HeatingHelp.com Bright Ideas! List # 314

31 Tips on How to Apply Antifreeze to a Hydronic Heating System, and How to Maintain it Afterwards

\Dan Holohan posed this question to the HeatingHelp.com emailing list:

What factors do you consider before putting antifreeze into a hydronic system and how do you go about doing it?

Here are the answers:

1. We use DOWTHERM or Union Carbide, usually 30% for burst protection. For jobs that have "bad" water, you can purchase pre-blended glycol, but it's expensive. Glycol is added at a shot feeder. We recommend that the customer call us for annual check up.

2. In Massachusetts, we mix it to 30% polypropylene in a barrel before we pump it into the drained boiler and piping. We use it when we are designing a hydro-air system and have hot water supply and return piping in the attic feeding air handlers. It needs to be checked every three years or so and drained and refilled. So far, I have not seen or heard of any corrosion problems. I have used it in my own house this way for five years now and replaced it once.

3. The only place that I use anti-freeze is in areas where there is a high possibility that the lines will reach sub-freezing temperatures. Crawl spaces and radiant within on-grade slabs are two that come immediately to mind.

We usually use Cryo-Tek mixed 1:1 (50% antifreeze). I calculate the amount of fluid the system will hold, add one half of that to the system and then fill the rest the system of the way with water. I use a drill pump with a couple of short garden hoses to inject the antifreeze in through a boiler drain.

I've only got two clients with anti-freeze. At some point, when the solution tests bad, we'll dump and refill.

4. We use glycol up here because it often gets -20 to -30° F below zero during winter. Many of the air handlers are 100% outdoor air. Even if they are mixed air, damper leakage can freeze a coil very quickly at those temperatures.

We like to keep the glycol loop(s) separate (by shell-and-tube exchanger) from the boiler(s) for the simple reason that, come boiler-inspection time, the glycol is

worth saving, but it's labor intensive to drain it, hold it and pump it back in. Yes, we use only shell-and-tube, as opposed to plate, exchangers. It always seems that those plate exchangers leak in the middle of winter and the distributors change product lines more often than they change their pants. You can hit a shell-and-tube exchanger with a bus and it will still last for years.

We used to use ethylene because of cost. But leaks and the regulatory disposal problems become costly so we now use polypropylene, which allows us to be environmentally responsible in the public's eye and dump it to drain if we must.

A 50/50 mix is standard. We don't take off the piping length from the drawing and calculate volume. This has been notoriously inaccurate. We fill the system with water and add a lithium tracer. Then, once that has circulated for about a week, we take a sample and send it off to the lab. The dilution factor corresponds to the system volume. We then drain the system and add (using a gear pump) half of the volume in pure glycol. You never seem to get all the water out because it hides in drops and places you didn't count on. And if you try to charge the complete volume with 50/50, the percentage almost always seems to be light. We follow this with the appropriate charge of molybdenum/azole inhibitor.

Unless there are leaks throughout the year, and there usually are not, as those loops are confined to air handler coils with good freeze-protection systems, the glycol is tested each fall and chemically adjusted for the next heating season.

5. No-burst antifreeze is the spec of choice because it can be added in low enough quantities that don't degrade heating performance, but will prevent freeze breaks by making the mixture "slush" instead of becoming expanding ice dams, which can break pipes. I've specified it at a 20-percent mix with good results. I hardly notice the lower heat capacity and don't sweat the freeze.

6. Factors to consider? What are the likely chances that freeze up will occur? Does the owner go on vacation for more than a few days in cold weather? Is there a radiant system in garage? If I use a constant flow pump with a diverting valve, I can usually eliminate the need for adding glycol due to the constant flow of water in the floor.

