BREOX HYDROLUBES

Introduction

BREOX Hydrolubes NF46 2180 and NF46 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 presses and hammers, machines and drive systems in the mining industry and robot welding machines).

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

BREOX Hydrolube 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.

Technical Performance

BREOX Hydrolubes NF46 2180 and NF46 2181 are high performance water glycol fluids possessing superior antiwear properties. Both fluids meet all the technical and flammability criteria of the Seventh Luxembourg Report. **BREOX** Hydrolube NF46 2181 also passes the toxicological requirements and has a full LOB certificate for coal mine service. For coal mining applications, Hydrolube NF46 2181 is renamed **BREOX** Hydrolube NF46-43E. The following approval authorities are involved:

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

The TÜV is the source of most of the data for Hydrolube NF46 2181 presented in the facing table. Both fluids are also Factory Mutual Approved.

Table 1: Typical Properties of BREOX Hydrolubes

Test		NF46 2180	NF46 2181
Specific gravity at 20 / 20 °C		1.08	1.08
Pour point (7th Lux. Report) °C		-40.00	-47.00
Viscosity at	0 °C	275.00	265.00
	20 °C	103.00	99.00
	40 °C	46.00	99.00
	50 °C	34.00	34.00
pH at 25 °C		9.60	9.60
Alkalinity (mls 0.1 N HCl) (to neutralise 50 g to pH 5.5 at 25°C.)		60.00	70.00
Corrosion protection (7th Lux. Report)		pass	pass
4 ball result (7th Lux. Report) scar diameter in mm		0.65	0.67
Vickers vane pump test, total wear after 250 h, ring and vanes, mg		< 50	< 100
Foam tendency	25 °C initial	20.00	20.00
Volume of foam, mls	25 °C after 10 min.	0.00	0.00
	50 °C initial	20.00	10.00
	50 °C after 10 min.	0.00	0.00
De-aeration time (7th Lux. Report) min.		20.00	20.00
Typical water content		36.00	43.00
spray flammability rating (7th Lux. Report)		1.00	1.00
Flame propagation, mixture of fluid and coal dust (mm)		-	79.00
Specific heat at 20 °C kJ/kgK		3.20	3.30
Thermal conductivity at 20 °C W/mK		0.45	0.45
Vapour pressure Pa (bars)	at 20 °C	2000 (0.02)	2000 (0.02)
	at 50 °C	9000 (0.09)	9000 (0.09)

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 a German Orsta gear pump. In all cases the **BREOX** Hydrolubes gave an outstanding performance.

Rexroth Hydromatik A2V5S LD Axial Piston Pump

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

The result clearly demonstrates the superior lubrication properties of Hydrolube **BREOX** 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 mineral oil. The performance demonstrated by **BREOX** Hydrolube NF46 2180 would suggest a bearing life of 55% compared to mineral oil.

Table 2 Rexroth Hydromatik A2V55 LD Pump Test

		FIRST 1000 HOURS	SECOND 1000 HOURS	THIRD 1000 HOURS	FOURTH 1000 HOURS	FIFTH 1000 HOURS
PUMP PRESSURE (BAR)		30 -120	150.00	30 - 250	250.00	350.00
SYSTEM PRESSURE (BAR)	**HIGH**	120.00	150.00	250.00	250.00	310.00
	LOW	30.00	30.00	30.00	30.00	100.00
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		4WRZ 16E 126		4WRZ 16E 126	DB20-2-41/350 4WRZ 16E 126
FLOW RATE (LITRES / MIN.)		77.00	75.00	50 - 77	50 - 77	40 – 75
PISTON WT. LOSS Mg.		407.60	260.60	52.50	93.20	Damaged by fragments so that weight loss meaningless
BARREL WT LOSS Mg.		0.30	0.30	0.50	0.60	Damaged by fragments so that weight loss meaningless

Orsta Gear Pump Model ND 160 TGL 10854

An Orsta gear pump model ND 160 TGL 10854 was tested with **BREOX** Hydrolube NF46 2181. This pump was made in the former GDR and is intended for coal mine service. The following test conditions are typical of coal mining service.

