Renewable Lubricants™, Inc.
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Bio-HVO™ Hydraulic Fluid
(ISO 46 & 68 FR Fluids)

STABILIZED™ by Renewable Lubricants

ISOGREEN CERTIFIED 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 previous test results, HVO Hydraulic Fluids ISO 46 (FR) and ISO 68 (FR) can be Factory Mutual approved as less hazardous fluid "Specification Tested" ISO/CD 15029-3 rating (HFDU), and ISO/TS 15029-2 Spray Ignition-Ignitability (Class H). The tests 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. Because they meet the environmental requirements they can also be used where ISO 15380 HEES (unsaturated) or HETG Hydraulic Fluids are specified. 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/Readily 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.

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

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

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TYPICAL SPECIFICATIONS

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	**45**	**45**
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
	OECD 301B	Readily	Readily
Environmentally Friendly	ISO 15380		
		Yes	Yes
USDA Biobased Tested	New Carbon		
Environmental Management System	ISO 14001:1996	Yes	Yes
		Yes	Yes
RLI Product Item #		**81500**	**81510**