Water Quality

Though often taken for granted, the quality of water mixed with glycol can have an enormous impact on system performance. Marginal quality water can lead to the development of scale, sediment deposits, or the creation of sludge in the heat exchanger, which will reduce heat transfer efficiency. Poor quality water can damage the system by depleting the corrosion inhibitor and promoting a number of corrosions including general and acidic attack corrosion.

Since it is vital to use high quality water for glycol dilution in order to maintain system efficiency and prolong fluid life, you must ensure your water is of sufficiently high quality. Good quality water contains:

- Less than 50 ppm of calcium
- Less than 50 ppm of magnesium
- Less than 100 ppm (5 grains) of total hardness
- Less than 25 ppm of chloride
- Less than 25 ppm of sulfate

Check with your county or city water department to determine the chemical properties of the local water. If your mixing water will be drawn from a well, which typically has extremely hard water, or the local water authority cannot provide an accurate profile, we recommend either testing the water yourself or hiring a commercial water treatment specialist to analyze the water.

A simple test to ensure that water contains less than 100 ppm of hardness is to fill a small sample bottle with 50% inhibited glycol and 50% water. Let the solution stand for 8-12 hours, shaking it occasionally. If any white-colored sediment forms, the water is too hard and should not be used to dilute the glycol.

In those cases where tap water does not meet the standards for quality, using demineralized water that has been distilled, deionized, or passed through a reverse osmosis process to remove harmful minerals and salts.

Fluid Maintenance

The anti-freeze solution must be checked at least once a year in accordance with the manufacturers' recommendations. A base line analysis should be performed within two to four weeks of initial mixing. This measurement will be used to verify that the fill was completed properly, and will serve as a reference point for comparison with future test results. As a bare minimum, the solution should be analyzed for glycol concentration, solution pH and general fluid quality.

Concentration Testing

Concentration can be easily and accurately checked using a handheld refractometer. Most quality instruments will test glycol concentrations from 0 to 55% directly, are portable, and require no complicated adjustments for temperature. System concentration should not vary significantly from test to test. Progressively lower concentrations indicate a loss of glycol through a leaking joint or component. Find and repair the leak and add an appropriate amount of concentrate to return the system to its design concentration.

P.O. Box 350 · Grand Haven, MI 49417-0350 · 800-878-5788 · Fax: 231-799-8850 · www.noblecompany.com

Water Quality

Solution pH Testing
While high quality glycol solutions may last in excess of 20 years, hard use, improper maintenance or chemical contaminants will significantly shorten fluid life. Fluid pH serves as a good barometer for the condition of the glycol and is best measured with a field pH meter. This method is significantly more accurate than litmus paper tests.

Although standard (not Aluminum) glycol fluid pH is primarily a function of the corrosion inhibitor, and therefore, will vary from product to product, a few rules of thumb will be helpful in determining what constitutes proper pH. Most inhibited glycols have a pH in the 9.0 to 10.5 range. When diluted in a 30% to 50% solution, the pH falls to between 8.3 and 9.0. A pH reading below 8.0 indicates that a significant portion of the inhibitor has been depleted and that more inhibitor needs to be added. When the pH of the mixture falls below 7.0, most manufacturers recommend replacing the fluid. A pH value of less than seven indicates that oxidation of the glycol has occurred. The system should be drained and flushed before severe system damage occurs. For additional product specific information, contact The Noble Company.

System Flushing
Should the system require cleansing after removing old or damaged anti-freeze, flush the system with a heated 1-2% solution of Trisodium phosphate (Noburst System Precleaner) for 2 to 4 hours, then drain and rinse Flushing the system prior to the initial introduction of the glycol solution is also highly recommended in order to remove excess pipe dope, cutting oils and solder flux.

Fluid Disposal
The EPA does not list propylene glycol as either "hazardous substances" or "extremely hazardous substances." While propylene glycol does not exhibit any of the four Resource Conservation Recovery Act characteristics of hazardous wastes, care must be taken to properly dispose of used solutions. Since conditions during use may generate by-products that are considered hazardous waste, used glycol fluids should be tested before disposal. Contact us for additional information on proper disposal or recycling procedures.

Pump Requirements
Since glycol is more viscous and less thermally efficient than pure water, pump selection must account for changes in heat transfer fluid performance. By properly applying two correction factors, it is possible to determine pumping requirements using a standard pump curve.

