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Bio-Ultimax™ 2000 Hydraulic Fluids

(AW ISO 32, 46, 68, 100)

"Biobased Lubricants that Perform Like Synthetics"

Bio-Ultimax™ 2000 Hydraulic Fluids are ultimately biodegradable[1] biosynthetic formulas that directly replace mineral oil based hydraulic fluids. These patented biobased hydraulic fluids are formulated to perform in high and low pressure hydraulic systems that require Anti-Wear (AW), anti-rust, anti-oxidation, anti-foam, and demulsibility properties. They are highly inhibited against moisture and rusting in both fresh and sea water and pass A and B Sequences of the ASTM D-665 Turbine Oil Rust Test. Incorporating the super high viscosity index (VI) of the Stabilized* High Oleic Base Stocks (HOBS) into the formulas, increases the viscosity index past synthetic levels (Energy Conserving Formulas). The super high viscosity index of the HOBS naturally improves the thermal shear stability of the formula and increases load capacity. The HOBS's extremely low volatility increases the flash and fire safety features in the formula. They are formulated to provide seal conditioning for longer seal life and to reduce oil leakage from the system. They are compatible with the same seals, filters, materials and components that are designed to operate on petroleum oil based formulations. An environmentally friendly, zinc-free additive system has also been developed that meets or exceeds high pressure pump requirements.

Bio-Ultimax™ Hydraulic Fluids have a long-term history of proven performance with over 15 years of successfully being used in a wide variety of stationary and mobile hydraulic equipment. These patented super high VI fluids have performed successfully in hydraulic systems up to 10,000 psi and in systems with ultra-fine filtration. They are designed for use in hydraulic vane, piston, and gear-type pumps that require DIN 51524 Part 2 and 3 (HLP/HVLP), Parker-Denison HF-O/T6H20C, HF-1, HF-2, Eaton-Vickers M-2950-S (35VQ-25) and I-286-S (V-104C), Rexroth, Sauer-Sundstrand, Bosch, Commercial Intertech, GM (LS-2), US Steel 126, 136, and 127. They also meet the requirements for ashless API GL-1, GL-2, GL-3, DIN 51517 Part 3, and AGMA Non-EP gear oils for bearings, reduction units, and gear sets where they meet the viscosity ranges. They have shown to have exceptional anti-wear performance in ASTM D-4172 Four Ball Wear Tests. **Very little wear was encountered in the field studies and in accelerated pump tests using biobased formulations in Denison T-5D, Vickers 20VQ, 35VQ-25 (M-2950-S), and V-104C (ASTM D-2882), Vickers I-286-S pump stand tests at pressures and temperatures ranging from 2000 to 3000 psi and from 150^0 to 210^0 F.** Their anti-wear performance **exceeds the requirements** for GM (LS-2), US Steel 126, 136 and 127, and load stage 10 in the FZG (DIN 51354). Bio-Ultimax™ Hydraulic Fluids meets and exceeds Federal Specifications A-A-59354 Superseding MIL-H-46001D Specification for machine tool hydraulic systems.

Bio-Ultimax™ 2000 Hydraulic Fluids meet the Environmental Protection Agency (EPA) 2013 Vessel General Permit (VGP) guidelines for Environmentally Acceptable Lubricants (EALs), and should be used in hydraulic systems where **LOW TOXICITY**, **BIODEGRADABILITY** and **NON-BIOACCUMULATION** properties are required. They exceed the acute toxicity (LC-50 / EC-50 >1000 ppm) criteria adopted by the US Fish and Wildlife Service and the US EPA. Because they meet the environmental requirements they can also be used where ISO 15380 (HEES/HETG) Hydraulic Fluids are specified. Bio-Ultimax™ Hydraulic Fluids are **ENVIRONMENTALLY ACCEPTED LUBRICANTS (EALs)** that are formulated from renewable biobased resources. We believe Earth's environmental future rests in the use of renewable materials.

[1]Ultimate / Readily Biodegradation Pw1 >60% within 28 days in ASTM D-5864 Aerobic Aquatic Biodegradation of Lubricants

STABILIZED by Renewable Lubricants™ is RLI's trademark on their proprietary and patented anti-oxidant, anti-wear, and cold flow technology. High Oleic Base Stock (HOBS) are agricultural vegetable oils. This Stabilized technology allows the HOBS to perform as a high performance formula in high and low temperature applications, reducing oil thickening and deposits.

Patented Product: US Patent 6,383,992, US Patent 6,534,454 with additional Pending and Foreign Patents

Bio-Ultimax™ 2000 Hydraulic Fluids ISO 32, 46, 68, 100

Bio-Ultimax™ 2000 Hydraulic Fluids are designed to provide high performance in the high temperature/high pressure machine tool environment. In machine tool equipment, the hydraulic pump may work continuously in automatic machines. Machines may run 24 hours and 7 days a week non-stop. Close tolerances (0.00015 in. = 3 micron) and fine system filters (3 to 5 absolute filtration) for hydraulic/electric servo drive systems can work to elevate hydraulic system temperatures rapidly. It is also not unusual for hydraulic system components to be located close to very high temperature areas, i.e., on the side of a plastic mold injection gun. The very high oxidative stability of Bio-Ultimax™ 2000 Hydraulic Fluids meets these demands. Bio-Ultimax™ 2000 exceeds the requirements for DIN 51524 Part 2 and 3.

