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GEOlube® NF46 Range

GEOlube® NF46 2180 & 2181 are fire resistant, water glycol (HF-C) based hydraulic fluids. Their use as replacement for mineral oil fluids is recommended whenever a major fire hazard exists associated with industrial hydraulic systems, for example in die casting machines, hydraulic forging press and hammers, machines and drive systems in the mining industry and robot welding machines.

GEOlube® NF46 2180, with a typical water content of 36%, is particularly designed for use in the metallurgic industry, where its excellent lubricity characteristics are beneficial in the heaviest operations (for example in die or continuous casting).

GEOlube® NF46 2181, with a typical water content of 43% is particularly recommended for use in coal mining, where the higher water content provides an extra safety margin.

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Technical Performance

GEOlube® NF46 2180 & **NF46 2181** are high performance water glycol fluids possessing superior antiwear properties. Both fluids meet all the technical and flammability criteria of the 7th Luxembourg Report. **GEOlube® NF46 2181** also passes the toxicological requirements for coal mining service. The following approval authorities are involved:

- **Rheinisch-Westfälischer Technischer Uberwachungs Verein e.v.**
- **DMT GmbH**
- **Pharmakologisches Institut der Universität, Hamburg**

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The TÜV is the source of most of the data for **GEOlube® NF46 2181** presented in the following table.

Table 1- Typical Properties of GEOlube® NF46 2180 & 2181

Test		NF46 2180	NF 46 2181
Density @20°C, kg/m^3		**1083**	**1076**
Pour point (7th Lux. Report),°C		**-40**	**-47**
Viscosity	@ 0°C	**275**	**265**
	@ 20°C	**103**	**99**
	@ 40°C	**46**	**46**
	@ 50°C	**34**	**34**
pH @ 25°C		**9.60**	**9.60**
Alkalinity (mls 0.1 N HCl) - to neutralise 50g to pH 5.5 @ 25°C		**60**	**70**
Corrosion protection (7th Lux. Report)		**pass**	**pass**
4 ball result (7th Lux. Report), scar diameter in mm		**0.65**	**0.67**
Foam tendency, volume of foam, mls	25°C initial	**20**	**20**
	25°C after 10 min.	**0**	**0**
	50°C initial	**20**	**10**
	50°C after 10 min.	**0**	**0**
De-aeration time (7th Lux. Report), min.		**20**	**20**
Typical water content, %		**36**	**43**
Spray flammability rating (7th Lux. Report)		**1**	**1**
Flame propagation, mixture of fluid and coal dust (mm)		**-**	**79**
Specific heat @ 20°C, kJ/kgK		**3.20**	**3.30**
Thermal conductivity @ 20°C, W/mK		**0.45**	**0.45**
Vapour pressure Pa (bars)	@ 20°C	**2000 (0.02)**	**2000 (0.02)**
	@ 50°C	**9000 (0.09)**	**9000 (0.09)**

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Pump Test Programmes

In addition to the standard Vickers vane pump test, these products have been tested in a variety of pumps in collaboration with pump and equipment manufacturers. The test schedules have been designed to simulate real working conditions. For example, tests have been carried out on a Rexroth Hydromatik axial piston pump, a larger model Vickers vane pump and an Orsta gear pump. In all cases, **GEOlube® NF46 2180 & 2181** gave an outstanding performance.

Rexroth Hydromatik A2V55 Axial Piston Pump

A Rexroth Hydromatik A2V55 axial piston pump (bent axis design) was tested to destruction with **GEOlube® NF46 2180** in collaboration with a major manufacturer of continuous casting equipment incorporating this pump design (see Table 2 for complete test schedule). The equipment manufacturer wanted a pump bearing life of at least 4000 hrs with an HF-C fluid running @120-150 bars. The test indicated that it is practical to expect a minimum bearing life of 5000 hrs with **GEOlube® NF46 2180** @150 bars and pump speed of 1500 rpm.

The results clearly demonstrate the superior lubrication properties of **GEOlube® NF46 2180**. As a guide, it is considered that pump bearing life with a water / glycol fluid is only 25% that of the pump bearing life with a mineral oil. The performance demonstrated by **GEOlube® NF46 2180** would suggest a bearing life of 55% compared to mineral oil.