To compensate for the difference in heat transfer characteristics, it is necessary to multiply the design flow rate by a factor obtained from Table 1. The resultant product is the corrected design flow rate. For example, if the design temperature is 140°F, design flow is 60 GPM, and a 50% ethylene glycol solution is used, a correction factor of 1.14 must be used. (114% from Table 1 divided by 100%) The corrected design flow rate equals 60 GPM x 1.14, or 68 GPM. To compensate for the viscosity differences, the system design head loss must be modified by the appropriate factor from Table 1. The result, the corrected design head loss, accounts for the additional pump head required due to the extra friction created by the glycol. For example, in a 140°F ethylene glycol solution with 30 ft of design head loss, the corrected head loss should equal 30 ft x 1.32, or 39.6 ft.

To select the properly sized pump, simply enter the unmodified pump curves using the corrected design flow rate and corrected design head loss. For additional information on pump selection techniques, contact your local pump distributor.

Water Quality

Air Expansion Tanks

Air expansion tanks should be sized in accordance with the manufacturers' catalog or the ASHRAE Guide. The tank selected should be 1.2 times the size of tank sized for a water system due to the higher expansion rate of the glycol fluid.

Special Design Considerations

- Do not use standard inhibited propylene glycol in systems with aluminum heat exchangers or galvanized pipe. Properly inhibited Antifreeze is made for aluminum systems. (Noburst AL)
- Make sure the system is clean before filling. Pre-fill flushing is highly recommended.
- Mix the solution at room temperature.
- In order to minimize the possibility of glycol loss due to undetected leaks, hydrostatically test the system for 24 hours prior to filling.
- Never use a chromate treatment. The chromate will damage the glycol and can lead to severe system degradation.
- Do not use an automotive type glycol. Automotive antifreeze is formulated with silicates, which tend to gel, reducing heat transfer efficiency. Use an inhibited glycol designed for heat transfer applications. There are also toxicity concerns.
- Do not use in a system that may have a solution temperature over 300°F, 250°F use HD instead.
- Do not use check valves or closed zone valves that would isolate a part of the system, preventing proper expansion and resulting in freeze damage.
- A strainer, sediment trap, or some other means for cleaning the piping system must be provided.
- It should be located in the return line ahead of the boiler and pump. This must be cleaned frequently during initial operation.
- Automatic make-up water systems should be avoided in order to prevent undetected dilution or loss of glycol.
- Check local codes to see if systems containing these solutions must include a back-flow preventor, or an actual disconnect from city water lines.

Adjusting Solution Concentration with 100% Glycol

To increase the concentration of the solution in the system, determine the percent of glycol in solution and apply the following equation:

$$Qa = \frac{Vs\ (Pd - Pt)}{(100 - Pt)}$$

Qa = Quantity, in gallons, to be added
Vs = System volume
Pd = Percent of solution desired
Pt = Percent of solution by test (Initial percent)

Drain the determined number of gallons from the system and refill with glycol concentrate.

valign - “top”>Example:	System volume = Vs = 120 gallons Initial percent of solution from test - Pt - 30% (+4F freezing point) Percent of solution desired = Pd = 50% (-34F freezing point)
$$Qa = \frac{120\ (50 - 30)}{(100 - 30)}$$ Qa = 34.3 gallons required	

Simple Solutions... Proven Performance

Water Quality

Table 1. Glycol Properties: A comparison of propylene glycol and ethylene glycol is shown in Table 1 below:

	Inhibited 100% Ethylene Glycol	Inhibited 100% Propylene Glycol
Heat transfer @180°F with no increase in flow rate		
20% soluiton	0.96	0.97
50% solution	0.87	0.90
Flow Rate Correction Required (with no change in pump curve)		
100°F	116%	
140°F	115%	
180°F	114%	110%
Pump Head Correction Required (with increase in flow)		
100°F	149%	
140°F	132%	
180°F	123%	123%
Specific Gravity @ STP	1.125 - 1.135	1.045 - 1.055
Pounds/Gallon @ 60	9.42	8.77
pH (of glycol concentrate)	9.3	9.5
Note: Except as indicated, comparisons are 50% glycol solution to water		

Table 2. Capacity of Pipe or Tube in U.S. Gallons per Linear Foot

Pipe Size	Steel Pipe - IPS	Copper Tube - Nom.
1/2"	0.016	0.015
3/4"	0.027	0.025
1"	0.044	0.044
1-1/4"	0.077	0.069
1-1/2"	0.105	0.095
2"	0.173	0.160
2-1/2"	0.248	n/a

Table 3. Pex Pipe Chart. Dimensions

Nominal ID	OD	Wall Thickness	Avg. ID	Volume gal/100*
1/4"	0.375	0.070	0.225	0.207
3/8"	0.500	0.070	0.350	0.500
1/2"	0.625	0.070	0.475	0.921
3/4"	0.875	0.097	0.681	1.837
1"	1.125	0.125	0.862	3.025