Six Tips, Tricks, and Secrets to Maximizing Performance of Glycol Systems

For use by the Practical Mechanical Contractor,
the Conscientious Design Engineer,
and the Prudent Building Owner/Operator

Covering both Ethylene Glycol and Propylene Glycol Systems

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Overview

The design, construction, and maintenance/operation of systems that contain glycol should be addressed somewhat differently from water systems.

In HVAC systems with glycol, the glycol is normally employed to provide the system piping with a measure of protection from freeze damage. Since glycol:water solutions have a lower freeze point than water alone, this works very well.

However, poorly designed systems can create a number of problems for the building owner. Also, a failure to operate and maintain the system in a way that recognizes the important role and fragile nature of the glycol can result in massive system damage.

This guide is not intended to serve as an all-inclusive manual. Rather, it should be viewed as providing a few ideas that can be used to maximize the efficiency and longevity of glycol systems.

We hope that you'll find a piece of information on the following pages that you can put to use. If so, we invite you to let us know.

If in your reading, you have questions, please give us a call and ask. We will be happy to help you out.

Sincerely,

The Technical Support Staff
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- Tip #1 -
To Get Started Right, Get Started Clean

Let's focus on the construction phase first, then we'll look at existing systems that need attention.

A lot of time and money has been spent to build the piping system that is going to be filled with a glycol:water solution. During the assembly of the piping and components, a number of contaminants enter the system. These can include:

oil/grease/coatings: these are often surface applied to black pipe to prevent corrosion during storage and shipping.

dirt/sand/mud: these can enter pipe sections when they are laying on the ground or from dust in the air that is normal on any construction site.

pipe dope/solder/flux: self explanatory.

Sometimes when existing systems are not properly cared for, it will become necessary to add all new glycol. Prior to this being required, the following contaminates were usually made in the system:

corrosion products: rusting of the interior of the piping due to improper (normally low) pH

degraded glycol: As the conditions in the system head south, the glycol degrades and leaves behind useless and acidic components.

These contaminates decrease the heat transfer efficiency of the system, cause plugging/gumming/improper sealing of control valves, and cause corrosion of the system's metal pieces which leads to premature failure.

THE SOLUTION

Thoroughly flush the system with water prior to the introduction or reintroduction of glycol. But don't stop there. Utilize an alkaline cleaner and/or polisher.

Once the cleaning process is complete, be sure all the

cleaner is removed from the system. Then add glycol as soon as possible to prevent corrosion of system piping.

- Tip #2 –
Not All Glycol is Created Equal

This makes sense. After all, some glycol is green, some is pink, or even yellow or clear. However, the important differences for system operation and protection go deeper than color.

Firstly, it must be determined if ethylene glycol or propylene glycol should be added to the system. This topic is covered in **The Glycol Manual** (available from Enerco [(800) 292-5908]), and thus will be skipped here.

When the raw glycol is manufactured, it is colorless and all ethylene glycol is pretty much equal. The same is true for propylene glycol, with the exception of some of it being purified to food grade standards.

Thus, the difference in quality of different brands of glycol is in the inhibitor additives that the specific manufacturer includes with the raw glycol.

In HVAC applications, the inhibitor package serves two indispensable functions. It serves as a corrosion inhibitor for the system's metal surfaces and it helps prevent the glycol from degrading.

The coloring does not serve a purpose from a system operation standpoint. It can sometimes be used in trouble-shooting leaks and keeping someone from mistaking the glycol for water, however.

To get the highest value from the glycol you are going to be putting in a system, choose the highest-quality glycol. Make sure that the inhibitor package is designed for HVAC applications. Make sure it will protect all the different system

metals from corroding. Make sure it will protect the glycol from degrading.

Never use automotive anti-freeze in HVAC systems. The inhibitor package used for automobile radiators is unsuitable for HVAC applications (it is notorious for creating off-white snot-like strings that plug in-floor and snow-melt tubing). Never use RV anti-freeze in HVAC systems; most of it has no inhibitor added at all (since it is designed to use for one season and then be flushed, there is no need for an inhibitor).

- Trick #3 – Plan for 10% Water Hide-out

This trick will help you get the desired ratio of glycol:water in your system. It is for use in initially adding glycol to a system or refilling a system after cleaning and draining. You'll only want to use it when the glycol is premixed (either on-site or by the manufacturer) prior to addition to the system.

After you've cleaned the system and rinsed out all traces of the cleaner, you are ready to add glycol. You figure the system volume is 2000 gallons, so you have a tank truck delivery of 30% ethylene glycol. The glycol starts to get pumped into the system, air is being bled off, everything is going well.

Problem #1: The system fills up, and there is still 200 gallons in the truck. Not too big of a problem, the system must have been smaller than everyone figured. Since you were prepared, you have enough drums on-site to empty the truck.

