Maintaining Water Content

Procedure Description

When well maintained, UCON™ Hydrolube HP-5046D will retain its optimum performance for fire-protection, corrosion resistance, and prolonging the service life of the equipment. Maintaining the water content provides the maximum fire resistance, while regulating the amine concentration preserves maximum corrosion protection for metals in contact with the liquid or vapor.

Proper filtration of dirt and sludge is essential for a well maintained fire-resistant hydraulic fluid. Removal of these contaminants will increase the service life of sensitive equipment (pumps, valves, and servomechanisms) and reduce downtime and overall costs caused by lost production.

The water content of UCON Hydrolube HP-5046D imparts fire resistance. As long as the water content is properly maintained, an ignition source will merely generate steam. Water does, however, evaporate during normal hydraulic systems operation. Therefore, deionized or distilled water must be added to retain optimum fire resistance. For addition, always use distilled or deionized water having a conductivity of $\leq 15\mu$mhos/cm.

Measure the water content at least every three to six months, and more often if experience suggests it, particularly where fluid operating temperatures exceed 50°C (122°F). For new service or for changes in operating conditions, test more frequently during the first few months of operation. To minimize evaporation, limit maximum bulk fluid temperature to about 65°C (149°F).

Water loss increases viscosity and changes the refractive index of UCON Hydrolube HP-5046D. Water content can be determined by measuring the viscosity or the refractive index. An accurate analytical method for determining viscosity has been outlined and standardized by the American Society for Testing Materials (ASTM) for correlation with water content, see Table 1 below:

### Table 1: Viscosity vs. Water Addition for UCON Hydrolube HP-5046D

<table>
<thead>
<tr>
<th>Water Make-Up(1) Required</th>
<th>Viscosity(2) at 40°C, cSt</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>42.0 – 53.5</td>
</tr>
<tr>
<td>5</td>
<td>53.5 – 63.0</td>
</tr>
<tr>
<td>10</td>
<td>63.0 – 76.0</td>
</tr>
<tr>
<td>15</td>
<td>76.0 – 92.0</td>
</tr>
</tbody>
</table>

(1) Gallons of water added to each 100 gallons of UCON Hydrolube HP-5046D. Use only distilled or deionized water having a conductivity of $\leq 15\mu$mhos/cm. Add one quart of morpholine to each 25 gallons of water.

(2) ASTM D 445 method.

A more practical plant method for measuring water content is by the refractive index (Table 2). A portable, temperature-compensated (no adjustment needed), hand refractometer determination has been developed for this test.
Maintaining Water Content
(continued)

Determining and Maintaining Water Content with a Refractometer†

1. Obtain a uniform sample of the fluid (one to two ounces should be sufficient) and allow any solids or abrasive matter to separate.

2. Remove the refractometer from its case. Hold the instrument in a horizontal position with the cover plate on top.

3. Lift the cover plate to expose the prism and, using the plastic dipstick, place three or four drops of the sample on the face of the prism. Close the cover plate over the prism immediately to keep evaporation at a minimum.

NOTE: Always use the accompanying dipstick, or an equivalent plastic object, to apply the fluid to the prism. This will avoid scratching the prism face. Plastic medicine droppers or syringes are also acceptable. Do not use glass, wood, metal applicators, or the fingers.

4. Point the prism toward a light source (window or an artificial source) and look through the eye-piece. Take the reading at the point where the dividing line between light and dark crosses the scale. Each unit is divided into quarters. Record the reading to the nearest quarter or, if a more exact number is desired, estimate to the nearest eighth.

5. Clean the prism and cover plate with a soft tissue or cloth moistened with water. Dry the prism and cover plate with a clean soft cloth or tissue and repeat steps 1 through 4 at least three times, taking care to thoroughly clean the instrument between readings.

6. Average the refractometer readings and record. Using this average, refer to Table 2 relating refractometer readings to water content additions for the fluid. Determine how much water, if any, is necessary; and slowly add to reservoir.