Antifreeze installation in a system is one that I have not perfected yet. The few times I have installed this in a system I installed a tap in the top of the system at the highest point. When I did this with a radiant system, I had a problem with air locking. I had to rely on a closely installed purge valve to allow air to get out. When I put the antifreeze in, I calculated the required solution quantity and just poured it in. Any better suggestions, I'd be happy to listen to them. The antifreeze of choice is propylene glycol due to its low toxicity. A note to mention is that I wish contractors would be sure to label systems with glycol to avoid accidental system dumping by technicians not looking for glycol.

7. In reference to using antifreeze in hydronic systems I have several in my plant. I am using propylene glycol according to Raypak, Laars, Dow and Virginia's KMP suggestions . Raypak has the best documents printable off the net site www.raypak.com/afreeze.htm. As to water quality issues, we use D.I. water in our process and is the least contaminated.

We pre-mix in a drum and use a hydrometer from KMP Cat # PSH. It costs about $13 and is available from the parts house. It also ensures the proper mixture.

How do I get it into a system? I use the same diaphragm pump that I use for cleaning water-cooled condensers . The pump is a positive-displacement pump and I have to be careful because it can develop high pressure and burst hoses or lift safety valves if valves are closed.

The pump is expensive but a time saver manufactured by Ace Pump Corp in Memphis, TN. The model is 77NRS and retails for approx $1,056, but well worth the price. Their phone number is 901-948-8514 and they can hook you up to a local suppliers.

8. EG as a default. PG for snowmelt, around food service or hospitals. The DOW versions, DOWTHERM SR1 (EG) and DOWFROST should last the life of the system, provided you get the true products and not a backroom mixture.

We offer a free fluid analysis to all customers to check for concentration, dissolved solids, and status of inhibitors, etc. This is done through the DOW factory and by DOW lab people. If deficient, they will recommend action to be taken – if required. This is a FREE service we offer to our customers.

Antifreeze DOES age. Engineered Thermal Transfer Fluids should last for a long time. The Dow family of products are Engineered Thermal Transfer Fluids. People who sell boiler chemicals want to sell a product that has a limited life. We don't sell boiler chemicals or annual maintenance – so we sell a product that will last a LONG time with minimal effort.

Putting into the system? Wessels Tank Co just came out with a very nice, affordable glycol-fill station that is suitable for the snowmelt system or residential system. Prior systems were large and for commercial-size systems.

In Michigan, it is very typical to use 40% EG for heating systems and 50% PG for snowmelt.

9. The first factor is why? I always recommend against it, but sometimes it's unavoidable. We try to figure the water content and then add an appropriate percentage and adjust as needed. I always tell the customer that it is expensive to run because of lower thermal conductivity, higher maintenance, wasted antifreeze, and the horrible things that it does to the equipment. On the upside, we get to replace more boilers because they do not maintain the antifreeze.

10. I put antifreeze in hydronic systems in accordance with the following guidelines:

1) I design the mix to accommodate 10 degrees below the ASHRAE heating design temperature for the area.

2) I specify nontoxic antifreeze.

3) I mix it in proportion to the system water content

4) I always install a backflow preventer on the makeup line to prevent cross-contamination of the building water supply.

11. I would not put antifreeze in a system unless it cannot be avoided. I would rather reroute piping to prevent freezing than to add antifreeze. Antifreeze is expensive, cuts heat transfer, requires additional expansion tank capacity, loses its potency, becomes corrosive, and will increase the cost of maintenance and repairs in the future. That being said, there are times it cannot be avoided. When I have to use it I will install Cryoteck brand. My usual procedure is to pump it into a low boiler drain. I purge the zones into a clean five-gallon pail that has the suction side of the pump in it. We always pipe our boilers pumping away, with good air eliminator on them, so that any remaining air will soon be gone. I check the potency and corrosiveness of the antifreeze each year during the annual maintenance on the system.

12. Prior to installing any antifreeze, we go through the system and make any necessary repairs and then we completely purge the system. Using a five-gallon container, we manually pump in the antifreeze. It usually takes eight to 10 gallons for your average 3,000-square-foot house, maintaining 12-15 psi. We will return every three years and test system water and add antifreeze as needed. This works for us.