SPEED	PRESSURE	POWER RATING	FLUID FLOW	TEST TIME
1450 rpm	130 bar	9kW	30 litres / min	1000 hours

The test was conducted for 1000 hours 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

	GEAR		BEARINGS			
HOURS	MOTOR SHAFT	SECONDARY	I	II	III	IV
500.00	60.00	40.00	8.50	9.20	5.30	9.30
1000.00	20.00	15.00	13.70	5.10	4.90	10.40
TOTAL WT LOSS	80.00	55.00	22.20	14.30	10.20	19.70

Vickers Vane Pump 25V21A-1C-10-180

A Vickers vane pump model 25V21A-1C-10-180 was tested with **BREOX** Hydrolube NF46 2181. The pump was fitted with a ring GE 30, size 21, coated internally with Molykote Q5-7409.

The following test conditions were employed.

SPEED	PRESSURE	FLUID TEMPERATURE	FLUID FLOW	TEST TIME
1500 rpm	175 +/- 2 bar	48 +/- 2 °C	85 +/- 2 litres / min	350 hours

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

Wear Performance

The information outlined above indicates that **BREOX** Hydrolubes 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 **BREOX** 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.

1. Wherever possible, sliding bearings should be selected to avoid the possibility of rolling wear.

2. System pressure reductions can lead to an improvement of the extent of rolling wear.

3. 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, and they can achieve substantially extended life to constitute an optimised solution to bearing problems.

Fire resistance

BREOX hydrolubes belong to the HF-C class of FR hydraulic fluids, which represent the lowest risk 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.

Choice of Fire Resistant hydraulic fluid - When to choose BREOX hydrolubes

BREOX hydrolubes normally represent the correct choice when the following apply:

- The highest level of fire protection is to be insisted upon for the maximum protectionof valuable plant and personnel.
- A low toxicity, environmentally safe fluid is required.
- In the vast majority of cases where the **BREOX** hydrolube provides a satisfactorylevel of wear performance.
- Where the system reservoir does not exceed 60°C. In most cases, reservoirsoperating at higher temperature on oils, esters or phosphate esters will experience a drop in temperature when HF-C fluid is 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.**

The dimensions of the pump inlet and outlet pipes must be those recommended by the manufacturers.

Efficient filtration is important when using water/glycol fluids, 10 micron filters should be used, as normally 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 three 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.

Many types of filters are suitable for use with **BREOX** Hydrolubes. 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 **BREOX** Hydrolubes.

Materials of construction

Packing and Hoses

Natural rubber, BR, SBR, NBR (Brecon™ ex BP Chemicals), Q, CFM and IIR rubbers can be used as packing materials, as well as PTFE. Perbunan™ grades ex 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 material 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 **BREOX** Hydrolubes 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 resin paints.

Metals

BREOX Hydrolubes are compatible with the metals normally employed in hydraulic systems. They should not be used in systems incorporating magnesium alloys, because of their reactivity with water. Zinc and cadmium plated parts should be avoided.

Change-over procedure

The following procedure is recommended in making the change-over from a petroleum hydraulic oil to a **BREOX** Hydrolube:

- 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 of 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 the **BREOX** Hydrolube. Steam cleaning has been very effective in many instances. The use of carbon tetrachloride or other chlorinate metal cleaners should be avoided.

- Remove or disconnect the filter.

- Flush the system with a minimum quantity of the **BREOX** Hydrolube. 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 deteriorated 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 **BREOX** Hydrolube.

- 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 **BREOX** Hydrolube. 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.