Table 2- Rexroth Hydromatik A2V55 LD Pump Test

	First 1000 hrs	Second 1000 hrs	Third 1000 hrs	Fourth 1000 hrs	Fifth 1000 hrs
Pump pressure, bars	30 -120	150	30 - 250	250	350
System pressure, bar high	120	150	250	250	310
low	30	30	30	30	100
Pressure sequence	5 cycles per minute	10 min - 150 bar 2 min - 30 bar	5 cycles per minute	10 cycles per minute	10 cycles per minute
Valves Vickers	ECG 6	XCT 10 F	ECG 6	ECG 6	-
Rexroth	-	4 WRZ 16E 126	-	4 WRZ 16E 126	DB20-2-41/350 4WRZ 16E 126
Flow rate, litres / min.	77	75	50 - 77	50 - 77	40 - 75
Piston weight loss, mg	407.60	260.60	52.50	93.20	*
Barrel weight loss, mg	0.30	0.30	0.50	0.60	*

* Damaged by fragments so weight loss meaningless

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Orsta Gear Pump Model ND 160 TGL 10854

An Orsta gear pump model ND 160 TGL 10854 intended for coal mining service was tested with **GEOlube® NF46 2181**. The following test conditions are typical of coal mining service:

Speed	Pressure	Power Rating	Fluid Flow	Test Time
1450 rpm	130 bar	9 kW	30 litres / minute	1000 hrs

The test was conducted for 1000 hrs after which the pump was found to be in excellent condition. See Table 3 for weight losses.

Table 3- Orsta Gear Pump Test Weight Losses in mg

Hours	Gear		Bearings			
	Motor shaft	Secondary	I	II	III	IV
500	60	40	8.50	9.20	5.30	9.30
1000	20	15	13.70	5.10	4.90	10.40
Total Wt. Loss	**80**	**55**	**22.20**	**14.30**	**10.20**	**19.70**

Vickers Vane Pump 25V21A-1C-1-180

A Vickers vane pump model 25V21A-1C-1-180 was tested with **GEOlube® NF46 2181**. The pump was fitted with a ring GE 30, size 21, coated internally with Molykote Q5-7409.The following test conditions were used:

Speed	Pressure	Fluid Temp.	Fluid Flow	Test Time
1500 rpm	175 +/- 2 bar	48 +/- 2°C	85 +/- 2 litres / min.	350 hrs

A total wear of 133 mg on ring and vanes was obtained after 354 hrs.

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Wear Performance

The information outlined above indicates that **GEOlube® NF46 2180 & 2181** provide a very high level of wear prevention performance for fluids of the HF-C class. Arguably, they provide wear protection in sliding wear systems equivalent to mineral oil, with results in Vickers vane pumps giving no greater wear than mineral oil. Similar results are achieved in piston and gear pumps.

It is recognised however that the same is not true where rolling wear environments occur, although **GEOlube® NF46 2180** has been shown to provide acceptable levels of performance in practical tests. Where problems are associated with roller bearings, a number of approaches can be considered to minimise the effects:

- Wherever possible, sliding bearings should be selected to avoid the possibility of rolling wear.
- System pressure reductions can lead to an improvement of the extent of rolling wear.
- Bearings which become subject to failures do so essentially as a result of metal fatigue. This can be remedied by use of bearings made from high nitrogen martensitic stainless steels. These stainless steels are used by bearing manufacturers especially for roller bearings as they can achieve substantially extended life and are an optimised solution to bearing problems.

Fire Resistance

GEOlube® NF46 2180 & 2181 belong to the HF-C class of FR hydraulic fluids, which represent the lowest risks of fluids generally suitable for use in performance hydraulic systems. They are substantially more fire resistant than synthetic polyol / organic esters or even phosphate esters.

This is demonstrated in a variety of tests, which show that HF-C fluids have:

- Lower efficiency of combustion compared to esters and mineral oils.
- Higher critical heat flux for ignition compared to esters and mineral oils.
- Lowest “spray flammability parameter” of all performance hydraulic fluids.

In fact, organic and polyol esters perform little better than mineral oil in these tests.

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Choice of fire resistant hydraulic - when to choose GEOlube® NF46 2180 & 2181

GEOlube® NF46 2180 & 2181 normally represent the correct choice when the following apply:

- The highest level of fire protection is to be insisted upon for the maximum protection of valuable plant and personnel.
- A low toxicity, environmentally safe fluid is required.
- Where the system reservoir does not exceed 60°C. In most cases, reservoirs operating at higher temperature on oils, esters or phosphate esters will experience a drop in temperature when HF-C fluids are used. Heat exchangers can also be upgraded where required and pressurised reservoirs have been used to extend the temperature range.
- Where a cost efficient balance of safety and performance is required.

System Design

To avoid excessive evaporation of water, the system should be designed in such a way that the temperature does not exceed 50°C. Due to their higher specific gravity and vapour pressure, water-glycol fluids have a higher tendency than mineral oil to produce pump cavitation. In order to overcome this, pump manufacturers normally work to the following conditions:

- Fluid speed in the pump outlet in the range of approximately 2-6 m/s.
- Inlet speed no higher than 1.5 m/s.
- The pump must not run empty or empty the intake pipe.

