

BioBlend White Paper:

## **Hydraulic Fluid Classifications per ISO 6743-4: A Brief Overview**

### **Abstract**

Hydraulic fluids continue to expand their critical role and work multi-functionality within the marketplace. Considering the incompressible nature of oils, the work performed by hydraulic fluids is essential to proper functioning of hydraulically actuated equipment of all types.

Biodegradable hydraulic fluids continue an increasing trend of replacing conventional petroleum and synthetic hydraulic fluids. Technology offerings have evolved to the point where many bio-hydraulic fluids offer the same or better performance than conventional petroleum or synthetic hydraulic fluids, while offering a decisive environmental advantage. Due in part to the expanding role of biodegradable hydraulic fluids, and because the diversity of hydraulic fluid types has become so broad, the need to further classify hydraulic fluid types was evident.

The International Organization for Standardization (ISO) established a classification system for hydraulic fluids that is designated; **ISO 6743-4: 1999, Lubricants, Industrial Oils and Related Products (Class L – Classification – Part 4: Family H (Hydraulic Systems))**.

- ✓ Lubricants, industrial oils and related products (*class L*)
- ✓ Classifications-Part 4L Family H (*hydraulic systems*)

The ISO 6743-4 classification system can be generally applied to the three primary classes of hydraulic fluids:

- ✓ Biodegradable Hydraulic Fluids
- ✓ Mineral (i.e. petroleum) Hydraulic Fluids
- ✓ Fire Resistant Hydraulic Fluids

For the purpose of providing generalized descriptions to aid you in understanding the many different hydraulic fluid classifications, this BioBlend white paper provides a generalized summary of the ISO 6743-4 classifications that you may find useful in understanding some of the most common hydraulic fluid classifications. It also provides insights into the ISO classification descriptions of the BioFlo Biodegradable Hydraulic Fluid technologies.

### **The ISO 6743-4 classification of [biodegradable hydraulic fluids](#):**

**ISO-L-HETG: Triglyceride Base** (*vegetable oils, i.e. plant oils*)

**HETG = Hydraulic Environmental Triglycerides** = A biodegradable (*vegetable oil based*) hydraulic fluid which uses triglyceride esters as the base fluid. Vegetable oils are all classified as triglyceride esters.

**ISO-L-HEES: Synthetic Ester Base** (*similar to triglyceride but with a non-vegetable based acid & alcohol*)

**HEES = Hydraulic Environmental Ester oil Synthetic** = A biodegradable hydraulic fluid which uses synthetic esters as the base fluid. Synthetic esters share a similar chemical structure to HETG types - but are synthesized rather than derived from natural sources.

**ISO-L-HEPG: Polyalkyleneglycol Base** (*i.e. polyglycol*)

**HEPG = Hydraulic Environmental Polyalkylene Glycols** = A biodegradable hydraulic fluid which uses polyalkylene glycols (*PAGS*) as the base fluid. PAGS are synthesized from hydrocarbon oxides. HEPG's are typically used in areas where fire is a hazard, and may require special seals and/or seal materials.

**ISO-L-HEPR: Other Base Liquid – primarily Polyalphaolefins**

**HEPR = Hydraulic Environmental PAO and Related products** = A biodegradable hydraulic fluid which uses polyalphaolefins and related hydrocarbons as the base fluid. These base stocks are synthesized from crude oil derivatives.

## The ISO 6743-4 classification of [mineral oils \(i.e. petroleum\) hydraulic fluids](#):

ISO-L-HH	Mineral lubricants without corrosion inhibitors
ISO-L-HL	HH lubricants with oxidation reduction and anticorrosive additives
ISO-L-HM	HL lubricants with wear reducing additives
ISO-L-HR	HL lubricants with a high VI
ISO-L-HV	HM lubricants with a high VI
ISO-L-HG	HM lubricants with shock resistant features
ISO-L-HS	Synthetic liquids

**NOTE on Global Classifications:** Because we operate in a global marketplace with equipment deployed throughout North America that's manufactured in other countries, it's likely you may see hydraulic fluid classifications beyond the ISO 6743-4 classification designations. For example, while the classifications of hydraulic fluid are set out in ISO 6743-4 with the designations HL, HM, HV ... in Germany the designations HL, HLP, HVLP are standard and frequently used, in accordance with DIN 51524.

