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# PRODUCT INFORMATION

*A PRODUCT OF AMERICAN CHEMICAL TECHNOLOGIES, INC.*

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## FR WG 200-D

*Water-Glycol, Fire Resistant Hydraulic Fluid*

The use of industrial fluid power or hydraulics has increased substantially over the past two decades---not only in U.S. industry but also in worldwide industry. In addition to this increase in fluid power usage, we have seen some rather drastic changes in the operating conditions of industrial hydraulic circuitry over the same time span.

Increased production demands, larger work pieces, and higher output machinery have all had the net effect of elevating hydraulic system operating pressures in most industries. This, in itself, has imposed greater performance demands on hydraulic fluids. Fluids that were designed to perform at 1,000 psi cannot adequately satisfy the requirements of today's pressures of 2,000 psi and higher.

Hand in hand with these changes in hydraulic system conditions, we also find a substantial increase in the volumes of fire resistant fluids being consumed by our industrial segment. This has been brought about, in part, by increased regulations at all levels of government to insure safe working conditions for our labor forces. In addition to these regulatory codes, industrial management, as a whole, has a keen awareness of the devastating cost penalties resulting from plant fires. As system pressures go higher, the chance of hydraulic line rupture increases and the potential for fire becomes greater. Therefore, a modern fire resistant hydraulic fluid must offer the consumer not only maximum fire protection, but must give the optimum lubrication and wear protection necessary for pumps and other hydraulic hardware running at these elevated pressures.

FR WG 200-D is a water glycol fire-resistant hydraulic fluid developed and designed specifically to operate at system pressures in the 2,000 to 4,000 psi range, depending on pump type (i.e., vane vs. piston). This unique formulation contains more than

a sufficient amount of water to prevent the propagation of fires in the event of a hydraulic line rupture near an ignition source. Moreover, FR WG 200-D has all the necessary lubrication and anti-wear properties required of a hydraulic fluid for service in high-pressure, high-output systems. Other advantages include:

- Excellent corrosion protection—both liquid and vapor phase—to the metals commonly used in hydraulic systems.
- The superior heat transfer characteristics of water.
- The viscosity/temperature properties, combined with a very low pour point, prevent or minimize cavitation and cold start-up pump wear problems associated with other fluids having poorer viscosity/temperature problems.
- Compatible with most conventional seals, gaskets, and “O” rings.
- Can be satisfactorily mixed with other water-glycol type fluids.
- Resistant to oxidation and chemical breakdown.
- Will not separate when in normal use and storage.

### **FIRE RESISTANCE**

Fire resistance is imparted to FR WG 200-D through its water content that is released as a snuffing blanket of steam if the fluid comes in contact with an ignition source. Because of its water content, this product has the ability to prevent flame propagation when fire occurs. FR WG 200-D has been tested and approved by Factory Mutual Research.

In order to insure continued fire resistance, the water content of FR WG 200-D must be maintained and not allowed to drop below 35%. This is true of any water-glycol fluid. In order to insure against excessive water evaporation in open hydraulic systems, operating temperatures should be maintained as low as possible and should not exceed 150°F.

A Hydraulic Fluid Monitoring Program is available for feedback on particular fluids in service.

### **HEAT TRANSFER**

Water and water containing compositions such as FR WG 200-D are superior heat transfer media. Water glycol fluids have marked advantages over mineral oils or synthetic type FR fluids in this respect.

### **SHEAR STABILITY**

FR WG 200-D contains a water soluble polymer which gives the fluid its viscosity properties. The close tolerances in hydraulic pumps and other hardware have a tendency to break down certain polymers. This action is called mechanical shearing. The special polymer used in formulating FR WG 200-D is completely resistant to this mechanical shearing, and the fluid will not undergo viscosity change due to shearing.

### **VISCOSITY INDEX**

The viscosity index of a fluid defines the degree to which the fluid resists thinning out at elevated temperatures. In the viscosity index rating system, the lower the VI number of an oil or fluid, the greater the spread between the fluid's viscosity measured at 100 °F, and its viscosity measured at 210 °F. Therefore, fluids with high VI numbers show a much lower spread than low VI fluids.