If oil samples are monitored and if the machine is running under clean conditions, fluid life can be increased with improved oxidation stability and proper lubricant filtration. Even though the US Steel requirement is a minimum of 125 minutes in the RPVOT, the hydraulic system's fluid life can be increased considerably when RPVOT exceeds 400 minutes and a proper preventative maintenance sampling program is used. General Electric, GEK 32568A, requires an RPVOT minimum of 450 minutes in turbine oil requirements. With Bio-Ultimax™ 2000 Hydraulic Fluids, an RPVOT of over 600 minutes has been met that increases fluid and equipment life.

TYPICAL SPECIFICATIONS	METHOD	**ISO 32**	**ISO 46**	**ISO 68**	**ISO 100**	Spec. Requirements
Specific Gravity @ 15.6°C	ASTM D-287	**0.89**	**0.89**	**0.90**	**0.90**	Report
Viscosity @ 40°C	ASTM D-445	**29.6**	**44.4**	**64.5**	**92.9**	Note 1
Viscosity @ 100°C	ASTM D-445	**6.5**	**8.9**	**12.1**	**16.3**	Note 1
Viscosity @ -15°C, Brookfield	ASTM D-2983	**530 cP**	**690 cP**	**1,270 cP**	**3,200 cP**	Note 1
Viscosity @ -25°C, Brookfield	ASTM D-2983	**1,180 cP**	**1,600 cP**	**3,600 cP**	**4,400 cP**	Note 1
Viscosity Index	ASTM D-2270	**183**	**186**	**188**	**189**	90 (min)
Pour Point	ASTM D-97	**-46°C**	**-45°C**	**-42°C**	**-40°C**	Note 1
Flash Point (COC)	ASTM D-92	**240°C**	**244°C**	**253°C**	**254°C**	198°C (min)
Fire Point (COC)	ASTM D-92	**265°C**	**272°C**	**275°C**	**279°C**	218°C (min)
Hydrolytic Stability,	ASTM D-2619					
Copper Wt. Loss (mg)		**0.0417**	**0.0208**	**0.0208**	**0.0208**	0.2
Copper Appearance		**1A**	**1B**	**1B**	**1A**	Report
Water Layer		**3.0**	**3.0**	**3.0**	**3.6**	4
Foam Sequence I, II, III (10 min)	ASTM D-892	**0 Foam**	**0 Foam**	**0 Foam**	**0 Foam**	150/0, 80/0, 150/0
Rust Prevention	ASTM D-665					
Distilled Water		**Pass**	**Pass**	**Pass**	**Pass**	Pass
Syn. Sea Water		**Pass**	**Pass**	**Pass**	**Pass**	Pass
Copper Corrosion Strip 3hr @ 100°C	ASTM D-130	**1A**	**1A**	**1A**	**1 A**	DIN 51524 2(max)
RPVOT, (minutes)	ASTM D-2272	**>600**	**>600**	**>600**	**>550**	USS 120 (min)
Dielectric Strength (KV) (Avg)	ASTM D-877	**42**	**40**	**40**	**40**	>35
Oxidation Stability (Pressure Differential Scanning Calorimeter) min	ASTM D-5483 Modified	**90 (165°C)**	**90 (165°C)**	**90 (165°C)**	**90 (165°C)**	Note 2
Neutralization Number mg KOH/g	ASTM D-974	**<0.4**	**<0.4**	**<0.4**	**<0.4**	1.5 (max)
Swell of Synthetic NBR-L Rubber, % (Avg.)	DIN 53538, Part 1					
Volume Change (%)		**9.0**	**9.0**	**9.0**	**9.0**	0 to 12
Shore A Hardness Change (%)		**-5**	**-5**	**-5**	**-5**	0 to -7
Filterability						
A-No Water (s) (Avg)	Denison TP 02100	**113**	**335**	**335**	**355**	600 (max)
B-2% Water (s) (Avg)	HF-0 Requirement	**187**	**449**	**449**	**470**	2xA (max)
Demulsibility, ML Oil/Water/Emulsion	ASTM D-1401	**40/ 40/ 0 (<10 minutes)**	**40/ 40/ 0 (<10 minutes)**	**40/ 40/ 0 (<10 minutes)**	**40/40/0 (<10 minutes)**	40/37/3 (max) (30 minutes)
4-Ball Wear, 1h, 167°F, 1200 RPM, 40 kg	ASTM D-4172	**0.3 – 0.4**	**0.3 – 0.4**	**0.3 – 0.4**	**0.3 – 0.4**	USS 127 0.5 (max)
FZG Test A/8,3/90	DIN 51354 Part 2	**12**	**12**	**12**	**12**	US.Steel 10 (min)
Biodegradation Classification	ASTM D-5864 OECD 301B	Ultimate PW1 Readily	Ultimate PW1 Readily	Ultimate PW1 Readily	Ultimate PW1 Readily	Ultimate PW1 Readily
Environmentally Friendly	ISO 15380	yes	yes	yes	yes	yes
USDA Biobased Tested	New Carbon	meets/exceeds	meets/exceeds	meets/exceeds	meets/exceeds	meets/exceeds (Over 50%)
Environmental Management System	ISO 14001	yes	yes	yes	yes	yes
Ecotoxicity LC-50 / EC-50	**EPA 560/6-82-002, 003**	meets/exceeds	meets/exceeds	meets/exceeds	meets/exceeds	meets/exceeds
Note 1 Viscosity Sufficient for Application						
Note 2 Not Required						
RLI Product Item #		**81100**	**81110**	**81120**	**81130**	

Availability	F.O.B.: Hartville, Ohio, USA	1 Gallon	5 Gallon Pail	Drum	Totes	Bulk