Control of BREOX Hydrolubes during service

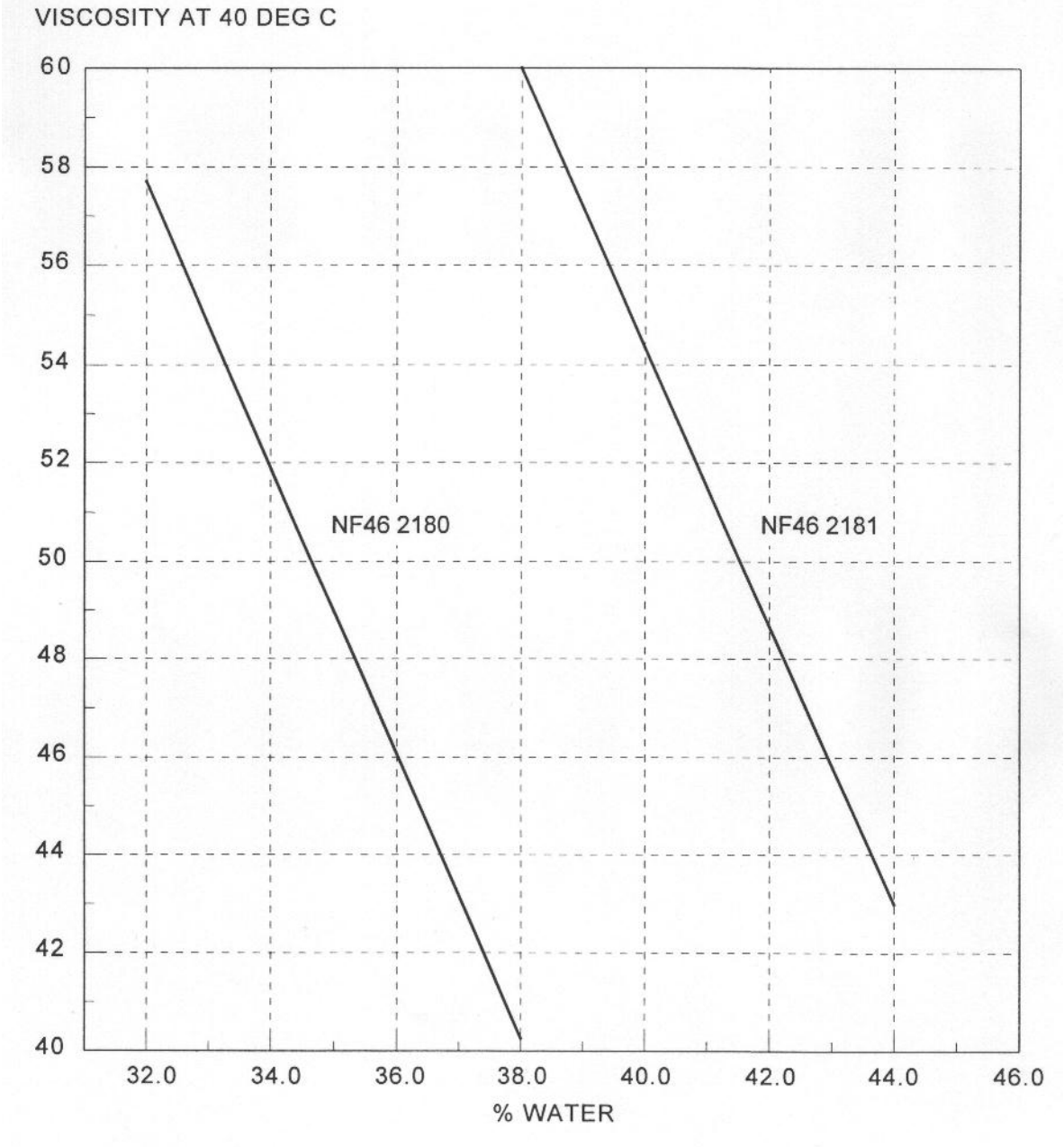
Water Content

BREOX Hydrolube 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. For further information contact your local CPC sales Office.