FR WG 200-D has a viscosity index of 200 when tested using the ASTM D-2270 procedure. Shown below is a comparison between FR WG 200-D and other commonly used hydraulic fluids.

<b><u>Fluid Type</u></b>	<b><u>Viscosity Index</u></b>
R & O Oil	95
A/W Hydraulic oil	95
Automatic Transmission Fluid	160
10 W 30 Motor Oil	140
Synthetic FR Fluid	70
<b><i>FR WG 200-D</i></b>	<b><i>200</i></b>

The temperature/viscosity relationship of FR WG 200-D assures the user of minimum fluid thin-out at operating temperatures, hence, better lubricity.

### **POUR POINT**

The pour point of a fluid is the measured temperature at which the fluid will no longer flow under prescribed test conditions. FR WG 200-D has a pour point below -35 °F. In addition, this fluid

can be repeatedly frozen and thawed without any loss in its homogeneity. The excellent low temperature flow properties of FR WG 200-D, coupled with its high viscosity index, offers the user the maximum in fluid performance over a wide temperature range. Its excellent low temperature properties minimize pump problems on cold start-up and its high VI assures adequate viscosity and lubricity at running conditions.

### **COMPATIBILITY WITH COMMONLY USED METALS**

FR WG 200-D is formulated with special corrosion inhibitors to provide corrosion protection in both the liquid phase and the vapor phase. Vapor phase protection is especially desirable when machines do not operate around the clock or are subject to short and long-term shutdowns.

FR WG 200-D will afford corrosion protection to aluminum, copper, brass, cast iron, steel and other metals commonly used in hydraulic circuitry.

Systems utilizing solder, tin, lead, zinc, cadmium or magnesium should not use water glycol fluids, since such fluids are corrosive to these metals. Zinc and cadmium are especially bad and can result in rapid fluid deterioration, as well as corrosion of metals.

### **COMPATIBILITY WITH OTHER WATER GLYCOLS**

FR WG 200-D is compatible and miscible in all proportions with other established water glycol type fire resistant fluids. This assumes that the competitive fluid has been adequately maintained with the proper amount of water and rust inhibitor and is reasonably free of particulate contamination or other forms of contamination.

It is highly recommended that all systems containing competitive water glycol, be laboratory tested at ACT's research facility prior to installing FR WG 200-D. These fluids will be tested for the following properties:

- Water Content
- Dirt Level
- Viscosity
- Particle Size
- Rust Inhibitor Level

The A.C.T. representative will be glad to initiate this work including all necessary sample containers, labels, etc.

## **LUBRICITY CHARACTERISTICS**

A high level of anti-wear protection is built into FR WG 200-D. This permits usage in hydraulic systems operating up to 4,000 psi, providing the hydraulic pumps are designed to operate on water glycol fluids at that pressure. Prior to converting any system over to a water glycol fluid from a conventional or synthetic fluid, the pump manufacturer should always be consulted to make sure that the circuit hardware is suitable for water glycol.

The excellent anti-wear properties of FR WG 200-D have been well demonstrated in actual field performance and in laboratory testing. The fluid meets all specifications of U.S. Steel Requirement No. 171, including the ASTM D-2882, 2,000 psi pump test. The following chart compares FR WG 200-D to other hydraulic fluids in this high-pressure pump test response:

<b><u>Fluid Type</u></b>	<b><u>Ring &amp; Vane Wear mg. (1)</u></b>
Straight Oil	600-800
R & O Oil	500-700
Inverted Emulsion	150-400
<b><i>FR WG 200-D</i></b>	<b><i>&lt; 50</i></b>
Other Water Glycols	50-100
AW Hydraulic Oil	15-50
Synthetic FR Fluid	< 30

(1) ASTM D-2882, 100 hours, 150 °F, 2,000 psi,  
Vickers 104-C Vane Pump

A.C.T.'s FR WG 200-D offers the consumer the maximum wear protection available in a water-glycol type hydraulic fluid.