13. I live in New England and the only reasons I would use antifreeze in a system would be if for some reason or another an insulated pipe was put to close to a outside wall, or if they ran a loop over a cellar window . Some houses up here have overhangs that stick out over the foundations, and there are pipes running out to some baseboard, or if there is a hydrocoil in the attic. Or if the house is going to empty for long periods of time in the winter.

The way I like to put it into the system is to totally fill the boiler and purge it out real well. Then run it up and make sure the air is all out and then shut the valves on the supply and return. And then drain down the boiler. Then I'll use a Teel mini pump, and two washing machine hoses – one in the bucket of No-Burst brand antifreeze. Fill the boiler from the bottom, removing an air vent on the top of the boiler and fill it until the No-Burst comes out the vent hole. Using two buckets will give about a 50/50 blend. Then bring the boiler up to pressure and open the valves and run the systems zones. This will mix the anti freeze in.

14. We will do everything possible to avoid the use of antifreeze in a residential heating system. The added maintenance and upkeep simply doesn't justify the use of this product. We consistently find corrosion-related problems due to lack of upkeep and monitoring, so we'll use alternatives like constant circulation and back-up generators if possible. When it becomes absolutely necessary to install antifreeze, we first check the system for size and water content. We drain off the system into barrels to measure content and then mix in the desired amount per manufacturers instructions for the level of protection we want. We then use the pump to refill the system and purge it back into the barrels until the system is full and air-free. The surplus antifreeze mix in put into sealable containers and marked and stored on site. Then we tag the system, identifying the type and solution mix of antifreeze. We also check for proper expansion tank sizing and change the tank when necessary. We install isolation valves for ease of service and the proper backflow device to protect the potable water source. Then we set up the account on a strict annual inspection routine to maintain freeze and corrosion protection.

15. I don't often put antifreeze into a radiant system, but when I do, it is usually because I have a small loop that's isolated from the rest of the system. I use a small acid pump that I used to use for running acid through water condensers in A/C units that had scale problems. I use propylene glycol because it is non-toxic. I pour it into a five-gallon bucket and connect the pump to the system in such a way that it has to flow through the whole system to get back out. I usually have a place in the system that I use to force air out by shutting a ball valve that has a hose connection on each side. I connect the hose from the pump to one side and then run a short hose from the opposite hose connection back into the bucket. When I turn on the acid pump, the glycol going into the system forces water out of the system and into the bucket to mix with the glycol. I let the pump run for a while until the loop has mixed to a fairly consistent mixture. I bring other work to do so I can let it run a while and mix thoroughly. I check the percentage of antifreeze to water and add more if I think I have to. When the mixture is right I pressurize the loop with a water feed line and turn off the water to the loop so that if any leaks develop, the water won't continue to feed the problem. I check the pH of the system once a year and replace the fluid when necessary. Maintenance is the hardest part of the job and that is why I don't use the glycol if I can avoid it.

16. We consider the boiler fluid capacity, and piping capacities when available. If no antifreeze exists in the system, then the decision is how low to protect it. The manufacturers have charts to determine solution strength for different levels of protection. We prefer food-grade antifreeze for two important reasons. First, if a backflow situation occurs, the damage is limited, and second, the disposal of old, tired antifreeze is simple.

We introduce the antifreeze with a pump through the boiler drain, after removing the required amount of water from the system. After the solution is introduced, and the air purge is next, we use the same pump to keep pressure up in the system while we bleed the air through the quick-purge drain.

We contact all our boiler customers during September and October to schedule fall startups, any with antifreeze, we include a pH test to determine the viability of the existing solution.

19. Traditionally, glycol make-up equipment in HVAC/Hydronics systems have been very loosely specified and rarely seen as a product in its own right. The contractor or end-user as a customized add-on assembly has usually provided it. The Armstrong GLA unit is a clearly defined product that can be specified and installed with confidence. This product takes out the guesswork, saves installation time and is a compact intelligent addition to the mechanical room.