Figure 1 - VISCOSITY V WATER CONTENT



BREOX HYDROLUBE CONCENTRATES

NF46 4005, NF 46 2190, NF46 2191

FOR THE PREPARATION OF HIGH PERFORMANCE
WATER GLYCOL HYDRAULIC FLUIDS

Introduction

The range of **BREOX** Hydrolube Concentrates offers unique advantages to formulators of water glycol hydraulic fluids. Two specific dilutions of these concentrates yield Hydrolubes NF46 2180 and 2181. Its unique advantage to formulators is that it allows the use of local glycol and water and therefore minimises transport costs.

BREOX Hydrolube Concentrates NF46 2190 and 2191 are concentrates derived by blending mono ethylene glycol with Concentrate NF46 4005. Full blend details are described below.

HYDRAULIC FLUIDS NF46 2180 AND NF46 2181:

The use of NF46 4005 offers considerable flexibility in blending finished hydraulic fluid. It is possible, for example, to select different glycols and different water contents to arrive at fluids offering various levels of performance. Two particular finished hydraulic fluids NF46 2180 and NF46 2181 can be blended from NF46 4005 by the addition of monoethylene glycol and water.

The addition of de-ionised water to NF46 2190 and NF46 2191 produces NF46 2180 and NF46 2181 respectively. These blends have the same viscosity but different water contents. **BREOX** NF46 2181 with a water content of 43% fully meets the requirement of the Seventh Luxembourg Report for coal mine service. NF46 2180 with a water content of 36% also meets these requirements (with the exception of water content), but is more widely used for heavy duty industrial service such as die casting where its excellent lubrication properties can be used to full advantage.

Typical Properties

The concentrates are pale viscous fluids of mild odour, which can be readily handled at temperatures of 25°C and above. Pumping is best achieved by a positive displacement pump such as a gear pump. The products are compatible with mild steel and polyethylene, but will cause softening of most painted surfaces. Bulk storage should be kept warm with a hot water or low pressure steam coil. High temperature heat sources should be avoided.

	NF46 4005	NF46 2190	NF46 2191
Viscosity, cSt @ 40 °C	1200	210	370
cSt @ 25 °C	2580	-	-
Water content % wt/wt	11.00	5.50	5.70
Colour, Gardner 1963 Standard	2.00	1.00	1.00
Appearance	slight haze	slight haze	slight haze

Blending Data for BREOX NF46 4005, NF46 2190 AND NF46 2191

Blends of the concentrates are readily prepared by adding the concentrate to a mixture of glycol and water or of water only (for NF46 2190 and NF46 2191) and stirring until homogeneous. The concentrates are best handled at 40°C when the viscosity is sufficiently low for easy pumping. Blend ratios are given in the table below:

% wt/wt	NF46 2181		NF46 2180	
NF46 4005	40.00	-	38.00	-
NF46 2190	-	-	-	68.00
NF46 2191	-	61.00	-	-
monoethylene glycol	21.00	-	30.00	-
water (deionised)	39.00	39.00	32.00	32.00
Total	100.00	100.00	100.00	100.00

Blending can be carried out in a mild steel tank, but a stainless or lined vessel is preferred. If a mild steel tank is used the discharge line for the finished product must be fitted with a cartridge filter (50 micron pore size) to remove rust.

BREOX NF46 4005 is relatively viscous and should be handled between 15°C and 40°C. In the winter it is necessary to move drum stock indoors sometime before processing. Bulk storage requires a tank heater supplied with hot water or low pressure steam. The tank can be in mild steel, but it must be well cleaned before use. A lagged transfer line of 100 mm diameter is recommended. A gear or rotary lube pump (11 KW) will transfer approximately 600 litres/minute at 40°C against a 30 meter head pressure.