## **TOXICITY AND HANDLING**

FR WG 200-D contains no nitrosamines or other established or suspected carcinogens.

FR WG 200-D contains about 40.0% diethylene glycol. The lethal dose for rats of diethylene glycol is 20,760 mg/kg. Oral toxicity is expected to be moderate in humans even though tests with animals show a low degree of toxicity. Should this product be ingested or swallowed, vomiting should be induced immediately, and a physician contacted at once. Breathing of the vapors should be avoided. This product could cause skin irritation or sensitization in some humans. Plastic or rubber gloves are recommended when handling. After handling, washing with soap and water is

recommended. FR WG 200-D contains a basic amine-type corrosion inhibitor. Compounds of this type will cause eye irritation. In case of contact, rinse the eyes with large amounts of cool water and contact a physician at once.

FR WG 200-D is a slippery liquid and spills constitute a definite safety hazard. Spills should be cleaned up immediately by either washing or hosing with water or by treating the affected area with commercially available spill absorbents.

## **SEAL AND "O" RING COMPATIBILITY**

FR WG 200-D can be operated with a wide variety of seal and gasket materials. Elastomers such as natural rubbers, Buna N, Buna S and Neoprene are unaffected by the fluid. Other materials such as Viton, Teflon, and other similar types are also satisfactory. The only seal and gasket configurations not acceptable are leather, cork, cellulose or other substances that will absorb water and either swell or deteriorate as a result.

## **OIL SEPARATION PROPERTIES**

When converting a hydraulic system over from a mineral oil, synthetic, or oil-synthetic fluid type, there is usually some residual oil based fluid left in the system which has a tendency to slightly emulsify with water glycol fluids. This results in a pink-milky looking mixture. In time, the oil or synthetic will separate. In the case of a mineral oil, it will float on top of the reservoir and can be skimmed. Phosphate esters or other synthetics have specific gravities greater than water glycol fluids and will collect at the bottom of the sump after separation. These residuals can be bottom drained from the reservoir.

FR WG 200-D is not prone to form stable emulsions and rapid oil separation can be expected after the conversion. However, certain used phosphate esters where oxidation has occurred may take longer to separate. A complete conversion is outlined later in this bulletin. The suggested conversion procedure is essentially that recommended in the National Fluid Power Association Standard P93-5-1973.

## **RESERVOIR PAINTS & COATINGS**

All water glycol type fluids will tend to dissolve or deteriorate many conventional paints and coating systems commonly used in sumps and reservoirs. When converting any system over to FR WG 200-D, any paint or coating used in the system, which is

known to be incompatible with water glycol systems, should be removed and replaced with a coating system that is compatible with water glycol. Several of the leading paint suppliers manufacture systems that are acceptable for water glycol usage. These suppliers should be contacted for application and paint types to be used.

### **PIPE JOINT COMPOUNDS & GREASES**

FR WG 200-D and all other water glycol fluids may tend to dissolve or soften certain pipe thread dopes. It is recommended that either Teflon pressure tape or pipe compounds that have water-glycol compatibility be used.

The use of soda based greases in and around hydraulic circuits should be avoided due to their proneness to emulsify with water glycol fluids. Grease selection should be restricted to those having good water tolerance such as lithium, calcium, aluminum complex and calcium sulfonate complex.

### **CONVERSION PROCEDURE**

When converting a system to FR WG 200-D from either a conventional mineral oil based fluid or another type of fire resistant or synthetic fluid, it is important that the following procedures be used. Compliance with these conversion procedures will permit the changeover to proceed with the minimum amount of difficulty and will benefit the service life and performance of the fluid.

Completely drain all fluid from the sump, lines, coolers, actuators, etc. Wipe clean. Remove any interior paint that is not compatible with water glycol type fluids. Sand blast sump interior down to white metal and apply water glycol paint system. Replace any seals or "O" rings that are not generally recommended for water glycol fluids. Reconnect lines, accumulators, coolers, etc. using either Teflon pressure tape or a suitable pipe joint compound. Make sure any grease used is water-resistant.