Problem #2: The lab test reports come back and the glycol in the system is only 27%. Call your supplier and complain that the tank truck wasn't prepared properly? This is a possibility. Water hide-out is also a possibility. If the retain sample, or the drums that you filled test at 30%, water hide-out is definitely the culprit.

When the system was drained, certain sections of the piping retained water. This water accounts for around 10% of the system volume in a typical system. Suddenly, it is clear why 200 gallons from the tank truck didn't fit into the system.

Problem #3: Raising the percentage to 30% is more expensive than getting it right in the first place. Now, you have to add some full-strength glycol to raise the percentage. How much? For this example, 88 gallons.

You ended up purchasing:

2,000 gallons of 30% pre-mixed glycol

1,712 gallons are in the system

200 gallons is sitting in drums

88 gallons were discarded to make room in the system for the full strength.

plus 88 gallons of full-strength glycol.

If 10% water hide-out had been figured into the initial order, here's what you would have purchased:

1,710 gallons of pre-mixed 30% glycol.

plus 91 gallons of full-strength.

Now it should be noted, that on rare occasions applying the principle of 10% hide-out will result in a slight shortage of solution for the system. However, this is generally easily remedied by ordering additional pre-mixed glycol in drums. And, this doesn't involve wasting glycol.

So, when filling an empty system with pre-mixed glycol remember the principle of 10% water hide-out.

- Secret #4 – Disconnect <u>All</u> Sources of Dilution Water

For the glycol solution to do it's primary job; that is, protect your system from freezing… the desired percentage of glycol must be maintained in the system.

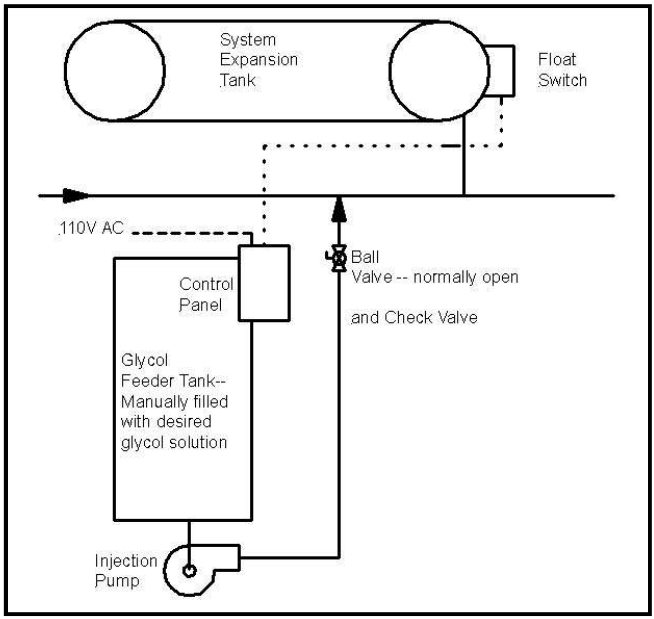
That is to say that when the system looses some of the glycol due to leaks, repairs, filter changes, etc, it needs to be replaced with a solution with the same percentage of glycol.

Allowing water alone to be the replacement liquid will soon result in only water being in the system.

Firstly, all sources for fresh make-up water should be valved-off. Or preferably, completely disconnected from the system. These lines are needed during construction and cleaning of the system, but should not be a part of system operation.

The second step is to replace the fresh water make-up with a set-up that will add the correct glycol solution to the system when it is required.

One simple method is illustrated below:



This method utilizes a float switch to monitor the liquid level in the system expansion tank. Use of a pressure switch to

turn on/off the injection pump is another good means of maintaining control in the system.

The method of addition of the glycol solution is secondary in importance to the fact of maintaining the system volume by the addition of a premixed glycol solution instead of only water.

Bonus Tip: For high quality results, pay as much attention to what is used for dilution water as you do in selecting the right glycol. Use water with the fewest impurities possible. DI or RO water is best. Softened water is ok if total hardness is $\leq$ 5 ppm, and chlorides and sulfates are $\leq$ 25 ppm each. Hard water is bad. If high quality dilution water is not available on-site, consider utilizing pre-mixed glycol (make sure your supplier uses DI water for the dilution).

- Trick #5 -
To Keep it Running Right, Keep it Clean

Would you consider running your car without an oil filter? Just put in clean oil and go… no need to worry about filtration. After all, you used clean oil. Ever operate your furnace for a while without air filters? Do so will quickly result in sneezing, stuffed-up noses, and lots of extra vacuuming/dusting.

Filtration, when properly utilized will remove both contaminates that enter the system from outside sources and those produced in the system.