H and HH	Mineral oil with no active ingredients – is no longer used in practice.
HL	With active ingredients to increase the corrosion protection and resistance to aging
HM	With active ingredients to increase the corrosion protection and resistance to aging and to reduce wear due to scoring in the mixed friction area
HLP	Further active ingredients in addition to HL oil to reduce wear and increase resistance in the mixed friction area – widest application in practice
HV and HVLP	Like HLP, but with increased resistance to aging, as well as an improved temperature-viscosity relationship
HLPD	Like HLP, but with additives to improve particle transport ( <i>detergent effect</i> ) and dispersion capacity ( <i>water carrying capacity</i> ) and active ingredients to increase the corrosion protection ( <i>German designation, not standardised</i> )

## The ISO 6743-4 classification of [fire resistant hydraulic fluids](#):

There are several types of fire-resistant fluids and they are generally classified as follows:

- ✓ Oil and water emulsions
- ✓ Water Polymer solutions
- ✓ Anhydrous Synthetics

ISO-L-HFAE	Emulsions – ‘oil-in-water’ (usually >80% water content)
ISO-L-HFAS	Synthetic aqueous fluids - chemical combination in water (usually >80% water content)
ISO-L-HFBB	Emulsions – ‘water-in-oil’ (usually >40% water)
ISO-L-HFC	Glycol solutions, polyalkylene glycol solutions or water glycols (usually >35% water content)
ISO-L-HFDR	Synthetic phosphate esters (without water)
ISO-L-HFDS	Chlorinated hydrocarbons (without water)
ISO-L-HFDT	HFDR/HFDS mixtures
ISO-L-HFDU	Synthetic anhydrous liquids (without water) - other than phosphate ester ... Polyol Ester or PAG (more resistant than HFDR, HFDS, or HFDT)

## Q&A Related to BioBlend Hydraulic Fluid Technologies

**Q. What ISO 6743-4 classification is the [BioFlo AW-series of Biodegradable Hydraulic Fluids](#) (canola base oil)?**

**A.** The BioFlo AW-series of biodegradable hydraulic fluids meet the ISO 6743-4 class definition of an HETG.

- ✓ **HETG = Hydraulic Environmental Triglycerides** = A biodegradable (*vegetable oil based*) hydraulic fluid which uses triglyceride esters as the base fluid. Vegetable oils are all classified as triglyceride esters.

**Q. What ISO 6743-4 classification is the BioFlo AWS-series of Biodegradable Hydraulic Fluids (semi-synthetic)?**

**A.** The BioFlo AWS-series of biodegradable hydraulic fluids is a semi-synthetic and thus is a hybrid or semi-synthetic 'blend' meeting the ISO 6743-4 class definition of an HETG:

- ✓ **HETG = Hydraulic Environmental Triglycerides** = A biodegradable (*vegetable oil based*) hydraulic fluid which uses triglyceride esters as the base fluid. Vegetable oils are all classified as triglyceride esters.
- ✓ **PAO=Polyalphaolefin** = A synthetic base fluid.

**NOTE:** One may consider the addition of PAO to the finished lubricant as an additive that imparts some PAO characteristics to the finished fluid. However it is still >75% biodegradable per OECD 301B testing, and since biodegradability >60% means it meets the EPA's current requirements to be classified as 'Readily Biodegradable', this technology meets the requirements to be classified as an Environmentally Acceptable Lubricant (EAL) as per the EPA's 2013 Vessel General Permit (VGP)..

**Q. What ISO 6743-4 classification is the BioFlo HEES-series of Biodegradable Hydraulic Fluids (full-synthetic)?**

**A.** The BioFlo HEES-series of biodegradable hydraulic fluids meet the ISO 6743-4 class definition of an HEES.

- ✓ **HEES = Hydraulic Environmental Ester oil Synthetic** = A biodegradable hydraulic fluid which uses synthetic esters as the base fluid. Synthetic esters share a similar chemical structure to HETG types - but are synthesized rather than derived from natural sources).