20. I like to use a mix to give freeze protection to 0° F and burst protection to -20°F (we're in Southern New England). We also recommend installing a corrosion inhibitor at the same time. We will usually try and talk the owner of zone valves into changing to circulators before we install the antifreeze. The rubber O-rings and stoppers don't usually fair all that well. Every two years, we test the antifreeze and adjust or flush and replace as needed.

21. I prefer other alternates to antifreeze because of the mess from leaks, especially if you use fiberglass insulation. Maybe if piping confined to the mechanical room I'd go with self-regulating heat trace tape, backup pump, auto-drain valves, or electric heater in the plenum/attic, flow switch alarms etc.

22. Most of my applications are of hot water baseboard. I am not a fan of glycol because people in general take the put-it-in-and-forget-about-it attitude until a problem arises years later. I don't spend a lot of time calculating exact water content of the system. Usually, I take the water content of the boiler and divide by two to give me an approximate 50/50 mix. I pump it in with a Blue Angel pump at the bottom of the boiler, and draw of the water from the purge at the top.

23. The choice to glycol or not is sometimes obvious. Certainly a snowmelt system would be a given. After that It really becomes a decision for the heating contractor and the owner.

Some contractors in the mountain states use glycol on all their installs. Considering the remote location of their jobs, power outages, extreme weather, winter accessibility, etc., the choice becomes easier.

Using glycol does take a little more effort on the part of the contractor. Sizing of equipment, pump, and expansion tanks for instance have to be considered. Threaded connections should be paid attention to, as glycol is more "leak prone."

All the components in the system need to be considered to assure they can be used with glycol. Not all glycols are created evenly and it is always best to consult with the manufacturer of the product to be assured that it is intended for hydronic applications.

Care should be taken when cleaning and flushing the system before adding glycol. The water used to blend the glycol NEEDS to meet certain requirements. A very important component of glycol use.

The installer needs to know the differences and pros and cons of ethylene vs. propylene glycol. I highly recommend that MSDS sheets be left with the equipment filled with glycol. Also label all glycoled equipment so the next guy knows what he is working with. Type of glycol, installation date, and percentage of mix would be a few pieces of info to leave behind.

The owner must understand that the fluid should be tested and maintained. Yearly is a good schedule to catch any problems before they get out of control and cause expensive damage.

When selected, installed and maintained properly, glycols will provide years of service and protection for equipment subjected to freezing conditions.

Obtain engineering guides from glycol manufactures and read and understand them!

24. We size based on the loss of heat transfer from the glycol. Normally, we use the food-grade propylene to avoid any toxic issues. The mix is typically 30% or 40% as the job dictates. We buy ours premixed and install it with a hand pump on small jobs, and an electric pump on large jobs. Most of our customers who have glycol monitor the chemicals in their systems so we do not deal with that a lot. We offer testing if they need though.

25. You have to make sure that the pump can handle the additional head loss of the antifreeze. Glycol is the type, we use Cry-tek by Hercules. It is pumped into the system with a hydrostatic hand pump thru the boiler drain. When we service the system we check the corrosion protection of the water.

26. I recommend antifreeze if there are outdoor areas (snowmelt) or if the owners are in the home only part time (like a vacation home, or primary homes for owners who go to Florida for the winter) An area I'm on the fence about is a heated garage. They are inside (sort of) but if the heat was off there for an extended period it would freeze and no one would know. Ideally, I would like to isolate garages with a heat exchanger, but its not always viable. For residences with snowmelt, I usually isolate the snowmelt and glycol only the snowmelt. For mixing, I premix in a bucket and pump it in with a submersible pump.