The following quality recommendations apply to the de-ionised water:

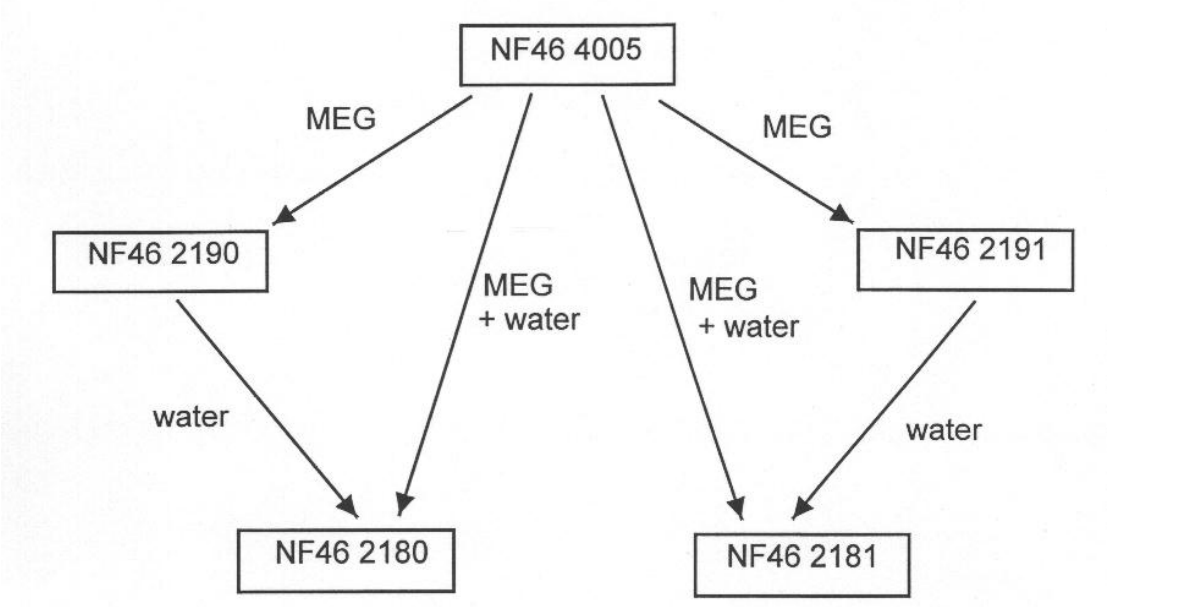
Total ion concentration	50 ppm max
Calcium	5 ppm max
Iron	c5 ppm max

Glycol Specification

A good quality standard or fibre-grade mono-ethylene glycol should be used. The use of antifreeze or recovered grades is **not recommended**. A typical specification should include:

Diethylene glycol	% wt/wt	0.5 max
Acidity as Acetic acid	% wt/wt	0.005 max
Water	% wt/wt	0.2 max
Water solubility at 25 °C	-	miscible, all proportions
Ash	g / 100 ml	0.005 max
Colour	Pt/Co	15 max
appearance	-	free of visible impurities

Blending sequence for preparation of different hydrolube grades from concentrates



BREOX NF46 2181 (43% water) and 2180 (36% water) made from NF46 4005. Adjustment of blends with high or low viscosities and water contents.

Viscosity	Water	Correction (addition of)
High	Correct	glycol and water (43 or 36%) blend
Low	Correct	concentrate and water (43 or 36%) blend
Correct	High	concentrate and glycol (blend of 46 cSt)
Correct	Low	concentrate and water (blend of 46 cSt)
High	High	initially adjust viscosity by adding glycol, then adjust as per 3/4 above if required
High	Low	initially adjust viscosity by adding concentrate and water, then adjust as per 3/4 above if required
High	Low	initially adjust viscosity with water, then adjust as per 3/4 above if required
Low	High	initially adjust viscosity with concentrate, then adjust as per 3/4 above if required

Remarks

Handling & Safety:
Storage:

Revision-No. 1.3-08.2004 Effective August 17, 2004

The product can be stored for at least 2 years at ambient storage conditions and temperature without any deterioration.

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