

# Hydraulic System Design Considerations When Using Water/Glycol Hydraulic Fluids

## Introduction

The following guidelines are offered as general recommendations for hydraulic systems employing No-Fire WG series water/glycol based fire resistant hydraulic fluids. In all cases equipment manufacturers' recommendations should be followed if they differ from those listed below.

## Pumps

Hydraulic pumps should not be operated above their recommended speed or pressure. For high pressure operations (> 3,000 psi) No-Fire HPWG 46B should be used, it is designed for use at pressures up to 7,000 psi. In general, most hydraulic pumps can be operated on water/glycol based fluids without being de-rated to lower speed operation.

Manufacturers' recommendations on pump inlet vacuum and inlet size for water/glycol fluids should be followed. Pump inlets should be kept as short as possible and free of any restrictions which may cause a pressure drop. In addition, pumps should be placed below the fluid reservoir in order to create a positive suction head and avoid cavitation. Cavitation results in excessive pump noise, vibration, erratic response, and reduced pump service life. Cavitation is also accompanied by metal removal, reduced flow, and loss in efficiency.

Suction strainers should be 50 mesh and be rated at 4 times the pump capacity.

## Fluid Reservoir

Pressurized fluid reservoirs are strongly recommended in order to minimize potential pump starvation and to minimize water evaporation from the fluid.

Contamination of fluid reservoirs can be minimized by installing filters on reservoir breathers. Air entrainment can be minimized by placing fluid return lines below the fluid surface and installing internal baffles. Internal baffling will also promote the settling of fines.

## Filters

Paper or cellulosic filters should not be used with water/glycol fluids, water resistant or fiberglass filters should be used instead. In many systems a 10 micron filter is adequate, but some users with fine servo valves may wish to use filters as small as 3 microns. In general, nominal filters should be avoided; filters with a beta ratio of at least 100 are recommended ( $\beta_x > 100$ ). The table below lists filter recommendations for various types of systems and suggested acceptable contamination levels. In all cases your equipment suppliers should be consulted to determine the appropriate degree of filtration for your various system components. Overfiltering generally leads to short filter life.

Target ISO Code for Particles		Maximum Particle Count		System Sensitivity	Type of Hydraulic System	Suggested Filter Size (mm)
5 mm	15 mm	5 mm	15 mm			
13	9	4,000	250	Critical	Silt sensitive control system with very high reliability. Laboratory or aerospace.	3
15	11	16,000	1,000	Semi-Critical	High performance servo & high pressure long life systems, i.e. aircraft, machine tool, etc.	5
16	13	32,000	4,000	Important	High quality reliable systems. General machine requirement.	10
17	14	130,000	8,000	Average	General machinery & mobile systems.	10
19	15	250,000	16,000	Crude	Low pressure heavy industrial systems, or applications where long life is not critical.	15-25

## Seals

Water/glycol fluids are compatible with many common seal materials which are normally used with petroleum based fluids. The table below lists general compatibility guidelines; however compatibility should be verified with your seal manufacturer.

### Suitable Elastomers

Fluorocarbon (Viton, Teflon)  
 Silicone (Silastic)  
 Fluorosilicone  
 PNF (phosphonitrilic fluoroelastomer)  
 Ethylene-Propylene  
 EPDM (ethylene-propylene diene terpolymer)  
 Natural Rubber (polyisoprene)  
 Butyl Rubber (isobutylene/isoprene)  
 Buna N (acrylonitrile-butadiene rubber, Nitrile, NBR)  
 Neoprene Rubber(Chloroprene)

### Unsuitable Elastomers

Buna S (styrene-butadiene rubber, SBR)  
 Polyurethane

PRODUCT DATA:	FIL-250-G2
REVISION:	001
ISSUED:	12/13/96
REVISED:	12/13/96

Epichlorohydrin  
Other polar elastomers  
Leather (dynamic seals)  
Cork (dynamic seals)

Moderate seal swell is generally desirable in order to ensure good sealing. Elastomers which shrink significantly should be avoided; systems employing them should be monitored and tightened up frequently to accommodate expected seal shrinkage. Teflon (fluorocarbon) is compatible with water/glycol, but does not swell significantly. Silicone is also compatible, but has been known to undergo considerable shrinkage.

Dynamic seals made of leather or cork should be avoided due to swelling caused by the water contained in water/glycol fluids. These materials, however, are suitable for use as static seals. Teflon back up rings are recommended in place of leather.

Compatibility should be assessed for any plastic components (such as reservoir sight glasses) exposed to a hydraulic fluid. Homalite polycarbonate is not recommended at 25C or 100C. Lexan resin is not a recommended polycarbonate.

## **Bearings**

For system components using internally lubricated bearings, sleeve and journal bearings work best. Ball and roller bearings can also be used, however, needle bearings should be avoided. Service life of some anti-friction bearings may be reduced when using water/glycol fluids, your bearing manufacturer should be contacted to obtain the specific derating or alternative bearing recommendations.

## **Fluid Coolers**

Fluid coolers should be employed to maintain the operating temperature of water/glycol fluids below 65°C (150°F). Cooler temperatures will result in better fluid lubricity and lower fluid maintenance (due to water evaporation from the fluid).

## **Aluminum Compatibility**

If aluminum components are to be used they should be anodized. Consult your component manufacturer regarding specific compatibility with water/glycol.

## **Other Components**

Most metals except zinc and cadmium are acceptable for use with water/glycol fluids.