Replace any filters that are not suitable for water glycol service. If there is any doubt, the filter supplier should be contacted for recommendations.

Make absolutely sure that the pump on the equipment is suitable for water glycol service. Consult the pump manufacturer.

Install a mesh strainer on the pump inlet. Usually a 60-mesh screen is adequate. DO NOT PUT A

FILTER ON THE PUMP INLET. Due to the high bulk density of water glycol fluids and the resultant suction lift demands, the pump inlet must never be restricted without prior discussion with the pump manufacturer. Cavitation can result from a restricted pump inlet.

When converting from a conventional petroleum fluid or other water glycol type, fill the system with FR WG 200-D to a minimum level to maintain pump suction and operate the system for 30 minutes at reduced pressures. When converting from a synthetic type oil-synthetic fluid first pre-flush the system with a light straight mineral oil before flushing with FR WG 200-D.

Drain system immediately and fill to operating level with FR WG 200-D.

Where a system already contains another water glycol fluid, it is permissible to start using FR WG 200-D directly as make-up, providing the existing fluid is of an acceptable cleanliness level and contains the proper amount of water and rust inhibitor. Prior to adding FR WG 200-D to a system containing another water glycol fluid it is strongly recommended that the fluid in the system be analyzed by A.C.T.'s laboratory. Your A.C.T. representative will furnish all necessary bottles, labels, etc. to facilitate this testing.

Start up the system and slowly bring it up to normal operating system pressure and conditions.

Periodically check filters and strainers for the first few weeks of operation. These components could get clogged with sludge and deposits resulting from the flushing of the system. If the system has been changed over from an oil or synthetic type fluid, FR WG 200-D may take on a pink-milky appearance. This is normal and will occur with any water glycol type fluid. This is due to slightly emulsified oil or synthetic fluid left in the system after flushing and, in time, the emulsion should break, allowing free oil to be skimmed from the sump if it is mineral oil or drained from the bottom if it is a synthetic.

### **WATER CONTROL & MAKEUP**

It is necessary to maintain the water level of FR WG 200-D within acceptable limits. Excessive water reduces the fluid's viscosity and its ability to lubricate and prevent pump slippage. Insufficient water will render the fluid non fire-resistant as well

as raise its viscosity and bulk density both of which will contribute to pump cavitation.

Two acceptable methods may be used to control the water level of FR WG 200-D: 1.) Indirectly, by viscosity determination, 2.) Directly, by laboratory methods, using the Karl Fischer titration. The water level of FR WG 200-D cannot be determined by distillation procedures. The viscosity approach is not acceptable to systems containing large amounts of oil or systems where the fluid is predominately not FR WG 200-D. Portable viscosity gauges are available at nominal costs to determine viscosity at machine side. It is important that the gauges be standardized for FR WG 200-D. The attached table can be used with acceptable accuracy to determine the amount of water required to adjust the fluid to acceptable limits. Only distilled, deionized, reverse osmosis, or controlled boiler feed water should be used as makeup. The use of hard tap water, well or spring water should be avoided since these waters will react with the additive system in the fluid causing fluid haziness and formation of soap-like insoluble material.

### **ALKALINITY CONTROL**

FR WG 200-D contains an alkaline corrosion inhibitor called morpholine. The fluid is blended to contain a surplus of the additive, which is called the alkaline reserve. Morpholine will slowly evaporate from the fluid, which gives vapor phase protection. The hotter the system operating temperature, the greater the evaporation loss. The morpholine loss usually goes hand-in-hand with the water evaporation loss.

Therefore it may be necessary, from time to time, to replenish the additive if normal fluid makeup is not sufficient to maintain the alkaline reserve. As a rule of thumb, if system-operating temperatures are maintained at 120 °F or lower, and a normal amount of new FR WG 200-D is being added as makeup, no alkaline adjustment will be necessary. Conversely, in systems running at more elevated temperatures, the morpholine loss may occur at a greater rate than normal new fluid makeup can replenish. When this occurs, supplemental morpholine should be added.