27. I usually go by what the manufacturer recommends on their containers, and also the total exposure of any piping in unconditioned areas through the structure. I haven't used antifreeze in a long time. I'm not a boiler installer, per say (more AC), but would like more info on this issue for future reference. Oh, I would usually use a transfer pump to fill the vessel, but this always added more air initially into the system.

28. We use propylene glycol (Noburst brand). Most of the systems we work with are already installed. We don't know how much volume of fluid is in these systems. We estimate the volume, bring enough glycol to exceed the anticipated mix and then start adding the material. We monitor the mix with a refractometer to determine how close we are to the target protection temperature. For residential application without significant "unusual exposure," such as cantilevered window boxes, we want the system to flow freely at -5°F. With Noburst, this will give us freeze protection to approximately -30°F. This is adequate for our area, even at higher elevations (8,000 - 9,000 feet).

We generally add the glycol to an operating purge pump system. While purging the various zones or heating devices, we continually add the glycol. We use the extra buckets to reserve the excess fluid from the system. We leave this material with the homeowner in the sealed containers as a reserve to help purge the system if some of the mixture is removed due to a leak or service.

I haven’t considered the ramifications of corrosion from breakdown of propylene glycol. I wasn't aware of the problem. I am looking forward to learning more about this issue from the other responses!

29. Being from Montana, we use lots of glycol in our hydronics systems. We deal with commercial and very-high-end residential. We pretty much approach our residential customers the same as our commercial customers, no furnaces, and not cheap just to be cheap.

We use propylene glycol in our systems. We specify Dowfrost, by Dow Chemical, or equal, with all the appropriate inhibitors, etc. We have the glycol installed with distilled or deionized water, so that the inhibitors will not be wasted on chemicals in the water.

We mix the glycol based on the expected outside-air temperatures. For an air-cooled chiller, we would specify a solution strong enough to prevent total freezing, but not turning to slush, as long as the chiller is not operated during the freezing weather. For heating applications, we would use a stronger solution to prevent freezing, so that the fluid can be pumped during freezing situations. For a snowmelt system, we would probably use a 50% mixture, so that the fluid could cool down to the ambient temperature of -30° to -40°F, then start pumping and heating the water without any adverse affects.

On larger projects, we use glycol feeders to maintain the glycol levels in the systems. On smaller systems, we use a chemical bypass feeder to add glycol. We do not allow a domestic cold-water connection to a system with glycol as this can allow undetected dilution of the glycol, then freezing of the system.

We allow the mechanical contractor to install the glycol in any way they want to. Usually they leave it up to the chemical supplier.

We like to specify the Dowfrost because Dow Chemical will provide annual free testing of their products. We encourage the owner to send in a sample each fall for the free testing.

30. What we do on any new installation is to calculate all the pipe runs for the system. Then, we calculate the amount of water these hold and divide by two. Next, we figure all the coils we have, find out how many gallons they hold and divide that by two as well. Finally, we figure the water content of the boiler, the indirect water heater and manifolds, and divide these by two. When we're done, we add our numbers and (hopefully) get the amount of glycol to be put in on approx. a 50/50 mix.

31. Rule Number 1 for Arctic Engineering. Anything can freeze, be prepared on how to thaw.

In Alaska, we use PG 50% on any preheat coil that can see mixed air temperatures below 50F. This happens on most typical light commercial air-handling units due to ventilation rate. Always have redundant pumping.

In addition, we use good spring-return, fail-to-heating on all dampers and control valves.

Avoid glycol in boilers, and try to use heat exchangers to limit glycol volume. Always let heating waterside of heat exchanger run wild and three-way valves and constant flow on glycol control. I have seen heat exchangers freeze on the waterside if controlled with control valve. We have had good success with automatic glycol make-up packages similar to Wessels and a pressure sensor to DDC system for alarm on low pressure.

On remote "bush" buildings all glycol because of unreliable electrical power and potential for freeze up.

Try to route all PSV and automatic vents back to glycol tank.

Glycol is just a way of life up here.