In the case of most HVAC glycol systems, the majority of the particles (contaminates) that need to be removed are generated in the system. These wear particles are small pieces of the interior of the pipes, pump impellors, and/or heat exchangers that break off. Either from the force of the liquid traveling past them,

or from collisions of other wear particles traveling with the fluid. The ones that do the most damage in this type of system are 10 – 50 microns in size.

Collectively, these collisions are known as erosion. Once these particles get started, the erosion created quickly becomes worse at an increasingly fast rate. As more particles are broken loose and travel with the fluid; they cause more and more collisions.

Additionally, these particles cause plugging and or sticking in control valves. Or, if the needle or seat is eroded, the valve will not seal closed properly.

To prevent these particles from damaging the system, they must be removed. The best method of removal is filtration with a cartridge type filter element of the appropriate micron rating.

Generally, the housing that holds the elements is installed in a side-stream configuration. Flow rate through the filter housing can be in the area of 10% of system flow rate for excellent filtration efficiency.

To maximize the performance and longevity of your glycol system, properly filter the glycol solution that is circulating in it.

- Tip #6 -
Get an Annual Physical for Your Glycol

To give yourself piece of mind, and to proactively counter future system problems, have a full laboratory analysis of your glycol done on an annual basis.

If the results come back, “all ok,” then you know your system is protected.

Recommendations for change could be presented. You

then have the opportunity to correct them before serious system problems occur.

Testing the percentage of glycol with a hand-held refractometer or anti-freeze tester is good, but it cannot provide you with the whole story. Properly done, you'll get an accurate result for the freeze and burst temperatures for the glycol.

You won't learn anything about the inhibitor level or its effectiveness. You won't be able to tell if iron or copper levels are above normal… an early indicator of corrosion. You won't determine if other molecular sized contaminates are present, or if different glycols have been mixed.

Rarely is it well received when you have to explain that although the system was protected from freezing based on your excellent on-site testing, the glycol solution ate holes in the piping.

The results of the tests run on the glycol is only the first key. Any lab with the right equipment can get you the results for the various tests. In choosing a laboratory to partner with, be sure that the laboratory personnel are experienced in the interpretation of the results. And can present them to you in a manner that is understandable.

The annual testing will be of great value in understanding the overall health of your glycol. For systems where problems are indicated or experienced, more frequent testing should be performed.

- BONUS - Secret #7 - BONUS -

How To Determine the System Volume Exactly

Knowing the volume of a system that will contain a glycol solution is very important. It can save you thousands of dollars and eliminate the stress of guessing.

It is thus with pleasure that we are able to include this bonus secret for you. When you use it, you'll actually measure the volume of the system. You won't have to calculate. You won't have to guess.

Let's take a look at why it is so important to know how much the system holds.

Water based corrosion inhibitors that do not provide any freeze protection for a system are generally added to the system at a very low rate. There are a number of these chemicals, but many are highly-effective around 5 gallons of inhibitor per 1000 gallons of water. And they, have a wide range of concentration where they are effective.

In this case, knowing the system volume to the nearest 25% will probably suffice. Further, if by test result, the inhibitor level is low, it can be easily corrected with small volume additions.

For systems with glycol, the amount of glycol required to achieve desired levels of freeze protection is high. Generally around 30% of the system volume. So, any errors regarding system volume create large errors in the amount of glycol needed (and purchased!) for the system.

The system volume is almost exclusively under estimated, so I'll use that as an example.

Let's say the system volume is actually 1000 gallons. You calculate or guess it to be 800 gallons. Your estimate is low by 20%.

If you are just adding a corrosion inhibitor, you'd remove 4 gallons of water and add 4 gallons of inhibitor. And test. Then, you would have to take 1 gallon of inhibited water out of the system and add 1 more gallon of treatment. No big deal.

If you wanted 30% glycol, you would drain put in 252 gallons of water and replace it with full-strength inhibited glycol (95% glycol, 5% inhibitors). This would provide you with 30% glycol in an 800 gallon system.

However, after testing, you will find you only have 24% glycol in the system. To fix it, you have to drain out 84 gallons of fluid (wasting 20 gallons of glycol!) and add an additional 84 gallons of full-strength.

Having the system volume accurately determined before any glycol is added to the system, would have saved 20 gallons of glycol. In our example, this is a waste of greater than 6% of the glycol needed.

I trust you can see the importance of knowing the system volume accurately when glycol is going to be used for freeze protection.

The most accurate way of determining the system volume is to measure the water as the system is filled for the very first time.

Even if it is temporary, put a watermeter with a totalizing register in the line (or hose) that will be used to fill the system for the first time. Then, without letting water drain out, fill the system to capacity making sure all the air is removed.

The watermeter reading will give you the volume of the system. If the register started at a volume other than zero, remember to subtract the initial reading from the final reading.

This is the easiest and most accurate way to determine the important but sometimes elusive “system volume”.

Notes:

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