| ExxonMobil | | | | | | | |
| Mobil SHC Aware Grease EP 2 | ✔ | ✔ | ✔ | ✘ | ✔ | ✔ | ✔ |
| Fuchs / Lukoil | | | | | | | |
| Plantogel 2S (EAL) | ✘ | ✘ | ✔ | ✔ | ✔ | ✔ | ✘ |
| Klüber | | | | | | | |
| Klüberbio AG 39-602 | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Shell | | | | | | | |
| Naturelle S2 Wire Rope Lubricant A | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Total / Lubmarine | | | | | | | |
| Bio Adhesive Plus | ✔ | ✔ | ✔ | ✔ | - | - | ✔ |
| Vickers | | | | | | | |
| Biogrease EP2 | ✔ | ✔ | ✔ | ✘ | ✔ | ✔ | ✔ |

✔ : resistant

✘ : not resistant, other seal materials recommended, see notes on page 2

- : not tested

u.e. : under evaluation

4. Comments on grease applications with swivel motion at low rotational speed

Sealing points in oil-to-sea-interfaces and/or bearing-to-sea-interfaces, below or close to seawater level, are often consisting of multiple seal arrangements. Seal systems operating with a swivel motion at low rotational speed are e.g. the azimuth slewing bearings of thrusters, steering gears, rudders posts, fin stabilizers.

The seal lubrication of the seals installed towards seawater is provided by a grease filling in the intermediate chamber(s). In addition this grease filling is used as an additional seal barrier. The intermediate chamber(s) should be completely filled with grease during installation. If possible the grease volume should be renewed completely within a certain period of time, e.g. via lubricating bores in the intermediate chamber(s). Greases should have a high water-spray-off resistance and a stable thickener structure when in contact with seawater.

The operating conditions of these lubricant-to-sea-interfaces is a swivel motion at low rotational speeds up to a work temperature of max. seawater temperature. Due to pump effects, vibrations, seal wear etc. it may occur that a grease-seawater mixture builds up inside the chamber(s). In principle a grease-seawater-mixture can have a negative influence on seal material resistance if a decomposition inside the mixture takes place.

An influence of decomposition products to the seal material, originated by e.g. synthetic ester based, rapidly biodegradable greases in contact with seawater, is not to be expected for applications with these operating conditions. The reasons for this are:

- low temperatures, the grease is cooled by the seawater.
- swivel motion at low rotational speeds, therefore no frictional heat of the seals.
- small contact surfaces between seawater and grease. The seawater will be encapsulated in hollows. In comparison to an oil-seawater mixture which can form an emulsion, a grease-seawater mixture is a clearly separated two-phase system.
- only swivel motion, therefore no intensive exchange of grease portions which have been in contact with seawater with other grease portions.
- recommended renewing of grease volume and thus washing out of intruded seawater.

Therefore the seals are able to operate even with this mixture. Long term experiences with synthetic ester based, rapidly biodegradable greases as lubricant for azimuth slewing bearing seals are given, without any negative acknowledgement.

Please note that a mixture of different grease types can change the seal material resistance and the grease performance. In case of changing the grease for seal lubrication it is therefore recommended to remove the previously used grease as completely as possible from the intermediate chamber and equipment.

Revisions

| Rev. ind. | Page (P) Chapt. (C) | Description | Date Dept. / Init. |
|-----------|------------------------|-------------------------------------|---------------------------|
| 0 | | Document released | 19.09.2014 AE / IR, HG |
| 1 | 8 3 | Plantogel 2 S (EAL) added | 29.09.2014 AE / HG |
| 2 | 5, 6 2 | Vickers, ExxonMobil div. added | 09.11.2015 AE / HG |
| 3 | 8 3 | Bio Adhesive Plus added | 03.05.2016 AE / HG |
| 4 | 8 3 | Chevron Clarity Synthetic EA Grease | 31.01.2018 AE / HG |