**Q. What ISO 6743-4 classification is the BioFlo HFDU-series of Biodegradable Fire-Resistant Hydraulic Fluids (full-synthetic)?**

**A.** The BioFlo HFDU-series of biodegradable hydraulic fluids meet the ISO 6743-4 class definition of an HFDU.

- ✓ **HFDU = Synthetic anhydrous liquids - other than phosphate ester ... Polyol Ester or PAG ...** (more resistant than HFDR, HFDS, or HFDT)

**Q. Does BioBlend have a hydraulic fluid that would meet the ISO 6743-4 HEPG classification?**

**A.** BioBlend does NOT currently offer any HEPG technologies. While PAG technologies have some interesting characteristics, in real world applications BioBlend believes there are simply too many incompatibility issues. PAG synthetics are incompatible with virtually every other type of oil ... including other PAG synthetics. These incompatibilities make their use in real-world applications problematic with incompatibilities often manifesting themselves as foam, with other operational challenges. Further, the unique specific gravity common to PAG's may be attractive to some ... and worrisome to others. PAG's have a higher specific gravity than water, which means they'll sink. While this addresses any concerns with creating an oil sheen should an inadvertent lube spill occur over water, the environmental impacts PAG's have by coating underwater surfaces as they settle to the bottom is relatively unknown. Lastly, while PAG's are recognized for their ability to hold a lot of water, once water contamination occurs it is extremely challenging to separate that water from the PAG fluid. Even vacuum dehydration units (deployed in some severe water removal scenarios) tend to struggle providing meaningful results trying to separate the water out of the PAG fluid, and vacuum dehydration units are very expensive (some models costing \$30k-\$50k or more).

- ✓ **HEPG = Hydraulic Environmental Polyalkylene Glycols** = A biodegradable hydraulic fluid which uses polyalkylene glycols (PAGS) as the base fluid. PAGS are synthesized from hydrocarbon oxides. HEPG's are typically used in areas where fire is a hazard, and may require special seals and/or seal materials.

**Q. Does BioBlend have a hydraulic fluid that would meet the ISO 6743-4 HEPR classification?**

**A.** BioBlend does NOT currently offer any HEPR hydraulic fluid technologies. There may be some general interest using HEPR hydraulic fluids since the chemical structure of the HEPR molecules are similar enough to conventional hydrocarbon

derivative technologies to minimize or alleviate fundamental consumer questions related to the viability of bio-fluid hydraulic fluids.

- ✓ **HEPR = Hydraulic Environmental PAO and Related products** = A biodegradable hydraulic fluid which uses polyalphaolefins and related hydrocarbons as the base fluid. These base stocks are synthesized from crude oil derivatives.

**Q. Do hydraulic OEM’s generally recognize the ISO 6743-4 hydraulic fluid classifications?**

**A.** BioBlend is a manufacturer and marketer of bio-lube and food grade technologies (*some BioBlend food grade technologies are based on bio-H1 technologies versus conventional white oil H1 technologies*). While we can’t speak directly for equipment OEM’s, a cursory evaluation of hydraulic fluid equipment OEM websites demonstrates the ISO classifications for hydraulic fluids are being used. As an example, look at the following example from the Bosch-Rexroth website:

<b>Hydraulic Fluids - Bosch Rexroth</b>				
<b>Title</b>	<b>Hydraulic fluids based on mineral oils and related hydrocarbons</b>	<b>Environmentally acceptable hydraulic fluids</b>	<b>Fire-resistant, water-free hydraulic fluids</b>	<b>Fire-resistant, water-containing hydraulic fluids</b>
<b>Standard</b>	DIN 51524	ISO 15380	ISO 12922	ISO 12922
<b>Rexroth Data Sheets</b>	RE 90220	RE 90221	RE 90222	RE 90223 <i>(in preparation)</i>
<b>Classification</b>	HL HLP HLPD HVLP HLPD <i>and more</i>	HEPG HEES- <i>partially saturated</i> HEES- <i>saturated</i> HEPR HETG	HFDR HFDU- <i>ester base</i> HFDU- <i>glycol base</i> <i>and more</i>	HFC HFB HFAE HFAS

We hope this basic overview provides you the insights necessary to better understand some of the basic hydraulic fluid classifications currently in use. Please let your BioBlend representative or I know if you have any additional questions.

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