Dimensions of the pump inlet and outlet pipes must be those recommended by the manufacturer.

Efficient filtration is important when using water-glycol fluids. 10 micron filters should be used, as recommended by equipment manufacturers. They are normally placed in the high pressure line and in the return line to the reservoir.

The surface of the filters should be large enough to avoid a high pressure drop and the volumetric capacity of all filters should be such that they are able to pass at least 3 times the output of the pump at the operating viscosity. By-passes are not recommended in the high pressure line and in the return line to the reservoir.

The surface of the filters should be large enough to avoid a high pressure drop and the volumetric capacity of all filters should be such that they are able to pass at least 3 times the output of the pump at the operating viscosity. By-passes are not recommended in the high pressure line and a pressure drop in excess of 3.5 bars is to be avoided.

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Many types of filters are suitable for use with **GEOlube® NF46 2180 & 2181**. Users should refer to individual manufacturers' recommendations. Inert metal mesh filters are preferred. Active clay or absorbent filters should not be used. Frequent filter changes are recommended, particularly during the initial stage of operation with **GEOlube® NF46 2180 or 2181**.

Materials of Construction

Packing and hoses

Natural rubber, BR, SBR, NBR (Brecon™ from BP Chemicals), Q, CFM and IIR rubbers can all be used as packing materials, as well as PTFE. Perbunan™ grades from Bayer must contain the maximum proportion of acrylonitrile. Polyurethane-based elastomers, asbestos, leather and cork material packings are not suitable since they absorb water.

High pressure or maximum pressure hoses and packings with wire, cotton or synthetic fibre inserts and a coating of natural rubber or the above synthetics may be used without restrictions.

Board and paper materials should not be used for flange and cover seals. Fluid packing compounds or mastics should be used sparingly so that these do not get into the fluid circuit and lead to valve blockages.

Paints

Water glycol fluids, because of their solvent action, are incompatible with older alkyd industrial paints. When a system is converted to **GEOlube® NF46 2180 or 2181**, all internal paints known to be adversely affected should be removed and the surface either left unpainted or treated with a coating that is resistant to water-glycol solution, for example epoxy resin or phenolic acid paints.

Metals

GEOlube® NF46 2180 & 2181 are compatible with the metals normally employed in hydraulic systems. They should not be used in systems incorporating magnesium alloys, because of their reactivity to water. Zinc and cadmium plated parts should be avoided too.

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Change-over Procedure

The following procedure is recommended in making the change-over from a petroleum hydraulic oil to a **GEOlube® NF46 2180** or **NF46 2181**:

- Drain oil from system completely. Particular attention should be paid to the reservoir, fluid lines, cylinders, accumulators, filters and other equipment where residual oil may be trapped.
- Clean the system or residual sludge and deposits. Remove the paints from the inside of the reservoir unless it has been tested and found to be resistant to the softening and lifting action of GEOlube® NF46 2180 or 2181. Steam cleaning has been very effective in many instances. The use or carbon tetrachloride or other chlorinate metal cleaners should be avoided.
- Remove or disconnect the filter.
- Flush the system with a minimum of quantity of GEOlube® NF46 2180 or 2181. Flush initially by operating at no load or at minimum pressure, then bring the fluid up to normal temperature and operate all parts. Many users follow the practice of operating on the flush fill for several hours in order to ensure complete circulation. Systems previously filled with HF-D (phosphate ester) fluid should be flushed with mineral oil before proceeding as above.
- Drain the flushing charge as completely as possible while it is still warm and without allowing it to settle. This fluid can be retained for further use after suspended solids have settled and residual petroleum oil has separated. With proper attention to removal of suspended contaminants, the flushing fluid can be used in preparing other machines for service.
- If a filter is used, install a clean filter cartridge. Replace filter elements having zinc or cadmium plated parts with appropriate substitutes. Do not use a highly absorptive filter medium such as activated clay or Fuller's Earth since these filters may alter fluid composition by removing essential additives.
- Examine pump parts, O-rings and auxiliary equipment. Worn pump parts should be replaced. Leaking pipe joints should be repaired and deteriorating gaskets, seals and packings should be replaced in order to minimise mechanical fluid losses. Cork shaft seals should be replaced if they are present in the system. Reconnect the system and tighten all joints and connections.
- Fill system with the selected **GEOlube® NF46 2180** or **NF46 2181**.
- Operate at reduced pressure to ensure proper lubrication of the hydraulic pump, then bring up to standard operating conditions.

