

Eco Fluid Center Ltd.

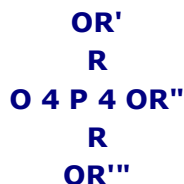
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WHAT ARE PHOSPHATE ESTERS?

There are many types of ester based fluids and several are widely as used as lubricants, as hydraulic fluids and/or as lubricant additives. Examples include phosphate esters, diesters and polyol esters. These are used because they have performance and/or safety advantages over just mineral oil based fluids.

More details later but first, esters themselves have been described as compounds formed by replacing the hydrogen of an acid by a hydrocarbon radical of the ethyl type. The name was coined by the German chemist Gmelin and was some time ago because he died in 1853. Without getting to much into the chemistry, esters can be produced by the reaction of an organic or inorganic acid with an alcohol or with another organic compound containing the hydroxyl (-OH) radical.

Chemically, phosphate esters can be called organic salts of orthophosphoric acid $O=P(OH)_3$. They are also organophosphorous compounds, of which there are thousands. However, only one relatively small group has found significant use as basestocks for synthetic fluids. These are the trisubstituted, or tertiary (t), phosphate esters with the general structure as follows;



Typically all three R groups are organic groups containing four or more carbon atoms. Consequently, the important phosphate esters are either triaryl, trialkyl or aryl alkyl phosphates. The triaryl phosphates are the most significant which can have all three organic groups the same as in tricresyl or trixylenyl phosphate or they might be different as in isopropylphenyl diphenyl phosphate.

Originally the raw materials used included cresylic acids derived from coal tar and coking operations. While still synthetic fluids, they have become known as "natural" phosphate esters. Examples include tricresyl or trixylenyl phosphate and GLCC (was FMC) fluids such as Reolube Turbofluid 32XGT and 46XC. Those made from phenolics derived from other processes are known as "synthetic phosphate esters. Examples of these are isopropylphenyl diphenyl phosphate and tertiary butylphenyl phenyl phosphate. The corresponding FMC fluids are Reolube Turbofluid 46 and Hyd 701 and 32B GT and 46B. The products with GT are for gas turbine driven equipment while the others are for hydraulic and/or electrohydraulic control applications. The different fluids are required because the various fluids have pros and cons. However, they all share the characteristics of being fire resistant and having high flash and fire points

as well as high auto ignition temperatures and low heats of combustion. Plus, having good oxidative stability and EP wear characteristics.

TYPES OF PHOSPHATE ESTER CONTROL FLUIDS					
GREAT LAKES¹ REOLUBE		AKZO-NOBEL² FYRQUEL		TYPE	
EHC³	HYD³	EHC³	HYD³		
Turbofluid 46XC and OMTI	220X	EHC-N (Stauffer EHC³)	220N	Trixylenyl Phosphate Ester (TXP)	Lowest air release times, best hydrolytic stability and good overall.
Turbofluid 46B (Durad EHB)	HYD 46B	EHC-S	220	Butylated Phenol Phosphate Ester (TBPP)	Best bulk oxidation resistance.
Turbofluid 46	HYD 46			Isopropyl Phenol Phosphate Ester (IPPP)	Better hydrolytic stability than butylated synthetics
		EHC⁴		Blend of Butylated Phenol and Trixylenyl Phosphate Ester	A compromise which may depend on what was used for that batch.

Notes

1. Fluids were originally from both FMC and Ciba-Geigy but became FMC and is now Great Lakes Chemical Company.

2. Fluids were originally supplied by Stauffer and later Chesborough, and Chesborough Ponds and Akzo and then Akzo Nobel Chemicals Inc. In 2004 the phosphorous chemicals business was sold to Ripplewood Holdings L.L.C.

3. EHC stands for electrohydraulic control systems that have servo-valves and HYD for control systems not having servo-valves. Typically EHC fluids can be used in HYD systems but the converse is seldom recommended. Also the listed fluids are not necessarily approved for use so check with the turbine manufacturer.

4. Fyrquel EHC was a 100% TXP until about the mid 80's. Exact date is not known.