NOTE: Use only distilled or deionized water having a conductivity of ≤ 15 µmhos/cm. Add one quart of morpholine for every 25 gallons of water added to the system.

†Manufactured by: Leica, Inc., P.O. Box 123, Buffalo, NY 14240-0123 (716) 891-3000
Distributed by: Fisher Scientific, American Scientific Products-
Model NO.: Reichart-Jung 10432 (Measured in Degrees Brix)

Table 2: Measuring Water Content of HP-5046D with a Refractometer

<table>
<thead>
<tr>
<th>Water Make-Up(1) Required</th>
<th>Refractive Index, Degrees Brix</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>1.411 – 1.416</td>
</tr>
<tr>
<td>5</td>
<td>1.416 – 1.420</td>
</tr>
<tr>
<td>10</td>
<td>1.420 – 1.424</td>
</tr>
<tr>
<td>15</td>
<td>1.424 – 1.429</td>
</tr>
</tbody>
</table>

(1) Gallons of water added to each 100 gallons of UCON Hydrolube HP-5046D. Use only distilled or deionized water having a conductivity of ≤ 15µmhos/cm. Add one quart of morpholine to each 25 gallons of water.

NOTE: All refractometers should be calibrated according to manufacturer’s recommendations.
Control of Alkaline Content

Procedure Description
Optimum protection of equipment against rusting and corrosion can easily be achieved by maintaining the proper level of morpholine in the hydrolube. Morpholine is a volatile vapor and liquid-phase corrosion inhibitor that protects surfaces above and below the liquid level. Because of its relatively moderate vapor pressure at system operating temperatures, the morpholine tends to slowly evaporate from the fluid during service.

Loss of morpholine can be expected to accompany the loss of water that occurs through evaporation under normal operating conditions. The rate of morpholine depletion depends on the operating temperatures (the higher the temperature, the more rapid the depletion) and the system design (an open system will lose additive faster than a closed system). Also the morpholine content can be depleted through contamination. Therefore, it is necessary to establish a routine testing interval for each hydraulic system based on operating experience.

Initially, check the fluid frequently to establish a pattern; then check the fluid on a semi-monthly basis. Depending on the conditions, the interval could then be extended to a quarterly or semi-annual schedule.

General practice has been to make morpholine additions in conjunction with water make-up. The addition of one quart of morpholine is recommended for each 25 gallons of added water. The fluid should then be thoroughly circulated in the hydraulic system reservoir and tested to determine the need for any further morpholine additions, when indicated by the alkalinity level.

Morpholine content in hydrolubes is determined by measuring the alkalinity of the fluid. The alkalinity measurement method follows.

Laboratory Method
The amount of morpholine in the system is a measurement of the alkaline content of the hydrolube. It is defined technically as the number of milliliters of 0.1 N hydrochloric acid necessary to neutralize 100 milliliters of the fluid to a pH of 5.5.

The normal alkaline reserve of UCON Hydrolube HP-5046D ranges from 150 to 210. An accurate determination of alkalinity should be conducted by a testing laboratory using standard accepted neutralization procedures. The following table indicates the amount of morpholine required to properly adjust the alkalinity of UCON Hydrolube HP-5046D.

<table>
<thead>
<tr>
<th>Determination Alkaline Content of UCON Hydrolube HP-5046D</th>
<th>Quarts of Morpholine to be Added to Each 100 Gallons of Hydrolube</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 – 210</td>
<td>None</td>
</tr>
<tr>
<td>125 – 150</td>
<td>1</td>
</tr>
<tr>
<td>100 – 125</td>
<td>2</td>
</tr>
<tr>
<td>75 – 100</td>
<td>3</td>
</tr>
<tr>
<td>50 – 75</td>
<td>4</td>
</tr>
</tbody>
</table>

†Expressed as milliliters of 0.1 N HCl required to neutralize 100 milliliters of fluid to a pH of 5.5.

NOTE: Since morpholine is an organic base, it should be handled with care. Refer to manufacturer’s Material Safety Data Sheet for handling procedures.
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