During the first few weeks of operation, particular attention should be paid to the filters and inlet screens. They may become clogged by sludge and deposits that have been loosened by the solvent action of the **GEOlube® NF46 2180 or 2181**. Such blockages may cause pump starvation, noisy operation and high pump wear. Therefore, filter cartridges should be replaced and inlet screens cleaned as often as needed.

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Control of GEOlube® Hydrolube During Service

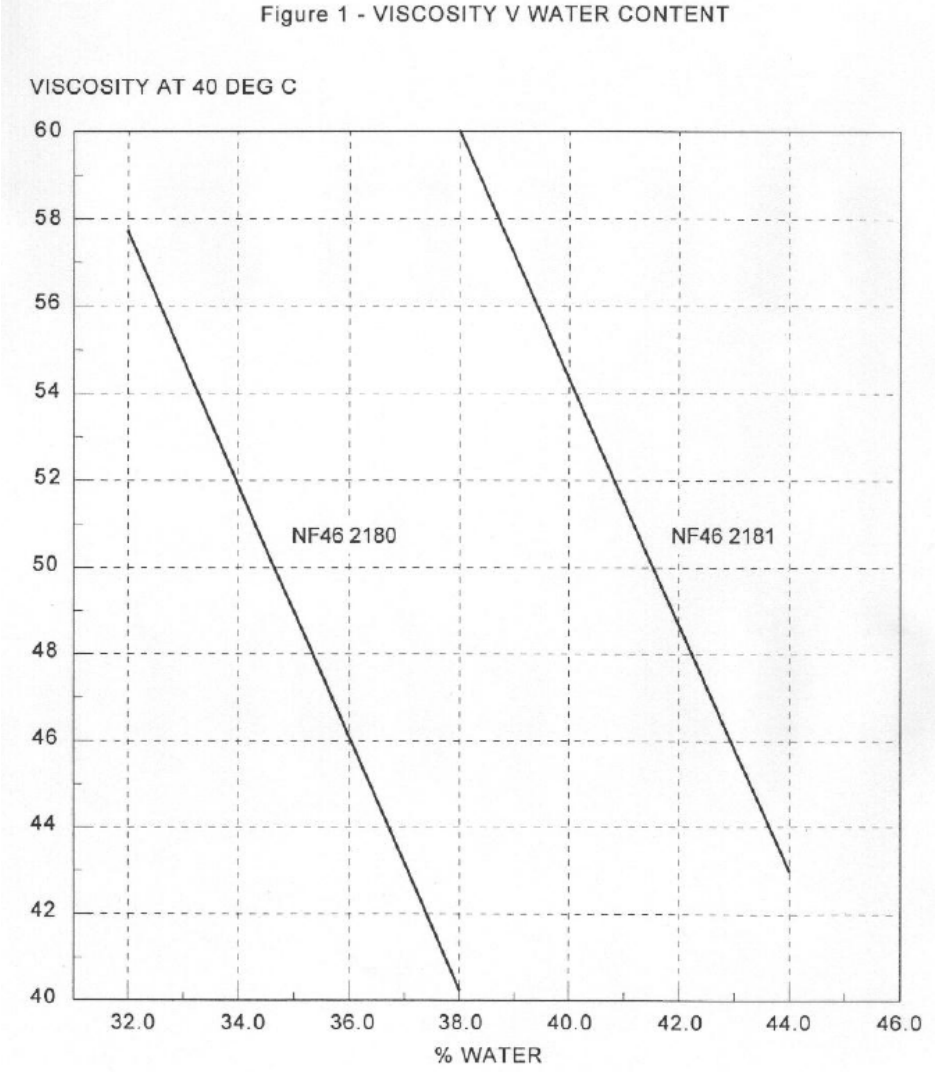
Water content

GEOlube® NF46 2180 & 2181 fluids can in some instances slowly lose water in service by evaporation. The water content can be monitored by the viscosity of the fluid (Figure 1). The graph provides an indication of the amount of water to be added to restore the original concentration. Use only de-ionised or distilled water.

Reserve Alkalinity

Reserve alkalinity is a measure of the corrosion protection provided by the fluid. It is defined as the number of millilitres of N/10 HCl to neutralise 50 mls of fluid to a pH of 5.5 and should always be between 55 and 75.

Figure 1 - VISCOSITY V WATER CONTENT



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Product Compliance

GEOlube® NF46 2180 & NF46 2181 conform to the Halal requirements in accordance with Islamic Law. (Copy of Halal Certificate available on request).

Registration & Regulatory Information: Please refer to the safety datasheet.

Handling & Storage: This product can be stored for up to 5 years at ambient storage temperature and conditions without any deterioration. Please refer to the safety datasheet for more details.

Miscellaneous: Various pack types available; please contact your local GEO Specialty Chemicals representative for further information.

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