AEC PowerFlow, LLC
100 SW Scherer Road
Lee's Summit, MO 64082-2000

Phone: 816.531.3800
Fax: 816.531.3806
www.aecpowerflow.com

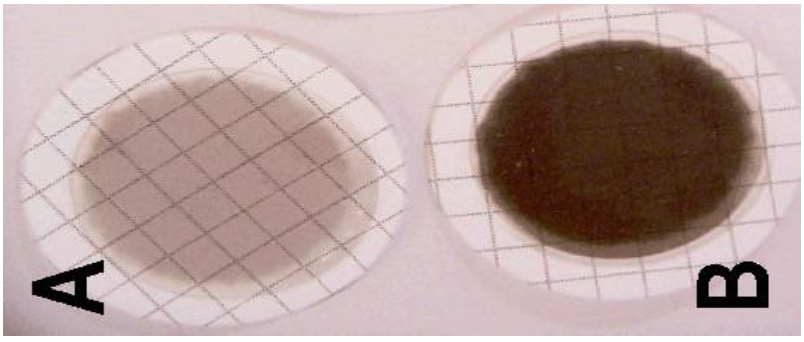
To our Valued Customers,

Subject: Improper Use of Draft ASTM MPC Procedure for Phosphate Ester Fluids

It's been reported that reported that the draft ASTM Membrane Patch Colorimetric (MPC) procedure (Work Item Number: 27308) for determining the "varnish forming potential" for phosphate ester based fluids, is being widely misapplied. The ASTM draft procedure mentioned above is specifically designed for mineral based turbine lube oils only and basically measures the discoloration or stain on a patch.

The procedure clearly states: "This standard was established to assist end users in monitoring their in-service turbine lube oils for the accumulation of lubricant generated insoluble particles, or insoluble oil degradation products." It has not been qualified for phosphate ester fluids and the results (MPC Delta E values) obtained using this procedure are meaningless in terms of their relation to the "varnish forming potential" in an EHC system. Therefore, anyone assigning "ratings" based on the MPC value obtained for phosphate ester fluid is incorrectly doing so based on the criteria established for mineral based turbine lube oils.

In addition, we have found in our testing, that some phosphate ester fluid samples that appear to be acceptable in terms of their key properties, precipitate out a black carbonaceous material when mixed with petroleum ether or hexane, as required by the MPC procedure. For example, both patches below were drawn from the same phosphate ester fluid sample. However, the patch on the left was drawn down without mixing the sample with hexane while the patch on the right was drawn down after mixing with hexane, in accordance with the MPC procedure. It should be noted that the MPC value for the patch on the left is 30, while the MPC value for the patch on the right is 70, which would fall into the "critical" category using the criteria for mineral based turbine lube oils.



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For reference purposes, the procedure for preparing a patch under the ASTM work document is described below. Once the patch is drawn and dried out, the next step is to use a spectrophotometer to determine the Delta E value.

1) Stabilize the sample for 96 hours at room temperature after it was obtained
2) Shake the sample well for a couple minutes
3) Mix 50ml sample fluid with 50ml solvent (petroleum ether) in a clean bottle for a minimum of 30 seconds
4) Draw down the mixture, within 1 – 2 minutes of mixing, through a 47mm diameter, cellulose nitrate analysis membrane using a vacuum setting of 21.0 +/- 1.5" Hg.
5) After drawn down, rinse the membrane thoroughly with a mimimum of 35ml of solvent
6) Let the membrane dry completely prior to the spectrophotometer analysis

Phosphate ester fluids are known to form soluble and insoluble metal soaps by a reaction of the acidic degradation products with the constituents of the solid adsorbents (Fullers Earth, Activated Alumina/zeolite) commonly used for acid scavenging. Metal soaps, particularly those of calcium and magnesium, can precipitate from the fluid and plug high pressure particulate filter elements. Under specific conditions, soluble metal soaps can be deposited on servo valve screens or in the valve body itself causing a "sluggish" response or sticking altogether. In addition, metal soaps can promote foaming, increase air release values and decrease fluid resistivity. Oxidation and hydrolysis of the fluid also produces byproducts that have limited solubility in the fluid and precipitate out as deposits under appropriate conditions. The presence of these materials causes discoloration of the fluid.

The specific tests recommended for monitoring the condition of the phosphate ester fluids are listed in the table below:

Test	Method	Suggested target	Warning level
Viscosity (cSt)	D445	38.4-44.2	+/- 10% initial
Fluid color	D1500	1.5	3
Water content(PPM)	D6304	<500	800
Acid Number (mgKOH/g)	D974	0.05	0.10
Chloride (PPM)	x-ray	10 max	50
Resistivity (Gohm-cm)	D1169	>5	5
ISO Cleanliness level	ISO4406	13/10	15/12
Mineral oil (%)	D02.CS96	<0.5	0.5
Foaming (tend/stab in ml)	D892	10 / 0	50 / 0
Total metal content (PPM)	D5185	0	3
Air release time (minutes)	D3427	<5	7
Flash point (°C)	D92	235`	235

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As a side note, it has also been widely reported that the Draft ASTM MPC procedure is being misapplied to a variety of other fluids, including various hydraulic fluids and gear oils. As discussed above, any results derived from this test would also be meaningless and irrelevant.

This information is being provided as a courtesy to our customers to keep you informed and updated on certain activities taking place in our industry. We are not making any claims, expressed or implied, as to the business practices of any other company or its designated representatives. It is our sole intent to provide you with the data necessary to make the most informed decisions possible.