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## Super Lube® Non-Flammable Hydraulic Oil Fluid Maintenance and Control of Alkaline Content

### Fluid Maintenance

Super Lube® Non-Flammable Hydraulic Oil will have optimum fire protection, impart excellent resistance against corrosion and rusting, and will prolong the service life of the equipment if the fluid is properly maintained. Maintaining the water content provides 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 Super Lube® Non-Flammable Hydraulic Oil imparts fire resistance. As long as the water content is properly maintained, an ignition source will merely generate steam.

Water does, however, evaporate from Super Lube® Non-Flammable Hydraulic Oil 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 <15 µmhos/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 the viscosity and changes the refractive index of Super Lube® Non-Flammable Hydraulic Oil. 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.

**Table 1 – Viscosity vs. Water Addition for Super Lube® Non-Flammable Hydraulic Oil**

Water Make-Up Required *1	Viscosity *2 (cSt at 40°C)
None	39-50
5	50-56
10	56-68
15	68-82
20	82-102
25	102-124

\*1 Gallons of water added to each 100 gallons of Super Lube® Non-Flammable Hydraulic Oil. Use only distilled or deionized water having a conductivity of <15 µmhos/cm. Add one quart of morpholine to each 25 gallons of water.

\*2 ASTM D 445 method.



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**Procedure for  
Determining and  
Maintaining Water  
Content of  
Super Lube®  
Non-Flammable  
Hydraulic Oil  
with a  
Refractometer (a,b)**

A more practical plant method for measuring water content is through refractive index. A portable, temperature-compensated (no adjustment needed), hand refractometer can be used for this purpose. Use the following procedure to measure the water content with this instrument.

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 a 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, turn to Table 2 and Table 3 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  $\mu$ mhos/cm. Add one quart of morpholine for every 25 gallons of water added to the system.

- (a) 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)
- (b) All refractometers should be calibrated according to manufacturer's recommendations.



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**Table 2 – Refractive Index vs. Water Addition for Super Lube® Non-Flammable Hydraulic Oil**

Water Make-Up Required *1	Refractive Index
None	1.409-1.414
5	1.414-1.416
10	1.416-1.420
15	1.420-1.423
20	1.423-1.427
25	1.427-1.431

\*1 Gallons of water added to each 100 gallons of Super Lube® Non-Flammable Hydraulic Oil. Use only distilled or deionized water having a conductivity of <15 µmhos/cm. Add one quart of morpholine to each 25 gallons of water.

**Table 3 – Refractive Index as Degrees Brix vs. Water Addition for Super Lube® Non-Flammable Hydraulic Oil**

Water Make-Up Required *1	Refraction Index
None	43.75-46.00
5	46.00-47.25
10	47.25-48.75
15	48.75-50.50
20	50.50-52.50
25	52.50-54.25

\*1 Gallons of water added to each 100 gallons of Super Lube® Non-Flammable Hydraulic Oil. Use only distilled or deionized water having a conductivity of <15 µmhos/cm. Add one quart for morpholine to each 25 gallons of water.

## Control of Alkaline Content

Optimum protection of equipment against rusting and corrosion can be assured and easily achieved by maintaining the proper level of morpholine in the Super Lube® Non-Flammable Hydraulic Oil. Morpholine is a volatile vapor and liquid-phase corrosion inhibitor, which 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 this 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 Super Lube® Non-Flammable Hydraulic Oils is determined by measuring the alkalinity of the fluid. The alkalinity measurement method follows.



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### Laboratory Method

The amount of morpholine in the system is a measurement of the alkaline content of the Super Lube® Non-Flammable Hydraulic Oil. 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 Super Lube® Non-Flammable Hydraulic Oils ranges from 150 to 210. An accurate determination of alkalinity should be conducted by a testing laboratory using the standard accepted neutralization procedures.

The following table indicates the amount of morpholine required to properly adjust the alkalinity of Super Lube® Non-Flammable Hydraulic Oil.

Determined Alkaline Content *1 of Super Lube® Non-Flammable Hydraulic Oil	Quarts of Morpholine to be Added To Each 100 Gallons of Super Lube® Non-Flammable Hydraulic Oil
150-210	None
125-150	1
100-125	2
75-100	3
50-75	4

\*1 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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