The amount of morpholine in FR WG 200-D is a measurement of the alkaline content of the fluid. It is defined technically as the number of milliliters of 0.1 N hydrochloric acid necessary to neutralize 100 ml of fluid to a pH of 5.5. This can only be

determined by a laboratory titration. The normal alkaline reserve of new FR WG 200-D ranges from 160 to 300 ml of 0.1 N hydrochloric acid required to neutralize 100 ml of the pH of 5.5. In an in-service basis, it is safe to continue to operate FR WG 200-D without a morpholine adjustment so long as the alkaline content does not fall below 120 in the titration.

If the user of FR WG 200-D suspects his morpholine loss may be excessive due to high operating temperatures and lacks the laboratory equipment necessary to check the alkaline reserve, your A.C.T. representative will arrange for sampling of systems and an A.C.T. laboratory analysis of the fluids.

A.C.T.'s Hydraulic Fluid Monitoring Program is a no-charge, laboratory analysis of in-service water glycol fluids. This analysis can be performed on FR WG 200-D as well as all competitive products. In-service fluids will be analyzed for the following properties:

- Viscosity
- Reserve Alkalinity
- Particle Count
- pH
- Tramp Oil

### **GOOD FLUID MAINTENANCE**

FR WG 200-D will retain its optimum fire protection, impart excellent resistance against rusting and corrosion and prolong the service life of hydraulic components only with good fluid maintenance. Proper water content assures fire resistance. Maintaining the alkaline reserve gives maximum corrosion protection. Proper filtration of dirt and sludge is essential for a well-maintained fire resistant fluid.

American Chemical Technologies has provided the consumer with a superior water glycol fluid in FR WG 200-D. Poor or inadequate fluid maintenance will result in reduced fluid performance and can certainly lead to reduced or lost production and costly downtime.

**FR WG 200-D  
Water Make-Up Chart**

<u>Viscosity, SUS @ 100 °F</u>	<u>Gallons of Water for each 100 gal. Fluid</u>
190-210	None
210-230	2
230-260	4
260-290	6
290-320	8
320-350	10
350-380	12
380-410	14
410-450	16
450-480	18
480-510	20
510-530	22
530-560	24

This chart is based upon the amount of fluid in the system at the time the viscosity is determined and not upon the original fluid charge.

Viscosities falling below 190 SUS @ 100 °F contain excess water and only new FR WG 200-D or FR WG 200-D Concentrate should be used as make-up.

Only distilled, deionized, reverse osmosis or steam condensate water should be used.

For larger or smaller systems than 100 gallons, use appropriate multiples or fractions for water addition based on the actual amount of fluid in the system.

This charge is only valid when the system is all FR WG 200-D.

**FR WG 200-D**

**Physical  
Properties**

Specific Gravity, 60/60 °F  
Viscosity, SUS @ 100 °F  
Viscosity, SUS @ 0 °F  
Viscosity, SUS @ 60 °F  
Viscosity, SUS @ 150 °F  
Viscosity, SUS @ 175 °F  
Viscosity Index

Pour Point, °F  
pH

Reserve Alkalinity  
Flash & Fire Point, °F  
Factory Mutual  
Rust Prevention

**Four Ball Wear Test:**

40 kg, 1800 rpm, 1 hr. @ 130 °F,  
Scar Dia., mm

**High Pressure Pump Tests:**

ASTM D-2882

Total Wear, Ring & Vane

ASTM D-2282 – Modified  
Vickers 25 V Intra-Vane Pump  
2,000 psi, 100 hrs., 150 °F  
1,200 rpm, 10 gpm, 5 gal. resr.

Total Wear, Ring & Vane

**Typical  
Value**

1.06-1.10  
195-215  
6,500  
500  
90  
70  
> 200

-53  
9.5  
19.0-23.0  
None  
Approved  
Pass

0.75

< 50 mg.

< 50 mg.