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Bio-HVO™ Hydraulic Fluid
(ISO 46 & 68 FR Fluids)

STABILIZED™ by Renewable Lubricants

"Biobased Lubricants that Perform Like Synthetics"

Bio-HVO™ Hydraulic Fluids are ultimately biodegradable[1] vegetable based formulas that have been USDA Biobased tested to show new carbon (vegetable oil) at >96% and they are **Specially formulated to offer the lowest toxicity in aquatic conditions.** They are an excellent choice for inner plant applications (ie. Steel Mills) as fire resistant (FR) hydraulic fluids, with exceptional oxidation stability (RBOT 350-400 minutes) and exceeding US Steel minimum requirement of 120 minutes. **Although they have a pour point of -25°C, care must be taken if used in hydraulic systems setting static below 0°C for extended periods.**

Bio-HVO™ Hydraulic Fluids are formulated to perform in stationary and mobile hydraulic systems that require Anti-Wear, Anti-Rust and Anti-Oxidation properties. These patented super high VI fluids have a long history of successfully being used in hydraulic systems designed with vane, piston, and gear-type pumps, that require DIN 51524 Part 2 and 3, Parker-Denison HF-O, HF-1, HF-2, Eaton-Vickers, Rexroth, and Sauer-Sundstrand. They also meet the requirements for ashless GL-1, GL-2, GL-3 and AGMA Non-EP gear oils in 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 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 DIN 51524 Part 2 and 3 load stage 10 in the FZG (DIN 51354). 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 of the Stabilized* High Oleic Base Stocks (HOBS) into the formulas, gives multi-grade synthetic base oils performance by boosting the viscosity index to synthetic levels (Energy Conserving Formulas). An environmentally friendly, zinc-free additive system has also been developed that meets or exceeds high pressure pump requirements.

Fire Resistant Performance: The super high viscosity index of the HOBS naturally improves the thermal shear stability of the formulas and their load capacity. The HOBS's extremely low volatility (NOACK <1) and excellent oxidation stability improves the flash and fire safety features in these formulas. In ASTM D-92, Flash Points range from 532°F (278°C) to 536°F (280°C) and Fire Points range from 635°F (335°C) to 644°F (340°C). Based on test results and proven optimized patented formulations, Hydro Safe® FR hydraulic fluids ISO VG-46 (FR), ISO VG-68 (FR), which are vegetable oils derived fire-resistant hydraulic fluids, meet the Factory Mutual as a less hazardous fluid "Specification Tested" ISO/CD 15029-3 rating (HFDU), and ISO/TS 15029-2 Spray Ignition-Ignitability (Class H). Previous studies have supported the expected temperature ranges of Autoignition (ASTM D-2155) @ 752 - 815°F (400 - 435°C) and Manifold Ignition (ISO 20823) @ 824 - 896°F (440 - 480°C).

Bio-HVO™ 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. Bio-HVO™ Hydraulic Fluids are **ENVIRONMENTALLY ACCEPTED LUBRICANTS (EALs)** that are formulated from renewable agricultural biobased resources. We believe Earth's environmental future rests in the use of renewable materials.

[1]Ultimate Biodegradation (Pw1) 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.

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

Bio-HVO™ Hydraulic Fluid

TYPICAL SPECIFICATIONS Page 2 TEST	METHOD	**Bio-HVO 46**	**Bio HVO 68**
Specific Gravity @ 15.6°C	ASTM D-287	**0.92**	**0.92**
Viscosity @ 40°C	ASTM D-445	**47.5**	**66.5**
Viscosity @ 100°C	ASTM D-445	**10**	**13.5**
Viscosity @ -15°C, Brookfield	ASTM D-2983	**1100 cP**	**1500 cP**
Viscosity Index	ASTM D-2270	**200**	**210**
Pour Point	ASTM D-97	**-25°C**	**-23°C**
Flash Point (COC)	ASTM D-92	**532°F/278°C**	**536°F/ 280°C**
Fire Point (COC)	ASTM D-92	**635°F/335°C**	**644°F/340°C**
Volatility 1 hour @ 250°C	NOACK	**1%**	**1%**
Hydrolytic Stability,	ASTM D-2619		
Copper Wt. Loss (mg)		**0.01**	**0.01**
Copper Appearance		**1B**	**1B**
Water Layer		**0.17**	**0.17**
Foam Sequence I, II, III (10 min)	ASTM D-892	**0 Foam**	**0 Foam**
Rust Prevention	ASTM D-665		
Distilled Water		**Pass/Clean**	**Pass/Clean**
Syn. Sea Water		**Pass/Clean**	**Pass/Clean**
Cincinnati Machine Thermal Stability Procedure A			
Precipitate or sludge, mg/100ml		**0.6**	**0.6**
Steel Rod			
Deposit, mg		**3**	**3**
Metal Removed, mg/200 ml		**Nil**	**Nil**
Copper Rod			
Deposit, mg		**7**	**7**
Accelerated Storage Stability		**Pass**	**Pass**
Copper Corrosion Strip 3hr @ 100°C	ASTM D-130	**1A**	**1A**
Copper Corrosion Strip 3 Days @ 100°C	ASTM D-130	**1B**	**1B**
RPVOT, (min)	ASTM D-2272	**350-400**	**350-400**
Dielectric Strength, KV (Avg)	ASTM D-877	**47**	**46**
Acid Number	ASTM D-974	**0.4**	**0.4**
Elastomer Testing BUNA-N Rubber			
Volume Change, %	D-471	**1.6**	**1.6**
Shore A Hardness Change	D-2240	**0.0**	**0.0**
Demulsibility, ML Oil/Water/Emulsion	ASTM D-1401	**40/ 40/ 0**	**40/ 40/ 0**
4-Ball Wear, 1h, 167°F, 1200 RPM, 40 kg	ASTM D-4172	**0.3-0.4**	**0.3-0.4**
FZG Test A/8,3/90	DIN 51354 Part2	**12**	**12**
Biodegradability	CEC-L33-T-82	**>80%**	**>80%**
	OECD 301B Mod. Sturm	**>60%**	**>60%**
	ASTM D-5864	**>60%**	**>60%**
Ecotoxicity			
Fathead minnow, 96h LC50, ppm		**>10,000 ppm**	**>10,000 ppm**
Daphnis magna, 48 h, EC50, ppm		**>10,000 WAF**	**>10,000 WAF**
Sludge respiration inhibition, EC50, ppm		**>10,000 ppm**	**>10,000 ppm**
Meets EPA requirements 560/6-82-002, 560/6-82-003		**Yes**	**Yes**
Biodegradation Classification	ASTM D-5864	Ultimate PW1	Ultimate PW1
Environmentally Friendly	ISO 15380	Yes	Yes
USDA Biobased Tested	New Carbon	Yes	Yes
Environmental Management System	ISO 14001:1996	Yes	Yes
RLI Product Item #		**81500**	**81510**